Quantitative Requirements in Undergraduate Business Courses: The Case Study of Victoria University of Technology

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Abbreviations

ASCPA	Australian Society of Certified Practising Accountants
BBus	Bachelor of Business
BCom	Bachelor of Commerce
DEET	Department of Employment, Education and Training
FIT	Footscray Institute of Technology
HSC	Higher School Certificate
MS	Management Science
NBEET	National Board of Employment, Education and Training
NESB	Non-English Speaking Background
OR	Operational Research
QM	Quantitative Methods
TAFE	Technical and Further Education
TER	Tertiary Entrance (Score)
TOP	Tertiary Orientation Program
VIC	Victorian Institute of Colleges
VUT	Victoria University of Technology

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Declaration of Originality

Except where reference is made in the text of the thesis, this thesis contains no material published elsewhere or extracted in whole or in part from a thesis presented by me for another degree or diploma.

No other person's work has been used without due acknowledgement in the main text of the thesis.

This thesis has not been submitted for the award of any other degree or diploma in any other tertiary institution.

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Abstract

Business educators and employers recognize the importance of quantitative methods to business professionals, and subjects in quantitative methods are among the most frequently required in the business undergraduate curriculum. However, both business employers and graduates have expressed some dissatisfaction with business education and comment that school training fails to prepare graduates adequately for the particular needs of business organisations.

Because of recent changes in technology in the business environment, business educators need to understand what employers consider important, what quantitative methods are required in industry, and how education in quantitative methods can best be prepared in order to meet the needs of business in the 21st century.

This research study attempts to answer these questions by investigating the content of quantitative programs offered at the Victoria University of Technology, the effectiveness of associated teaching methods in undergraduate business courses and the viewpoints of final-year students, graduates, educators and business employers about the courses.

Both quantitative and qualitative data were collected from detailed questionnaire surveys of the four groups mentioned above, regarding their perceptions and attitudes towards undergraduate Quantitative Methods programs at Victoria University of Technology. The data includes a personal interview with Paul Casey, one of the first to develop the curriculum for these programs, and interviews of business educators currently teaching theses programs in the School of Applied Economics.

The questionnaires developed in this study contained six main sections including Assessing the Business School and its Quantitative Methods programs, Course Organisations and Teaching Methods, Course Experience, Co-op Education and/or Industrial Experience, Employment Expectations and Training, and finally the

Quantitative Methods Topics and Skill Levels Required in Industry.

The statistical techniques employed here included ANOVA, Hypothesis Two-Sample Proportions Test, Spearman's rho and the Mann-Whitney U-test. In qualitative analysis especially regarding the in-depth interviews, the process involved data reduction, data organisation and interpretation. The statistical software programs used in this study were GBStat and SPSS.

The results of the surveys showed that in regard to the business school education, both business educators and employers agreed that business schools in general, were not adequately responding to the needs of industry, especially in the areas of liaison with employers and professional bodies, of provision for academic staff development and industrial experience, of research activities and of the structure and content of undergraduate courses.

With regard to Quantitative Methods programs in general, the study showed a large gap between the expectations of business educators at Victoria University of Technology and business employers. This gap was largely measured by the Education Preparation for business graduates, the Employment Expectations and the Contents of existing Quantitative Methods programs including essential topics and skill levels required in industry.

The overall evaluation of the programs including class sizes, class hours, course assessment, text readings and exam format, were indicated to be satisfactory by both the final-year business students and the graduates at Victoria University of Technology. However, in regard to the computing facilities and software programs in business, both groups raised concerns that there was a lack of accessibility to do case studies and some software programs were a outdated. The ratings of educators in Quantitative Methods subjects, regarding their knowledge and competence in guiding students' learning, were above average according to the current students and graduates of this University.

Work Experience was considered by employers as a most important factor in the Education Preparation for business graduates. The study showed that both students and graduates agreed that this experience played a key role in their performance when they started work, and it should be obtained before course completion. However, regarding cooperation between University and industry, both groups rated this issue poorly.

In conclusion, Quantitative Methods are regarded as an important decision making tool in business, and it is our responsibility to provide business with the best prepared future employees. In doing this, a University needs to examine its programs to ensure that the courses meet the needs of today's business. The existing curricula for Quantitative Methods undergraduate business courses have been modelled on similar courses offered by other tertiary institutions which are very similar to those in the United States, and none has been developed specifically for the needs of Australian industry. Hopefully, the outcomes of this study will result in a curriculum design for undergraduate courses in business Quantitative Study most suited to the needs of Australian industry.

CHAPTER ONE

Introduction

1.1 Background and Context

Much research has been done to identify how well tertiary[1] business courses are responding to economic and industrial needs in the United States (Gustafson, Johnson & Hovey 1993; Raymon & McNabb 1993), what Quantitative Methods are required in both undergraduate and MBA course curricula (Hamada, Patell, Staelin & Wecker 1988; Cullen & Lambert 1987; Unger & Eisenberg 1983), and the current state of the teaching of Statistics and Quantitative Methods in business courses (Gallagher 1991; Gunawardane 1991; Franklin, Bialaszewski & Turnquist 1989). The importance of the role of Statistics and Quantitative Methods to business education is illustrated by the number of conferences which have been held throughout America (Easton, Roberts & Tiao 1988; Rose, Machak & Spivey 1988; McAlevey & Sullivan 1992). However, very little similar research has been conducted for Australian institutions. This paucity of research not only makes it difficult to assess the effectiveness of Australian tertiary business curricula, but also for Australian tertiary institutions to find an appropriate direction to update curricula.

The curricula for Quantitative Methods in business courses at most Australian tertiary institutions are very similar to those at United States tertiary institutions (Morley 1992; McAlevey & Sullivan 1992), even though the United States and Australia have fundamental differences in their economic and industrial structures (The Economist Books 1989). This leads naturally to the question of how well the quantitative training of Australian tertiary business graduates is responding to the particular needs of Australian industry.

Appropriate tertiary training for business graduates will lead to a more productive business sector for the country, and if tertiary education does not equip the business graduate with

[1] Tertiary in this study refers to Higher Education Degree Awarding Courses only.

those quantitative skills required by the economy and industry, there will be some negative implications on the economy and the performance of industry. For example, if Australian companies are required to train newly recruited Australian business graduates to perform a particular numeric technique, then the absence of this technique from the university curriculum not only incurs a cost in staff training for Australian industry, but also impairs the Australian business graduates' competitive position in the job market. Unfortunately, very little research on this issue has been conducted in Australia.

In summary, there seems to be a need for research into how effectively the Australian university curricula for Quantitative Methods in business courses are serving industry's needs, in order to enhance the development of higher human resource productivity, management efficiency and greater utilization of resources.

However, very recently the government has initiated a review of core graduate attributes (AC Neilsen Research Services 2000; Candy 2000; Gallagher 2000). This study is a one aspect of a larger study and is in parallel with this sort of work mentioned above.

1.2 Statement of the Problem

In this study, business employers' expectations relating to quantitative skills will be canvassed in order to determine what quantitative methods and skill levels are required by their employees. The study will also examine the current education of business undergraduates at Victoria University of Technology (VUT) as perceived by Quantitative Methods educators and final year business students, to determine if there is a gap in graduates' academic training and employer expectations. Finally, an investigation and analysis, based upon the perceptions of graduates who have completed their Bachelor of Business degree with major studies in quantitative methods, will be carried out. This investigation is designed to assess of the adequacy of students' courses in Quantitative Methods to meet the needs of a range of Australian industries.

It is noted that since no published research study about the development of Quantitative Methods studies has previously been undertaken in Australia and most universities have developed their own curriculum, it is not possible to provide a systematic literature review relating to curriculum development in this area. As a consequence, in the early stages of the research an interview with Paul Casey, who established the quantitative curriculum at Victoria University of Technology, was carried out. This interview has been included in the literature review section to fill the gap in the history of curriculum development.

Hence, in this study the specific problem statement can be stated in the following way:

(1) Reconnoitre the Quantitative skills expected by Australian industry from business graduates. This knowledge will naturally lend itself to a more objective curriculum design for Australian industrial conditions.

(2) Examine the course structure and specific content of the Major in business Quantitative studies at Victoria University of Technology. A comparison between the content of Quantitative Methods subjects and the expectation from industry will provide bench mark information for updating curricula.

(3) Research into various methods of evaluation of staff teaching, course experience and industrial placements of business students and graduates, in order to analyze the requirements of an acceptable Quantitative Methods program in the undergraduate business degree, as perceived by Australian industry and the university. Finally, the above aims should result in a recommended curriculum outline for programs in business quantitative study that is most suited to Australian industrial requirements.

1.3 Nomenclature of Quantitative Methods Studies

Most universities and colleges in Australia offer a business degree as a Bachelor of Business (B Bus) or Bachelor of Commerce (B Com), which is normally three years of full time academic study, or four years if a year of industrial training is included. Students are required to study 24 semester subjects over three years, and these include a core of compulsory business subjects, a sequential major in designated specialist subjects, and several elective subjects. The degree course offers many streams or majors specialising in different areas of business. Large institutions may offer more than a dozen majors (for example: Monash University Handbook 2002; University of Melbourne Handbook 2002), and among these is the major in quantitative methods which includes studies in Mathematics and Statistics.

It is noted that the term *Course* in British English refers to a period of study at college/university, for example 'a three-year university course'. The equivalent word in American English would be 'a three-year university program'. In Australia, course is used in a similar way to British universities, for example 'the course consists of three years of study and a year of optional co-operative education'. Graduates in a business course will earn a degree at the end of, say three years of academic study. As mentioned earlier, business students in Australia are required to complete 24 subjects over three years and these include a core of compulsory subjects, a sequential specialised subjects such as Quantitative Methods, and elective subjects.

In United States, these specialized Quantitative Methods *subjects* are referred to as Quantitative Methods *courses*. Because most journal articles and texts are American, it is necessary to clarify and distinguish these terminologies. Since this research study is a case study of Victoria University of Technology - Australia, the term 'course' is used to refer to a degree course, and 'subject' to an individual unit that forms part of the degree course. When referring to United States studies, the translation to the British system has been made.

Both the course structures and the course titles in the area of Quantitative Methods vary among business schools. Examples of titles are Management Science, Operations Research, Quantitative Methods, Quantitative Analysis, Decision Making and Operations Management (Gunawardane 1991; Gallagher 1991; Carraway & Freeland 1989). Nevertheless, it is common that every Business School requires a program in Quantitative

Methods as part of their undergraduate curriculum. According to Gallagher (1991), although the course title Management Science is least used, the textbooks that use this in their titles are most favoured by instructors. As Australasian academics (Morley 1992; McAlevey & Sullivan 1992) indicate, textbooks used in Australian business statistics subjects are mostly American-based texts and the course structure and teaching units are very similar to those of American courses.

Subjects in Quantitative Methods are often taught by staff from different areas such as operations and marketing, and a Quantitative Methods department (if it exists) carries a variety of names including Management Science and Information Systems, Management Science, Operations Research or Decision Sciences (Carraway & Freeland 1989). In Australia, universities offer Quantitative Methods subjects in a variety of faculties, including the Faculty of Business, School of Economics & Commerce, School of Management or School of Economics & Financial Studies. In Victoria, Business Faculties take on a variety of names such as Faculty of Management, Faculty of Business & Economics, Faculty of Economics & Commerce or Faculty of Business & Information Management (Clark 1994); however the name Faculty of Business is the most widely used term in Australian universities.

Perhaps because of this lack of reference in the development and positioning of Quantitative majors in business courses, no systematic work has been done on a national basis comparing the quantitative requirements in Faculty of Business Australian universities. This means that there is a paucity of information regarding the common content of these Quantitative Methods subjects, and a lack of systematic information about current developments in these curricula over the past 20 years.

It is known, however, that most university Quantitative Methods programs in business courses are developed by academics themselves or as adaptations of other mathematical statistics courses (NBEET 1992; Morley 1992). Because this study will focus on Quantitative Methods development in Faculty of Business and Law at Victoria University of Technology, to give an understanding of the rationale and context of the course development in Quantitative Methods, a review of the factors involved in the growth of the Victoria University of Technology Business and Law Faculty from its vocational beginnings is given.

1.4 Historical Beginnings of the Undergraduate Quantitative Methods Programs at Victoria University of Technology[2]

1.4.1 The Development of Curriculum in Statistics and Quantitative Methods

Victoria University of Technology had its beginnings in 1915 as the vocational Footscray Technical School and remains the only institution of higher education in the Western Metropolitan Region of Victoria. In its 80 year history, the institution has grown extensively into a large university which offers a wide range of courses from introductory certificates to postgraduate PhD programs. Over 600 academic staff are teaching across all campuses of the university, with two campuses located in the Central Business District and nine others located in the Western Metropolitan Region including rural campuses at Sunbury and Werribee (Quality Assurance Portfolio 1995, VUT Website 2001). In 2000, the University had approximately 50,000 students of whom 28 per cent are Non-English Speaking Background students, 53 per cent are from the Western Metropolitan Region of Melbourne and nine per cent of enrolments are post graduate students (Useful Facts of VUT 1999/2000).

In 1958, Footscray Technical School became Footscray Technical College which was among the first colleges to affiliate with the Victorian Institute of Colleges (VIC). Paul Casey was appointed as lecturer in Business Statistics in the Department of Business Studies at Footscray Institute of Technology (FIT) in 1969 (Appendix B, p.1), after Footscray Technical College became the Footscray Institute of Technology (FIT). After 1968, FIT offered a wide range of vocational undergraduate and postgraduate courses, including 15 postgraduate diplomas in all faculties. In 1990, Footscray Institute of Technology and Western Institute merged to form the Victoria University of Technology

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[2] This section includes information provided by Mr. Paul Casey, who was involved in the development of the quantitative methods program at this University from its inception. Mr. Casey is introduced in the text.

(VUT). One of the main objectives of the University, as stated in the University Legislation (1993) and the Quality Assurance Portfolio (1995), is to develop into an institution with excellence in teaching, training, research and scholarship, with an emphasis on technological development and the application of knowledge.

In early 1973, the first degree course in Business in Accounting was commenced and the Department of Business Studies offered Quantitative Methods in the Bachelor of Business (Accounting). About this time (1977), Paul Casey was promoted to principal lecturer and then Head of the Department of Applied Economics. When Casey first joined FIT in 1969, the school of business was very small, 'about nine or ten staff' (Appendix B, p.1), and Casey was the only lecturer teaching Business Statistics at that time.

In 1980 the School of Business was established, which later became the Faculty of Business (in 1985) and then Faculty of Business and Law (in 2000), and is the largest faculty in the Institution in terms of student numbers (Rasmussen 1989; VUT Business Handbook 2000). In 1983, Statistics and Quantitative Methods became available, as a Sub-Major and then Minor in Statistics and Quantitative Methods in 1985, within the Department of Applied Economics (Brown 1996; FIT/VUT Handbooks 1970-96).

It was prior to 1980 that the School of Business began to offer degree courses and Casey, who was the chairman of the curriculum development group at that time, put together the degree proposal to the Academic Board of Studies. According to Casey, 'because it was only a very small group, everyone had to do a bit of everything' (Appendix B, p.1), which included teaching, developing courses, writing proposals and putting the course together. However, because the development of the curriculum in Quantitative Methods was largely derived from existing courses at other universities, the VUT courses accessed the experience and development parallel by these larger groups of academics.

Casey, being a statistician, was strongly arguing for the introduction of quantitative units; on the other hand, other academic staff who were from sociology, politics and economics were also advocating the incorporation of their units. The imperative for a business degree course at that time by the VIC was to have a major in accounting, so a structure of six semester units for each of the three years which covered the requirements of the VIC and also the requirements of the Australian Society of Certified Practicing Accountants (ASCPA) was developed.

As a result, the course structure included a compulsory core of one unit of statistics, two units of accounting, two units of economics, two units of law, two units of sociology and one unit of computer systems. Students enrolled in six common core units and two specialized units in first year, leaving four compulsory units and two specialized units in second year, leaving two specialized units and elective units in third year. Various major and minor streams could be selected. For example, they could choose to do a sub-major in Statistics and Quantitative Methods (offered in 1983). In order to qualify for the award, students were required to complete 24 semester units approved by the school. It is noted that, at that time, only five statistics units were available: one basic statistics unit in the first year, two units in the second year - Advanced Statistics and Introduction to Quantitative Methods, and two units in the final year - Elementary Econometrics and Advanced Quantitative Methods (Casey 1996; FIT Handbooks 1980-1983). A comprehensive history of VUT and its Quantitative Methods Curricula is shown in Figure 1.1.

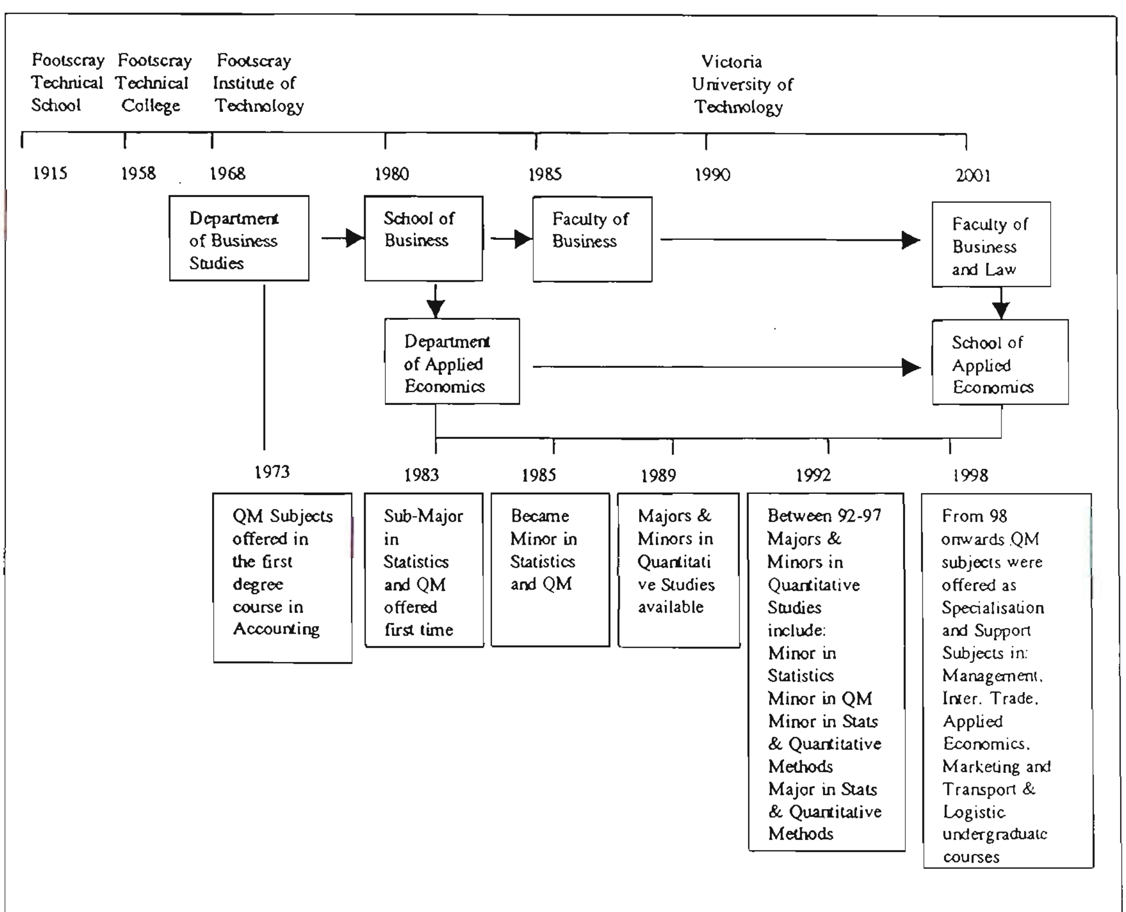

Figure 1.1 History of Victoria University of Technology and its Quantitative Methods Curricula

1.4.2 The Organisation of Statistics and the Quantitative Methods Curriculum

When asked about the rationale for the introduction of Quantitative Methods in the course curriculum, Casey believed that each student had to do at least two quantitative units in their degree; one compulsory in the first year Basic Statistics and another one semester unit in their third year. This was based on what other universities and colleges across the country were doing.

At this time, Casey was the only statistics lecturer in the department, so he was the only one involved in the quantitative methods curriculum development. It is known that Robert Johnson joined the department (two or three years later) in 1972 to teach statistics. According to Casey, by the time Johnson arrived, most of the course development on the first year Basic Statistics and third year quantitative methods units had been effectively completed. However, since no student had actually enrolled in the second year quantitative methods units, the syllabus at this level had not been finalized.

Decisions about which content to include were derived mainly from what Casey had experienced at Monash University. He intended to mirror the syllabus of the Monash course, and as the first year 'Basic Statistics subject is very standard around the world' (Appendix B, p.2), there was not much modification made. By contrast, for the third year quantitative units, Casey concentrated on Operational Research (OR) rather than Econometrics. The reason for this decision was based upon his belief that 'the mathematics was less complex in OR and many FIT students were not strong in mathematics' (Appendix B, p.2). Additionally, it was believed that Operational Research was more appropriate for the accounting and business degree students, since it was essentially viewed as applied economics with industry applications.

The course materials were based on standard texts at that time. These texts, however, were mainly from Casey's library which he had collected over the years and were in turn based on what other universities and colleges were using. Casey recalls that whenever he saw a book another institution was using, he would get a copy. He then went through them all and tried to select the one which was most 'user-friendly' for the students. At the same time, he produced a series of case studies for both Basic Statistics and Quantitative Methods because there were no materials currently available.

At that time, most of the exercises had to be done manually and computers in the early days were very slow; if anything had to be done on computers, it had to be done using punch cards, left overnight and the results collected in the morning. As calculators were elementary at that time, students were using slide-rules for the manual solutions to problems. This meant that when designing a case study, the number of elements such as variables in the problems had to be limited simply because of the lack of computational power.

Class contact was two one-hour lectures and two one-hour tutorials. However, part time students were required to undertake only one tutorial per week. There was no mathematics prerequisite, and students only needed good marks at Year 12 secondary school to enter the degree program.

When asked which curriculum model was the basis used in developing the quantitative unit, Casey indicated that no particular model was used. However, post-analysis shows that the resulting curriculum was essentially the Walker model (Print 1993) which belongs to the dynamic/interaction model category.

As described in the curriculum models section (2.2), there are four major 'conceptions' of curricula, and according to Casey, the conception underpinning the FIT course was mainly Academic. However, it was emphasized that although it was an academic orientation, the students of Footscray Institute of Technology at that time were not only being trained with an academic approach to thinking, but also with a practical approach to doing a job. This was in line with the vocational mission of FIT (FIT Handbook 1990) which insisted that students, when they graduated, would immediately be able to be employed. The intention was to use an academic approach with a practical bias where applications were integrated with theory to give students some sort of experience with problem solving. It was also pointed out that students at University of Melbourne probably would spend a lot of time in understanding the principles underlining accounting, economics or quantitative analysis, whereas FIT staff were more concerned about giving their students practical problems and problem solving.

In the early days, there was no work experience. The course was of three years duration and more than half of the students were part-time. This reflected the demographic nature of the Western suburbs where the majority of students could not afford to attend full-time.

Although the major in quantitative studies was an element of the original conception of the degree, it was not taught immediately. The major was not formalized from the compulsory and optional subjects until 1989, notwithstanding the fact that sufficient units existed when the degree course was firstly introduced in 1973.

1.5 An Examination of Existing Quantitative Methods Programs and the Methods of Teaching

1.5.1 The Course Structure of the Bachelor of Business Degree at Victoria University of Technology

From its modest beginning in 1973, the Faculty of Business and Law at Victoria University of Technology has grown to be one of the largest business faculties in Australia. The Faculty of Business and Law covers an extensive range of business education, research and consultancies (VUT Handbook 2000), with seven teaching departments:

. Accounting & Finance

. Applied Economics

. Hospitality, Tourism & Marketing

. Information Systems

. Legal & Executive Studies

. Management

. Graduate School

There are 18 undergraduate degree courses available (not including the combined courses), which have been developed with the cooperation of the business community to enable students to link theory with practice and to ensure that the courses are relevant to the needs of industry. The course comprises three years of academic study and one year of optional cooperative education, which is usually taken during the third year of the four year program. It is this continued nexus with industry which underpins the concern about the nature of the current Quantitative Methods curriculum.

1.5.2 The Development of the Major in Quantitative Studies from 1989 to 1997

There are now approximately 20 majors available in the Faculty of Business and Law, and among these are the one in Quantitative Methods which was developed from the subjects Paul Casey introduced in 1973 and first formalised in 1989.

The initial seven units in the major study of Quantitative Studies were offered for three years, from 1989 to 1991. However, when Footscray Institute of Technology and Western Institute merged to form Victoria University of Technology in 1990, the course structure of Quantitative Studies was significantly changed. Only two units stayed the same: namely Basic Statistics and Business Decision Making. The other five were replaced by new units with different subject codes.

From 1992 to 1997, the course structure and contents were virtually unchanged, with only the subject codes and names being altered. The aim was to ensure that all campuses across the newly merged university offered the same course and taught the same curriculum (Thompson 1996; FIT/VUT Handbooks 1989-97). The detailed development of course structures which occurred during this time are recorded in Appendix E.

To be able to complete a major in this area, students are required to study six statistics and Quantitative Methods subjects out of a choice of seven. The current 1997 course structure of the business program at Victoria University of Technology is attached in Appendix D and the majors available are given in Table 1.1.

Table 1.1 **Subjects which comprise the Major in Statistics and Quantitative Methods (1997)**

BEO1106	Business Statistics
BEO2254	Statistics for Business and Marketing
BEO2381	Business Decision Methods
BEO2258	Economic and Business Analysis
BEO2283	Applied Regression Analysis
BEO2284	Business Forecasting Methods
BEO3352	Business Decision Analysis

All undergraduate courses are offered on a full- and part-time basis and evening classes are mainly available to part-time students. The general teaching mode consists of a combination of lectures, tutorials, and / or laboratory workshops and some special classes organized by individual departments are offered to students with learning difficulties. Even though the detailed tutorial delivery through computers has been a continual change in delivery, the major lecture / tutorial laboratory pattern and the syllabus are comparable.

The class contact for each Quantitative Methods subject is three hours per week, comprising two one-hour lectures and one one-hour tutorial/computer workshop for one semester. The components of assessment for each subject are varied, and are generally through tests, essays, assignments, case studies, articles and examinations. Generally, most Quantitative Methods subjects allocate 40 percent of assessment to case-studies and/or tests and 60 percent to a three-hour examination at the end of the semester. Students are expected to satisfactorily complete each component of the assessment to gain a pass in the subject (VUT Handbook 1997).

Finally, from 1998 to date, Quantitative Studies were no longer available as majors; rather, they were offered as specialization and support subjects in various undergraduate courses such as Management, International Trade, Applied Economics, Marketing, and Transport & Logistic (VUT Handbooks 1998-2000).

1.6 Chapter Structure of the Dissertation

In chapter one, I have introduced the general background of the Quantitative Methods programs at Victoria University of Technology in the early days. I also presented the current course structure of the undergraduate business courses and the development of the major in Quantitative Methods from the beginning 1989 to 1996. Chapter two goes on to present a review of the literature, which includes an historical overview and the importance of Quantitative Methods. Teaching matters such as the curriculum and methods of teaching, the role of computers in classroom and the perceptions of business employers, educators and graduates regarding the education of Quantitative Methods, are also mentioned.

Chapter three has been devoted to the Conceptual Framework of the study, based on Gowin's vee Heuristic model. The research questions including focus questions, key questions have also been presented. Chapter four looks at the research methodology, the nature of the study and its limitations. This work includes the techniques used to analyze both quantitative and qualitative data and the data collection procedure. A brief review of relevant literature on the research approach has been carried out here, which provides a rationale for adopting certain research methods.

Chapters five and six present the findings of the research study. The details of questionnaire surveys sent to business employers, university business educators, final year students and the graduates, probes each groups' attitudes to Quantitative Methods programs. A comparison between the contents of Quantitative Methods programs at Victoria University of Technology and the expectations from industry has also been made to compare the responses from educators and employers. Finally, a longitudinal update in business employers' surveys has been carried out to determine if any significant attitudinal change has occurred between 1995 and 1999.

The interviews conducted with business educators at Victoria University of Technology, with a view to assisting the interpretation of differences and apparent contradictions in responses between employers and educators, have also been included in chapter seven as qualitative analysis.

Chapter eight completes the study with a summary of the findings, their conclusions and implications for research and practice and recommendations for possible further research. A concept map summarizing the dissertation structure is shown in Figure 1.2.

In the chapter two, a literature review of Quantitative Methods in undergraduate business courses will be given, together with a brief overview of the curriculum models and teaching methods commonly used. To conclude the chapter, a review of an investigation into Quantitative Methods programs both in Australia and overseas is presented.

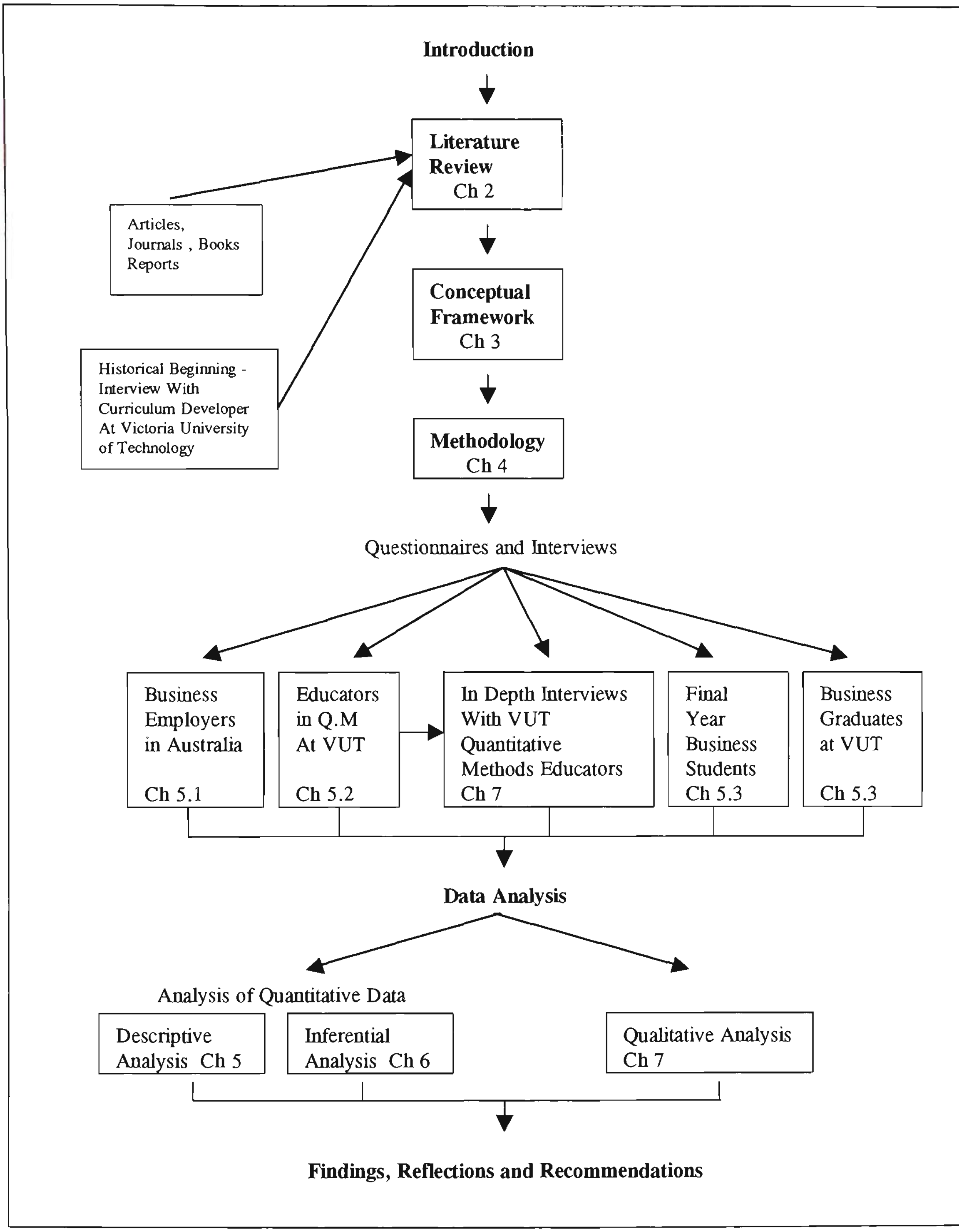

Figure 1.2 Concept Map Summarizing Dissertation Structure

CHAPTER TWO

Literature Review

2.1 An Historical Overview and the Importance of Quantitative Methods

Today, Quantitative Methods are universally regarded as an important decision-making tool by business and government. Many organizations employ a large staff of statisticians, operations research analysts or consultants, to apply quantitative techniques to the solution of practical problems and to aid in decision making (Render & Stair 1988; Bouldin 1985; Carter 1980).

The formal study and application of Quantitative Methods was developed within the traditional subject areas of statistics and operations research, and was expanded into areas such as Accountancy, Applied Economics, Banking and Finance, Catering and Hotel Management, Information Systems, Production Management and Marketing. The importance of Quantitative Methods in business is apparent, as subjects in Quantitative Methods are among the most frequently required in the undergraduate business curriculum (for example in Victoria; University of Melbourne handbook 2002, Monash University handbook 2002, Latrobe University handbook 2002, RMIT handbook 2002).

Study in Business majors in United States is placing increasing demands on the mathematical skills of students entering business courses, and in order to cope with the changes taking place in business schools, D'Augustine (1989) feels that the content of secondary mathematics curricula need to be reassessed to determine how appropriate they are as a preparation for modern business programs.

D'Augustine (1989) demonstrated the great impact that preparation has on the training of the managerial level in business. These include the audit manager, the marketing manager and the production manager. D'Augustine claimed that because of the new demands in mathematical skills, some manufacturing companies have to seek out trained engineers who are thought to have sufficient mathematical background to serve as production managers. On the other hand, marketing managers and auditors have to adopt highly technical sampling and sophisticated statistical techniques, in order to meet the changing mathematical-skill requirements.

Because of these new demands, D'Augustine recommended that business faculties restructure their curricula in three ways: first, to increase the amount, and change the nature, of the mathematical content which students are required to complete before beginning formal business programs; second, to require business majors to take Quantitative Methods subjects as part of the general business core requirements; and finally, to focus business-major courses on advanced mathematical skills. In light of these changes, reassessment of the prerequisite study in mathematics for business courses may be necessary. D'Augustine further suggested that (i) intending business students should take as many mathematics units as their secondary program offers with the expectation that the students' preparation should include two years of algebra, geometry, statistics and calculus, and (ii) students should have some experience with personal computers and communication before entering a university business program.

Not only does there appear to be a need to reexamine the prerequisites in mathematics for students entering business courses, in recent years reports from the United States indicate there is a strong movement calling for a revision of quantitative core requirements in Schools of Business. These authors (Browne, McFarlane, Mendenhall, Neyhart & Widicus 1981; Easton et al. 1988) suggest that such a change will make the course more relevant in that it will respond to the basic needs of the student, and also to ensure that it will integrate well with other business core courses.

For example, Browne et al. (1981) report how the Undergraduate Program Committee of the School of Business at Oregon State University evaluated and revised the entire quantitative core requirements. The idea of the core review was to ensure that each course reflected the basic needs of the business student and to ensure that it suitably integrates its content with that of other core courses. The previous 24-hour quantitative core requirement, which consisted of four mathematics courses and two management science courses, was analyzed and modified into the new 16-hour mathematics, statistics and management science requirement. It is believed that with the new quantitative core, many of the redundancies had been eliminated, and some of the core areas of study were being reorganized to better reflect the needs of the entire School of Business and to provide more meaningful business-related applications. It is also believed that the new core should prepare students for careers in their major areas of study and in business in general.

A later survey of 150 Heads of Departments in Schools of Business in United States by Gunawardane (1991) reported that the required subject in Management Science or Quantitative Methods (MS/QM) in undergraduate business courses had not significantly changed its coverage of topics over the last decade. However, the trend seemed to be toward the incorporation of more applications such as case studies, microcomputer usage and report writing, and less emphasis on tedious computation. The respondents also emphasized that these changes should not be done at the expense of theory. They were also critical of the fact that there seemed to be no change in examination techniques and in the time spent on remedial education in mathematics and statistics. Apart from meeting the requirements of the Schools of Business, the Management Science / Quantitative Methods Faculty believed that their responsibility was to improve the overall quantitative skills of business students. Also, the concepts and techniques taught in this area should be useful in functional area courses since these are considered to be important for later use as managers. The Faculty also viewed undergraduate Quantitative Methods subjects as serving primarily the production and operations management courses, then finance, marketing and personnel and human resources in that order.

The first conference on 'Making Statistics More Effective in Schools of Business', held at the Graduate School of Business - University of Chicago in June 1986 (Easton et al. 1988), had sparked considerable interest in the teaching of statistics in undergraduate business courses. This was consequently followed by a number of conferences held throughout America (McAlevey & Sullivan 1992) in which the role of statistics in the business curriculum was discussed. The concern was that the basic statistics subject had not essentially changed and the subject was a continuation of the basic undergraduate course that came into being at least 20 to 25 years ago. It was agreed by the participants of the conference that the basic statistics subject should be redesigned to be problem-oriented rather than topic-oriented. For the study of statistical techniques to be effective, the basic subject should deal with more realistic problems from the business world rather than textbook examples because students best learn statistics by doing their own analyses, especially with the use of microcomputers.

The role of time series analysis and forecasting in business was also discussed in great length during the conference (Easton et al. 1988). There was a suggestion that since forecasts play an important role in decision making and businesses are routinely involved in forecasting, when a single statistics subject is required of all business students, then forecasting and time series analysis should be included. However, it would be better to cover forecasting and time series analysis in a second, elective subject, rather than to risk inadequate coverage, although it was recognized that many schools could accommodate one statistics subject only. [3]

Finally, the university staff who participated in the workshop agreed that the first statistics subject should include a moderate amount of abstract notation, since some mathematical treatment is necessary for effective treatment of forecasting and time series analysis in an elective subject. Also, the participants suggested that ideas of model building, which are central to time series analysis, should be included, and regression could only be taught if there was time to discuss the concept of auto-correlated error. When discussing the nature of an elective subject on time series analysis and forecasting, the participants generally agreed that ARIMA[2] modelling, seasonality, and the topic of combined forecasts should be covered. It was emphasized that when using a computer package to teach ARIMA modeling, it was imperative to ensure the package included some of the recently developed aids to model selection, as this particular topic is difficult to teach. It was claimed that many existing subjects on forecasting and time series analysis tend to heavily emphasize technique and are lacking in realistic applications. Finally, it was suggested by the group that good forecasting cases should be developed and more time be spent studying these in the classroom.

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[3] Auto Regressive Integrated Moving Average (ARIMA) models have frequently been used in analyzing time-series forecasting methods and applications (Makridakis, WheelWright & Hyndman 1998).

In summary, there was an expression of much dissatisfaction, from industry and university participants in the conference (Easton et al. 1988), with the current state of the teaching of introductory statistics subjects in Schools of Business. It was thought by all participants that the subject should deal with more practical problems and more emphasis should be placed on time series, quality control, experimental design, sampling and the communication of statistical results, and less on the formal theory of probability and hypothesis testing.

The next section looks into the question of how well the quantitative training of Australian tertiary business graduates is responding to the needs of business organizations. In order to determine if there is a gap in expectations between education and industry, it is essential to study the role of higher education in general, the expectations of business employers and perceptions of educators towards undergraduate Quantitative Methods programs and the experience of business graduates at VUT in particular. Together, these views will indicate how effectively the curriculum of Quantitative Methods is in meeting the needs of Australian industry.

2.2 Business Employers, Educators and Students' Perceptions of Quantitative Methods Programs

In the report of the National Education-Industry Conference at Sydney (1987), John Dawkins, the Minister of Employment, Education and Training stated:

> Educational Institutions at all levels must be prepared to adjust their curriculum offerings to ensure that students will be able to contribute to society in a productive way... We want to improve the quality and flexibility of our systems of education and training to better meet the needs of the economy and labour market. We want to raise the level of private sector involvement in these processes...(pp.18-19).

Australia's success depends upon the education and skills of young people. It is important to create opportunities and to provide the right education and training to these people so they can best serve the needs of the nation. As Gale (1995) noted it:

> ...a university education is an investment for the future. Not only does it result in economic benefit for the individual, a highly educated society results in economic savings for the entire country...(p.222).

This view suggests that it is the university's responsibility to contribute to national needs and to bring education and training up to the level which Australia's economic development demands. The questions raised are: what kind of education does the nation require in the 21st century and how best can a university education contribute to these national needs? To achieve this, the university has to ensure that its curriculum is designed to make the course continually relevant to the world of work and it is necessary to revise the curriculum to match change in a fast moving high-tech world. Furthermore, as Australia moves to a more global economy, industry will place more demands on education and training to provide courses and curricula which parallel the latest developments and directions.

It has been shown that the number of students in business grew extensively over the decade proceeding our data collection period (DEET 1993) with the number of students in business courses doubling in size during this time[4]. Also, the quality of these students, as shown by their Tertiary Entrance Ranking (TER[5]), indicated that the calibre of these students interested in pursuing a business career, was very high. In order to help support and foster economic growth, there is a need to link education to the workforce by working closely together to devise strategies to improve the quality of education. There is also a need for educators to professionally develop themselves to understand the current requirements in industry, and hence produce graduates with the ability to adapt to the changing needs of industry. In this way, university students are aware of workplace expectations and are prepared to commit themselves by constantly developing more technical and general skills as required (Co-op Links 1997).

[4] The greatest number of students during this period was Arts (22 per cent of students were enrolled in this field), next was Business with 21 per cent of students enrolled (DEET 1993).

[5] A minimum rank that high school students must attain on the basis of their Year 12 studies in order to gain tertiary entry.

However, the report from the National Board of Employment (1995) indicates that employers found that many academic staff are not familiar with relevant techniques used in industry, and they recommend lecturers undertake regular industry replacement programs so they can re-establish contact with current practices. Also, questions raised in an International Conference on the Transition from Elite to Mass Higher Education in Sydney 1993 were; how many graduates should the nation produce, at what level of qualification, and in what fields of knowledge? In relation to curriculum relevance, it asked (i) if the undergraduate curriculum is appropriate and sufficient in terms of the dual role of meeting the requirements of initial employment and preparing the graduate for lifelong learning, (ii) if the undergraduate curriculum is too generalized or too specialized and (iii) if there is a need to establish a balance between academic and vocational orientations, that is between theory and practice and between general and specialized studies (DEET 1993).

As the paper (DEET 1993) pointed out:

> A first degree program that was too general or too theoretic as to be a passport to nowhere, however, would not meet the needs of students and would be a waste of public resources ... (p.39).

It is believed that the quality of graduates is important to industry and commerce, and in meeting the needs of today's business, university education has to change its quality according to the viewpoint of industry. As Wright (1990) described in 'Industry and Higher Education', graduates can attain quality in higher education by mastering both professional / technical and general knowledge, by 'perceiving things beyond the confines of one's discipline'. Wright also believes that the length of study affects the quality of education, and industry and commerce generally agree that the courses should not extend beyond five years.

'Higher education is only a stage in a lifetime process of learning' (Wright 1990), and one important function of Business courses is to ensure that students understand this concept and be prepared for this lifelong learning process. It is essential, for example, that students be aware of the personal transferable skills that can be achieved during their courses. Higher education can develop these necessary skills in students by forming a closer relationship with industry in order to build effective industry-education partnerships to make possible powerful learning environments, that are profitable for business and industry, as well as for the students and their university.

In addition, higher education should also be prepared to adopt different teaching methods, if required, that include life skills training for students. The qualities of a lifelong learner defined in the Candy report 'Developing Lifelong Learners through Undergraduate Education' (NBEET 1994), include an enquiring mind, a sense of the interconnectedness of fields, a breadth of vision, an ability to critically evaluate information, a number of personal attributes and a range of learning skills. Nijhop and Brandsma (1999) also indicated that skills like problem-solving, team work and communication are important for students to develop.

Higher education recognizes the increasing demands on graduates to acquire lifelong learning skills due to the rapid changes in the economic environment. Higher education also recognizes the need to balance the curriculum content, between general knowledge/generic skills and specific vocational/professional skills, to enhance lifelong learning skills and attributes (NBEET 1996).

2.2.1 Business Employers' Expectations of Graduates

In order to understand what is demanded of working life in the continually changing circumstances of today's business world, several studies in the United States have been carried out to determine what areas employers consider important to the career opportunities of future business graduates (Gustafson, Johnson & Hovey 1993; Raymond & McNabb 1993; Buckley, Peach & Weitzel 1989). These were determined to be communication skills, interpersonal skills, analytical skills, quantitative skills and work experience. By acquiring these skills, many employers believe that business graduates will be more successful in gaining and securing initial employment as well as better equipped to pursue job advancement.

Similar findings have also been reported in Australia. According to surveys conducted by the Monash University Course and Career Centre (Dwyer 1992), the National Board of Employment, Education and Training (1995) and the Graduate Careers Council of Australia (Guthrie 1994), employers in Australia are generally looking for graduates who can display strong communication skills, organisational skills and analytical skills. They also suggest that higher education should provide greater opportunities for students to develop knowledge and technical skills specific to their organisation and the ability to apply academic learning to the workplace. Moreover, regarding the cognitive attributes and skills such as logic, analysis, reflection, curiosity, creativity and synthesis, approximately 70% of employers in Australia consider quantitative thinking and numeracy skills as necessary for all new graduate recruits (Guthrie 1994). According to this report, these employers would also provide training courses to their new graduate recruits in the Quantitative Methods and numeracy area in the first two years of employment. However, these surveys only indicate what Australian graduate recruiters' expectations are in terms of work-related generic skills and attributes. There are no currently available reports on what business employers desire their graduates to have studied, especially in the area of Quantitative Methods, during their business courses.

2.2.2 Business Educators' Attitudes Towards Undergraduate Quantitative Methods Programs

One useful contribution to this area is the report by Morley (1992) of the Graduate School of Management at RMIT. Although this report only concerns the teaching of statistics in MBA courses, it can be used, at least, as an indication of what educators think about the current statistics programs in Australia. Like McAlevey and Sullivan's study (1992) which gives an overview of the general state of teaching in introductory business statistics subjects in Australasia, Morley agrees that the statistics course content, computing usage and teaching problems for business study in Australia are very similar to courses in United States.

With respect to course content, both studies (Morley 1992; McAlevey & Sullivan 1992) show that nearly all introductory statistics subjects in most Australian business schools include descriptive statistics, probability, random variables, sampling distributions, inferences and regression analysis. Both studies also confirm that textbooks used in Australian business statistics subjects are mostly American based texts, and the course structure and teaching units are found to be similar to American courses.

However, as indicated by Morley (1992), the current business curricula in Australia have placed more emphasis on the use of statistical techniques than on an understanding of essential concepts. Morley suggested that in devising a new business statistics program, the curriculum designers should face the questions of what Quantitative Methods are needed in business, what Quantitative Methods are used in business and whether techniques are important for statistics students to acquire. He also emphasized that the new course curriculum should be useful, practical, comprehensive and relevant to business managers. This means that the revised course should meet the needs of Australian business and industry and it should be more data oriented, requiring minimal mathematical background and the usage of business computer packages. Finally, Morley also pointed out that the responsibility for business educators is to decide on what should be in the course, as Australian business employers seem to be unsure what quantitative skills they expect from business graduates.

2.2.3 Victoria University of Technology's Business Graduate Profile Outcomes

In 1988, the Student Services Department of Victoria University of Technology (Hastings 1989) conducted a survey to find out what graduates thought of their current employment, career prospects and experience at their university. The majority of VUT's graduates believed that their training was unsuitable for the jobs (60%). This belief was highest for Applied Economics graduates, where only 20 per cent of students thought their training was suitable for their current jobs. Also, about one-third of graduates felt they were not using the skills they had acquired in their courses. Again, Hospitality and Tourism Management graduates in particular, expressed more dissatisfaction about this than other graduates (48.4%). These graduates were also less inclined to think employers were well informed about their courses (14.3%) compared with graduates across from other schools of the university (50%). Regarding the effectiveness of this university experience, business graduates were less inclined than other graduates to agree that industry links were a strength of VUT, that learning was relevant to work (about 30%) and that VUT was a good place to study (about 50%). In general, the 1989 VUT Graduate Profile report revealed that, in some aspects (of the job and university experience), business students were more dissatisfied, in general, than other graduates across the university. Regarding the suitability of Quantitative Methods curricula, this report did not indicate whether the teaching of Quantitative Methods subjects at this university was adequate to prepare graduates for the workforce. However, as mentioned above, VUT's graduates expressed that they were not using the skills they had acquired in their courses, and this might simply imply some disquiet with the Quantitative Methods area.

In light of the dissatisfaction expressed both by business employers and educators, there appears to be a need to assess the existing programs and their effectiveness in Australia. That is, both the content and the methods of teaching in Quantitative Methods subjects needs to be examined in detail to determine if the current training is suitable within an Australian context. Hence, it is necessary to look at the curriculum design and its conceptions to determine the underlying rationale and philosophy used when developing the curriculum.

2.3 The Curriculum Models

An effective, efficient and appropriate curriculum is required to meet the needs of today's business students, and in order to have a sound and well-prepared curriculum, curriculum designers need to have the skills and the principles of curriculum development and design. The curriculum development process is described by many curriculum authors (Brady 1990; Print 1993; Armstrong 1989) as a series of steps that involve making decisions about educational objectives, subject matter, the organization of course content and curriculum evaluation. Also, how successfully curriculum designers develop and devise curriculum depends partly on the curriculum models they employ.

Initially, the word 'curriculum' was derived from the Latin term, meaning a 'running course'. Through time, several definitions of curriculum have been identified and the term 'curriculum' is viewed differently according to one's orientation. According to Print (1993), curriculum is defined as all the planned learning opportunities offered to learners by the educational institution, and the experiences learners encounter when that curriculum is implemented. Armstrong (1989) suggested that 'curriculum involves planned interactions among instructors, learners, and learning resources in the school or in other appropriate instructional settings'. In whatever way curriculum is defined, its meaning in general is 'the aggregate of courses of study taught in schools or colleges' and it is these courses which allow learners to have a standard learning experience in an educational setting.

Curriculum models by Print (1993) are classified into three categories; the rational, cyclical and dynamic models, which can be organized into a form of continuum from the rational, to the cyclical and then the dynamic models. According to Print, curriculum writers prefer either rational or cyclical models when devising curricula largely because of their explicit structure, whereas teachers tend to advocate the use of dynamic models such as that devised by Malcolm Skilbeck (Skillbeck 1976 cited in Print 1993).

Rational models, sometimes referred to as objective, classical or means-end models, enable curriculum writers to follow a logical, sequential and rigid approach, starting with objectives, moving to content and learning activities, and finally to evaluation. We can see that in these models, such as those of Ralph Tyler (1949) and Hilda Taba (1962), the role of objectives is very important as it serves as a basis for devising subsequent curriculum elements.

On the other hand, dynamic or interaction models such as those suggested by Decker Walker (cited in Print 1993) and Malcolm Skilbeck (1984), are more flexible and interactive. Here curriculum writers are free to be more creative, being able to start at any point in the process that is appropriate to their needs. It is noted that in the continuum of curriculum models, rational models lie on one end and dynamic models lie on the other, in terms of flexibility. Cyclical models are intermediate and they are usually considered as an elaboration of rational models which are becoming more flexible in application. Examples of these cyclical models are those of Wheeler (1974) and Nicholls (1978). Here, typically curriculum writers begin with a general idea, then they move around in a continuous cycle that responds to changes in situation. A collection of diagrammatic representations of curriculum models described by Print (1993) is shown in Appendix C.

Before being able to work on the development of a curriculum, one has to conceptualize what a piece of work is like at the end. Also, a whole range of questions are usually posed, including:

- Who is involved in this curriculum development ?
- What is the rationale for the introduction of this curriculum ?
- How do we make decision about which content to include or about the curriculum materials ?
- Is there any particular curriculum model to base development upon?

These questions above need to be answered before the curriculum development can be carried out. However, it is essential to be clear about one's initial directions or conceptions of curriculum. It is known that numerous conceptions of curriculum can be organized into four major areas; these are academic, humanistic, social reconstructionist, or technological conceptions; these are described (Print 1993) as:

- .Academic conception enhances the individual's intellectual abilities through the study of worthwhile subjects.
- Humanistic conception is to enhance personal growth.
- .Social reconstructionist conception claims that the school curriculum should effect social reform and help produce a better society for all.
- Technological conception seeks to produce a more effective and efficient resolution of objectives.

Questions regarding appropriate conceptions in today's Quantitative Methods course curriculum will be raised , particularly in section B - Business schools and their Curricula of Business Employers survey (Appendix G), and section C - Quantitative Methods course organization and teaching methods of Business Academic Staff at VUT (Appendix H). These conceptions will be examined by surveyed participants to determine their appropriateness in devising a Quantitative Methods curriculum for today's business environment.

Also, in the development of curriculum, Bloom, Engelhart, Furst, Hill & Krathwohl (1956), Simpson (1977) and Davies (1976) pointed out that it is important that the major objectives of the course unit be clearly identified in relation to various questions such as: what educational purposes or objectives should the course seek to attain, how can learning experiences be provided such that they will likely bring the attainment of these purposes, or the correct conception of the course? Bloom (1956) also suggested that precise questions should be discussed, including how much knowledge should be required learning, how precisely the student learn the required knowledge and what is expected of students with the information they have acquired?

In other words, curriculum objectives have to be specific; not only should they refer to the content of the topics, but contain a criterion for the level of learning required. As Cowan (1998) has emphasized, the focus was not just on what students know, but on how well they know it. Therefore, it is necessary to specify in advance the levels of understanding expected of students, and to embody them in the objectives.

To help with the levels of knowledge desirable for students to acquire, Bloom, as an editor of a committee of college and university examiners, developed a taxonomy of educational objectives in which the objectives are organized in hierarchical order into major classes, namely: knowledge, comprehension, application, analysis, synthesis and evaluation. These classes were arranged from simple (level 1) to complex (level 6), and from these levels the curriculum developer or designer can state clearly, in the objectives, the skill levels it is expected the students will acquire. The definitions of these skill levels are stated in Appendix F of this study, and are used later in the questionnaire to determine what quantitative topics, and what skill levels, are expected of students from both university and industry.

Having examined various curriculum models, the conceptions of curriculum and taxonomy of educational objectives, the next section will study various methods of teaching including work experience in order to determine how effective these teaching methods are in the training of Quantitative Methods to business graduates.

2.4 Methods of Teaching and Work Experience

There have been a number of international conferences relating to the subject matter of statistics studies, but not much has been done on the methods of teaching in the Quantitative Methods area, especially at undergraduate level.

The International Statistical Institute's Round Table Conference, 'Training Teachers to Teach Statistics', held in Hungary 1988, was the first to concern itself exclusively with training statistics teachers (Hawkins 1989). The nature of the conference was to ensure strong links between participants from many different countries, and to provide an on-going channel of communication for facilitating the development of statistics teaching and teacher training.

According to Hawkins, there was much discussion about the need for competent teachers of statistics as there were not enough teachers with training in the pedagogy of teaching statistics. However, the problem lay in the research of the pedagogy, as it was not yet well defined, given research in this area was fairly new. Also, changes in methods of assessment, which placed more emphasis on practical course work, were also changing the role of teachers and the types of skills they needed. Unfortunately, the article only reported on what had been discussed at the Round Table Conference, giving no details about how teachers should be trained to teach statistics or discussion of changes in school curriculum or assessment methods.

Similar work carried out in a number of environment has shown this work to be observed. For example Ware & Brewer (1988) said that students find statistics difficult to learn because the subject involves abstract concepts, data and inferences. Similarly, Vu & Zhang (1998) at VUT also noted identical situation. The course also requires more interpretation, in that calculations can lead to several solutions. Unlike mathematics, statistics obtains data from experiments and not from calculations, and in addition statistical notation and terminology are relatively more confusing and ambiguous (Watts 1991). In order to make the learning of introductory statistics easier, Watts suggested that if teachers could remove ambiguities, and make the terms more evocative and meaningful, then the concepts would be much simpler.

Subjects in statistics are often rated by students as boring, confusing, too technical and ineffective (Ware & Brewer 1988; Mortensen 1991; Jaisingh 2000). Usually, students approach these subjects with anxiety, especially in the mechanical process of calculating statistical analyses. To assist students with the learning of statistics, some effective techniques have been suggested by statistics teachers. These include asking students to express their feelings about taking the subject, letting them know that their concerns are shared by their classmates, and also that these concerns are acknowledged by their teacher (Dillon 1988). Also, by using information obtained either from within the classroom or from industry and by working with these real data sets, students will be motivated as they can see the use of statistics in real life (Beins 1988).

Another approach, described by Jacobs (1988) to help students reduce statistics anxiety, was to devise a brief questionnaire in the classroom, then illustrate the statistical concepts by using the data obtained. In this way, students were given an overview of the subject while working with a real data set which could be used throughout the semester to supplement problems available in the text. Jacobs also believed that the first class meeting was supposed to set the mood for future classes in which the instructor should create motivation and pay more attention to reduce the students' anxiety, before giving an introduction to the subject.

Finally, in order to improve study skills in statistics, Hastings (1982) recommended that the instructor should treat the statistics subject as a 'language' course in which students are expected to be able to verbalize and visualize concepts such as sampling and random sampling distributions. Hastings also encouraged students to study statistics every day and to ask questions where possible.

Apart from helping students to overcome their anxiety about statistics, the role of future business educators, according to Haynes (1992), is to provide students with opportunities to conduct research, to work cooperatively, to enhance communication skills, and to improve critical thinking and problem solving abilities. Haynes also pointed out that educators should use learning activities such as the use of guest speakers, case studies and discussions of current events to assist students in preparing for a changing world. In addition, there should be continued emphasis on teaching methods that involve more learning by doing, and both faculty and business professionals must continue to provide practical experience and help students learn to think. This should also expose students to business ethical issues and global dimensions.

A detailed examination of existing Quantitative Methods programs at Victoria University of Technology was presented in the previous chapter (1.5) to show how the subjects were put together. However, not only should the content of the subjects be looked at, the methodology and teaching methods or techniques by which that content is taught should also be examined, as these both play an intimate part in preparing graduates for the workforce. As Stigler and Hiebert (1999) also emphasize, long term improvement in teaching will depend more on the development of effective teaching methods. Hence, in examining methodology and techniques in detail, there is a need to define the techniques used in Quantitative Methods training. Later on, the content of, and teaching methods used in, these subjects will be assessed by both graduates and business employers, in order to determine their efficiency and effectiveness within an Australian context. Following, are the conveniently divided categories of training techniques used in most Quantitative Methods subjects:

- The Lecture Method
- Tutorials & Classroom Discussion
- Workshop Method

- Team Teaching Method
- Case-Study Teaching
- Work Experience

2.4.1 The Lecture Method

According to Bredon and Shanahan (2000), the most common and efficient method used in teaching a large group of students is the lecture method. The idea is to present materials, theories and concepts to give students an overview of a particular topic. The lecture provides an opportunity to present information, to convey knowledge of teaching content as well as providing a structure for learning and sometimes to elaborate in details about the topic to a large audience (Bredon & Shanahan 2000). However, the material presented in the lecture should not be regarded as the only source of information required for understanding the topic. Students are expected to supplement this through prescribed readings in their own time. The lecture is defined as 'knowledge presented by all who write or research the subject as being a verbal disposition... in a carefully prepared and well organized form' (Prichard & Sawyer 1994).

This method has been used for a very long time and is regarded as the best teaching method to a large group in higher education (Hart, Waugh & Waugh 2000). These authors argue that not only is it an economic means of teaching a large group of students, it is the method that can cover a great volume of material most effectively. In Quantitative Methods classes, usually one large lecture is given, followed by several small groups called tutorials, except first year core unit – Business Statistics in which a large number of students attend each semester (approximately 700 students). School of Applied Economics has to offer several lecture streams to accommodate the needs of such large groups. It is noted that significant movement now tends towards online delivery teaching mode. For example, the core Quantitative Methods subject BEO1106 – Business Statistics lecture materials can be viewed and downloaded from the central point of VUT, website address of www. Business.vu.edu.au/beo1106.

Apart from providing students with a good background of the subject, this lecture method is also regarded as an excellent way of explaining definitions, terminologies or keywords and can also be used effectively to summarize the results of large numbers of studies or theories. However, it is noted that with this standard lecture method, the flow of information is one-way in which student contributions are usually limited to questions and requests for clarification (Biggs 1999). As mentioned earlier, this method is normally used over a considerable range of class size. However, in classes of about twelve students and fewer, Biggs noticed that most teachers would change from a straight lecturing style and become more interactive, deliberately eliciting contributions from students.

2.4.2 Tutorials and Classroom Discussions

Unlike lectures, tutorials in Quantitative Methods are commonly conducted in small groups. The number of students is varied; here can be in a group of six or eight or twelve, but ideally no more than twenty students. The term 'tutor' derived from a Latin word meaning 'a guardian' and the role of tutors is to expand and clarify materials presented in lectures. Through tutorials, students have an opportunity to discuss and explore ideas and to learn the material in a more practical way, through problem solving, computing work, projects or case studies. In this way, tutorials allow students to interact more with their instructors, and allows students to re-design courses to fit their personal needs.

There are various forms of tutorials in Quantitative Methods classes; these include problem solving, discussion groups, case studies, project work or open format. In any form, the role of a tutor is to develop practical skills associated with teaching materials, to answer questions and ultimately to provide a contact point for students when they have any query. Hence, unlike the lecture where the lecturer delivers the information and students are passive, with tutorial classes, students do much of the work and the tutor's role is to facilitate this change. As Biggs (1999) asserted:

> good tutorials are those that promote active learning, where tutors are able to facilitate good debate, to open out the quieter students and to provide a focus for discussion and interaction that requires students to prepare in advance...(p.85).

Discussion groups are the most common form of tutorials. These allow students to express themselves orally, thus developing communication and thinking skills. Students also have a greater confidence in mastering the concepts of lecture materials by working out problems either with calculator or using statistical software package SPSS and presenting the findings to other fellow students. Moreover, through discussion students have an opportunity to know themselves and others better.

2.4.3 Workshop Method

Research has shown that students learn more by becoming personally involved in the learning process (Prichard & Sawyer 1994). This active learning method is commonly adopted in the workshops and it is more of a 'learner-centred rather than instructor-centered instruction' (p.112). In this way, students learn more actively by discovering the knowledge themselves as suggested in the Experiential-Learning Cycle (Kolb 1984). As explained by Jones (Prichard & Sawyer 1994), in this process students learn by doing things, that is experiencing, observing and reflecting, generalizing and testing implications of concepts/ models/ principles in new situations. This process can also be most effective when learning is collaborative - that is when students are working together in small groups.

To assist students with the learning of Quantitative Methods, some effective techniques have been suggested by Haynes (1992). These include using case studies, inviting guest speakers and discussing the current events. Haynes also emphasized on teaching methods that involve more learning by doing such as the workshop method which is described as efficient, active and effective method used in teaching small groups of students.

In Quantitative Methods, workshop method is widely used at VUT. Apart from the conventional two one-hour lectures and one one-hour tutorial a week, students in first year

Business Statistics are encouraged to attend one additional workshop. These extra workshops usually commence in second week of the academic semester and take the form of small groups and individual consultations. The goal of these workshops include:

- Going through main points, expanding and clarifying materials presented in lectures
- Strengthening students' statistics terminologies
- Learning to use statistical calculator
- Familiarising with the software package such as SPSS
- Problem solving and going through simple exercises which reinforce techniques and principles
- Other matters such as interpreting formulae and reading statistical tables

2.4.4 Team Teaching Method

Team teaching has been introduced into colleges and universities, in an attempt to bring multiple perspectives into the classroom. Both students and faculty members often find team teaching more creative and stimulating than single lecture presentations (Prichard & Sawyer 1994). Team teaching can involve collaboration among instructors of the same discipline, or it can be several instructors from different disciplines, or it can involve one faculty member as a generalist while others are specialists. In any form, team teaching is intended to strengthen students' abilities by building bridges between skill and content courses in the curriculum. It is also aimed at building a stronger relationship between colleagues and to provide new insights about their disciplines (Prichard & Sawyer 1994).

This team teaching method is not adopted in Quantitative Methods subjects at VUT. However, as mentioned above if team teaching does involve one staff member as a generalist and other as specialist, then first year Business Statistics subject does have a 'specialist' whose duty is to assist students with learning difficulties. Some staff members also specialize in teaching statistics to full-fee paying overseas students or students with non-English speaking background.

2.4.5 Case-Study Teaching

The term 'case-study', as used in Quantitative Methods subjects, usually refer to research / study and evaluation, where data are collected, analyzed and evaluated. Mostly, these case-studies are 'real-life' problems where 'real data' are used and through these, students can develop reasoning, analytical and problem solving skills. For example, in first and second year Quantitative Methods subjects (BEO1106 and BEO2254) at VUT, case-studies with topics link to real life business industry have been provided to students as part of the course requirements. These serve as a link between education and practice and they can allow students to experience problems faced by employers, especially when working with 'actual' data.

The use of case studies has rapidly grown over the past few years and now has become widely adopted in teaching Quantitative Methods subjects. Case studies are also used as part of the internal assessment and its numbers can be varied according to course coordinator or at different course levels.

Case studies are interesting to the student. They provide interaction between participants as two or more students usually working on a case study. Case studies stimulate and force students to think analytically, develop knowledge and technical skills. Case studies are active learning in which students can utilize all the factual knowledge at their command.

2.4.6 Work Experience

Co-operative education has been a feature of advanced education for a long time. To develop knowledge and technical skills, work experience is usually included in most business courses where students are required to study at university for three years and spend a year working in a relevant industry (Co-op Links 1997; Guthrie 1994).

This is termed 'Co-operative education' and here business is working co-operatively with education to provide an opportunity for students to learn more about industry and to understand why work is important and how it brings benefit to society. Ideally, students will attain both theory and experience from the workplace during their degree studies, and they will be highly motivated and adapt more easily to a new environment. The advantage is that academic staff will become more aware of current topics required by industry, and industry has the opportunity to select future competent employees. Also, involvement between education and work will create a more relevant and resource intensive learning environment with the introduction of, for example, joint research projects, equipment donations, course prizes and sponsorships (Guthrie 1994).

Co-operative Education is compulsory for Victoria University of Technology undergraduate students in Catering and Hotel Management, Tourism Management, and Hospitality and Tourism Management. Co-operative education is a minimum of 40 weeks in duration, in which full time paid professional work is experienced in a relevant industry. Normally, the placement is taken as the third year of the course, and the final year of academic studies is taken as a fourth year in the course.

Apart from gaining 'hands on' professional work experience, co-op education enables students to develop contacts within an industry, to allow them to be an integral part of a team and to test future employment possibilities. At the end of the work experience period, some employers encourage students to continue employment with them by making 'pre-graduation offers' of employment.

At Victoria University of Technology, there is a special Co-operative Education unit in which coordinators organize, prepare students, make arrangements, and supervise students during their placement in industry.

2.4.7 Summary of Teaching Methods

In summary, there is no single, 'best' teaching method for Quantitative Methods subjects. As Biggs (1999) pointed out, teaching is individual and teachers have to adjust their teaching decisions to suit the subject matter, the available resources, the students and even their own individual strengths and weaknesses as a teacher. Table 2 presents the characteristics of training techniques used in Quantitative Methods subjects at the Victoria University of Technology.

Prichard & Sawyer (1994) defined the laboratory teaching method in classroom 'as an opportunity for students to learn concepts and process skills through direct experience'. Nowadays, the laboratory is not only pictured as the 'scientist in a lab setting', it can also be a field setting or 'working with data from the literature'. In Quantitative Methods subjects, laboratory work is referred to as computer-based technology work, where several applications of computer technology are widely used. The next section will focus on the role of computers in classroom and determine whether computer-based teaching methodology can be sources of problems in Quantitative Methods education.

Table 2. Characteristics of Training Techniques Used in Quantitative Methods Subjects

	Training Techniques						
Variable	**L**	**T&C**	**W**	**TT**	**L/C**	**C**	**WE**
Theory / Concepts or Material Presentation	x	x	-	x	-	-	-
Interaction Between the Participants	-	x	x	-	x	x	x
Developing Knowledge and Technical Skills	-	x	x	-	x	x	x
Discussing & Solving Problems	-	x	x	-	-	x	-
Active Learning / Learner-Centered Instruction	-	-	x	-	-	x	x

L Lecture
T&C Tutorial & Classroom Discussion
W Workshop
TT Team Teaching
L/C Laboratory or Computer-Based Teaching Method
C Case Study
WE Work Experience

2.5 The Role of Computers in Teaching

The literature also indicates a trend in recognizing the importance of computer literacy in Business courses. Some authors have identified computing skills as a quantitative skill, given that much statistical work is now done on computers (Bialaszewski, Franklin & Turnquist 1992; Nellermore 1992; Franklin et al. 1989; Easton et al. 1988). Others have recommended that educators increase the classroom time with computers as well as maintaining student engagement in the technology-rich classroom (Brady, Long & Slaughter 1985; Sandholtz, Ringstaff & Dwyer 1996; Pea 2000). These authors noted that the importance ranking of computers was found to be significantly different between small business executives and educators. As business executives ranked the computer area sixth while educators ranked it eleventh in a listed of twelve subject areas (Brady et al. 1985).

The Chicago conference report on 'Making Statistics More Effective in Schools of Business' in June 1986, emphasized the use of computers as an instructional tool in teaching statistics. Three independent surveys, undertaken to obtain information about statistical software packages used in business schools, were reported here. The Rossi/Miller Telephone survey suggested that most major business schools had adopted the IBM PC for teaching introductory statistics. The Michigan survey ranked the software packages used as followed: on mainframes - Minitab, SAS, SPSS, BMDP, IDA, other; on microcomputers - other, Minitab, SYSTAT, SPSS, SAS, BMDP. Similar results were also found in the Association for Computing Machinery (ACM) survey, except that Lindo and Microstat were used instead of BMDP, IDA and SYSTAT (Easton et al. 1988).

The role of computers in teaching was also discussed at the Chicago conference. The increasing availability of microcomputers offers many advantages in the statistics classroom. The computer has the ability to manage large data sets efficiently, the ability to process or simulate data quickly, and the capacity to display results graphically. However, the pedagogical question that should be addressed is the amount and extent to which students are required to carry out statistical calculations manually rather than make use of accessible statistics software packages.

More recently, there has been considerable discussion relating to the use of microcomputers in teaching introductory statistics. As Stirling (1987) commented:

> ...although many introductory statistics courses now make use of computers, they are not currently being used to their full potential as teaching tools. In most courses they are just used as sophisticated calculators to relieve the drudgery of performing statistical calculations manually and to allow computationally difficult techniques like multiple regression to be performed by students...(p.46).

A survey conducted by Shufeldt, Parmley and Kopp (1992) investigated the use of computers in applied business statistics curriculum in 669 American Schools of Business. These survey findings showed the number of semester hours required in the business core varied from school to school (over half of the 213 respondents indicated that three semester hours were required, and those reporting more hours showed greater computer software requirements). The report also indicated a lack of agreement in Schools of Business regarding the use of software packages in business statistics. Topics that frequently utilize computer software packages were regression, central tendency, dispersion and graphical displays of data, hypothesis testing, confidence intervals and analysis of variance. Shufeldt (1992) also reported that marketing classes utilized more of a given computer software package, than all the other upper level undergraduate classes.

Nellermore (1992) provides a useful summary, on the basis of educational requirements desired by businesses, of new graduates and the relationship of the computer to their work. It was suggested that for students to enter the business work force and be successful in their chosen careers, they must possess certain skills. The trends as seen today that all established disciplines were converging through the use of computers (Nellermore 1992; Newby, Stepich, Lehman & Russel 2000). For computer related skills, all managers of selected companies indicated that students should have a computer background in word processing, data processing, programming and information systems.

In general, the results revealed that computer applications were a requirement of most major business schools in America (Gray & Tall 1994; Newby et al. 2000; Loveless &

Ellis 2001). The benefits of using computers for laboratory instruction are numerous. These include reducing cost and saving time in analysing data, allowing students to absorb abstract concepts in a practical way, providing students immediate data results thus allowing them to have an overview about the data set, developing problem-solving skills and increasing computer operation skills. In general, computer-based teaching methodology is widespread and is considered to be productive and effective in the laboratory setting.

Again, this computer-based teaching methodology will be investigated to determine if the introduction of computer-based work is a source of some of the problems in the education of Quantitative Methods. Questions, regarding computer software packages used in classroom, computing facilities and the importance of software application skills for a Quantitative Methods graduate career, will be addressed to final-year business students, graduates and employers in the surveys.

2.6 Summary

It is clear that in today's business environment, to be successful graduates have to possess certain skills, which are essential for their career opportunities. The importance of quantitative techniques in business is apparent, as subjects in Quantitative Methods are among the most frequently required in the business undergraduate curriculum. These increasing demands in mathematical and statistical skills have already made a great impact on the training of the managerial level in business. Production managers are required to have sufficient background in mathematics to do meet their position requirements, and marketing and audit managers have to adopt highly technical sampling and sophisticated statistical techniques in order to meet the changing quantitative skill requirements.

Hence, it is likely that future business majors will place further demands on the Quantitative Methods skills of students entering the school of business. This investigation will determine the views of current school of business staff lecturing in Quantitative Methods as to the academic level of students entering business undergraduate Quantitative

Methods courses.

The current literature revealed that the required study in Quantitative Methods in undergraduate programs has not changed its coverage of topics much over the past 20 years. However, the trend seems to be the incorporation of more applications, case studies, microcomputer usage, report writing and less emphasis on tedious computations. There seems to be no change in examination techniques or time spent on remedial education in the quantitative area.

However, because of recent changes in currency of the topics presented in the business environment, it is important that business educators need to examine the Quantitative Methods subjects in business schools. Educators need to explicitly defend why these Quantitative Methods topics have been essentially unchanged for the past two decades. This investigation will ask questions such as: are existing topics appropriately for modern industry, and what new topics business employers might consider important.

As mentioned previously, not much has been done on the current Quantitative Methods requirements and methods of teaching in undergraduate business programs in Australia, excepting the work of Morley (1992) at the Graduate School of Management at Royal Melbourne Institute of Technology. As stated by Morley, the current business curricula in Australia has placed more emphasis on the use of statistical techniques than on an understanding of these methods. Morley suggested that the course curriculum should be revised to meet the needs of Australian business and industry. This new course should be more data oriented, requiring minimal mathematical background and the use of business computer packages.

Because of the paucity of information related to the issue, the effectiveness of teaching methods in undergraduate Quantitative Methods business courses is addressed in this research study. If there are any tensions between business employers and educators regarding the state of teaching of the indication of the curriculum then this study will need to illuminate and analyse the source of these differences in order to produce a new direction for a curriculum design for business courses in Quantitative Methods most suited to Australian industry requirements.

Hence, it is the opinion of the investigator that in order to consider how well Quantitative Methods business courses are responding to the needs of Australian industry, there is a need to stop and re-gather at this time in order to re-assess these developments in an Australian context. It is essential to identify which quantitative techniques and skill levels are required in business, to examine the options for curricula ahead and provide the best suitable training for business graduates. These aims are intended as a whole to break the traditional reliance on business quantitative study to transfer and adapt developments from other disciplines, and to place more reliance upon business educators themselves to develop an understanding of their own needs. Also, from this understanding and the understanding of what employers expect from business graduates in quantitative skills, a curriculum design for courses in business quantitative study most suited to Australian requirements can be achieved.

The next chapter introduces the conceptual framework which was used for this work, and develops the research question and four questions which form the keystone to the investigation. Finally, an answer of the areas considered by the work is given, in order to show the relationships between the various phases of the data collection and analysis.

CHAPTER THREE

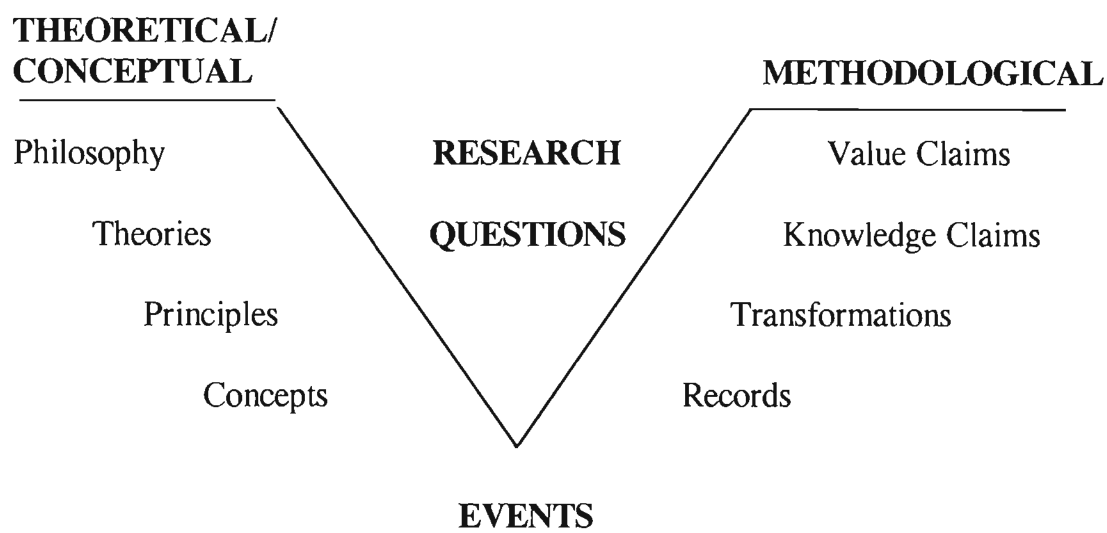
Conceptual Framework

3.1 Comment on Methodology

The central element of this study is the determination of the perceptions and opinions of key personnel involved with the Quantitative education of business graduates. It seeks to elicit and compare the range and nature of the views of educators, graduates and employers in an effort to establish how well the current Quantitative Methods curricula fit VUT graduates to the needs of business. Such questions of opinion and the determination of singular views are profitably investigated using a qualitative methodology, where methods are available that allow key individual's perceptions to be pursued in some depth. At the same time, it is important that the extent of agreement and disagreement regarding emerging themes and perceptions both within and between the informant groups be estimated. Such an estimate is most easily obtained using quantitative methodology, for which there are a number of convenient survey methods available. As a consequence, the methods employed in this study are best described as a 'mixed method' approach (Tashakkori & Teddlie 1998) and specific details of methods used will be given in Chapter four.

3.2 The Conceptual Framework

As a prelude to the detailed discussion of the methodology and methods used in this work, the conceptual framework within which the investigation has been designed will be described. The presentation of this chapter largely follows the work of Novak and Gowin (1984) who suggested that any research in education 'must be rooted in a set of evolving concepts, principles and theories regarding teaching, learning, curriculum and governance' (pp. 22-23). To facilitate the development of a framework in a particular context, Gowin has devised a 'Vee heuristic', which is a simple device for systematizing the presentation and explanation of an investigative project. The device brings together the theoretical and conceptual elements of an investigation with the methodological processes used to collect and analyse relevant data. The two elements are linked, in an interactive way, through the Research Question that drives the study and the educational events that supply the empirical data for the analysis. Figure 3.1 presents the Vee heuristic framework. Each of the components of this device will be briefly addressed in this chapter (Figure 3.2) to acquaint the reader with the key ideas behind the development of the thesis.



Source: Novak & Gowin 1984, *Learning How To Learn*, Cambridge University, London.

Figure 3.1 The Vee Heuristic Framework

3.2.1 The Research Question

Because of recent changes in business technology and the increasing demands of the business environment, business educators are being required to understand, in more detail, what emerging Quantitative Methods are currently required by business organisations, and, in addition, how students in Quantitative Methods programs are best prepared in order to meet these current, and future, needs. We ask then, in the first instance, *How well the Quantitative Training of VUT's Business Graduates is responding to the needs of Australian industry?* However, such a complex question cannot be broached successfully with selected informants unless it is broken down into a series of more objective, focused questions. Further, these focus questions need to be crafted into unidimensional survey or interview questions to allow systematic analysis. Figure 3.3 illustrates the relationship between the research question and the focus questions that have been used for the collection of data.

3.2.2 The philosophy

The philosophy that underpins this investigation is consistent with the central objectives of the Victoria University of Technology (2000) as detailed in the Faculty of Business and Law Handbook. In summary, VUT has a commitment to excellence in teaching, research and professional development. This commitment requires that the university attempts to provide its students with a positive learning environment, relevant curricula, best practice pedagogy and close links with Australian industry. These objectives are consistent with the suggestions made in the Federal Government White Paper (Dawkins 1988) regarding the importance of closer ties between universities and the economic sector. This also suggests that significant emphasis on close interaction with industry through co-operative education plus continuing consultation with selected representatives of key companies should be instituted if the objectives are to be realized. Indeed, recent developments in university education (Marginson & Considine 2000) have further underlined the importance of this instrumental role of the modern Australian university, which serves to illustrate the importance that we place upon the current study.

3.2.3 Theories

As indicated in the review of the literature, the university's responsibility in preparing graduates manifests in many ways, and we have identified for investigation; the nature of curriculum development; the setting of educational objectives; methods of instruction; and the role of computers in workshop settings. Each of these areas has been subjected to intense theoretical consideration, and as a result there are a number of theories that have emerged to help determine the most effective and efficient system of education in a particular setting. To aid the work of the current project, the following theoretical positions have been found useful:

Philosophy

The Philosophy upon which the investigation was based followed the idea of the objective of the university as suggested in the Faculty of Business and Law handbook (VUT 2001). That is, the Victoria University of Technology has a commitment to excellence in teaching, research and professional development. From this the university provides its students with a positive learning experience and best practice and thus they are extremely attractive to potential employers. In addition, the university must ensure that all students, including those with a non-traditional backgrounds, have access to university programs to achieve high quality education (Dawkins 1988).

Theories

The theories which have great influences to the development of this research study are:

- According to Print (1993), curriculum is defined as all planned learning opportunities offered to learners by the educational institution. Hence, it is necessary to see how successfully curriculum designers develop and devise curriculum that will effectively meet the need of today's business.
- Regarding the development of curriculum, Bloom (1956) raised two questions, that is what educational objectives should the course seek to attain and what learning experiences can be provided that are likely to bring about the attainment of these purposes. In order to specify the educational objectives and to plan learning experiences, a taxonomy of objectives is used.
- In developing curriculum, content of the courses are essentially looked at, teaching techniques by which that content is taught should also be examined. Prichard and Sawyer (1994) describe in details a number of teaching methods and techniques used in educational courses.

Principles

The principles which have been identified by various research work to contribute to the development of future work include:

- That the curriculum should provide relevant theoretical work to underpin the quantitative skills that the students will be asked to master.
- That the examples and case studies presented to students be consistent with the type of work and concerns of Australian business organizations.
- That, because of the rapid change in the nature of the business world, the approach taken to development of the QM curriculum and the teaching methods should be consistent with the principle of life-long learning.
- That the almost total reliance on computing technology in current business practice be reflected in the curriculum and examples involved in the students' work.

Concepts

Notwithstanding the widespread use of computer packages for Quantitative Methods applications in business organizations, there remains a need for graduates to have understood certain key concepts that define the competent practice of Quantitative Methods. This study will investigate whether the current VUT curricula cover all of the concepts perceived as necessary by business practitioners, and whether the level of knowledge of the concept is appropriate.

Research Question

How well the Quantitative Training of VUT's Business Graduates is responding to the needs of Australian industry?

Value Claims

The mixture of quantitative and qualitative methodologies plus the careful selection of respondents means that the knowledge claims we have are of educational worth, and have provided a rigorous background against which sensible and considerate curriculum reform can be made to the benefit of Australian business.

Knowledge Claims

Conclusions drawn from the analyzed data provide for knowledge claims in this area. Because of the local nature of the sample and the focus upon Victoria University of Technology, knowledge claims are clearly very narrowly focused.

However, it is anticipated that local modification to Quantitative Methods education can be effective, and that the gained knowledge approval might profitably be used in other settings.

Transformations

The purpose of this transformation is to translate and organize the raw data into a form that allows convenient analysis. In this study, we have used mixed methodology, and two broad transformation schemes have been used:

- For quantitative data, arising from the questionnaires, statistical analysis using SPSS has been used. Statistical analysis of quantitative data to provide descriptions of respondents' perceptions. Statistical comparisons of quantitative data regarding Quantitative Methods requirements and expectations of business employers and VUT's educators.
- For qualitative data, arising from the interviews, data are displayed in a detailed research matrix form. This matrix usually involves the cross-tabulation of two or more variables to see how they interact (Miles & Huberman 1994). The purpose is to display data so that both researcher and reader can focus upon the issues of the investigation.

Records

Various forms of record arise from the collection of data:

- VUT Business' Archives were used to locate the historical notes on statistics and quantitative studies in early days.
- Mailed questionnaires sent to selected groups of respondents such as business employers, final-year students, graduates and VUT's teaching staff. These questionnaires provide quantitative records and are suitable for statistical analysis.
- Open responses resulted from interviews of academic staff teaching Quantitative Methods. These responses provide qualitative data suitable for qualitative analysis.
- Taped recordings and transcripts of in-depth interviews. Interview tapes and transcripts were confidential. The researcher had access to raw data and be responsible for data analysis, and the removal of any references which could lead to identification of the interviewees.

Educational Events

The research 'events' that provide the empirical material for analysis in this study include:

(i) Document analysis of public statements of curricula that form the basis of Quantitative Methods subjects at VUT

(ii) Personal perceptions of the Quantitative Methods at VUT; final-year VUT students; and VUT graduates from Quantitative Methods courses. We feel that this data triangulation is essential when investigating a research question where a considerable degree of personal bias and individual experience is involved.

Figure 3.2 Analysis of the Research Study using Gowin's Vee Heuristic

(i) Curriculum models and conceptions: Print (1993) has given a useful compilation and description of a number of relevant curriculum models. Of these, we have found the following to be of particular use to this investigation; Walker (Print 1993), Skilbeck (1984), Tyler (1949), Taba (1962), Wheeler (1974) and Nicholls (1978) models. These models have assisted us in our discussion of how curriculum designers have developed and devised quantitative methods subjects in order to effectively meet the needs of business organisations.

(ii) Educational Objectives: in regard to curriculum development, Bloom et al. (1956) raised two questions: what educational objectives should the course seek to attain and what learning experiences can be provided that are likely to bring about the attainment of these purposes? In order to specify the educational objectives and to plan learning experiences, a taxonomy is useful in determining whether students have acquired certain levels of knowledge and are able to apply correct knowledge in the new situation, as the result of learning.

(iii) Methods of instruction: in developing curriculum, not only the curriculum and content of the courses are essentially looked at, the teaching techniques by which the content is taught should also be examined since these play an intimate part in preparing graduates for the workforce. Pritchard and Sawyer (1994) describe in detail a number of teaching methods and techniques used in educational courses.

3.2.4 Principles

Within this range of theoretical positions available to guide our investigations into curriculum development, setting of educational objectives and appropriate methods of instruction, we were able to articulate a number of practical educational principles that we believed were consistent with the stated philosophy behind the course. These were:

(i) That the curriculum should provide relevant theoretical work to underpin the quantitative skills that the students will be asked to master. The relevance of this work should take into account the current requirements of Australian business organisations.

(ii) That the examples and case studies presented to students be consistent with the type of work and concerns of Australian business organisations. Where possible, the examples and case studies should be presented in a realistic business context.

(iii) That, because of the rapid change in the nature of the business world, the approach taken to the development of the quantitative methods curriculum and the teaching methods should be consistent with the principle of life-long learning.

(iv) That the almost total reliance on computing technology in current business practice be reflected in the curriculum and examples involved in the students' work.

3.2.5 Concepts

Notwithstanding the widespread use of computer packages for Quantitative Methods applications in business organisations, there remains a need for graduates to have understood certain key concepts that define the competent practice of Quantitative Methods. These include, for example, measures of central tendency and dispersion; hypothesis testing; regression and correlation analysis; time series and forecasting; ANOVA; and modelling. This study will investigate whether the current VUT curricula cover all of the concepts perceived as necessary by business practitioners, and whether the level of knowledge of the concepts is appropriate.

3.2.6 Events

The research 'events' that provide the empirical material for analysis in this study include:

(i) Document analysis of public statements of curricula that form the basis of Quantitative Methods subjects at VUT.

(ii) Personal perceptions of the Quantitative Methods programs from; business employers; lecturers in quantitative methods at VUT; final year VUT students; and VUT graduates from Quantitative Methods business courses. We feel that this data triangulation (Tashakkori & Teddlie 1998, p. 41) is essential when investigating a research question where a considerable degree of personal bias and individual experience is involved.

3.2.7 Records

From the research events noted above, arise a number of research records. The nature of these records depends upon the methods used to collect the data, and in this study, these include:

(i) Mailed questionnaires sent to selected Australian business employers. These questionnaires provide quantitative records, suitable for statistical analysis, from employers who employ Bachelor of Business graduates with quantitative methods skills. From such records we can determine the extent of agreement between employers regarding the survey questions.

(ii) Internal mail questionnaires sent to selected staff teaching Quantitative Methods at VUT. These questionnaires provide quantitative records and aim to investigate the extent of agreement of what quantitative methods should be taught and how best they can be taught.

(iii) Mail questionnaires conducted on selected Bachelor of Business graduates with majors in Quantitative Methods from VUT. These questionnaires are carried out to find out if they consider themselves as being adequately prepared in quantitative skills.

(iv) Mail questionnaires sent to selected final-year business students in Applied Economics, Retail Management and International Trade at VUT. These questionnaires aim to elicit attitudes towards various aspects of the undergraduate Quantitative Methods subjects in business.

(v) Taped recordings and transcriptions of interviews: the tapes are transcribed by the researcher and provide qualitative information from the respondents' perspectives. In line with ethical procedure in qualitative analysis, transcriptions are confidential and are summarized to maintain the essence of the interviews.

(vi) Victoria University of Technology's archives were used to locate the historical notes on statistics and quantitative studies at Victoria University of Technology from the early days.

(vii) Personal responses to a series of questions resulted from interviews of academic staff teaching Quantitative Methods at VUT. These responses provide qualitative data suitable for qualitative analysis.

3.2.8 Transformations

The purpose of transformation is to translate and organize the raw data into a form that allows convenient analysis. In this study, we have used mixed methodology, and two broad transformation schemes have been used:

(i) For quantitative data, arising from the questionnaires, statistical analysis using SPSS has been used. In the questionnaires, we have used Likert scales, which are commonly employed as measurement scales in survey work. These 'summated rating scales' are a set of uniformly graded statements which allow the respondent to reflect favourably or unfavourably on the attitude object. The total or average score of a five-point scale can be used to interpret the answers, and comparisons of scores can also be made between different groups.

For example, raw data (in Likert scales form) were transformed to mean scores, which were determined by averaging the numerical responses given for each option, which were then turned into rankings. Appropriate statistical tests then take place in the form of ANOVA, hypothesis two-sample proportions test, Spearman's rho and the Mann-Whitney U-test. Statistical analysis of quantitative data provides a convenient description of the respondent groups perceptions and statistical comparisons of quantitative data allows differences in expectations of business employers and VUT's educators to be demonstrated. Various statistical tests are used for the comparison of responses of the business employers with those of the educators for most questions.

(ii) For qualitative data arising from the questionnaires and interviews, data obtained for the key research areas such as: curriculum; course experience and teaching methods; industrial placement; employment expectations; and Quantitative Methods topics and skill levels required; from business employers, educators, final-year business students and graduates, are displayed in a detailed 'research matrix form' (refer to Figure 4.2 and 4.3). This matrix usually involves the cross-tabulation of two or more variables to demonstrate how they interact (Miles & Huberman 1994). The purpose is to display the data in a clear accessible form so that both researcher and reader can focus upon the issues of the investigation.

3.2.9 Knowledge Claims

Conclusions drawn from the analysed data provide our knowledge claims in this area. Because of the local nature of the sample and the focus upon VUT, knowledge claims are clearly very narrowly focused. However, it is anticipated that local modification to Quantitative Methods education can be effective, and that the gained knowledge might profitably be used in other settings.

3.2.10 Value Claims

We believe that the mixture of quantitative and qualitative methodologies, plus the careful selection of respondents, means that the knowledge claims we have made are of educational worth, and have provided a rigorous background against which sensible and considered curriculum reform can be made to the benefit of Australian business.

3.3 The development of questionnaires

The research question and other focus questions developed in the questionnaires are summarized in Figure 3.3.

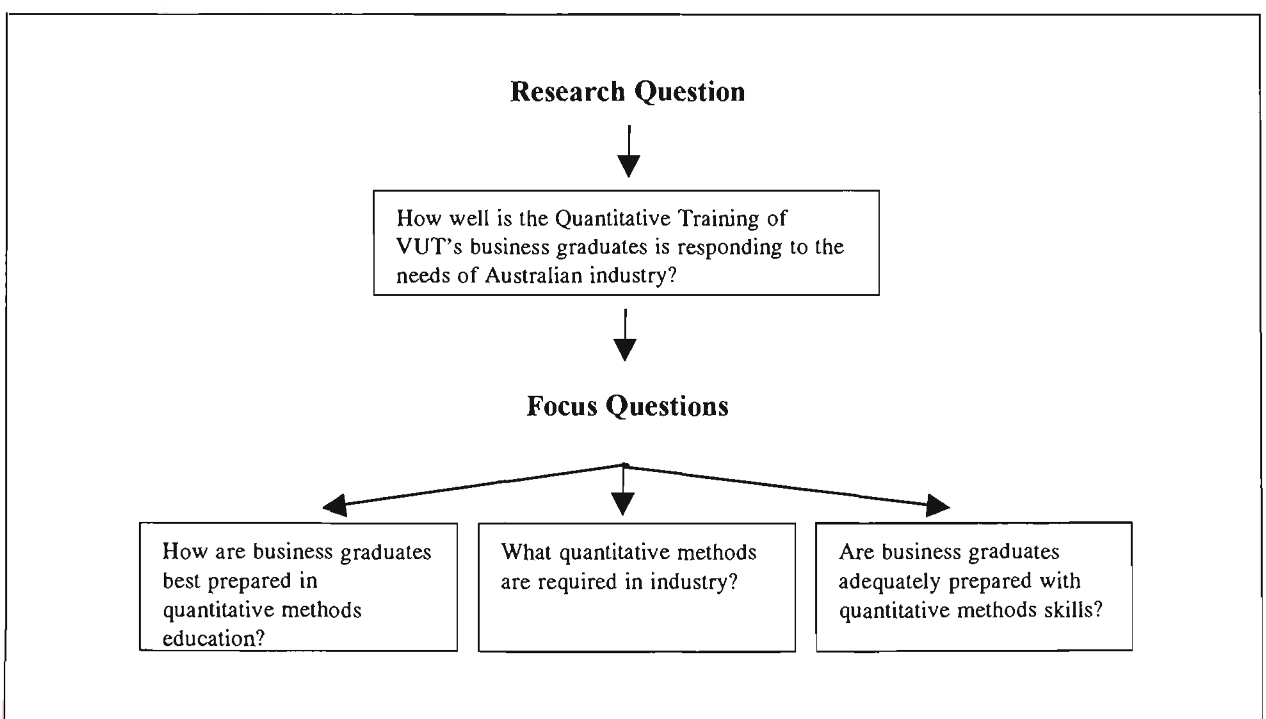


Figure 3.3 Question Schedule Used in Collection Data

3.4 Summary

This chapter has mapped out an approach which we considered appropriate to answer questions arising from literature review. Our conceptual framework has followed the work of Novak and Gowin who believed that educational research must be rooted in a coherent set of concepts, principles and theories regarding teaching, learning, curriculum and governance (Novak & Gowin 1984).

The framework of this study followed Gowin's Vee-heuristic, which is a simple device for systematizing the explanation of an investigative project. In this investigation, research and focus questions to graduates, educators and industry personnel will be carried out in parallel, in order to illuminate some of the emerging tensions developed from the literature review.

From the investigator's standpoint, questions that involve complex issues such as personal opinion, experience in the profession and predictions of future trends in the area, require both qualitative and quantitative data to enable a useful picture to emerge. The theoretical framework proposed here enables the mixed method approach of chapter four to be more carefully designed.

The next chapter discusses the sample selection and data collection procedure, the nature of the study, and its limitations. The techniques used in analysing both quantitative and qualitative data are discussed, and a brief review of relevant literature on the research approach is also carried out. This is done with a view to providing a rationale for the adoption of certain methods.

CHAPTER FOUR

Data Collection and Methods of Analysis

4.1 The Research Approach: An Overview

The objective of this research project is to gather and analyze the views of expert individuals regarding various quantitative techniques required by Australian industry, in order to determine whether the curricula and teaching of business Quantitative Methods programs at Victoria University of Technology are effectively serving Australian business needs.

It is important to access the views of individuals who have detailed knowledge and experience in quantitative techniques and their use in industry, since these views constitute the primary source of our understanding. These perspectives will be sought from educational course leaders in quantitative areas, business employers in a range of industries which rely upon Quantitative Methods, and students and graduates who are using quantitative techniques in their work-related environment.

Several methods of data collection have been used in this study. First, it was decided that the most convenient way to collect data from a large number of business organisations throughout Australia, taking into account the complexity of the questionnaire, the time required to complete it and the widespread distribution of the target population, was to use a mail questionnaire approach since it is efficient, economical and feasible.

Second, the views of quantitative educators at Victoria University of Technology were obtained via a handout questionnaire, as it was very convenient to distribute the questionnaire to colleagues then instigate a follow-up a short time later. Third, an in-depth interview with the educators was carried out following the comparison between business employers and educators' responses to the questionnaires, to seek their interpretation of the differences in expectations and perceptions between two groups. Both the hand-out questionnaires and interviews were considered to be an effective way to collect data for this study, as only a relatively small number of educators are involved.

Finally, for both final-year students at VUT and business graduates of VUT who are currently in quantitative methods careers, a mail questionnaire was used. This was an effective way of collecting data regarding study background, career prospects and relevance of courses relating to their current work, because this was a large target group who were geographically widely dispersed.

4.2 Mixed Quantitative and Qualitative Methods

This study involves the use of mixed method studies (Tashakkori & Teddlie 1998) in which the quantitative and qualitative approaches are combined into the research methodology of a single study. Creswell (1995) categorizes the mixed method studies into four designs, namely: the sequential, simultaneous, equivalent status and dominant /less dominant studies. In this study, the two-phase or sequential design was chosen; that is, a quantitative data collection method was firstly conducted, then, after analysis, a qualitative study was carried out. Figure 4.1 shows the timing and relationships of the methods used within different phases of the study.

4.3 Permission to Conduct the Research

A detailed proposal of the research plan was submitted to the Human Research Ethics Committee (HREC). Provisional approval was granted to commence interviews in June 1999, and this was formalized in September 1999. It is noted that the conduct of mail questionnaires did not require permission of HREC since replies were anonymous. A copy of the letter of approval is included in Appendix M. The Ethics Committee Approval number for this study is BHREC 99/17.

During the interview phase, respondents were assured of confidentiality and anonymity in reporting of all results, in order to protect their identities of individuals. In the case of the preliminary interview with Paul Casey which is reported in the literature review, only factual information was involved and no matters of opinion have been sought.

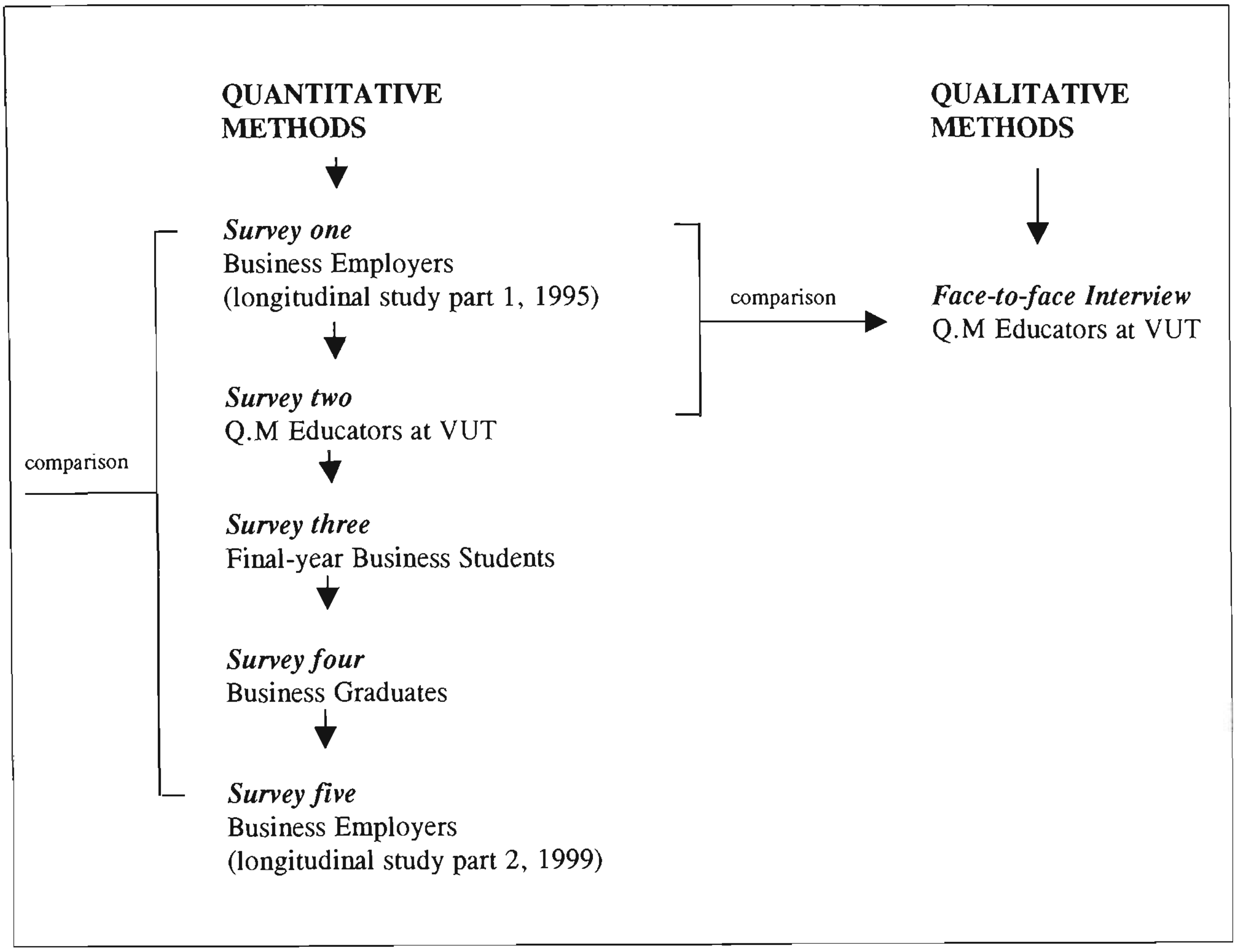


Figure 4.1 Quantitative and Qualitative Methods Used in the Study

4.4 Limitations of the Study

This research study may be described as an investigation of certain aspects of teaching and learning of Quantitative Methods at Victoria University of Technology in the undergraduate Business School. The following limitations of this study are recognized.

a) Delimitation by School and Faculty

The study relates to the education of Quantitative Methods and whether its curricula are serving industrial needs, using a case study approach of Business courses offered in the

Faculty of Business and Law at Victoria University of Technology. As such, the case study approach is limited to one university which may not be generalize able to all institutions. However, since most quantitative course development in Australian universities is suggested by the literature review to be similar, it is reasonable to expect that this work at Victoria University of Technology represents a reasonably representative case study of Quantitative Methods programs in Australian universities.

b) Delimitation by Year Level and Curriculum

The Quantitative Methods programs examined in this study are at undergraduate level only, and it is possible that an investigation of postgraduate programs will find different curriculum strategies, teaching methods and different acceptance by Australian business organizations.

c) Delimitation by Industry

The study is confined to business organisations throughout Australia which we have assumed recruit business graduates with quantitative methods qualifications. We recognize that graduates may find themselves in many diverse areas for which they are more or less suited. No inferences, on the basis of this study, can be made for these cases.

4.5 Data Sources

The target population of this research project consists of business employers, business Quantitative Methods educators, final-year business students and business graduates, since these four groups are most intimately concerned with the outcomes of Quantitative Methods programs.

4.5.1 Selection of Business Employers in Australia

Data for this study were collected from business employers in Australia. A questionnaire was mailed to the entire pool of 213 relevant business organisations throughout Australia. The mailing list was drawn from the Official Handbook of the Graduate Careers Council of Australia - Graduate Opportunities 1993-94 and from the Ultimate Career Guide 500 Top Employers 1991. These organisations listed in the handbook were listed under degree disciplines such as Accountancy, Acturial Studies, Banking and Finance, Business Studies, Catering and Hotel Management, Industrial Relations, Marketing and Economics, from which areas they recruit business graduates.

The first survey of business employers was conducted during January to April 1995. A questionnaire with a covering letter was mailed out in January 1995. Approximately three weeks after the original mail out, a follow-up letter and questionnaire were sent out to the non-respondents and, eight weeks later, another questionnaire and covering letter were sent to the remaining non-respondents. The response rate was 38 per cent (that is, 81 organisations of the original 213 responded to the questionnaire overall).

However, of the 81 personnel managers who responded, only 65 questionnaires were used in the data analysis, because 16 of the questionnaires were either only partly completed or were accompanied with letters of regret in which they stated that the company was 'in the process of being closed down', or the 'resources required to respond to the survey were not available'. It is noted that because of some unanswered questions in the questionnaires used, the total number of responses to each question may vary from question to question.

In late 1999, the business employers who had responded to the mail survey in 1995 were invited to participate in this study again. This longitudinal investigation was considered to be more useful than a single cross-sectional approach, because any changes that have occurred during this five-year period could be assessed.

For this second survey, the mailing list was checked from the Official Handbook of the Graduate Careers Council of Australia 1999. Some of the business organisations had either moved, merged with larger companies or no longer existed (1999-2000), and as a result, the mailing list was reduced to 54. The survey was conducted during September to November 1999, using the same approach as described earlier. This gave a response rate of 78 per cent (that is 42 of the 54 survey businesses responded to the second survey).

4.5.2 Selection of VUT's Quantitative Methods Educators

The selection of educators of Victoria University of Technology was made on the basis of records of staff teaching loads held by the School of Applied Economics. As mentioned earlier, the study of statistics and quantitative methods for business is offered only in the School of Applied Economics. Since the introduction of the study of statistics and quantitative methods in 1989, most staff who have taught these units are still currently working in the Faculty of Business and Law, Victoria University of Technology.

Quantitative data were collected first via a questionnaire, then followed by an interview to seek further information regarding as parts of the responses for both business employers and educators. The chosen undergraduate curricula for Quantitative Methods subjects in this study were post 1992 (1992-1996) which was after the formation of the Victoria University of Technology. Quantitative Methods subjects at first, second and third year levels were considered. The pool of business educators consisted of all lecturers and tutors teaching Quantitative Methods subjects at all levels. All staff teaching these subjects, at Victoria University of Technology, were invited to participate in this survey giving a total of 13 respondents.

The survey was conducted between August and September 1998. A first questionnaire with a covering letter was distributed in early August, and a follow-up letter was then sent out to non-respondents a few weeks later. In total, all thirteen Quantitative Methods teaching staff in the School of Applied Economics participated in the study.

To provide information via interview, for each Quantitative Methods subject, one interviewee was selected. As the first year Business Statistics core subject involved a large number of instructors, the coordinator/lecturer of this subject was also chosen for an interview. In all, seven interviewees, representing the seven Quantitative Methods subjects across all year levels, were invited to participate in interviews, to give their opinions and help to interpret the differences in the expectations of educators and employers. These interviews took place at Victoria University of Technology in August 1999.

4.5.3 Selection of Final-year Business Students

The business students surveyed in this research study were those enrolled within the Department of Applied Economics, Faculty of Business and Law, Victoria University of Technology, since it was likely that students who enrolled in Quantitative Methods subjects in undergraduate business courses were completing their degrees in Applied Economics, Retail Management and International Trade. The groups of business students in this study consisted of all final-year students who completed their degree courses in 1999. Final-year students (85), including full-time and part-time students, were identified from the list provided by the Student Administration of Victoria University of Technology.

The survey was conducted from March to June 1999. The questionnaire was mailed out in March 1999. Approximately four weeks after the original mailing, a follow-up questionnaire was mailed to the non-respondents, and three weeks after that, a final reminder letter and questionnaire was sent out to the last remaining non-respondents. This yielded a response rate of 62 per cent (that is 52 students of the 84 responded to the survey).

4.5.4 Selection of Business Graduates

The business graduates selected for this study consisted of 198 students who completed their degrees in Applied Economics, International Trade and Retail Management during the period from 1995 to 1997 (note that as mentioned in section 4.5.3, it was likely that students who were enrolled in Quantitative Methods subjects in undergraduate business courses would complete their degrees in the areas mentioned above). These graduates were identified from the list provided by the Student Administration of Victoria University of Technology.

The survey was conducted during September to November 1999. A questionnaire with a covering letter was mailed out in late September 1999. Approximately four weeks after the original mailing, a follow-up questionnaire was mailed to the non-respondents. Two weeks later, a final reminder and questionnaire was sent out to the remaining non-respondents. This yielded a response rate of 30 percent (that is, 60 graduates of the 198 responded).

4.6 The Questionnaires

The questions in the questionnaire were developed against the conceptual framework described in chapter three, and assisted, where appropriate by reference to previous work (Jones 1981, DEET 1988, DEET 1990). The questionnaires used to collect data in this research consisted of the six main sections detailed below.

Section A - Background Information. This section consisted of questions related to background characteristics of various groups. The characteristics for business employers are name of organisation and contact number, business sector, industry group and staff size of business. For educators in quantitative area, these were their academic background and highest qualification, and specialized field or discipline area. The background information of final-year business students and graduates at VUT include both personal and education background. These were age, sex, main language spoken at home, permanent residence status in Australia, methods of qualifying to enter degree course, secondary education background, highest level of mathematics attempted when first applied the course, first preference when first applied the course, current course title, field of specialisation, enrolment mode, and time taken to complete course.

Section B - Business School and Quantitative Method Education. In this section, both business employers and educators in the quantitative area were asked about their perceptions on how business schools are responding to the needs of industry, the conception or philosophy approach most appropriate to quantitative methods course curriculum, and the preparation of graduates in this area. Business employers were also asked to indicate whether they provide support to business schools in Australia such as giving scholarships, providing work experience for students, making donations for facilities or providing financial support to employees attending postgraduate courses.

Educators in quantitative area at VUT were asked for their perceptions on the best quantitative educational preparation for a business graduate career, and criteria such as skills and knowledge areas that are important in recruiting business students. Educators were also asked to indicate their suggestions for the best ways to overcome shortages (if any) in industry of employees with quantitative skills.

Section C - Employment Expectations. The section of the questionnaires sent to business employers and graduates consist of questions regarding employment and training of business graduates in quantitative area. Types of questions asked in business employers' questionnaire include: indication of difficulty in recruiting suitable graduates; change in the number of graduates employed with quantitative techniques; shortage of graduates in future and best ways to overcome this problem; and criteria in recruiting graduates. On the other hand, graduates were asked about the criteria in terms of knowledge and skills expected of them, and areas they were expected to develop, during their first year of employment.

Section D - Course Organisation and Teaching Methods. This section of the educators' questionnaire consists of five response questions. Educators in the quantitative area were asked to indicate the conception or philosophical approach they consider most appropriate to the current quantitative methods curriculum, selecting from academic, technological, humanistic or social reconstructionist conceptions as discussed in the literature review. Educators were also asked for: their preferred curriculum model when developing course material; prerequisites in mathematics for students to enter business quantitative area; the percentage of class time devoted to various teaching techniques; and particular software packages used in their discipline area.

Section E - Course Experience and Industrial Placement. In this section, both final-year business students and graduates were asked for their study experiences at VUT. Questions were posed regarding: Quantitative Methods subjects chosen during their degree course; main reason for studying these subjects; overall evaluation of the course; the rating of staff teaching these subjects; and their personal reflection on the best and worst things about the courses in general.

Regarding industrial experience, both groups were asked to indicate: whether they have completed the co-op education year; their perceptions on the important role of work experience; and their opinions on the cooperation between business and industry. In addition, final-year business students were asked whether their work was related to the use of quantitative methods and whether they consider themselves to be adequately prepared for the work utilizing quantitative skills. These students were also asked for their further interest in quantitative methods after they complete their degree courses.

Section F - Quantitative Methods in Business. In this section, business employers, educators and graduates were asked to identify particular quantitative topics and skill levels expected of graduates. The topics included statistics and mathematics methods, and the skill levels or levels of knowledge desirable for students to acquire were based on Bloom et al.'s taxonomy of educational objects as previously discussed in literature review.

To provide a summary of the questionnaire structure, a matrix showing the four groups surveyed and the relevant key research are given in Figure 4.2.

Groups Surveyed / Key Research Areas	Business Employers	Educators in QM	Final-year Students	Business Graduates
Background Information	Sector Industry Group Size of Company	Highest Qualification Specialized Field	Age / Gender Main Language Spoken Secondary Education Entry Mode Course Title Specialized Field	Age / Gender Main Language Spoken Secondary Education Entry Mode Course Title Specialized Field Highest Mathematics Level Attempted
Business School & QM Education	Support to Business School Curriculum Conception Educational preparation of Graduates in QM area Knowledge & Skill Areas Expected of Graduates	Curriculum Conception Meeting the needs of Industry Educational Preparation of Graduates in QM area Knowledge & Skill Areas Expected of Students		
Employment Expectations & Training of Business Graduates	As of Graduates' also No. Employed in Future Shortage of Employees with QM Skills Best Ways to Overcome Shortages of Graduates Software Packages Used			Criteria to Recruit Graduates Knowledge & Skill Areas Expected Areas Developed in First Year Employment
Course Organisation & Teaching Methods		Curriculum Models & its Conceptions Mathematics Prerequisites Percentage of Class Time Devoted in each Teaching Techniques Statistical Software Packages Taught		
Course Experience & Industrial Placement			QM Subjects Studied Reasons to Enrol Course Evaluation Course Perceiving Difficulty Co-Op between University & Industry Work related to the Use of QM Further Study in Future	QM Subjects Studied Reasons to Enrol Course Evaluation Course Perceiving Difficulty Co-Op between University & Industry Work related to the Use of QM Further Study in Future
QM Topics & Skill Levels Required	QM Techniques and Skill Levels Required in Industry	QM Topics and Skill Levels Taught		QM Topics and Skill Levels Used

Figure 4.2 Matrix of Key Research Areas

4.7 Data Analysis

4.7.1 Quantitative Analysis

The process of quantitative data analysis involves six major steps which are described by Sarantakos (1984) as follows: data preparation, counting, grouping, relating, predicting and statistical testing. In this study, analysis was undertaken using both hand-calculator and the statistical software packages GBStat and SPSS.

4.7.1.1 Hypothesis Statements

In this study, the hypothesis statements for three main areas are:

Area I - The perceptions between industry groups regarding Quantitative Methods education. The null hypothesis states: there is no difference in response between industry groups at a 95% level of confidence.

Area II - Business employers' surveys: a longitudinal update 1995-1999. The null hypothesis states: there is no difference in employers' response over the five-year period regarding Quantitative Methods education at a 95% level of confidence.

Area III - A comparison between the contents of Quantitative Methods programs and expectations from industry. The null hypothesis states: there is no difference in response between business employers and educators regarding Quantitative Methods education at 95% level of confidence.

4.7.1.2 Analysis Methods

The quantitative data analysis in this study involves both parametric and non-parametric tests and their use depends on whether the data satisfy the assumptions on which the tests are based. Whereas, the function of both types is identical, parametric tests are considered to be more powerful at picking up significant differences in data scores than non-parametric tests, as these parametric tests have the ability to calculate variances apart from taking into account the order of the scores. The descriptions of parametric and non-parametric tests used in this study are described as follows.

4.7.1.2.1 Parametric Tests

In choosing parametric tests, it is essential to check if the theoretical assumptions are met. That is: (i) parametric tests are should be in terms of numerical values of the observations; (ii) these observations are normally distributed; and (iii) the variance should be equally distributed among experimental conditions. In this study, the parametric tests involved are the ANOVA and Two-sample Proportions Tests, and they are discussed as follows.

a) ANOVA Test

Runyon and Haber (1984) describe this analysis of variance test as a technique of statistical analysis that allows us to overcome the ambiguity involved in assessing significant differences between factors when more than one comparison is made. It helps to answer questions such as: is there an overall indication that the 'experimental treatments' where the term is used in the broadest sense, are producing significant differences among the means of the treated groups? This analysis has its greatest usefulness when two or more independent variables, or factors, are studied.

In this study, the 'experimental treatments' are the industry groups, namely Manufacturing, Finance and Wholesale/Retail Trade. The analysis of variance is used to compare the mean scores calculated from Likert scale options for each of the three groups of industry. This analysis is done on a computer using the GBStat statistical package, and differences are claimed at the 95% level of significance.

b) Two Sample Proportions Test

In the two-sample proportions hypothesis testing, the observed statistics are proportions, and the test involves the question of whether statistics observed in two random samples differ significantly. That is, whether the difference between these two sample proportions are due to chance sampling errors or whether the populations from which the samples are drawn have equal proportions. In this study, the statistics observed are the proportion of skill levels (low or high) nominated by each group, and the test is to determine if the proportion of skill levels nominated by educators is different from the proportion of skill levels nominated from business employers. For a more complete account of the use of the Two-sample proportions test, see Tables 6.3.8 and 6.3.9.

4.7.1.2.2 Non-parametric Tests

Those methods discussed above involve assumptions about the distributions of populations sampled. That is, the observations are drawn from normally distributed populations. However, hypothesis tests that do not require such restrictive assumptions are referred to as non-parametric tests. The non-parametric tests used in this study are the Spearman's rho and Mann-Whitney U-test. These hypothesis testing techniques are discussed as follows.

a) Spearman's rho Test

Generally, when certain hypothesis techniques are used, it is assumed that the data are drawn from normally distributed populations. For data that may not meet such criteria, a number of hypothesis-testing techniques that do not make these restrictive assumptions have been developed, and these are referred as non-parametric or distribution-free tests (Hamburg 1991). In this study the two non-parametric tests used are the Spearman rank order correlation and the Mann-Whitney U-test. These tests use the *ranks* of the measurements rather than *numerical values* (parameters) of the observations.

This correlation technique is typically used when there are only a few observations involved and the data can be ranked, and is the alternative to the Pearson correlation test. This technique also tests hypotheses of relationships to see how strongly variables are related to each other; it provides a measure of the degree of correlation between the two ranked sets. In this study, the ranks involve the order of importance in areas of knowledge, and the skills that every business student should possess. They also can be the ranks of the criteria that were most important in recruiting business students. For a more complete account of the use of the Spearman rank test, see Tables 6.3.3 to 6.3.7.

b) Mann-Whitney U-Test

This is one of the most powerful of the non-parametric tests, since it utilizes most of the quantitative information inherent in the data (Runyon & Haber 1984). It was decided to use the Mann-Whitney U-test when testing for differences between the two independent groups and it is the non-parametric equivalent of the T-test, that is the educators and business employers since the data for this test are not required to be normally distributed.

For an illustration of the use of the Mann-Whitney U-test or the rank sum test, consider Table 6.3.1 and 6.3.2. In Table 6.3.1, the rank sum test was carried out to determine if the perceptions of business employers and educators differed with regard to the response that business education in Quantitative Methods has made to the needs of the business sector. In Table 6.3.2, the response was related to the preparation of undergraduate business students in the Quantitative Methods area. Both were tests at a significance level of 0.10.

4.7.2 Qualitative Analysis

By contrast to the relatively systematic data collection and analysis procedures involved in the quantitative phase of this project, the analysis of the qualitative data collected by comment and interview is less straightforward. Indeed, Robson (1993) suggests that there are 'no clear and accepted set of conventions for analysis corresponding to those observed with quantitative data' (p. 370). The approach taken in this work follows that described by Newman (1997) who notes that qualitative data analysis can involve organizing the data obtained from respondents on the basis of recurring apposite themes and concepts. This approach to data reduction is 'a form of analysis that sharpens, sorts focuses, discards and reorganizes data in such a way that 'final' conclusions can be drawn' (Miles & Huberman 1994, p. 11) from the many pages of qualitative data that emerges as a natural consequence of interview.

In contrast to quantitative analysis, analysis of qualitative data can take place either during or after data collection, but in this project we have chosen to take the latter course. The responses to interview questions were, with permission of respondents, tape recorded so that a full transcription could be produced. This transcription then became the primary data source for this phase of the project. The mechanics of reducing qualitative data to themes and categories took the approach made popular by Miles and Huberman (1994) where they recommended the use of a matrix composed of questions (rows, r) and respondents (columns, c). By setting up this display of r x c separated pieces of data, recurring comments can be easily descried by inspection. As completion of the grid below implies:

- each research question can be singled out for special focus, and the portions of the data which are relevant to them can be collected in one place;
- that full analysis of the data can be made, because no relevant information is ignored;
- the themes and concepts which are recurrent are conveniently on display for audit.

Responses*

Respondents	Part 1	Part 2	Part 3	Part 4	Part 5	Part 6
1						
2						
3						
4						
5						
6						

Figure 4.3 Qualitative Analysis Grid (adapted from Miles, M.B. and Huberman, A.M, (1994) *Qualitative Data Analysis*, Thousand Oaks, Sage.)

In this project, we have posed six questions to business employers and Quantitative methods educators, and display of their responses has allowed differences and apparent contradictions to be easily detected.

4.8 Data Collection Timeline

The time frame of data collection for this study is shown in Figure 4.4. In the next chapter, the findings of the research study from questionnaire surveys and interviews will be reported. Details of final-year business students and graduates' attitudes to Quantitative Methods programs are also reported.

1995		
	Jan-Apr	*Survey one* Business Employers (longitudinal study part 1, 1995)
1998		
	Aug-Sep	*Survey two* Quantitative Methods Educators at VUT
1999		
	Mar-Jun	*Survey three* Final-year Business Students
	Aug	*Face-to-face Interview* Quantitative Methods Educators at VUT
	Sep-Nov	*Survey four* Business Graduates
	Sep-Nov	*Survey five* Business Employers (longitudinal study part 2, 1999)

Figure 4.4 Data Collection Timeline

CHAPTER FIVE

Descriptive Analysis of Quantitative Data

5.1 Structure of the Chapter

This Chapter presents an overview of the information gathered from all sources regarding undergraduate Quantitative Methods programs at Victoria University of Technology (VUT). The major sources of data were: (i) questionnaires that were sent to business employers in Australia in 1995 and 1999; (ii) a questionnaire and in-depth interview that were targeted at business educators of Quantitative Methods subjects at VUT; (iii) questionnaires that were sent to final-year business students completing their undergraduate courses in 1999; and (iv) questionnaires to graduates who completed their business degree courses in Applied Economics, International Trade and Retail Management from 1995 to 1997 at VUT. The Statistical information relating to perceptions of various respondents towards Quantitative Methods programs at VUT are drawn from these sources and presented in sections 5.1 to 5.5 (Figure 5.1).

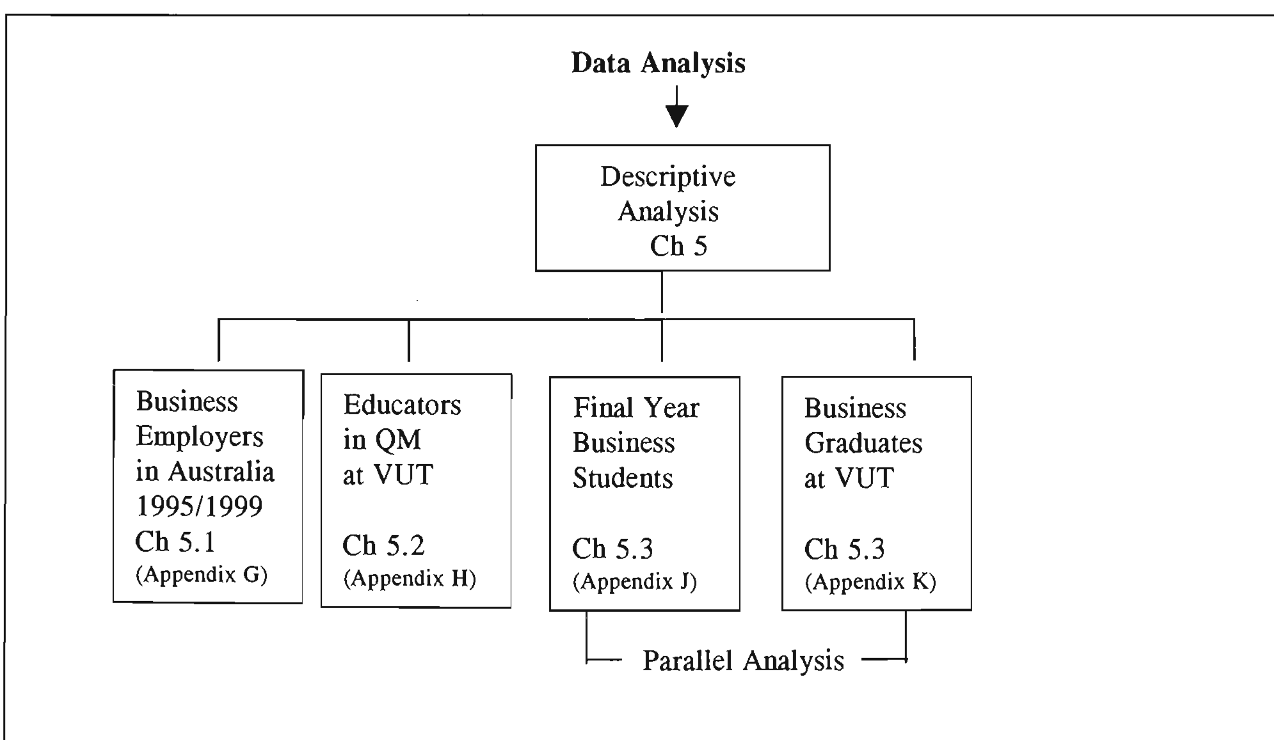


Figure 5.1 Descriptive Analysis Scheme

5.1.1 **Business Employers' Attitudes to Quantitative Methods Programs in Australia**

A mail questionnaire (Appendix G) was sent to business organisations throughout Australia requesting information on: their main business activities; their views regarding the School of Business at VUT and its Quantitative Methods programs on the basis of their experience with those graduates they had employed in the last five years; their opinions on whether there should be changes in current Quantitative Methods education; whether a closer relationship between university and industry is needed. The descriptive statistical analysis of each question is accompanied by a brief discussion. These results are the basis for the inferential analysis in Chapter six.

Respondents were asked to classify their organisations by sectors (Table 5.1.1) and industrial grouping (Table 5.1.2) drawn from Australian and New Zealand Standard Industrial Classification (ABS 1993) and Pocket Yearbook Australia (ABS 2000). The responses show that (i) the majority of surveyed companies (80% in 1995 and 88.1% in 1999 respectively) belonged to the 'Private Business & Industry' sector, another 12 (5) organisations (18.4%/11.9%)) were from the 'Government' sector, whilst only one was classified in 1995 as 'Other'; and (ii) 32 (28) organisations (49.2%/66.7%) belong to the 'Finance, Insurance & Real Estate' industry group, the 'Manufacturing' industry group contained 13/7 (20 %/16.7%) respondents, and seven/one (10%/2.4%) were in the 'Wholesale & Retail Trade' group.

Table 5.1.1 Classification of Organisation by Sector

Question 1. In what sector does your organisation belong?

Sector	1995 (1999) Frequency	Percent
Private Business & Industry	52 (37)	80.0 (88.1)
Commonwealth Government	9 (5)	13.8 (11.9)
State Government	3 (0)	4.6 (0)
Local Government	0 (0)	0 (0)
Other (specify)	1 (0)	1.5 (0)
Total	65 (42)	99.9* (100)

* Rounding Error

This is consistent with the Graduate Profile (Hastings 1989) and Graduate Destinations Report (VUT 1994) which found the majority of business graduates work in two main groups namely: Finance, Insurance & Real Estate and Wholesale & Retail Trade. The results of Analysis of Variance (Appendix L), on the combined responses, indicate that the three main groups do not significantly differ from one another at the $\alpha=0.05$ level of significance. Consequently, we have considered that there is no statistical reason not to consider the responses from the industry group as a whole (see Chapter 6.1).

Table 5.1.2 Surveyed Organisation's Industry Group

Question 2. To which industry group does your organisation belong?

	1995 (1999) Frequency	Percent
Agriculture, Forestry, Fishing	1 (0)	1.5 (0)
Mining	1 (0)	1.5 (0)
Construction	1 (0)	1.5 (0)
Manufacturing	13 (7)	20.0 (16.7)
Transport, Communications, Utilities	1 (3)	1.5 (7.1)
Wholesale & Retail Trade	7 (1)	10.8 (2.4)
Finance, Insurance, Real Estate	32 (28)	49.2 (66.7)
Services	2 (1)	3.1 (2.4)
Public Administration, Defence	5 (2)	7.7 (4.8)
Non-classifiable Establishments	2 (0)	3.1 (0)
Total	65 (42)	99.99* (100.1*)

* Rounding Error

Business employers were asked to indicate how well business schools responded to industry's needs (Table 5.1.3). Ratings, which ranged from poorly (1) to excellently (5), revealed that with regard to the needs of industry in the areas of 'Liaison with Employers and Professional Bodies', 64.5% (73.8%) of respondents reported business schools responded *adequately* and *well*. Business schools were doing quite well with respect to their 'Structure and Content of Undergraduate Courses' with 74.6% (76.2%) of the respondents responding as *adequately* to *excellently*. Half the respondents in 1995 (69.0% in 1999) agreed that 'Provisions for Academic Staff Development and Industrial Experience' are doing *adequately and well*, and 63.6% (61.9%) of respondents believed that the business school was doing *well* in the area of 'Research, Design and Development Activity'.

Table 5.1.3 Business Schools' Response to the Needs of Industry

1 = Poorly, 2 = Fairly, 3 = Adequately, 4 = Well, 5 = Excellently

Question 3. How well do you consider business education schools are responding to the needs of industry in Australia with respect to:

	1995 (1999) Percent						
	[1]	[2]	[3]	[4]	[5]	[3+4+5]	n
a) Liaison with Employers and Professional Bodies	5.1 (7.1)	30.5 (19.0)	49.2 (52.4)	15.3 (21.4)	0 (0)	64.5 (73.8)	59 (42)
b) The Structure and Content of Undergraduate Courses	3.4 (4.8)	22.0 (19.0)	49.2 (45.2)	23.7 (31.0)	1.7 (0)	74.6 (76.2)	59 (42)
c) Provisions for Academic Staff Development and Industrial Experience	3.7 (7.1)	46.3 (23.8)	35.2 (45.2)	14.8 (23.8)	0 (0)	50.0 (69.0)	54 (42)
d) Research, Design and Development Activity	3.6 (4.8)	32.7 (33.3)	47.3 (35.7)	14.5 (21.4)	1.8 (4.8)	63.6 (61.9)	55 (42)

Business employers were asked 'How well prepared' undergraduate business students were in the Quantitative Methods area. Table 5.1.4 showed 20 % (22.5%) of respondents indicated undergraduate business students were *not adequately prepared* in this area, whilst 58.2% (50%) of respondents indicated business students as *adequately prepared*, and 21.8% (27.5%) indicated them as *well-prepared* or *excellently*.

Table 5.1.4 Preparedness of Undergraduate Business Students in the Quantitative Methods Area

Question 4. How well prepared are undergraduate business students in the Quantitative Methods area?

	1995 (1999) Frequency	Percent
Not Prepared	0 (0)	0.0 (0.0)
Fairly Prepared	11 (9)	20.0 (22.5)
Adequately	32 (20)	58.2 (50.0)
Well Prepared	10 (10)	18.2 (25.0)
Excellently	2 (1)	3.6 (2.5)
Total	55 (40)	100.0 (100.0)

Table 5.1.5 indicates that respondents feel that the 'best quantitative educational preparation for a quantitative graduate career' is 'Practical Experience while going through College'. The next best preparation in quantitative education suggested includes 'More Practical and more Case Study Based Materials', 'More Emphasis on Software

Applications Skills', 'More on Teaching a wider range of Quantitative Techniques' and 'More Short Specialist Courses'. One respondent in 1995 suggested that more theory should be taught in class as students seemed to know more on how to perform the technique than on understanding its derivation.

Table 5.1.5 Opinion on the Best Quantitative Educational Preparation for a Quantitative Graduate Career

1=Not At All 2=Not Too Important 3=Important 4=Fairly Important 5=Very Important

Question 5. Rate the best quantitative educational preparation for a quantitative graduate career.

		1995 (1999) Percent					
		[1]	[2]	[3]	[4]	[5]	n
a)	More Emphasis on the Teaching of a wider range of Quantitative Techniques.	1.8 (0)	23.2 (17.5)	53.6 (52.5)	14.3 (20.0)	7.1 (10.0)	56 (40)
b)	Education should be more Practically Oriented, more Case Study Based.	0 (0)	5.3 (2.5)	21.1 (30.0)	42.1 (42.5)	31.6 (25.0)	57 (40)
c)	Practical Experience while going through College, Work Experience Oriented.	0 (0)	5.3 (7.5)	21.1 (22.5)	36.8 (40.0)	36.8 (30.0)	57 (40)
d)	More Short Specialist Courses.	2.2 (2.5)	33.3 (17.5)	51.1 (62.5)	2.2 (15.0)	11.1 (2.5)	45 (40)
e)	More Emphasis on Software Applications Skills.	0 (0)	22.8 (15.0)	45.6 (50.0)	24.6 (30.0)	7.0 (5.0)	57 (40)
f)	Other (specify) * More Theory				*		

Rank		Mean Score***
1 (1)	Practical experience while going though college	4.05 (3.93)
2 (2)	Education should be practically oriented	4.01 (3.90)
3 (3)	More emphasis on software applications skills	3.16 (3.25)
4 (4)	More emphasis on teaching Quantitative Techniques	3.02 (3.23)
5 (5)	More short specialist courses	2.86 (2.98)

*** The mean scores were determined by averaging the numerical responses given for each option, i.e.[(1xfrequency)+(2xfreq)+(3xfreq)+(4xfreq)+(5xfreq)]/total number .

Business employers were asked in what way their organisations would be prepared to support Post-Graduate Business schools in Australia (Table 5.1.6). The highest report was that they would be happy to 'Encourage their own Employees to attend Post-Graduate Courses' (88.3%/71.4%), followed by 'Providing Financial Support to those who attended' (66.1%/54.8%). Fifty percent of business employers would be willing to 'Provide Vacation Work Experience for Students' in 1995 survey compared to 54.8% in

1999. While other support includes 'Participating in Staff Exchanges between Industry and the Business Schools' (18%/16.7%), and to give 'Scholarships or Sponsor Students' (13.1%/19.1%), around ten percent of organisations were willing to 'Give Financial Support for Research Projects' or to 'Make Financial Donations for Equipment and Facilities'.

Table 5.1.6 Support of Employers for Postgraduate Business Schools in Australia

Question 6. Would your organisation be prepared to support business schools in Australia in any of the following ways?

	YES 1995 (1999)	n
Encourage own Employees to attend	88.3% (71.4%)	60 (42)
Provide Financial Support to Employees who attend	66.1% (54.8%)	62 (42)
Sponsor students, giving Scholarships	13.1% (19.1%)	61 (42)
Make Financial Donations for Equipment/Facilities	3.3% (4.8%)	60 (42)
Give Financial Support for Research Projects	8.3% (11.9%)	60 (42)
Participate in Staff Exchanges between Industry and the Business School	18.0% (16.7%)	61 (42)
Provide Vacation Work Experience for Students	50.0% (54.8%)	60 (42)
Other (specify)	* $	

* Give lectures

$ Provide opportunities for students doing industry based thesis work

Employers were asked whether, in the past five years, they had found it difficult to recruit suitable graduates from any of the specific areas (Table 5.1.7). Under 30% in 1995 compared with 5% in 1999 survey of the business employers reported difficulty in recruiting suitable graduates. The reported difficulties in specific areas and various reasons are given in Table 5.1.7, although some reported difficulties without giving reasons in areas such as Information Technology, Business Law, Actuary and Economics.

Table 5.1.7 Difficulty Faced by Employers in Recruiting Suitable Graduates

Question 7. In the last five years, have you had difficulty in recruiting suitable graduates in Quantitative area? If yes, please give reasons.

	Frequency 1995 (1999)	Percent 1995 (1999)
No difficulty	47 (38)	72.3 (95.0)
Difficult	18 (2)	27.7 (5.0)
Total	65 (40)	100 (100)

Table 5.1.7 (continued)

Specific Area	Reason
Accountancy	Required experienced undergraduates and quality candidates
Personnel I/R	Poor quality and/or personality fit
Transport Business Admins	Lack of quality candidates
Insurance	Nature of payment, i.e. commission
Funds Management & Investment	No relevant studies
Sales & Marketing	Due to nature of our industry and location of head office
Information of Technology Business Law Actuary Economics	No reasons given

The expected average number of employees recruited each year is given in Table 5.1.8. It is noted that only 13 out of 65 business employers responded to this question in 1995 compared with 40 out of 42 in 1999 survey. Nine (32 in 1999) respondents indicated that they expected *no change* to occur in the number of graduates employed in five years time. However, four business employers in 1995 indicated there could be either *more* or *less* graduates with quantitative techniques employed in the future, whereas, seven out of 40 business employers in 1999 survey indicated *more* graduates could be employed in five years time.

Table 5.1.8 Expectation of Change in Number of Graduates Employed with Quantitative Techniques in Five Years Time

Question 8. Please indicate whether you expect the number of graduates employed with Quantitative Techniques in five years time, to be more, less, or stay the same?

	1995 (1999) Frequency	Percent
More	2 (7)	15.4 (17.5)
Less	2 (1)	15.4 (2.5)
Same	9 (32)	69.2 (80.0)
Total	13 (40)	100.0 (100.0)

In response to a question about the shortage of business graduates in industry (Table 5.1.9), it seemed that the supply of employees with quantitative technical ability was inadequate, as a majority of business employers (76.9%/67.5%) could foresee *some shortage* in the future whilst only 23.1% (32.5%) of respondents could see *no shortage* in the future.

Table 5.1.9 Foreseen Shortage in Industry of Employees with Quantitative Techniques Abilities in the Future

Question 9. Do you foresee a shortage in industry of employees with Quantitative Techniques abilities, in the future?

	1995 (1999) Frequency	Percent
No	12 (13)	23.1 (32.5)
Yes	40 (27)	76.9 (67.5)
Total	52 (40)	100.0 (100.0)

However, if there is any shortage of graduates with quantitative technical skills, business employers suggested the best way to overcome this shortage is a 'Closer Association between Industry and Training Institutes' (Table 5.1.10). There is also a need to 'Train more People' and 'Run more Quantitative Workshops'. The next preference is to 'Restructure Quantitative Development Programs', 'Higher Rewards' and to 'Bring in Guest Speakers' respectively. According to business employers, the most significant problems to overcome shortage were to 'Adopt Migration Policies to attract Overseas Skills' or to 'Employ Overseas Workers'. In this way, Australian employees' privilege would be more protected, and may be the economy loss would be prevented at some degree.

Table 5.1.10 Business Employers' Ratings of Possible Strategies for Overcoming Staff Shortage

1 = Worst   2 = Bad   3 = Average   4 = Good   5 = Best

Question 10. Rate in order of preference the best ways that shortages can be overcome.

1995 (1999)

Percent

	[1]	[2]	[3]	[4]	[5]	n
Train more People.	0	4.2	25.0	45.8	25.0	48
	(0)	(3.7)	(22.2)	(59.3)	(14.8)	(27)
Employ Overseas Workers.	31.8	40.9	18.2	9.1	0	44
	(25.9)	(29.6)	25.9)	(18.5)	(0)	(27)
Migration Policies to attract Overseas Skills.	22.2	40.0	28.9	8.9	0	45
	(14.8)	(44.4)	(25.9)	(14.8)	(0)	(27)
Bring in Guest Speakers.	15.6	13.3	48.9	17.8	4.4	45
	(11.1)	(25.9)	(48.1)	(11.1)	(3.7)	(27)
More Quantitative Workshops.	2.2	8.7	37.0	43.5	8.7	46
	(0)	(11.1)	(51.9)	(33.3)	(3.7)	(27)
Higher Rewards.	4.3	13.0	43.5	30.4	8.7	46
	(3.7)	(18.5)	(48.1)	(25.9)	(3.7)	(27)
Closer Association between Industry and Institutes.	0	2.1	12.8	53.2	31.9	47
	(0)	(3.7)	(33.3)	(48.1)	(14.8)	(27)
Restructuring Quantitative Development Programs.	2.3	6.8	52.3	34.1	4.5	44
	(0)	(0)	(51.9)	(33.3)	(14.8)	(27)
Other (specify)					*#	

* Internal development & succession planning
# Develop more and better technology

Rank		**Mean Score*****
1 (2)	Closer association between industry and institutes	4.15 (3.74)
2 (1)	Train more people	3.92 (3.85)
3 (4)	More quantitative workshops	3.48 (3.30)
4 (3)	Restructuring quantitative development programs	3.32 (3.63)
5 (5)	Higher rewards	3.26 (3.07)
6 (6)	Bring in guest speakers	2.82 (2.70)
7 (7)	Migration policies to attract overseas skills	2.25 (2.40)
8 (8)	Employ overseas workers	2.05 (2.37)

*** Mean Score (see Table 5.1.5)

Table 5.1.11 shows the results of business employers' ratings of criteria in recruiting business students. Communication skills (73%/64.3%), motivation (65.1%/54.8%) and analytical skills (50%/54.8%) were ranked highest as the very important criteria. Flexibility/adaptability (41.3%/35.7%), personality (38.7%/28.6%) and maturity (27.4%/33.3%) were ranked respectively as the next highest in order of importance. Surprisingly, academic results (23.8%/28.6%) and work experience (16.1%/9.5%) were ranked low compared to others. Extracurricular activities was ranked as the lowest (50%

/38.1%) regarded it as not at all important or not too important). It is noted that business

Table 5.1.11 Criteria in Recruiting Business Students

1=Not At All 2=Not Too Important 3=Important 4=Fairly Important 5=Very Important

Question 11. Rate in order of importance the criteria you believe are most important in recruiting business students.

1995 (1999)

Criteria	Percent [1]	[2]	[3]	[4]	[5]	n
Academic Results	1.6	6.3	41.3	27.0	23.8	63
	(0)	(7.1)	(38.1)	(26.2)	(28.6)	(42)
Communication skills	1.6	0	4.8	20.6	73.0	63
	(0)	(2.4)	(9.5)	(23.8)	(64.3)	(42)
Analytical skills	0	3.2	9.7	37.1	50.0	62
	(0)	(2.4)	(7.1)	(35.7)	(54.8)	(42)
Personality	1.6	4.8	22.6	32.3	38.7	62
	(0)	(2.4)	(23.8)	(45.2)	(28.6)	(42)
Motivation	0	3.2	3.2	28.6	65.1	63
	(0)	(2.4)	(7.1)	(35.7)	(54.8)	(42)
Maturity	1.6	4.8	30.6	35.5	27.4	62
	(0)	(4.8)	(14.3)	(47.6)	(33.3)	(42)
Flexibility / Adaptability	1.6	3.2	15.9	38.1	41.3	63
	(2.4)	(4.8)	(11.9)	(45.2)	(35.7)	(42)
Extracurricular activities	12.9	37.1	19.4	14.5	16.1	62
	(11.9)	(26.2)	(33.3)	(19.0)	(9.5)	(42)
Work experience	6.5	29.0	37.1	11.3	16.1	62
	(9.5)	(11.9)	(47.6)	(21.4)	(9.5)	(42)
Other (specify)				* @	#	

* Humor
@ Commitment to the organisation
# Interpersonal Skills

	Rank	Mean Score***
1 (1)	Communication	4.63 (4.50)
2 (2.5)	Motivation	4.56 (4.43)
3 (2.5)	Analytical Skills	4.34 (4.43)
4 (5)	Flexibility/Adaptability	4.14 (4.07)
5 (6)	Personality	4.02 (4.00)
6 (4)	Maturity	3.82 (4.10)
7 (7)	Academic Results	3.65 (3.76)
8 (8)	Work Experience	3.02 (3.10)
9 (9)	Extracurricular Activities	2.84 (2.88)

*** Mean Score (see Table 5.1.5)

employers may want to emphasize the term 'work experience' here. That means they may want to point out the difference between 'work' experience and 'professional business' experience. Work experience could be defined as 'any' type of work such as working at a

McDonald's counter, whereas professional business experience could suggest an exposure to business decision making. A clearer picture will emerge in chapter seven where business educators will give a further explanation about this work experience.

Table 5.1.12 shows the results of business employers' ranking in order of importance the skills that every business graduate should possess. The results show that Communication is the most required skills (74%/61.9%). Then next highest ranks in order of importance were Motivation (50.8% / 50%), Problem Solving (36.5% / 47.6%), Organization and

Table 5.1.12 Skills that every Business Graduate should possess [n=63(42)]

1=Not At All   2=Not Too Important   3=Important   4=Fairly Important   5=Very Important

Question 12. Rate in order of importance the skills that every business graduate should possess.

1995 (1999) **Percent**

Skill	[1]	[2]	[3]	[4]	[5]
Communication Skills	0	0	3.2	22.2	74.6
	(0)	(2.4)	(4.8)	(31.0)	(61.9)
Negotiating Skills	0	15.9	41.3	22.2	20.6
	(0)	(16.7)	(26.2)	(28.6)	(28.6)
Motivation	0	0	6.3	42.9	50.8
	(0)	(0)	(21.4)	(28.6)	(50.0)
Organization & Coordination	0	0	30.2	38.1	31.7
	(0)	(0)	(35.7)	(35.7)	(28.6)
Data Analysis	0	4.8	38.1	41.3	15.9
	(0)	(4.8)	(26.2)	(50.0)	(19.0)
Problem Solving	0	0	12.7	50.8	36.5
	(0)	(0)	(14.3)	(38.1)	(47.6)
Computer Utilization	0	6.3	44.4	34.9	14.3
	(0)	(7.1)	(26.2)	(54.8)	(11.9)
Application of Quantitative Techniques	1.6	14.3	41.3	33.3	9.5
	(0)	(14.3)	(33.3)	(38.1)	(14.3)
Other (specify)					*
* Ability to work as part of a team					

Rank		**Mean Score *****
1 (1)	Communication	4.71 (4.52)
2 (3)	Motivation	4.44 (4.28)
3 (2)	Problem Solving	4.24 (4.33)
4 (4)	Organization & Coordination	4.02 (3.93)
5 (5)	Data Analysis	3.68 (3.83)
6 (6)	Computer Utilization	3.57 (3.71)
7 (7)	Negotiating Skills	3.48 (3.69)
8 (8)	Applications of Quantitative Techniques	3.35 (3.52)

*** Mean Score (see Table 5.1.5)

Coordination (31.7%/28.6%); Data Analysis (15.9%/19%) and Computer Utilization (14.3%/11.9%) were ranked low. Negotiating Skills (mean score of 3.48/3.69) and Applications of Quantitative Techniques (mean score of 3.35/3.52) were ranked lowest. An additional skill that every business graduate should possess which was regarded as a very important one, is the 'ability to work as part of a team'.

When business employers were asked to rate the areas of knowledge that every business graduate should possess, the area of 'Human Relations' was ranked highest as *fairly and very important* (Table 5.1.13). Computer Capability (mean score of 3.65/3.76) and Accounting (mean score of 3.64/3.48) were ranked *high* in both cases, Finance and Basic Skills in Management were also *high* in order of importance. Economics, Marketing and Statistics & Quantitative Methods were ranked *low* with mean scores of 3.27(3.26), 3.23 (3.02) and 3.22 (3.40) respectively.

Table 5.1.13 Areas of Knowledge that every Business Graduate should possess

1=Not At All 2=Not Too Important 3=Important 4=Fairly Important 5=Very Important

Question 13. Rate in order of importance the areas of knowledge that every business graduate should possess.

	1995 (1999) Percent					
Areas of Knowledge	**[1]**	**[2]**	**[3]**	**[4]**	**[5]**	**n**
Basic Skills in Management	0 (0)	11.3 (16.7)	38.7 (42.9)	33.9 (35.7)	16.1 (4.8)	62 (42)
Human Relations	0 (0)	1.6 (0)	35.5 (40.5)	32.3 (45.2)	30.6 (14.3)	62 (42)
Computer Capability	0 (0)	3.2 (7.1)	41.9 (28.6)	41.9 (45.2)	12.9 (19.0)	62 (42)
Accounting	1.7 (2.4)	6.8 (7.1)	37.3 (42.9)	33.9 (35.7)	20.3 (11.9)	59 (42)
Economics	3.3 (4.8)	9.8 (9.5)	57.4 (52.4)	19.7 (21.4)	9.8 (11.9)	61 (42)
Finance	0 (0)	8.5 (11.9)	40.7 (38.1)	37.3 (38.1)	13.6 (11.9)	59 (42)
Marketing	0 (0)	15.0 (21.4)	51.7 (54.8)	25.0 (23.8)	8.3 (0)	60 (42)
Statistics & Quantitative Methods	0 (0)	16.7 (11.9)	51.7 (45.2)	25.0 (33.3)	6.7 (9.5)	60 (42)

Table 5.1.13 (continued)

Rank		Mean Score ***
1 (2)	Human Relations	3.92 (3.74)
2 (1)	Computer Capability	3.65 (3.76)
3 (4)	Accounting	3.64 (3.48)
4 (3)	Finance	3.56 (3.50)
5 (6)	Basic skills in management	3.55 (3.29)
6 (8)	Economics	3.27 (3.26)
7 (7)	Marketing	3.23 (3.02)
8 (5)	Statistics & Quantitative Methods	3.22 (3.40)

*** Mean Score (see Table 5.1.5)

Table 5.1.14 reveals that 'Knowledge of Organisation' was the most important area (mean score of 4.53/4.43) that new graduates should develop during their first year of employment. Interpersonal, Self-Management and Specific Technical Skills were ranked second, third and fourth in order of importance. Communication Skills, both oral and written, ranked next highest (mean scores of 4.02/4.02 and 3.974.10 respectively).

Table 5.1.14 Areas Employers Aim to Develop in new Graduates during their First Year of Employment [n=64 (42)]

1=Not At All 2=Not Too Important 3=Important 4=Fairly Important 5=Very Important

Question 14. Rate in order of importance the areas you aim to develop your new graduates during their first year of employment.

1995 (1999)
Percent

Areas of Development	[1]	[2]	[3]	[4]	[5]
Knowledge of Organisation	0	3.1	7.8	21.9	67.2
	(0)	(0)	(11.9)	(33.3)	(54.8)
Business Presentation Skills	0	3.1	28.1	40.6	28.1
	(0)	(4.8)	(23.8)	(40.5)	(30.9)
Specific Technical Skills	0	1.6	17.2	48.4	32.8
	(0)	(0)	(21.4)	(33.3)	(45.2)
Oral Communication Skills	0	1.6	28.1	37.5	32.8
	(0)	(2.4)	(26.2)	(38.1)	(33.3)
Written Communication Skills	0	3.1	25.0	43.8	28.1
	(0)	(2.4)	(19.0)	(45.2)	(33.3)
Self-Management Skills	0	0	15.6	57.8	26.6
	(0)	(2.4)	(16.7)	(50.0)	(30.9)
Interpersonal Skills	0	3.1	10.9	53.1	32.8
	(0)	(2.4)	(14.3)	(50.0)	(33.3)
Broad Based Skills	0	3.1	31.3	45.3	20.3
	(0)	(4.8)	(23.8)	(45.2)	(26.2)
Other (specify)				*	$

* Commercial Acumen
$ Team work skills

Rank		Mean Score ***
1 (1)	Knowledge of organisation	4.53 (4.43)
2 (3)	Interpersonal skills	4.16 (4.14)
3 (2)	Self-management skills	4.13 (4.24)
4 (4.5)	Specific technical skills	4.11 (4.10)
5 (6)	Oral communication skills	4.02 (4.02)
6 (4.5)	Written Communication skills	3.97 (4.10)
7 (7)	Business presentation skills	3.94 (3.98)
8 (8)	Broad based skills	3.83 (3.93)

*** Mean Score (see Table 5.1.5)

Although 'Business Presentation Skills' and 'Broad Based Skills' came last in order of importance, still a high percentage of respondents considered them as important areas for first year business employees (68.7%/71.4% and 65.6%/71.4% respectively). Apart from those areas mentioned above, business employers in the 1995 survey also recommended two essential areas for newly graduate employees; they were 'commercial acumen and team work skills'. However, team work skills seemed to be highly recommended as its rating (very important) was higher than the commercial acumen (*fairly important*).

As seen in Table 5.1.15, the statistical methods required most by employers were Presentation of Data (82%/98%), such as graphical descriptions of data and numerical descriptive measures. Sampling Methods (76%/95%) was the most frequently required of all other methods, followed by Introduction to Probability (71%) and Random Variables and Probability Distributions (69%/93%). The remainder of the various statistical methods required by employers is summarized in Table 5.1.15.

It was reported that Analysis of Variance was in the group of the least statistical methods used (with only 3.6%) in undergraduate business classes (Krehbiel & McClure 1993), whereas in Australia, about 65% (90%) of business employers would require their employees to have studied this topic. In general, business employers indicated that the three most important quantitative topics (in statistics) were presentation of data, sampling and probability.

Australian business employers were also asked to specify the skill level for each statistical method that they required their employees to study. Again, the skill level required for Presentation of Data was at a *high* level (level 3), in which employees were expected to be able to apply learned material in a particular and concrete situation. The same level was also expected by employers for 'Sampling Methods', 'Sampling & Estimation', 'Statistical Quality Control' and 'Time Series Analysis & Forecasting'. The majority of statistical methods, however, were required at a level of *understanding* only, as seen in Table 5.1.15.

Table 5.1.15 Statistical Methods and Skill Levels Required by Australian Business Employers [n=51(40)]

Question 15. Identify which quantitative topics and skill levels, you as a business employer, desire your employees to have studied.

1995 (1999)

Method	Cited By %	* Skill Level (%) 0	1	2	3	4
. Presentation of Data	82 (98)	18 (2)	8 (3)	22 (25)	43 (57)	10 (13)
. Introduction to Probability	71 (93)	29 (7)	14 (17)	31 (48)	26 (20)	0 (8)
. Random Variables & Probability Distributions	69 (93)	31 (7)	14 (28)	31 (42)	18 (15)	6 (8)
. Sampling & Estimation	76 (93)	24 (7)	14 (22)	25 (30)	33 (35)	4 (5)
. Sampling Methods	76 (95)	24 (5)	14 (25)	25 (33)	35 (35)	2 (3)
. Hypothesis Testing	63 (88)	37 (12)	10 (22)	31 (38)	22 (25)	0 (3)
. Nonparametric Statistics	55 (73)	45 (27)	14 (23)	33 (40)	8 (8)	0 (3)
. Linear Regression & Correlation	59 (85)	41 (15)	16 (18)	25 (33)	16 (30)	2 (5)
. Multiple Regression Methods	57 (83)	43 (17)	10 (20)	35 (43)	10 (12)	2 (8)
. Bayesian Decision Making	51 (80)	49 (20)	18 (33)	22 (27)	10 (15)	2 (5)
. Time Series Analysis & Forecasting	63 (93)	37 (7)	10 (20)	20 (33)	31 (35)	2 (5)
. Analysis of Variance	65 (90)	35 (10)	8 (15)	27 (28)	24 (35)	6 (13)
. Statistical Quality Control	63 (90)	37 (10)	10 (20)	20 (28)	31 (30)	2 (13)

* Skill Levels (Bloom, 1956)

0 = Not Required
1 = Awareness
2 = Understanding
3 = Application
4 = Synthesis

Australian business employers were asked to indicate which mathematical methods and skill levels they would require their employees to have studied. Table 5.1.16 indicated that the three most important mathematical methods to teach business students were 'Functions & Graphs', 'Mathematics of Finance' and 'Elementary Algebra'. 'Inventory Models' (both certainty and risk) ranked fourth, whereas 'Sets & Probability' ranked fifth. The ranking of remaining methods were similar where both 'Growth & Decay' and 'Queuing Theory' were at the bottom list of the table of 1995 survey ('Calculus' and 'Equations' ranked lowest in 1999 survey).

In terms of skill levels, two mathematical methods required at level 3 (i.e. *application*) were 'Functions & Graphs' and 'Mathematics of Finance'. The majority of other mathematical methods required would be at level 1 and 2, which were *awareness* and *understanding*. In summary, it is essential for business students to equip themselves sufficiently, that is to understand and know how to apply these important methods before they can enter the working business environment.

Table 5.1.16 Mathematical Methods and Skill Levels Required by Australian Business Employers [n=51(40)]

Question 15. Identify which quantitative topics and skill levels, you as a business employer, desire your employees to have studied.

1995 (1999)

Method	Cited By %	* Skill Level (%) 0	1	2	3	4
. Elementary Algebra	69 (93)	31 (7)	20 (8)	27 (25)	16 (53)	6 (7)
. Functions & Graphs	73 (95)	27 (5)	12 (0)	22 (25)	31 (55)	8 (15)
. Matrix Algebra	59 (88)	41 (12)	18 (25)	25 (35)	14 (23)	2 (5)
. Growth & Decay	53 (85)	47 (15)	16 (30)	25 (30)	10 (20)	2 (5)
. Linear Programming	57 (88)	43 (12)	22 (33)	24 (35)	10 (15)	2 (5)
. Nonlinear Programming	55 (83)	45 (17)	22 (35)	22 (30)	10 (13)	2 (5)
. Game Theory	55 (80)	45 (20)	22 (35)	22 (35)	10 (5)	2 (5)
. Inventory Control: Certainty	67 (93)	33 (7)	24 (20)	24 (43)	15 (23)	4 (7)
. Inventory Models: Risk	65 (93)	35 (7)	22 (20)	25 (40)	14 (25)	4 (7)
. Queuing Theory	51 (80)	49 (20)	18 (18)	21 (45)	8 (10)	4 (7)
. Simulation Models	61 (88)	39 (12)	22 (28)	25 (37)	10 (13)	4 (10)
. Network Analysis	59 (93)	41 (7)	22 (33)	23 (40)	10 (13)	4 (7)
. Markov Models	55 (88)	45 (12)	23 (38)	22 (35)	6 (8)	4 (7)
. Mathematics of Finance	73 (95)	27 (5)	18 (7)	18 (28)	31 (50)	6 (10)
. Differential Calculus	61 (83)	39 (17)	27 (40)	24 (25)	10 (13)	0 (5)
. Multivariate Differential Calculus	55 (75)	45 (25)	25 (35)	22 (23)	8 (13)	0 (5)
. Integral Calculus	59 (78)	41 (22)	27 (35)	20 (23)	10 (15)	2 (5)
. Sets & Probability	63 (90)	37 (10)	22 (33)	25 (32)	12 (18)	4 (7)
. Differential Equations	57 (78)	43 (22)	23 (30)	18 (20)	12 (18)	4 (10)
. Difference Equations	57 (78)	43 (22)	25 (38)	20 (20)	10 (13)	2 (7)

* Skill Levels (see Table 5.1.15).

5.1.2 Summary of Business Employers' Responses

The survey results indicate that, in the opinion of employers in both 1995 and 1999, business quantitative courses are responding adequately to the needs of Australian industry. They feel the best quantitative educational preparation for a business quantitative graduate is to provide practical work experience while going through college, with practical education applications such as case study based training. A small percentage of business employers indicate a shortage in industry of employees with quantitative techniques in the future; and the best way to overcome this shortage is to have a closer association between industry and universities as well as training more people. However, they feel the worst approach to overcoming this shortage would be to adopt migration policies to attract overseas skills or to employ overseas workers.

Business employers in both public and private sectors indicated that they were looking for qualities in graduates of a different kind. Graduates sought were who are able to think, communicate and have high motivation; who have the ability to analyze and solve problem and who have developed interpersonal, self-management skills and specific technical skills. Business employers also pointed out that business graduates should know about human relations, be proficient computer users and they were very keen to develop graduates in their first year of employment with knowledge of their organisation.

Finally, this is only part of a business employers' survey. The results of this study show what Australian business employers desire in relation to quantitative techniques in business education. Additional research needs to be conducted to compare the views of business employers and educators to see whether there is a significant difference between what employers need and what educators teach, to insure that current business curricula are most suited to Australian industrial requirements. Hence, the next section will look into the details of a questionnaire survey of business educators regarding Quantitative Methods education at VUT.

5.2.1 Analysis of Questionnaire Survey into VUT's Business Educators Attitudes to Quantitative Methods Programs

A questionnaire was sent to all staff teaching Quantitative Methods in undergraduate business courses at Victoria University of Technology (VUT). Later, in-depth interviews were conducted with teaching staff and coordinators to ascertain their interpretations of the differences in expectations between industry and business educators. It is noted that because this study is a case study of Victoria University of Technology only, the small response rate might introduce bias in interpretation of the specific results. In reading the results, it should be kept in mind that these outcomes were responses only by academic staff teaching Quantitative Methods subjects in Applied Economics department. Following are the summary statistics of their attitudes towards the courses.

Victoria University of Technology's business educators were asked to indicate 'How well business schools are responding to the needs of industry'. This question measured the expectations of the mission of business school education. Ratings ranged from *Poorly* to *Excellently* with values of 1 to 5 assigned respectively. Results (Table 5.2.1) showed that with respect to the 'Structure and Content of Undergraduate Courses', business schools are doing *adequately well* with a mean score of 3.27.

Table 5.2.1 Business Schools' Response to the Needs of Industry (n=13)

1=Poorly 2=Fairly 3=Adequately 4=Well 5=Excellently

Question 1. How well do you consider business education schools are responding to the needs of industry in Australia with respect to:

		Mean Score ***
a.	Liaison with Employers & Professional Bodies	2.73
b.	The Structure & Content of Undergraduate Courses	3.27
c.	Provisions for Academic Staff Development & Industrial Experience	2.36
d.	Research, Design & Development Activity	2.55

*** The mean scores were determined by averaging the numerical responses given each sub-question

In other areas, such as 'Provisions for Academic Staff Development and Industrial Experience', results showed that business schools are *not adequately* responding to the needs of industry. To accomplish their mission, business educators feel they need to look more into areas such as 'Liaison with Employers' and increase the 'Research, Design and Development Activity'.

The second question asked respondents to indicate 'How well prepared' were their undergraduate business students were in the Quantitative Methods area. On a scale of 1 to 5 (1=Not Prepared, 5=Excellently), on average the rating of preparation of business students in the Quantitative Methods area is 2.46 (Table 5.2.2). Whilst 53.8% of the respondents indicated their students were *adequately prepared* in this area, none would agree that their students were *well prepared or excellently prepared.*

Table 5.2.2 Preparedness of Business Students in Quantitative Methods Area

Question 2. How well prepared are our undergraduate business students in the Quantitative Methods area?

	Frequency	Per Cent
Not Prepared	1	7.7
Fairly	5	38.5
Adequately	7	53.8
Well Prepared	0	0.0
Excellently	0	0.0
Total	13	100.0

The following question was intended to elicit information from respondents regarding Quantitative Methods education. Business educators of Victoria University of Technology believed that, in order of importance, the best quantitative educational preparation for business graduates should be 'Practically Oriented Education', 'More Emphasis on Software Applications Skills' and 'Teaching a wider range of Quantitative Techniques' (Table 5.2.3). 'Work Experience' and 'Short Specialist Courses' were also considered important for a business graduate career. It is noted that all of these options were considered as important, as even the lowest rank showed a mean score of 3.00.

Table 5.2.3 Opinion on the Best Quantitative Educational Preparation for a Business Graduate Career (n=13)

1=Not At All 2=Not Too Important 3=Important 4=Fairly Important 5=Very Important

Question 3. Rate in order of importance the best quantitative educational preparation for a business graduate career is.

Rank		Mean Score ***
1.	Education should be more Practically Oriented, More Case Study Based	4.15
2.	More Emphasis on Software Applications Skills	3.92
3.	More Emphasis on the Teaching of a wider range of Quantitative Techniques	3.77
4.	Practical Experience while going through College, Work Experience Oriented	3.62
5.	More Short Specialist Courses	3.00

*** Mean score (see Table 5.2.1)

In recruiting business students, business educators indicated that the most desired criteria listed were Motivation, Maturity and Flexibility/Adaptability respectively (Table 5.2.4). Both Communication and Analytical Skills were considered equally as *fairly important*. In descending order, the least desired criteria were Academic Results, Personality and Work Experience. However, all of these criteria listed above were considered at least *important*, based on a 5-point scale (5=very important). The only criteria that was regarded as *not too important* was Extracurricular Activities.

Table 5.2.4 Criteria In Recruiting Business Students (n=13)

1=Not At All 2=Not Too Important 3=Important 4=Fairly Important 5=Very Important

Question 4. Rate in order of importance the criteria you believe are most important in recruiting business students.

Rank		Mean Score ***
1.	Motivation	4.77
2.	Maturity	4.54
3.	Flexibility / Adaptability	4.38
4.	Communication Skills	4.31
4.	Analytical Skills	4.31
6.	Academic Results	4.15
7.	Personality	3.69
8.	Work Experience	3.15
9.	Extracurricular Activities	2.83

***Mean score (see Table 5.2.1)

The next question asked business educators to rate the skills that every business students should possess. Motivation, Communication and Organization and Coordination were ranked highest as the *very important* skills (Table 5.2.5). Data Analysis and Computer Utilization skills were both equally ranked as the next highest in order of importance. In descending order, Problem Solving, Negotiating Skills and Application of Quantitative Techniques were of the *least important* skills compared to others. However, all of these skills displayed a mean score of at least 4.08, which ranged between *fairly important* to *very important*.

Table 5.2.5 Skills Important to Business Students (n=13)

1=Not At All 2=Not Too Important 3=Important 4=Fairly Important 5=Very Important

Question 5. Rate in order of importance the skills that every business students should possess.

Rank		**Mean Score *****
1.	Motivation	4.69
2.	Communication Skills	4.62
3.	Organization & Coordination	4.54
4.	Data Analysis	4.46
4.	Computer Utilization	4.46
6.	Problem Solving	4.38
7.	Negotiating Skills	4.17
8.	Application of Quantitative Techniques	4.08

*** Mean Score (see Table 5.2.1)

This question focused on eight main knowledge areas and asked respondents to rate the areas that every business graduate should possess. The analysis of business educators' responses showed that all listed areas were important to business students. The result listed the two most important areas that every business graduate should possess were Computer Capability and Statistics & Quantitative Methods. Economics, Finance and Human Relations were next important. The relatively least important areas, in descending order, were Basic Skills in Management, Marketing and Accounting, although absolutely they were considered *important*, even as the lowest rank had a mean score of 3.15.

Table 5.2.6 Areas of Knowledge Important to Business Graduate (n=13)

1=Not At All 2=Not Too Important 3=Important 4=Fairly Important 5=Very Important

Question 6. Rate in order of importance the areas of knowledge that every business graduate should possess.

Rank		Mean Score ***
1.	Computer Capability	4.33
2.	Statistics & Quantitative Methods	4.23
3.	Economics	3.92
4.	Finance	3.85
4.	Human Relations	3.85
6.	Basic Skills in Management	3.77
6.	Marketing	3.77
8.	Accounting	3.15

*** Mean Score (see Table 5.2.4)

In response to question relating the solution for shortage of employees with Quantitative Methods skills in industry, educators in this study indicated that they would prefer the options of 'Training more People' and creating a 'Closer Association with Industry', if there was a shortage of graduates with quantitative skills.

Table 5.2.7 Educators' Ratings of Possible Strategies for Overcoming Graduate Shortage (n=13)

1 = Worst 3 = Average 5 = Best

Question 7. If there is a shortage in industry of employees with quantitative abilities, rate in order of preference the best ways that shortages can be overcome.

Rank		Mean Score ***
1.	Train more People	4.54
1.	Closer Association between Industry & Institutes	4.54
3.	Higher Rewards	4.50
4.	More Quantitative Workshops	4.08
5.	Restructuring Quantitative Development Programs	3.85
6.	Bring in Guest Speakers	3.58
7.	Migration Policies to attract Overseas Skills	3.15
8.	Employ Overseas Workers	2.77

*** Mean Score (see Table 5.2.1)

They also prefer the options of 'Higher Rewards', offer 'More Quantitative Workshops' and 'Restructure the Quantitative Programs' respectively. The least preferred option was to adopt 'Migration Policies to attract Overseas Skills' and to 'Employ Workers Aboard'.

Views on the most appropriate theoretical concept to underpin contemporary Quantitative course curriculum revealed that the majority of business educators in this survey voted for the 'Technological' approach (Table 5.2.8). Only two out of 13 respondents prefer the 'Academic' approach and three respondents believed that a combination of both 'Academic and Technological' approaches are more appropriate in today's curriculum.

Table 5.2.8 Theoretical Concepts in Quantitative Methods Curriculum

Question 8. Which of the following concepts are most appropriate in today's Quantitative Methods curriculum?

	Frequency
a. Academic	2
b. Technological	6
c. Humanistic	1
d. Social Reconstructionist	0
3 said a & b	
1 blank	

It is apparent from Table 5.2.9 that Academic staff in undergraduate business courses at VUT claimed that no particular curriculum model was employed when developing Quantitative Methods subjects. Similar reports were also found in other Higher Education institutes as mentioned in the Literature Review section. This suggests that curriculum writers developed their own curriculum based on a combination of what they had been taught and on what other universities appear to be doing.

Table 5.2.9 Curriculum Model Used When Developing Quantitative Methods Subjects

Question 9. Is there any particular curriculum model that can be used when developing Quantitative Methods subjects?

	Frequency	Per Cent
No	13	100
Yes	0	0
Total	13	100

Table 5.2.10 indicates that Algebra and Calculus are preferred as prerequisites for Quantitative Methods subjects. McAlevey and Sullivan (1992) noted that Calculus appeared as prerequisites in 54% of Australasian undergraduate business statistics subjects.

Table 5.2.10 Mathematics Prerequisites Required of Students Entering Business Quantitative Methods Programs

Question 10. Are there any prerequisites in mathematics for students entering business Quantitative Methods programs?

	Frequency	Per Cent
No	8	61.5
Yes	5*	38.5
Total	13	100.0

* Algebra and Calculus Required

Except for Business Statistics, which will be discussed later, the percentage of class time devoted to lectures for each subject area by educators ranges from 40 to 70 percent (Table 5.2.11). Discussion took approximately 20 per cent of class time in most subjects, with the exception of Business Statistics and Statistics for Business and Marketing. For student presentations and testing, educators indicated they spent from 20 to 30 percent of class time in subjects such as Business Decision Methods, Economics & Business Analysis, Business Forecasting Methods and Business Decision Analysis. The only subject that required significant practical work, which was 50 per cent of class time, was Statistics for Business & Marketing.

Business Statistics is a core subject in first year business courses, and because of the large number of students enrolled, five instructors were involved in this subject. As shown in Table 5.2.12, lecturers indicated that from 80 to 90 per cent of class time is spent in lecturing and discussion. By comparison, those who were tutors spent from 60 to 85 percent of class time in discussion. Only one tutor expressed a preference for spending 95 percent of class time for student presentation and/or revision, with the remaining 5 per cent being used for testing.

Table 5.2.11 Percentage of Class Time Devoted to each of the following Teaching Techniques (n=13)

Question 11. Indicate the approximate percentage of class time as an instructor devoted to each of the following teaching techniques (please note that these activities should add up to 100%).

	L	D	S	T	O
a) Business Statistics	See Next Table				
b) Statistics for Business & Marketing	50	-	-	-	50#
c) Business Decision Methods	40	20	15	15	10*
d) Economic & Business Analysis	50	20	20	10	-
e) Applied Regression Analysis	60	20	-	-	20+
f) Business Forecasting Methods	50	25	20	5	-
g) Business Decision Analysis	70	10	20	-	-

L = Lecture
D = Discussion
S = Student Presentation and/or Revision
T = Testing
O = Other:
#Practical Work
*Additional Lab Instructions
+Workshops

Table 5.2.12 Breakdown of Teaching Methods in Business Statistics (n=5)

	L	D	S	T	O
Instructor 1	-	-	95	5	-
Instructor 2	10	85	5	-	-
Instructor 3	60	20	-	-	20@
Instructor 4	80	10	-	10	-
Instructor 5	20	60	-	-	20@

lecturers Instructors 3 & 4 are
Instructors 1,2 & 5 are tutors

@Self-paced Learning

The following question asked business educators in Quantitative Methods area to indicate which software package was used in their teaching. The results indicated SPSS was the most popular software used in most Quantitative Methods subjects. As seen from Table 5.2.13, SPSS was required in first year core subject Business Statistics, whilst in

Table 5.2.13 Statistical Packages Required in Instructor's Discipline Area

Question 12. Indicate the statistical packages that are required in your discipline area.

	Package Used
a) Business Statistics	SPSS
b) Statistics for Business & Marketing	SPSS
c) Business Decision Methods	SAS
d) Economic & Business Analysis	SPSS
e) Applied Regression Analysis	SAS
f) Business Forecasting Methods	EXCEL & SPSS
g) Business Decision Analysis	_

second year, SPSS was required in Statistics for Business & Marketing and Economic & Business Analysis; and SAS was required in Business Decision Methods and Applied Regression Analysis. The only subject that used SPSS in conjunction with EXCEL was Business Forecasting Methods in second year. There was no indication of any software package being required in third year subject Business Decision Analysis.

Table 5.2.14 shows these statistical methods which were offered in the Major of Quantitative Methods at Victoria University of Technology. The methods rated most important on the 'skill level scale' were Presentation of Data, Probability, Sampling, Hypothesis Testing, Linear Regression and Time Series. It is noted that these statistical methods, that educators expect students to have a *high* skill level (*Application and Synthesis*) include Presentation of Data, Sampling & Estimation, Hypothesis Testing, Regression and Time Series Analysis, whereas, Introduction to Probability was required only at the *low* skill level (*Awareness and Understanding*). The percentage of *low* and *high* skill levels required for each method was summarized in Table 5.2.14.

Another method that was used to distinguish the relative importance of various techniques was the frequent of reference as shown in the column 'Cited By'. In this column, it appears that there are eight methods which educators regard as essential in Quantitative Methods studies, these being Presentation of Data, Introduction to Probability, Random Variables & Probability Distributions, Sampling & Estimation, Sampling Methods, Hypothesis Testing, Linear Regression & Correlation and Time Series Analysis & Forecasting.

Table 5.2.14 Statistical Methods and Skill Levels Offered in the Quantitative Methods Subjects (n=13)

Question 13. Identify quantitative topics and skill levels that are offered and should be achieved by students in your discipline area.

Statistical Methods	* Skill Level 0 1 2 3 4	Cited By %	Percentage of Low & High Skill Level Response Low	High
. Presentation of Data	0 0 5 7 1	100	38	62
. Introduction to Probability	0 2 6 5 0	100	62	38
. Random Variables & Prob. Distributions	0 0 6 7 0	100	46	54
. Sampling & Estimation	0 0 3 8 2	100	23	77
. Sampling Methods	0 2 4 7 0	100	46	54
. Hypothesis Testing	0 0 3 7 3	100	23	77
. Nonparametric Statistics	2 0 4 7 0	85	31	54
. Linear Regression & Correlation	0 0 2 7 4	100	15	85
. Multiple Regression Methods	3 0 2 3 5	77	15	62
. Bayesian Decision Making	4 4 2 3 0	69	46	23
. Time Series Analysis & Forecasting	0 1 3 8 1	100	31	69
. Analysis of Variance	2 0 5 6 0	85	38	46
. Statistical Quality Control	3 1 2 6 1	77	23	54

*Skill Levels (Bloom 1956)
0 = Not Required
1 = Awareness
2 = Understanding
3 = Application
4 = Synthesis

Low = Levels 1&2
High = Levels 3&4

Table 5.2.15 reflects the level of achievement in Mathematical methods that Business Educators believed appropriate for students majoring in Quantitative Methods studies. The methods most required were Elementary Algebra and Functions & Graphs. Linear Programming, Sets & Probability and Growth & Decay were the next frequently required. In Calculus, Differential Calculus was more frequently required than Integral and Multivariate Differential Calculus. Other methods such as Mathematics of Finance, Queuing Theory and Inventory methods were also expected of students. By looking at related h*igh* and *low* skill level columns, it appears that Elementary Algebra, Functions & Graphs and Linear Programming methods were required at a *high* skill level (*Application and Synthesis*), whereas, Matrix Algebra, Sets & Probability and Growth & Decay were only expected to have a level of *Awareness and Understanding*. The rest of mathematical methods and related skill levels that should be required of students majoring in Quantitative Methods, is summarized in Table 5.2.15.

Table 5.2.15 Mathematical Methods and Skill Levels Offered in the Quantitative Methods Subjects

Question 13. Identify quantitative topics and skill levels that are offered and should be achieved by students in your discipline area

			Percentage of Low & High Skill Level Response	
	* Skill Level	Cited By %	Low	High
Mathematical Methods	**0 1 2 3 4**			
. Elementary Algebra	1 1 4 5 2	92	38	54
. Functions & Graphs	1 1 4 5 2	92	38	54
. Matrix Algebra	6 4 3 0 0	54	54	0
. Growth & Decay	5 4 2 2 0	62	46	15
. Linear Programming	4 0 3 4 2	69	23	46
. Nonlinear Programming	8 3 1 1 0	38	31	8
. Game Theory	5 4 1 2 1	62	38	23
. Inventory Control: Certainty	6 1 2 4 0	54	23	31
. Inventory Model: Risk	6 1 3 3 0	54	31	23
. Queuing Theory	6 2 2 3 0	54	31	23
. Simulation Models	7 2 1 2 1	46	23	23
. Network Analysis	7 2 1 3 0	46	23	23
. Markov Models	8 1 2 2 0	38	23	15
. Mathematics of Finance	6 0 4 2 1	54	31	23
. Differential Calculus	6 0 3 4 0	54	23	31
. Multivariate Differential Calculus	9 0 2 2 0	31	15	15
. Integral Calculus	8 3 2 0 0	38	38	0
. Sets & Probability	4 3 4 2 0	69	54	15
. Differential Equations	9 3 1 0 0	31	31	0
. Difference Equations	9 3 1 0 0	31	31	0

* Skill Level (see Table 5.2.14)

5.2.2 Summary of VUT Business Educators' Responses

In general, regarding business school education and its response to the needs of industry, educators at VUT believe that business schools are not adequately responding to the needs of industry, especially in the areas of 'Liaison with Employers & Professional Bodies', 'Provisions for Academic Staff Development & Industrial Experience' and 'Research, Design & Development Activity'.

In Quantitative Methods area in particular, VUT's business educators believed that their business students were not adequately prepared for the work place. In preparation for a Quantitative Methods graduate career, they believe that education should be more practically oriented, with more case studies being involved, and that software application skills should be more emphasized in class rather than just teaching a wider range of Quantitative Techniques.

When developing the curriculum for Quantitative Methods programs, whilst business educators at VUT did not follow any particular model, they preferred a 'Technological' approach than 'Academic' for a theoretical concept. With regard to students who enter the courses, although there are no prerequisites in mathematics requirement, educators suggested some Algebra and Calculus skills would be helpful. The computer software packages taught in most Quantitative Methods subjects were SPSS, SAS and EXCEL respectively.

With regard to specific areas of knowledge, business educators considered Computer Capability, Quantitative Methods and Economics to be the three most areas that every business graduate should possess. In the contents of existing Quantitative Methods subjects, they required students to master essential methods (both Statistics and Mathematics) at *higher skill* level.

In summary, the survey indicated that courses in Quantitative Methods played a critical role in the preparation of business graduates, and that educators have the responsibility to provide education as well as to ensure the courses' contents and structure meet the needs of today's business. The survey aimed to elicit the attitudes of VUT's business educators towards various aspects of the undergraduate Quantitative Methods programs in business.

However, in order to gain a clear understanding of what Quantitative Methods techniques are needed in industry, thus allowing the development of the course curriculum to meet the contemporary requirements of Australian business and industry, it is essential to make comparison between the expectations of business employers and educators. This comparison, in turn, will help to determine how well business schools are meeting the needs of industry. Examination of these expectations will be carried out in the next chapter.

5.3.1 Details of Final Year Business Students' and Graduates' Attitudes to Quantitative Methods Programs: A Parallel Analysis

The purpose of these surveys were to elicit the attitudes of business students and graduates towards undergraduate Quantitative Methods training at VUT. In the student mail survey conducted in this study, final-year students were invited to evaluate their business courses in Quantitative Methods in three parts. In the graduate mail survey, business graduates were invited to express their viewpoints and share their experience as a graduate of VUT and as an employee in business industry.

Whilst the mail survey for students was divided into three sections and the graduates' survey was divided into five main sections, the first three sections for both surveys were similar. The first section asked respondents about their course degree and background information, including questions regarding their age, gender, language spoken at home, type of school spent in final year of secondary education, methods of qualifying to enter the degree course and whether this course was their first preference when first applied to university.

The second section of the survey asked questions related to respondents' course experience, and was designed to elicit their perceptions of various aspects of teaching and learning, and their overall satisfaction with the course in general. In the third section, respondents were asked about their work experience and the cooperation between university and industry. Students, in particular, were also asked whether they would consider doing a further Quantitative Method study in the future.

The fourth and final sections were related to the graduates' survey. In the fourth section, graduates were asked about their work experience and employment expectations. Also, work that related to the use of Quantitative Methods skills, the knowledge areas and skills required at work, as well as special areas that need to be developed during the first year of employment was explored. The final section of the survey asked graduates to identify particular Quantitative Methods topics and the skill levels required in their industry.

Students		Graduates
Section One		
Q1	Title of Qualification	Q1
	Field of Specialisation	Q2
Q2	Enrolment Mode	Q3
Q3	Duration of Course Completion	Q4
Q4	Age	Q5
Q5	Gender	Q6
Q6	Main Language Spoken At Home	Q7
Q7	Permanent Residence	Q8
Q8	Method of Qualifying to Enter the Course	Q9
Q9	Final-year of Secondary Education	Q10
Q10	University First Preference	
	Highest Level of Mathematics Attempted	Q11
Section Two		
Q11	QM Subjects Studied at VUT	Q12
Q12	Main Reason to Enrol in QM Subjects	Q13
Q13	Rating of Academic Staff in QM	Q14
Q14	Overall Evaluation of QM Subjects	Q15
Q15	Detailed Evaluation of QM Subjects	Q16
Q16	Emphasis in QM Subjects	Q17
Q17	Level of Difficulty Perceived in QM Subjects	Q18
Q18	Rating of Quantitative Educational Preparation For a Graduate Career	Q19
Q19	Comments on QM Subjects at VUT	Q20
Section Three		
Q20	Cooperative Education Participation and Industrial Placement	Q21
Q21	Attitude Towards Work Experience	Q22
Q22	Appropriate Time To Do Work Experience	Q23
Q23	Cooperation Between Business Schools and Industry	Q24
Q24	Students' Employment During University Teaching Semester	
Q25	Preparedness of Respondents with QM Skills and Relevance of Study to Their Work	Q31
Q26	Students' Intention of Further Study in QM After Graduation	
Section Four		
	Organisation Sector	Q25
	Industry Group	Q26
	Job Titles	Q27
	Areas of Knowledge Required of Graduates	Q28
	Skills Required of Graduates	Q29
	Areas of Development Expected of Graduates During First Year of Employment	Q30
	Quantitative Topics and Skill Levels Required At Work	Q32

Figure 5.2 Parallel Diagram of Business Students' and Graduates' Attitudes

The response rate to the survey was 60 percent of the total pool of students, and 30 percent of the total pool of graduates at VUT. An interesting early observation was the close similarity of views regarding Quantitative Methods education and its quality between the final-year students and of recent business graduates. In the report below, the findings of the final-year students' and graduates' surveys are presented in the same table, with graduate results given in brackets for reference:

Section One – Students and Graduates

In the first question, respondents were asked to indicate the undergraduate course in which they were studying under the categories of Applied Economics, International Trade, Retail Management or Other courses. The responses showed that the majority of final-year business students in this survey were from either Retail Management, 34.6%, or International Trade, 51.9%. Out of 52 respondents from students' survey, only five students were from Applied Economics, even though Quantitative Methods subjects were offered in this department, and there were two from Other business courses. Whereas, the majority of business graduates was from Applied Economics (76.7%), International Trade (15.0%) and three graduates obtained their degrees as Master of Business.

Table 5.3.1 Respondents' Course Category: Students (Graduates)

Question 1 (1). Full title of qualification

Course Name	Frequency	Percent
Retail Management	18 (2)	34.6 (3.3)
International Trade	27 (9)	51.9 (15.0)
Applied Economics	5 (46)	9.6 (76.7)
Other	2 (3#)	3.8 (5.0)
Total	52 (60)	99.9* (100.0)

* Rounding error

Master of Business

Note that during the stage of this thesis, it has been difficult to obtain an accurate estimate of the number of Quantitative Methods students and graduates. One of the main problem has been that the number of Quantitative Methods students is rarely identified in Faculty records. However, it is found, by examining typical course enrolments, that students who enrolled in Retail Management, International Trade and Applied Economics were likely to do advanced courses in Quantitative Methods in their subsequent years of study.

It is noted that the majority of business graduates were from Applied Economics in which Quantitative Methods subjects were offered. However, by looking at their particular field of specialisation, Marketing made up more than one-half of the graduate respondents in this survey (Table 5.3.2), followed by Applied Economics and International Trade which were indicated as fields of specializations by graduates. Only ten percent of graduate respondents specialized in the area of Quantitative Methods.

Table 5.3.2 Field of Specialisation: (Graduates)

Question (2). Your particular field of specialisation

	Frequency	Per Cent
Marketing	33	55.0
Applied Economics	12	20.0
International Trade	9	15.0
Quantitative Methods	6	10.0
Retail Management	4	6.7
IT	1	1.7
Accounting	2	3.3

n=(60)

The next question was intended to elicit information from respondents regarding their status as students, indicating whether they were full-time or part-time. The results were shown in Table 5.3.3. The enrolment mode of the student respondents in this survey was equally divided into full-time and part-time sectors, with only one student respondent

Table 5.3.3 Enrolment Mode: Students (Graduates)

Question 2 (3). Enrolment Mode

Mode	Frequency	Percent
Full-time	26 (51)	50.0 (85.0)
Part-time	25 (6)	48.1 (10.0)
Other	1* (3)	1.9 (5.0)
Total	52 (60)	100.0 (100.0)

* Complementary Enrolment

enrolment as a mixture of full and part-time. Whereas, the majority of business graduates indicated his/her in this survey was enrolled as full-time students (85%) and six graduate respondents enrolled in part-time mode (10%).

Students were asked to indicate the likely time duration to reach the final year of their course. The findings in Table 5.3.4 indicated that most student respondents, 72.5%, were anticipating that they will complete their courses between three and four years full-time. However, only 7.8% of student respondents indicated that they would complete their courses in less than three years, and 19.6% of them would complete their courses in more than four years. By comparison, the majority of business graduates completed their degrees in three or more years, whilst only about ten percent of graduate respondents completed their courses in less than three years.

Table 5.3.4 Time Taken to Reach the Final Year of Degree Course: Students (Graduates)

Question 3 (4). How long has it taken you to reach the final year of your course?

Duration	Frequency	Percent
Less than 3 years	4 (7)	7.8 (11.7)
Between 3 and 4	37 (26)	72.5 (43.4)
More than 4 years	10 (27)	19.6 (45.0)
Total	51 (60)	99.9* (100.1*)

* Rounding error

Respondents were asked for their age at the time of the survey. The results of Table 5.3.5 showed that, consistent with the age distribution in the traditional university sector, the sample contained a majority of younger students and graduates. Most student respondents, 88.0%, in this survey were in the age range 20 to 25 years old. Three students were in the age group of 26 and 30, and three others were from 41 to 45. However, none indicated their age group to fall between 31 and 40. In addition, since these were graduates who had completed their degree courses recently, it is apparent that the majority of them were in the age range of 26-30 (43.3%). In overall, 49 out of 60 graduates in this survey were under thirty years old (81.6%).

Table 5.3.5 Age: Students (Graduates)

Question 4 (5). Age			
	Age (years)	**Frequency**	**Percent**
	20 - 25	44 (23)	88.0 (38.3)
	26 - 30	3 (26)	6.0 (43.3)
	31 - 35	0 (5)	0.0 (8.3)
	36 - 40	0 (4)	0.0 (6.7)
	41 - 45	3 (2)	6.0 (3.3)
	Total	50 (60)	100.0 (99.9*)
	* Rounding error		

Regarding respondents' gender, Table 5.3.6 shows that 57.7% of final-year business students were female and 42.3% were male in the student survey. With the graduate sample, more male respondents (61.7%) than female (38.3%) participated in the graduate survey.

Table 5.3.6 Gender: Students (Graduates)

Question 5 (6). Gender			
	Gender	**Frequency**	**Percent**
	Male	22 (37)	42.3 (61.7)
	Female	30 (23)	57.7 (38.3)
	Total	52 (60)	100.0 (100.0)

In Table 5.3.7, respondents were asked the main language they spoke at home. The results showed that out of 52 (60) students (graduates), 37 (41) indicated English as their language spoken at home, 71.2% (68.3%), compared with 15 (19) who speak other-than English language at home, 28.8% (68.3%).

Table 5.3.7 Language Spoken at Home: Students (Graduates)

Question 6 (7). Main language spoken at home		
	Frequency	**Percent**
English	37 (41)	71.2 (68.3)
Non-English	15 (19)	28.8 (31.7)
Total	52 (60)	100.0 (100.0)

Table 5.3.8 indicated that of those respondents who responded to the survey, 92.3% students' permanent residence was in Australia, while only four students, 7.7%, resided elsewhere. Of those graduates who responded to the survey, the profile (Table 5.3.8) showed that almost every business graduate who participated in this survey are Australian permanent residence (98.3%).

Table 5.3.8 Permanent Residence: Students (Graduates)

Question 7 (8). Your permanent residence

	Frequency	Percent
In Australia	48 (59)	92.3 (98.3)
Elsewhere	4 (1)	7.7 (1.7)
Total	52 (60)	100.0 (100.0)

When asked respondents for the method of entry that they used to qualifying to enter the course, Table 5.3.9 showed 69.2% of student respondents and (58.3%) of graduate respondents were qualified to enter the business courses via a standard year 12 program. 17.3% of student respondents, as compared with (15.0%) of graduate respondents, in the survey had partially completed and fully completed tertiary courses, and 7.7% of student respondents were qualified under special entry provisions such as TOP, TAFE[5] certificates

Table 5.3.9 Method of Qualifying to Enter the Course: Students (Graduates)

Question 8 (9). Method of qualifying to enter the course

	Frequency	Percent
Year 12 School Certificate	36 (35)	69.2 (58.3)
Tertiary Orientation or other bridging course	1 (3)	1.9 (5.0)
Partially completed tertiary course	6 (5)	11.5 (8.3)
Completed tertiary course	3 (4)	5.8 (6.7)
TAFE certificate	3 (7)	5.8 (11.7)
Other	3* (6#)	5.8 (10.0)
Total	52 (60)	100.0 (100.0)

* One respondent was a Mature Age student
# One VCE Equivalent, Four Mature Age, One Overseas Qualification

[5] See Abbreviations page vi.

or bridging courses compared with (16.7%) of graduate respondents in the same category. One student respondent reported his/her course entrance as a Mature Age student compared with four respondents from graduates' survey.

Both students and graduates were asked to indicate the type of school in which they spent their final year of secondary education. The results from Table 5.3.10 showed that 55.8% of final-year students, compared with (45.0%) of graduates, spent their secondary education at a Government High School. Whilst 36.5% (41.7%) of respondents spent their final year of secondary education at independent schools. A small percentage, 7.6% and (5%) respectively, of the respondents attended TAFE college or overseas private schools before entering the business course.

Table 5.3.10 Final Year of Secondary Education: Students (Graduates)

Question 9 (10). Where did you do your final year of secondary education?

	Frequency	Percent
Government (State) high school	29 (27)	55.8 (45.0)
Independent school	19 (25)	36.5 (41.7)
Technical school	0 (0)	0.0 (0.0)
TAFE college	2 (3)	3.8 (5.0)
Other	2# (5)	3.8 (8.3)
Total	52 (60)	99.9* (100.0)

* Rounding error

One was attending Private School in Ethiopia and the other was unspecified

Regardless of the method qualifying to enter the course, when asked about their first choice when first applied the degree course, the majority, 90.4%, of student respondents in Table 5.3.11 indicated that a business course was their first preference. Only 9.6% of business students put their first preference as a non-business course at VUT.

Table 5.3.11 University First Preference: Students

Question 10. What was your first course preference when you first applied for a university course?

Course	Frequency	Percent
Business	47	90.4
Non-business	5	9.6
Total	52	100.0

This question asked graduates to indicate the highest level of mathematics they had attempted when first applied this degree course. The responses from Table 5.3.12 showed that 43 out of 60 business graduates had attended year 11 or 12 mathematics when they first entered the degree courses (71.7% in total). Five graduate respondents attempted mathematics at Degree course (8.3%) and eight (13.3%) had attempted mathematics at TAFE level when they first applied the course.

Table 5.3.12 Highest Level of Mathematics Attempted When First Applied This Course: (Graduates)

Question (11). What was the highest level of mathematics you have attempted when you first applied this course?

	Frequency	Per Cent
Year 10	4	6.7
Year 11	10	16.7
Year 12	33	55.0
TAFE	8	13.3
Degree	5	8.3
Total	60	100.0

Section Two – Students and Graduates

Since Business Statistics is the core subject of all undergraduate business courses, all respondents in this sample had completed this subject. Other Quantitative Methods subjects are at second and third year levels. Results from Table 5.3.13 showed that apart from the first year Business Statistics, two most popular Quantitative Methods subjects are Economic & Business Analysis, 90.4% of student and (63.3%) of graduate respondents respectively, and Statistics for Business & Marketing, 78.8% (85.0%). Eight out of 52 student respondents enrolled in Business Decision Methods, 15.4%, as compared with 27 out of 60 graduates (45.0%); Applied Regression Analysis, 11.5% and (16.7%) respectively; Business Forecasting Methods, 9.6% (41.7%), and Business Decision Analysis, 1.9% (8.3%).

Table 5.3.13 Quantitative Methods Subjects Studied at VUT: Students (Graduates)

Question 11 (12). Which of the following Quantitative Methods subjects have you done?

	Frequency	Percent
Business Statistics	52 (59)	100.0 (98.3)
Statistics for Business and Marketing	41 (51)	78.8 (85.0)
Business Decision Methods	8 (27)	15.4 (45.0)
Economic and Business Analysis	47 (38)	90.4 (63.3)
Applied Regression Analysis	6 (10)	11.5 (16.7)
Business Forecasting Methods	5 (25)	9.6 (41.7)
Business Decision Analysis	1 (5)	1.9 (8.3)

n=52 (60)
note that some respondents have studied more than one subject

When asked for the main reason that respondents enrolled in one of the higher level Quantitative Methods subjects, the majority of them responded (Table 5.3.14) that because it was part of the course requirements, 92.3% (85.0%). A small percentage of respondents expressed that these courses were either interesting, 11.5% (16.7%), potentially useful to gain employment, 11.5% (10.0%) or they were a major subject, 9.6% (11.7%). However, all student respondents agreed that Quantitative Methods subjects were definitely not in the category of a soft option, and one student, 1.9%, indicated that the subject had 'suited the student'. Around 10% of respondents had indicated these Quantitative Methods subjects were part of their Major, 9.6% (11.7%), or were potentially useful to gain employment, 11.5% (10.0%).

Table 5.3.14 Main Reason to Enrol in one of those Quantitative Methods Subjects: Students (Graduates)

Question 12 (13). What was the main reason that you enrolled in one of those subjects above?

	Frequency	Percent
It was part of course requirements	48 (51)	92.3 (85.0)
It was interesting	6 (10)	11.5 (16.7)
It was my major subject	5 (7)	9.6 (11.7)
It suited my timetable	1 (2)	1.9 (3.3)
It was a soft option (easy to pass)	0 (1)	0.0 (1.7)
It was potentially useful to gain employment	6 (10)	11.5 (10.0)
Other (specify)	0 (1*)	0.0 (1.7)

n=52 (60)
* Combination of 'part of course requirements' and 'a major'

Final-year business students and graduates at VUT were asked to rate educators in regards to their knowledge and competence in guiding students' learning. The results in Table 5.3.15 reveal that educators in Quantitative Methods are perceived by 57.7% (42.4%) of respondents, to have a *fairly good* knowledge of current technology, and 69.2% (54.3%) of respondents gave a rating from *fairly good to very good.* It is note that 23.1% of student respondents gave *an average* rating to educators as compared with 44.1% of graduate respondents' rating. When ratings were coded from *very poor to very good* with

Table 5.3.15 Respondents' Rating of Educators in Quantitative Methods for their Knowledge of Current Technology: Students (Graduates)

Question 13a (14a). How in general would you rate the Educators in Quantitative Methods for their knowledge of current technology?

	Frequency	Percent
Very Poor	3 (0)	5.8 (0.0)
Fairly Poor	1 (1)	1.9 (1.7)
Average	12 (26)	23.1 (44.1)
Fairly Good	30 (25)	57.7 (42.4)
Very Good	6 (7)	11.5 (11.9)
Total	52 (59)	100.0 (100.1*)

* Rounding error

Mean Score = 3.67 (3.64)
Standard Deviation = 0.92 (0.71)

values of 1 to 5 assigned respectively, Table 5.3.15 showed that with respect to their knowledge of current technology, educators in general were rated by student respondents as above average with a mean score of 3.67 as compared with graduate respondents' mean score of 3.64.

It is apparent from the responses of respondents in Table 5.3.16 where they were asked to rate their educators for their competence in guiding students' learning in Quantitative Methods subjects. Overall, student respondents rated *above average* with a mean score of 3.37 as compare with 3.18 by graduate respondents. The frequency distribution table below showed 23.3% of graduate respondents rated their lecturers as *incompetent* (with ratings of *fairly poor* and *very poor*) in guiding their learning.

Table 5.3.16 Rating of Educators in Quantitative Methods for their Competence in Guiding Student Learning: Students (Graduates)

Question 13b (14b). How in general would you rate the Educators in Quantitative Methods for their competence in guiding your learning?

	Frequency	Percent
Very Poor	3 (2)	5.8 (3.3)
Fairly Poor	5 (12)	9.6 (20.0)
Average	20 (23)	38.5 (38.3)
Fairly Good	18 (19)	34.6 (31.7)
Very Good	6 (4)	11.5 (6.7)
Total	52 (60)	100.0 (100.0)

Mean Score = 3.37 (3.18)
Standard Deviation = 1.01 (0.95)

When final-year student respondents were asked to give an overall evaluation of the Quantitative Methods subjects, on a scale of 1 to 5 (1=very dissatisfied, 5=very satisfied), the average ratings of the overall evaluation of Quantitative Methods programs at VUT was 3.37 as compared with graduate respondents' rating of only 3.28. Again, the frequency distribution table below showed that nine respondents were *dissatisfied* and *very dissatisfied* with the program, 17.3% (15.0%) in general.

Table 5.3.17 Overall Evaluation of Quantitative Methods Subjects: Students (Graduates)

Question 14 (15). In general, what is your overall evaluation of your Quantitative Methods subjects?

	Frequency	Percent
Very Dissatisfied	2 (1)	3.8 (1.7)
Dissatisfied	7 (8)	13.5 (13.3)
Neutral	17 (30)	32.7 (50.0)
Satisfied	22 (15)	42.3 (25.0)
Very Satisfied	4 (6)	7.7 (10.0)
Total	52 (60)	100.0 (100.0)

Mean Score = 3.37 (3.28)
Standard deviation = 0.95 (0.88)

The question asked respondents to evaluate their Quantitative Methods subjects in various areas. The mean scores of the results in Table 5.3.18 showed how satisfied they have been with their Quantitative Methods subjects. The results indicated that student respondents are generally satisfied with the organisations of the programs, as all mean scores showed a rating of *above average* (mean score of at least three). The least satisfying areas in students' opinions were 'the text reading material' which was given a mean score of only three, which is just average, and 'computing facilities' with an average of 3.14.

Table 5.3.18 Respondents' Evaluation of Quantitative Methods Subjects: Students (Graduates)

1=Very dissatisfied 2=Dissatisfied 3=Neutral 4=Satisfied 5=Very satisfied

Question 15 (16). Overall in your Quantitative Methods subjects, how satisfied have you been with the following?

	Mean Score	Standard Deviation
Lecture class size	3.81 (3.57)	0.86 (1.01)
Tutorial class size	3.63 (3.70)	0.86 (0.98)
Other (e.g. workshop) class size	3.51 (3.63)	0.98 (0.82)
Number of lecture hours	3.71 (3.55)	1.00 (0.85)
Number of tutorial hours	3.52 (3.40)	1.06 (0.87)
Number of other classes hours	3.37 (3.43)	1.03 (0.77)
Course assessment procedures	3.38 (3.31)	1.03 (0.93)
Exam paper format	3.54 (3.40)	1.13 (0.92)
Computing facilities	3.14 (2.97)	1.25 (0.97)
Text reading material	3.00 (3.32)	1.18 (0.77)
Computer software package	3.21 (3.10)	1.04 (0.90)

Similar views about the course had been found in the graduates' survey. Table 5.3.18 indicated that business graduate respondents were generally satisfied with the organsations of the courses, especially tutorial class size. All scores, rated by graduate respondents, were above average, except computing facilities, which has a mean score of only (2.97).

The next question focused on the six main skills involved in Quantitative Methods subjects and asked respondents to indicate how much emphasis each skill had been given to the particular skill of the subject content. The analysis reported in Table 5.3.19 gave codes of '1' for *little or no emphasis* to '5' for *a great deal of emphasis*. Overall, two areas appeared to student respondents, have not been given much emphasis in Quantitative Methods subjects were the 'Calculator Application Skills' and the 'Knowledge of Interaction between Quantitative Methods and Related Disciplines'. Other areas like application of 'Quantitative Methods Skills', 'Software Application Skills', 'Problem Solving Skills' and 'Reading Statistical Table Skills' were generally given a *moderate* emphasis in the subjects. Similar to the students' survey analysis, the results of graduate respondents in Table 5.3.19 showed that areas that have not been given *much emphasis* (mean score of *below average*) in Quantitative Methods subjects, were 'Software and Calculator Applications Skills' and the 'Knowledge of Interaction Between Quantitative Methods and Related Disciplines'. Other areas rated by graduate respondents as *moderate emphasis* in the subjects.

Table 5.3.19 Emphasis in Quantitative Methods Subjects: Students (Graduates)

1=No emphasis 2=Some emphasis 3=Neutral 4=Good emphasis 5=A great deal of emphasis

Question 16 (17). How much emphasis has been given to it in your Quantitative Methods subjects, relating the content below?

	Mean Score	Standard Deviation
Quantitative Methods skills	3.30 (3.15)	0.71 (0.82)
Software applications skills	3.10 (2.92)	0.97 (0.87)
Calculator application skills	2.92 (2.92)	1.07 (0.96)
Problem solving skills	3.20 (3.32)	0.95 (0.97)
Skills in reading statistical tables	3.32 (3.12)	0.94 (0.88)
Knowledge of interaction between Quantitative Methods and related disciplines	2.84 (2.82)	0.87 (0.93)

n=50 (60)

When asked to indicate the level of difficulty that they found in Quantitative Methods subjects, the results in Table 5.3.20 showed that on average, the level of difficulty in Quantitative Methods subjects in general was perceived by respondents as *moderately difficult* with a mean score of 3.61 (3.55). Only six respondents in each category 11.8% (10.0%), indicated the subject as *very easy or easy*.

Table 5.3.20 Level of Difficulty Perceived in Quantitative Methods Subjects: Students (Graduates)

Question 17 (18). How difficult were the Quantitative Methods subjects in general?

	Frequency	Percent
Very Easy	0 (1)	0.0 (1.7)
Easy	6 (5)	11.8 (8.3)
Average	16 (17)	31.4 (28.3)
Difficult	21 (34)	41.2 (56.7)
Extremely Difficult	8 (3)	15.7 (5.0)
Total	51 (60)	100.1* (100.0)

* Rounding error

Mean Score = 3.61 (3.55) Standard Deviation = 0.90 (0.79)

The next question asked respondents to reveal their preference for the nature of Quantitative Education for business graduate career. Each respondent was asked to rate, in order of importance, their opinion of the best type of Quantitative educational preparation. As reported in Table 5.3.21, both student and graduate respondents expressed strongly that 'education of Quantitative Methods should be more practically oriented', with mean scores of 4.00 and (3.80) respectively. Also, they thought the courses should give 'more emphasis on software applications skills', with mean scores of 3.88 and (3.75) respectively, and 'work experience should be part of the courses', with mean scores of 3.88 and (3.78) respectively. Student respondents also indicated that 'more emphasis on the teaching of a wider range of Quantitative Methods techniques' (mean score=3.12) would be an advantage. However, business graduate respondents were not very keen in placing more emphasis in this area as their mean score is only 2.97. When asked about the importance of more short specialist courses, student respondents did not consider this as *very important* in the Quantitative Methods education (mean score=3.06).

Table 5.3.21 Rating of the Best Quantitative Educational Preparation for a Business Graduate Career: Students (Graduates)

1=Not at all 2=Not too important 3=Neutral 4=Important 5=Very Important

Question 18 (19). Rate in order of importance the best quantitative educational preparation for a business graduate career .

	Mean Score	Standard Deviation
More Emphasis on the Teaching of a wider range of Quantitative Techniques	3.12 (2.97)	0.90 (0.94)
Education should be more Practically Oriented, more Case Study based	4.00 (3.80)	0.94 (0.90)
Practical Experience while going through College, Work Experience oriented	3.88 (3.78)	1.05 (0.99)
More Short Specialist Courses	3.06 (3.23)	1.13 (0.95)
More Emphasis on Software Applications Skills	3.88 (3.75)	0.94 (1.04)
Other (from graduates' survey)		

a) Refresher courses where real life situations can be related and analysed and discussed openly

b) More practical ability in economic forecasting - the subject was all theory and left very little practical ability to perform forecasts

n=52 (60)

Table 5.3.22 shows comments of student respondents regarding the Quantitative Methods education at VUT. Part (a) groups the student respondents' positive comments about the programs and Part (b) provides their negative comments. It is interesting to see that students perceived Quantitative Methods as an important knowledge area, but that these subjects were viewed as 'complicated' and 'too technical'.

One of the most positive things student respondents reported about the programs were the analytical and computer application skills. Some software packages were a bit dated and there was a lack of computer use availability for completing case studies and assignments. The open book exam format and the course assessment were also well appreciated by students, and educators were considered as knowledgeable and helpful. However, some staff were not contactable and there was a lack of assistance in some areas. In general, the courses were well-perceived despite their difficulty. Student respondents also emphasized that tutorial hours should be increased and more workshops were needed as students who had a non-mathematical background tend to struggle.

Table 5.3.22 Comments of Student Respondents on the Quantitative Methods Subjects at VUT

Question 19. Please comment on the Quantitative Methods subjects in general

a) On reflection the best things about the subjects are:

. Quantitative methods knowledge area (c)
. Analytical skills (c)
. Computer applications skills (c)
. Case studies (c)
. Academic Staff knowledgeable and helpful (s)
. Exam format (open book) (e)
. Course Assessment (e)
. Good evening hours (c)

b) The worst things about the subjects are:

. Quantitative Methods subjects are complicated and too technical (c)
. More workshops needed (c)
. Tutorial hours should be increased (c)
. Some lecturers assume students know as much as they do (s)
. Non-mathematics background students tend to struggle (c)
. Some staff members are uncontactable and lack of assistance in some subjects (s)
. Computer soft wares seem a bit dated (r)
. Lack of availability of computers for case studies (r)

Note: c – curriculum, s – staffing, e – examination, r – resources

On the other hand, the responses from business graduates regarding the Quantitative Methods education at VUT are more positive and there seems to be a contrast in some areas. Some reported that the courses enable them having the ability to analyse and forecast with 'greater accuracy', to work as a team and to 'build on individual intellect'.

Table 5.3.23 Comments of Graduate Respondents on the Quantitative Methods Subjects

Question 20. Please comment on the Quantitative Methods subjects in general.

a) **On reflection the best things about the subjects are**

- Ability to improve problem solving and analytical skills and to build on individual intellect (c)
- Tutors and Lecturers are very helpful, approachable, accessible and have good understanding of their fields (c)
- Courses are useful in all business decisions, ability to analyze problems (c)
- Having the ability to analyze and forecast with greater accuracy (c)
- Use of many Statistics programs (c)
- Use in future job prospects (c)
- Practical case studies, assignments, general knowledge of varying types of Statistics (c)
- The linkage between real life and theories (c)
- Ability to work with other students and to complete group-assignment (c)
- Computer programs and facilities are good (r)
- Assignments using a computer software package which relates more to real life use (c and r)
- Practical subjects, good class sizes and course contents (c)
- Useful Quantitative Methods for work related projects, good preparation for workforce and problem-solving (c)
- Understanding of how business can be measured by statistical programs and to evaluate emerging trend (c)
- Courses are excellent, practical and useful (c)
- Courses are interesting. Friendly staff and good lecturers (c and s)
- Good Exam assessment (e)

b) **The worst things about the subjects are**

- Irrelevant to real world; not knowing how to apply practically (c)
- Courses are impractical with no real life usage (c)
- Should be more case-study based, should relate to real world cases (c)
- Computing facilities and accessibility and software programs are not appropriate (r)
- Lecturers inability to get their view across to students (c)
- Lecturers difficult to understand due to their accents (c)
- Some text books and course materials are not relevant to current workforce (c)
- These Quantitative Methods subjects are difficult and the work which are not using software packages is not useful (c)
- A lot of theory (c)
- Not enough time to do assignments because usually have to learn the software package first (c)
- Teaching methods of some lecturers (c)

Note: c – curriculum, s – staffing, e – examination, r – resources

The course organization such as good class size and course content and assessment are well-perceived by graduate respondents. However, there are some mixed feelings regarding lecturers and their teaching methods. Some graduate respondents praised lecturers in Quantitative Methods subjects as friendly, approachable, accessible and have a good knowledge, whist others complained on the ability of some lecturers to 'get their view across to students'. Some graduate respondents also criticized on the lecturers' accents which were difficult to understand. Perhaps these contradictory comments are due to individual lecturers that graduates were referring to. Computing programs and facilities are considered as good to some graduate respondents and inappropriate to others. A few graduate respondents also comment that there was not enough time to complete assignment work due to the amount of time spent early on learning the software package. In general, business graduates were more enthusiastic in giving their feedback about the Quantitative Methods programs at VUT and generally they perceived the programs as useful in job prospects and in business decisions with good understanding of business and its emerging trend.

Section Three – Students and Graduates

In a two-part question, respondents were asked to indicate firstly whether they had done the cooperation education year during their courses. Their responses, shown in Table 5.3.24, indicated that 40.4% of students completed their cooperative education year and 59.6% of the respondents completed their courses without having the co-operative education experience. In contrast, out of 60 business graduate respondents, only eight completed their co-operative education. A high percentage of them completed their courses with no co-operation year in between (86.7 %).

Table 5.3.24 Cooperative Education Participation: Students (Graduates)

Question 20 (21) part one: Did you complete the cooperative education year?

	Frequency	**Percent**
Yes	21 (8)	40.4 (13.3)
No	31 (52)	59.6 (86.7)
Total	52 (60)	100.0 (100.0)

Those respondents who had participated in the co-operative program were then asked to reveal their opinions of the nature of their industrial placement. Table 5.3.25 showed that both student and graduate respondents strongly agreed that industrial work experience was valuable, with mean scores of 4.85 and (5.00) respectively, and the industrial placement

Table 5.3.25 Respondents' Perspectives On Industrial Placement: Students (Graduates)

1=Strongly disagree 2=Disagree 3=Neutral 4=Agree 5=Strongly agree

Question 20 (21) part two: If you completed the cooperative education year, please indicate how much you agree with each of the following statements about your industrial placement.

	Mean Score	**Standard Deviation**
Industrial work experience is generally valuable	4.85 (5.00)	0.37 (0.00)
My industrial placement was well integrated with the academic components of the course	3.55 (3.75)	1.23 (0.89)
During my placement, I learnt to tackle Quantitative Methods problems	2.85 (2.88)	1.14 (1.73)
I understand more of Quantitative Methods concepts than from the course work	2.80 (2.88)	1.20 (1.81)

n=20 (8)

was well integrated with the academic components of the course (mean scores of 3.55 and (3.75) respectively). However, in relation to Quantitative Methods education topics such as Understanding More Quantitative Methods Concepts and Learning to Tackle Real Problems during their Placement, respondents' responses were not so positive, as both groups have mean scores of *below average*.

The next question asked respondents for their opinion on whether prior work experience was an important factor in the performance of graduates when they started work after graduating from university. There appeared to be little equivocation in the responses to this question as the majority of student respondents, 92%, shown in Table 5.3.26, believed that Prior Work Experience played an important role in the performance of graduates when they start work. This opinion is an important one as it supports the view expressed by graduate respondents (91.7%), that is the attainment of this prior work experience is an essential part of Quantitative Methods education.

Table 5.3.26 Attitude Towards Work Experience: Students (Graduates)

Question 21 (22). Do you think that prior work experience plays an important role in the performance of graduates when they start work?

	Frequency	Percent
Yes	46 (55)	92.0 (91.7)
No	4 (5)	8.0 (8.3)
Total	50 (60)	100.0 (100.0)

Respondents were then asked for their opinion on the most acceptable method by which work experience should be obtained. The responses to this question were shown in Table 5.3.27. An analysis of responses showed that both student and graduate respondents believed work experience should be obtained 'as part of undergraduate course', 68.6% and (70.0%) respectively, or during vacation, 17.6% and (20.0%) respectively. Compared with 0% of the graduate respondents, 7.8% of student respondents suggested work experience after the completion of the course but prior to employment, and 5.9% of student respondents and (10.0%) of graduate respondents believed that work experience should be obtained on the job.

Table 5.3.27 Appropriate Time to Do Work Experience: Students (Graduates)

Question 22 (23). When do you think this work experience should be obtained?

	Frequency	Percent
As part of undergraduate course	35 (42)	68.6 (70.0)
Vacation employment as part of undergraduate course	9 (12)	17.6 (20.0)
After graduation as part of the course	4 (0)	7.8 (0.0)
On the job	3 (6)	5.9 (10.0)
Total	51 (60)	99.9* (100.0)

* Rounding error

Respondents were asked for their perceptions of the cooperation between university and industry. The feedback to this question was not encouraging as shown in Table 5.3.28. The responses showed that on the scale of 1 to 5 (1=poorly, 5=excellently), on average the cooperation between business school and industry perceived by business student respondents at VUT was *below average* as reflected in a mean score of only 2.98. Similar responses had also found in the graduates' survey (mean score=2.66).

Table 5.3.28 Cooperation between Business Schools and the Industry: Students (Graduates)

Question 23 (24). How well is the cooperation between business schools and the industry?

	Frequency	Percent
Very Poor	5 (7)	11.1 (11.9)
Poor	8 (17)	17.8 (28.8)
Average	16 (25)	35.6 (42.4)
Well	15 (9)	33.3 (15.3)
Excellently	1 (1)	2.2 (1.7)
Total	45 (59)	100.0 (100.1*)

* Rounding error

Mean Score = 2.98 (2.66)
Standard Deviation = 1.03 (0.94)

The next question asked students respondents to indicate whether they were currently working during the university teaching semester. The results from Table 5.3.29 showed that 68% of student respondents are currently employed while taking study. This question gives important background information for the next one as the work experience of students (only those whose work were directly related to the use of Quantitative Methods) would give their opinion regarding the use of Quantitative Methods and its degree of relevance to their work.

Table 5.3.29 Number of Students Working During Semester: Students

Question 24. Are you currently employed during the university teaching semester?

	Frequency	Percent
Yes	34	68.0
No	16	32.0
Total	50	100.0

Of those who said Yes that they had paid work during the term and their work directly related to the use of Quantitative Methods techniques (17), on average these student respondents felt *adequately prepared* for work with Quantitative Methods skills (Table 5.3.30). Results from the table below also showed that, on a scale of 1 to 5 on average, business graduate respondents rated themselves as *just enough prepared* for Workforce regarding the Quantitative Methods skills (mean score=3.12).

Table 5.3.30 Preparedness of Respondents with Quantitative Methods Skills in their Work: Students (Graduates)

Question 25a (31a). How adequately are you prepared in terms of Quantitative Methods skills?

	Frequency	Percent
Not Prepared	1 (2)	5.9 (3.3)
Not good prepared	2 (11)	11.8 (18.3)
Average	7 (29)	41.2 (48.3)
Good prepared	6 (14)	35.3 (23.3)
Well Prepared	1 (4)	5.9 (6.7)
Total	17 (60)	100.1* (99.9*)

* Rounding error

Mean Score = 3.24 (3.12)
Standard Deviation = 0.97 (0.90)

However, when asked if these Quantitative Methods topics taught at school were relevant to their work, their responses were *below average*, with student respondents' mean score of 2.94 and graduate respondents' mean score of only (2.50) as shown in Table 5.3.30.

Table 5.3.31 Relevance of Quantitative Methods Topics to Respondents' Work: Students (Graduates)

Question 25b (31b). To what degree are the Quantitative Methods topics taught relevant to your work?

	Frequency	Percent
Not Relevant	0 (14)	0.0 (23.3)
Some irrelevant	5 (19)	31.3 (31.7)
Average	7 (14)	43.8 (23.3)
Some relevant	4 (9)	25.0 (15.0)
Extremely Relevant	0 (4)	0.0 (6.7)
Total	16 (60)	100.1* (100.0)

Mean Score = 2.94 (2.50)
Standard Deviation = 0.77 (1.20)

Finally, student respondents were asked about their future study of Quantitative Methods after completing their degree course (Table 5.3.32). More than half of final-year student respondents had no intention in doing further Quantitative Methods studies (52.17%). Nearly a third of them said they would do further studies, 28.26%, and 19.6% of them said 'maybe' in the future. Note that, the 'No' response could imply either the structure were of their course preclude them from further study in Quantitative Methods or they were simply not interested in pursuing this area further.

Table 5.3.32 Students' Intention of Further Study of Quantitative Methods Studies after Graduation: Students

Question 26. Looking forward to five to ten years, are you likely to engage in further study of Quantitative Methods studies after the completion of the degree(s) for which you are now enrolled?

	Frequency	Percentage
Yes	13	28.3
No	24	52.2
Maybe	9	19.6
Total	46	100.1*

* Rounding error

Section Four - Graduates

Table 5.3.33 revealed that the majority of business graduates at Victoria University of Technology ended up working in Private Business and Industry Sector (86.44%). Four of 60 graduates work for Government and four others work elsewhere.

Table 5.3.33 Organisation Sector: Graduates

Question (25). In what sector does your organisation belong?

	Frequency	Per Cent
Private Business & Industry	51	86.4
Commonwealth Government	1	1.7
State Government	2	3.4
Local Government	1	1.7
Other (specify)	4	6.8
Total	60	100.0

The three most popular industry groups that business graduates work for are Wholesale and Retail Trade, Finance, Property and Business Services and Manufacturing (Table 5.3.34).

Table 5.3.34 Industry Group: Graduates

Question (26). To which industry group does your organisation belong?

	Frequency	Per Cent
Agriculture, Forestry & Fishing	1	1.7
Manufacturing	8	13.3
Construction	0	0.0
Transport & Storage	3	5.0
Finance, Property & Business Services	16	26.7
Community Services	0	0.0
Mining	0	0.0
Electricity, Gas & Water	4	6.7
Wholesale & Retail Trade	17	28.3
Communication	6	10.0
Public Admin. & Defense	0	0.0
Ownership of Dwellings	1	1.7
Recreation, Personal & Other Services	4	6.7
Total	60	100.1*

* rounding error

Business graduates were asked about their current position and duties. These can be summarized in Table 5.3.35. It is likely that these graduates work in the Sales and Marketing sector, attaining high positions as Managers and Executives. More than ten percent work as Business and Marketing Analysts in which they are required to analyze market opportunities, provide statistics or involve in risk management and forecasting. Other jobs include admin officer, credit controller, postal service officer, clerk and reporting coordinator.

Table 5.3.35 Job Titles: Graduates

Question (27). What is your job title and in brief what are your duties?

	Frequency	Per Cent
Sales & Marketing Manager	23	38.3
Customer Service Consultant	5	8.3
Business & Marketing Analyst	8	13.3
Project Coordinator	4	6.7
Account Executive	4	6.7
Others	16	26.7
Total	60	100.0

This question asked business graduates to rate in order of importance the areas of knowledge that every graduate should possess. Computer Capability, Human Relations and Basic Skills in Management were ranked highest as the very important areas (Table 5.3.36). Followed by Marketing, Finance and Quantitative Methods which were ranked as important. Economics and Accounting were regarded as the least important areas of knowledge. However, all areas listed above were generally regarded as important since they all had mean scores of three and above.

Table 5.3.36 Areas of Knowledge that every Business Graduate should possess: Graduates (n=60)

Question (28). Rate in order of importance the areas of knowledge that every business graduate should possess. (1=Not At All, 5=Very Important).

Areas of Knowledge	Mean Score	Standard Deviation	Ranking
Basic Skills in Management	4.1667	0.8268	3
Human Relations	4.3833	0.7386	2
Computer Capability	4.4333	0.6979	1
Accounting	3.2500	0.9320	8
Economics	3.5667	0.9454	6
Finance	3.6833	0.7009	5
Marketing	3.7667	0.9273	4
Statistics & Quantitative Methods	3.5167	0.9654	7

Business graduates indicated in Table 5.3.37 that Communication, Computer Utilization and Motivation are the most important skills that every graduate should possess. Problem Solving, Organization & Coordination and Negotiation are also considered as quite important since they all have mean scores of more than 4 (3=important, 5=very important). Data Analysis and Application of Quantitative Techniques are the next important skills in that order. Again, all skills listed above are considered essential according to business graduates.

Table 5.3.37 Skills that every Business Graduate should possess: Graduates

Question (29). Rate in order of importance the skills that every business graduate should possess (1=Not At All, 5=Very Important).

Skills	Mean Score	Standard Deviation	Ranking
Communication Skills	4.6667	0.5420	1
Negotiations Skills	4.2667	0.8995	6
Motivation	4.3500	0.7089	3
Organization & Coordination	4.3167	0.6507	5
Data Analysis	3.8500	0.7324	7
Problem Solving	4.3333	0.6806	4
Computer Utilization	4.3667	0.6881	2
Application of Quantitative Techniques	3.5167	0.7477	8
Other (specify)			
a) flexibility			
b) commonsense			
c) sales			
d) stress / crisis management			

n=60

It is noted that The Commissioned Report No.20 of NBEET (1992) explored skills and personal qualities sought by Australian employers when recruiting graduates. The majority of employers (90%) indicated that academic results was one of the decisive criteria at the initial screening of job selection. However, in the final stage of job selection, academic results were considered to be less important in the screening of candidates, and 48 per cent of employers indicated academic results as being important at this final stage. As employers were more interested in work-related general skills such as social skills (i.e. interpersonal and presentation at interview) and oral communication skills. Subsequent to selection, successful candidates would then be trained in-house during their first year of employment. Hence in the next question, we would explore in what areas graduates were expected to be developed during their first year of employment.

Graduates showed the same pattern of response as business employers in the areas in which business graduates were expected to develop during their first year of employment.

Table 5.3.38 reported that these were Knowledge of Organization and Oral Communication Skills. Next, in order of importance, Self-Management, Interpersonal and Written Communication Skills were regarded as quite important (mean scores of above 4). Presentation Skills, Broad-based Skills and Specific Technical Skills were regarded as important as they all have mean scores of a high 3. A few business graduates also mention Time Management as one of the important areas that should be developed in the first year of employment as well.

Table 5.3.38 Areas Expected of Graduates to Develop During First Year of Employment: Graduates

Question (30). In what areas are you expected to develop during your first year of employment?

Areas of Development	Mean Score	Standard Deviation	Sample Size
Knowledge of Organisation	4.2667	0.7099	60
Business Presentation Skills	3.8833	0.8847	60
Specific Technical Skills	3.6667	0.8766	60
Oral Communication Skills	4.2500	0.8156	60
Written Communication Skills	4.1186	0.8922	59
Self-management Skills	4.1667	0.7628	60
Interpersonal Skills	4.1667	0.9051	60
Broad Based Skills	3.7288	0.8058	59
Other (specify)			
* time management			

Section Five - Graduates

In this question, business graduates are asked to identify the Quantitative Methods and skill levels required in their work. The Quantitative Methods are categorized into Statistical and Mathematical Methods (Table 5.3.39), with the skill levels based on Bloom's Taxonomy of Educational Objectives (1956) ranging from 0 to 4 (0=not required, 1= awareness, 2=understanding, 3=application, 4=synthesis). According to the survey results, Quantitative Methods required most in Statistics consist of: Presentation of Data, Sampling Methods & Estimation and Introduction to Probability. In Mathematics: Functions & Graphs, Mathematics of Finance, Elementary Algebra and Inventory are the most required methods of graduates at work.

Table 5.3.39 Quantitative Topics and Skill Levels required At Work: Graduates

Question (32). Identify Quantitative topics and skill levels required in your work.

	Cited By %	*Skill Level Lo %	Hi %
A. <u>Statistics</u> (n=58)			
. Presentation of Data	89	34	55
. Introduction to Probability	58	48	10
. Random Variables & Probability Distributions	38	31	7
. Sampling & Estimation	57	36	21
. Sampling Methods	60	41	19
. Hypothesis Testing	45	36	9
. Nonparametric Statistics	36	26	10
. Linear Regression & Correlation	48	34	14
. Multiple Regression Methods	29	19	10
. Bayesian Decision Making	20	17	3
. Time Series Analysis & Forecasting	49	21	28
. Analysis of Variance	48	22	26
. Statistical Quality Control	45	26	19
B. <u>Mathematics</u> (n=57)			
. Elementary Algebra	58	28	30
. Functions & Graphs	70	33	37
. Matrix Algebra	33	28	5
. Growth & Decay	36	25	11
. Linear Programming	36	25	11
. Nonlinear Programming	26	19	7
. Game Theory	29	25	4
. Inventory Control: Certainty	54	26	28
. Inventory Models: Risk	51	25	26
. Queuing Theory	32	30	2
. Simulation Models	30	12	18
. Network Analysis	33	21	12
. Markov Models	21	21	0
. Mathematics of Finance	58	11	47
. Differential Calculus	23	21	2
. Multivariate Differential Calculus	16	16	0
. Integral Calculus	14	14	0
. Sets & Probability	38	33	5
. Differential Equations	16	16	0
. Difference Equations	18	18	0

* Skill Level (Bloom 1956):
Lo = Awareness & Understanding   Hi = Application & Synthesis

However, by looking at the column of *Low* skill levels (level 1 and 2), Quantitative Methods required in Statistics include Introduction to Probability, Sampling Methods, Hypothesis Testing, Linear Regression & Correlation. In Mathematics, Matrix Algebra, Queuing Theory, Sets & Probability, Differential and Difference Equations are topics that only required by business employers at *low skill* levels.

In distinguish, two topics required at *High* skill levels are Presentation of Data and Mathematics of Finance. According to Bloom's Taxonomy (1956), this means these methods should be mastered by business graduates at level 3 and 4. That is, graduates should be able to *apply* these methods in particular and concrete situations. Also, they should be able to *synthesize* them, to put parts together into a whole in order to constitute a pattern or structure.

5.3.2 Summary of VUT Final-year Business Students' and Graduates' Responses

In general, similar findings have been reported in both students' and graduates' surveys. Both groups rated their educators highly for their knowledge of current technology and competence in guiding their learning. Respondents from both groups' overall evaluation of these Quantitative Methods subjects was quite satisfactory, from class size, class hours, course assessment, textbooks, computer software package and facilities.

Perceptions of Quantitative Methods subject content from both groups covered various skills and Knowledge of Interaction between Quantitative Methods and Related Disciplines. There was a tendency for graduates to perceive a fair emphasis on Problem Solving skills, Quantitative Methods skills and skills in Reading Statistical Tables. While Calculator and Software Application skills were reportedly less emphasized in the studies. Both groups also felt that insufficient emphasis was given to them the Knowledge of interaction between the Quantitative Methods studies and other Related Disciplines. In general, Quantitative Methods subjects were perceived as *average difficult*.

For the nature of Quantitative Methods education, respondents from both groups regard the best type of educational preparation was More Practically Oriented Education, that is it should be More Case Study Oriented. Practical Experience whilst going through University was also considered important. They also agreed that the emphasis of Software Applications was more important than the emphasis of Teaching a Wider Range of Quantitative Techniques.

In recent years, the co-op education year become 'optional' as the industrial placement is getting more difficult to obtain. Although a small number participated in this program, their responses regarding the work experience were invaluable. They claimed that they had understood more of Quantitative Methods concepts and had learnt to tackle real problems in the work place. Graduates and final-year students with co-operative education also found the placement was well integrated with the academic components of the courses in general.

The majority of respondents believed that prior work experience did play an important role in the performance of graduates when they start work. They also indicated that this work experience should be obtained as part of undergraduate course. However, in their opinions, they had a poor perception about the cooperation between university and industry. Regarding employment and expectations, most graduates in this survey work in Private Business and Industry, in the popular areas of Wholesale & Retail Trade, Finance, Property & Business Services and Manufacturing. About their work position and duties, these graduates are likely to work in the Sales & Marketing sector, attaining high positions as managers and executives.

In the first year of employment, graduates were expected to have knowledge of their organisations, to develop their Oral Communication, Self-Management and Interpersonal skills respectively. Other skills were also important to develop such as Written Communication, Presentation, Broad-based skills and Specific Technical skills. Business graduates considered themselves as *just enough prepared* for the work force regarding the Quantitative Methods skills. However, the degree of relevance of Quantitative Methods topics towards their work was *below average*.

This chapter provides information gathered from various respondents towards Quantitative Methods programs at Victoria University of Technology. These statistical findings are details of questionnaire surveys and are organized in form of descriptive analysis. The next chapter presents inferential analysis of data relating to perceptions between major industrial groups towards Quantitative Methods education. A longitudinal update in business employers surveys was carried out to see if any change occurred between 1995 and 1999, and finally a comparison between the contents of Quantitative Methods at Victoria University of Technology and expectations from industry is made to determine if there is a gap between educators and employers.

CHAPTER SIX

Inferential Analysis of Quantitative Data

6.1 Structure of the Chapter

The findings of the research study from survey questionnaires and its descriptive analysis has been presented in Chapter five. This chapter completes our quantitative survey with inferential analysis of the data. It is divided into three main areas. The flow chart of inferential analysis for this study is shown in Figure 6.1.

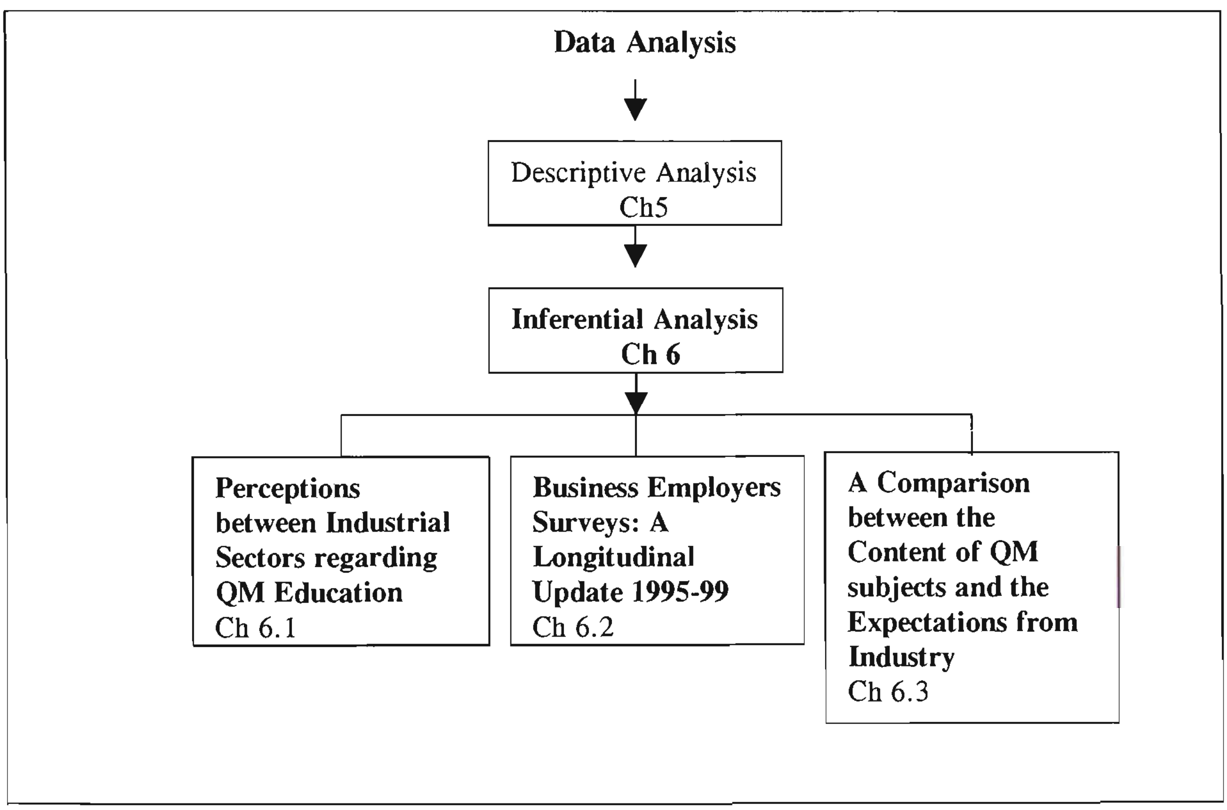


Figure 6.1 Inferential Analysis of Quantitative Survey Data

The hypothesis statements for three main areas are:

Area I - The perceptions of various industry sectors regarding Quantitative Methods education. The null hypothesis states: there is no difference in the responses to the survey questions between industry sectors at a 95% level of confidence.

Area II - Business employers' surveys: a longitudinal update 1995-1999. The null hypothesis states: there is no difference in the employers' responses to the survey questions over the five-year period regarding Quantitative Methods education at a 95% level of confidence.

Area III - A comparison of the current curriculum of Quantitative Methods subjects and the expectations of Quantitative Methods graduates from industry personnel. The null hypothesis states: there is no difference in the responses between business employers and educators regarding Quantitative Methods education at 95% level of confidence.

In the following sections, the specific survey question will be presented first, followed by the summarized analysis results, and finally a brief discussion of the completeness of the analysis.

6.1.1 Differences In Perceptions Between Industrial Sectors Regarding Quantitative Methods Education

The literature review and the survey of business graduates indicate that the majority of business graduates at Victoria University of Technology have entered the workforce in three main industry sectors - Manufacturing, Finance Services and Wholesale & Retail Trade.

This section looks at these three business industry sectors to determine whether their perceptions regarding the appropriateness of current Quantitative Methods education differ significantly from each other. The ANOVA, Mann-Whitney U-Test, Spearman's rho and Two Sample Proportions Hypothesis Tests were used for this difference analysis.

For each of these analyses, we refer to:

Sector one: Manufacturing
Sector two: Finance
Sector three: Wholesale

Each industry group was asked in question three of business employers survey (1995) to rate their perceptions of current business courses on a Likert scale in four key areas, to determine if their perceptions differed with regard to whether business schools were meeting the needs of industry. In all four key nominated areas, the ANOVA based on results in Table 6.1.1 showed there was no significant difference on perceptions between the sectors at a 95% level of confidence.

Table 6.1.1 Business Schools' Response to the Needs of Industry

1=Poorly, 2=Fairly, 3=Adequately, 4=Well, 5=Excellently

Question.3. How well do you consider business education schools are responding to the needs of industry in Australia with respect to:

			size	mean	variance
a.	Liaison with Employers and Professional Bodies	sector one	12	3.00	0.36
		sector two	28	2.89	0.54
		sector three	7	2.29	0.57
b.	The Structure and Content of Undergraduate Courses	sector one	12	3.08	0.63
		sector two	28	3.07	0.66
		sector three	7	3.14	0.48
c.	Provisions for Academic Staff Development and Industrial Experience	sector one	11	2.64	0.65
		sector two	26	2.42	0.57
		Sector three	6	2.67	0.67
d.	Research, Design and Development Activity	sector one	11	2.82	0.16
		sector two	26	2.88	0.83
		sector three	7	3.14	0.48

ANOVA Test

Ho: No difference in response between industry sectors.

a.	F-Ratio = 2.51889,	p(2-tail) = 0.0921,	accept Ho
b.	F-Ratio = 0.02279,	p(2-tail) = 0.9775,	accept Ho
c.	F-Ratio = 0.42869,	p(2-tail) = 0.6543,	accept Ho
d.	F-Ratio = 0.39864,	p(2-tail) = 0.6738,	accept Ho

Conclusion: There is no statistically significant difference in response between the sectors in any of the key areas.

Business employers of three industry sectors were then asked in question four for their perceptions about how well prepared students who had studied Quantitative Methods subjects appear to be. An ANOVA test was carried out to determine if there was significant difference in response between the sectors. Result given in Table 6.1.2 show that null hypothesis was accepted with 95% level of confidence.

Table 6.1.2 Preparedness of Undergraduate Business Students in the Area of Quantitative Methods

1=Not prepared, 2=Fairly, 3=Adequately, 4=Well, 5=Excellently

Question 4. How well prepared are undergraduate business students in the area of Quantitative Methods?

	size	**mean**	**variance**
Sector one	13	3.08	0.24
Sector two	28	3.04	0.55
Sector three	5	2.80	0.20

ANOVA Test
Ho: No difference in response between industry groups.
F-Ration = 0.33468, p (2-tail) = 0.7174, accept Ho
Conclusion: There is no statistically significant difference in response between the sectors.

As shown in Table 6.1.3, each industry sector was asked in question five for their preference for the nature of Quantitative Education for business graduates at Victoria University of Technology. This was done by asking each respondent to rate their opinion of the best type of Quantitative educational preparation for five choices. An ANOVA test was performed to determine if the ratings among the sectors were different. The test results showed no significant difference in response between the sectors at a 95% level of significance.

Table 6.1.3 Best Quantitative Educational Preparation for a Quantitative Graduate Career

1=Not At All, 2=Not Too Important, 3=Important, 4=Fairly Important, 5=Very Important

Question 5. Rate the best quantitative educational preparation for a quantitative graduate career.

			size	mean	variance
a.	More emphasis on the teaching of a wider range of Quantitative Techniques	sector one	10	3.10	0.32
		sector two	28	3.07	0.88
		sector three	7	2.29	0.24
b.	Education should be more practically oriented, more case study based	sector one	10	3.60	0.93
		sector two	28	4.11	0.69
		sector three	7	3.86	0.48
c.	Practical experience while going through college, work experience oriented	sector one	10	3.80	0.62
		sector two	28	4.04	0.85
		sector three	7	4.14	0.81
d.	More short specialist courses	sector one	10	2.60	0.71
		sector two	28	3.21	0.84
		sector three	7	3.43	1.95
e.	More emphasis on software applications skills	sector one	10	2.80	0.84
		sector two	28	3.21	0.62
		sector three	7	3.29	0.90

ANOVA Test

Ho: No difference in response between industry sectors.

a.	F-Ratio = 2.77564,	p (2-tail) = 0.0738,	accept Ho
b.	F-Ratio = 1.38575,	p (2-tail) = 0.2613,	accept Ho
c.	F-Ratio = 0.36354,	p (2-tail) = 0.6974,	accept Ho
d.	F-Ratio = 1.85981,	p (2-tail) = 0.1683,	accept Ho
e.	F-Ratio = 1.02882,	p (2-tail) = 0.3663,	accept Ho

Conclusion: There is no statistically significant difference in response between the sectors on any question.

Business employers from three industry sectors were asked in question ten to rate ways in which a shortage of employees with Quantitative Methods skills could be overcome. Table 6.1.4 showed the preference of total number of respondents in each sector and the results of ANOVA tests, which indicated that there was no significant difference in response between the sectors at a 95% level of confidence.

Table 6.1.4 Best Ways that Shortages of Employees with Quantitative Methods Skills can be Overcome

1=Worst, 2=Bad, 3=Average, 4=Good, 5=Best

Question 10. Rate In order of preference the best ways that shortages can be overcome.

			size	mean	variance
a.	Train More People	sector one	9	3.67	0.25
		sector two	24	4.04	0.65
		sector three	6	4.00	0.40
b.	Employ Overseas Workers	sector one	9	2.00	0.50
		sector two	23	2.09	1.17
		sector three	6	1.50	0.30
c.	Migration Policies to Attract Overseas Skills	sector one	9	2.11	0.36
		sector two	23	2.22	1.09
		Sector three	6	2.00	0.80
d.	Bring in Guest Speakers	sector one	9	2.67	0.75
		sector two	23	2.78	1.18
		sector three	6	3.17	0.57
e.	More Quantitative Workshops	sector one	9	3.44	0.28
		sector two	23	3.39	0.79
		sector three	6	3.50	0.30
f.	Higher Rewards	sector one	9	3.11	1.11
		sector two	24	3.17	0.93
		sector three	6	3.67	0.67
g.	Closer Association between Industry and Institutes	sector one	9	4.33	0.25
		sector two	23	3.96	0.68
		Sector three	7	4.29	0.24
h.	Restructuring Quantitative Development Programs	sector one	9	3.33	1.75
		sector two	24	3.50	0.78
		Sector three	6	3.50	0.30

ANOVA Test

Ho: No difference in response between industry sectors.

a.	F-Ratio = 0.89163,	p (2-tail) = 0.4188,	accept Ho
b.	F-Ratio = 0.92041,	p (2-tail) = 0.4078,	accept Ho
c.	F-Ratio = 0.14243,	p (2-tail) = 0.8677,	accept Ho
d.	F-Ratio = 0.48559,	p (2-tail) = 0.6149,	accept Ho
e.	F-Ratio = 0.05174,	p (2-tail) = 0.9497,	accept Ho
f.	F-Ratio = 0.73357,	p (2-tail) = 0.4872,	accept Ho
g.	F-Ratio = 1.17942,	p (2-tail) = 0.3191,	accept Ho
h.	F-Ratio = 0.10333,	p (2-tail) = 0.9021,	accept Ho

Conclusion: There is no statistically significant difference in response between the sectors.

In question 11, respondents from each industry sector were asked to rate the criteria used in recruiting business students for a position in industry. The responses are presented in Table 6.1.5. In all nine supplied criteria, ANOVA tests provided strong evidence that there was no significant difference in responses between industry sectors at a 95% level of confidence.

Table 6.1.5 Criteria in Recruiting Business Students

1=Not At All, 2=Not Too Important, 3=Important, 4=Fairly Important, 5=Very Important

Question 11. Rate the following criteria you believe are most important in recruiting business students.

	Criteria		size	mean	variance
a.	Academic Results	sector one	11	3.82	0.56
		sector two	32	3.47	1.10
		sector three	7	3.43	0.62
b.	Communication skills	sector one	12	4.50	0.45
		sector two	32	4.78	0.24
		sector three	7	4.71	0.24
c.	Analytical skills	sector one	11	4.64	0.25
		sector two	32	4.19	0.67
		sector three	7	4.57	0.29
d.	Personality	sector one	12	3.67	1.70
		sector two	31	4.26	0.73
		sector three	7	3.86	1.14
e.	Motivation	sector one	12	4.58	0.45
		sector two	32	4.56	0.51
		sector three	7	4.43	0.29
f.	Maturity	sector one	12	3.67	1.52
		sector two	31	3.87	0.72
		sector three	7	4.43	0.62
g.	Flexibility / Adaptability	sector one	12	4.33	0.61
		sector two	32	4.19	0.74
		sector three	7	3.71	0.90
h.	Extracurricular activities	sector one	12	2.92	2.45
		sector two	30	3.03	1.96
		sector three	7	2.71	1.24
i.	Work experience	sector one	12	3.00	1.09
		sector two	31	3.06	1.73
		sector three	7	3.43	0.95

Table 6.1.5 continued

ANOVA Test

Ho: No difference in response between industry sectors.

a.	F-Ratio = 0.59706,	p (2-tail) = 0.5546,	accept Ho
b.	F-Ratio = 1.19317,	p (2-tail) = 0.3121,	accept Ho
c.	F-Ratio = 1.94964,	p (2-tail) = 0.1537,	accept Ho
d.	F-Ratio = 1.66409,	p (2-tail) = 0.2003,	accept Ho
e.	F-Ratio = 0.12956,	p (2-tail) = 0.8788,	accept Ho
f.	F-Ratio = 1.47920,	p (2-tail) = 0.2382,	accept Ho
g.	F-Ratio = 1.21808,	p (2-tail) = 0.3048,	accept Ho
h.	F-Ratio = 0.15276,	p (2-tail) = 0.8588,	accept Ho
i.	F-Ratio = 0.30892,	p (2-tail) = 0.7357,	accept Ho

Conclusion: There is no statistically significant difference in response between the sectors on all outcome.

As skills in applying Quantitative Methods play a important role in recruiting business graduates, question 12 examined the attitudes of three industry sectors towards the relative importance of a broad range of skills. Each group was asked to rate, in order of importance, the skills that every business graduate should possess. Results from Table 6.1.6 suggested that, in all skills except Data Analysis, there was no significant difference in responses between industry sectors at a 95% level of confidence.

Table 6.1.6 Skills that Every Business Graduate Should Possess

1=Not At All, 2=Not Too Important, 3=Important, 4=Fairly Important, 5=Very Important

Question 12. Rate the importance of skills that every business graduate should possess.

Skill		size	mean	variance
a. Communication Skills	sector one	12	4.58	0.27
	sector two	32	4.81	0.16
	sector three	7	4.57	0.62
b. Negotiating Skills	sector one	12	3.50	1.18
	sector two	32	3.59	1.09
	sector three	7	3.29	0.90
c. Motivation	sector one	12	4.67	0.24
	sector two	32	4.41	0.38
	sector three	7	4.00	0.67
d. Organization & Coordination	sector one	12	4.42	0.45
	sector two	32	3.97	0.74
	sector three	7	4.14	0.48

Table 6.1.6 continued

e. Data Analysis	sector one	12	4.25	0.39
	sector two	32	3.50	0.77
	sector three	7	3.57	0.62
f. Problem Solving	sector one	12	4.17	0.52
	sector two	32	4.28	0.53
	sector three	7	4.14	0.48
g. Computer Utilization	sector one	12	3.58	0.45
	sector two	32	3.56	0.83
	sector three	7	3.71	0.57
h. Application of Quantitative Techniques	sector one	12	3.50	0.64
	sector two	32	3.28	1.24
	sector three	7	3.43	0.29

ANOVA Test
Ho: No difference in response between industry sectors

Skill	F-Ratio	p (2-tail)	Decision
a. Communication Skills	1.35772	0.2669	accept Ho
b. Negotiating Skills	0.25707	0.7744	accept Ho
c. Motivation	2.56837	0.0872	accept Ho
d. Organization & Coordination	1.37965	0.2615	accept Ho
e. Data Analysis	3.76628	0.0302	**reject Ho**
f. Problem Solving	0.17661	0.8387	accept Ho
g. Computer Utilization	0.09307	0.9113	accept Ho
h. Application of Quantitative Techniques	0.23603	0.7907	accept Ho

Conclusion: There is no statistically significant difference in response between the sectors in the skills except for data analysis skill.

Each industry sector was asked to rate eight prominent knowledge areas in order of importance. Their responses to question 13 are showed in Table 6.1.7. ANOVA tests were carried out with the conclusion that there was no significant difference in responses between industry sectors in all knowledge areas.

Table 6.1.7 Areas of Knowledge that Every Business Graduate Should Posses

1=Not At All, 2=Not Too Important, 3=Important, 4=Fairly Important, 5=Very Important

Question 13. Rate the importance of areas of knowledge that every business graduate should possess.

	Areas of Knowledge		size	mean	variance
a.	Basic Skills in Management	sector one	11	3.36	0.65
		sector two	32	3.56	0.77
		sector three	7	4.14	0.81

Table 6.1.7 continued

b.	Human Relations	sector one	b11	3.91	0.69
		sector two	32	4.03	0.68
		sector three	7	4.00	1.00
c.	Computer Capability	sector one	11	3.55	0.47
		sector two	32	3.69	0.67
		sector three	7	3.29	0.24
d.	Accounting	sector one	10	3.90	1.21
		sector two	32	3.66	0.88
		sector three	6	2.83	0.57
e.	Economics	sector one	10	3.10	0.99
		sector two	32	3.16	0.65
		sector three	7	2.86	0.48
f.	Finance	sector one	10	3.50	0.50
		sector two	32	3.59	0.70
		sector three	6	2.83	0.57
g.	Marketing	sector one	10	3.40	0.49
		sector two	32	3.19	0.67
		sector three	7	3.43	0.95
h.	Statistics & Quantitative Methods	sector one	10	3.10	0.32
		sector two	32	3.13	0.
		sector three	7	3.00	0.67

ANOVA Test

Ho: No difference in response between industry sectors.

a.	F-Ratio = 1.81352,	p (2-tail) = 0.1743,	accept Ho
b.	F-Ratio = 0.08474,	p (2-tail) = 0.9189,	accept Ho
c.	F-Ratio = 0.84256,	p (2-tail) = 0.4370,	accept Ho
d.	F-Ratio = 2.48728,	p (2-tail) = 0.0945,	accept Ho
e.	F-Ratio = 0.36965,	p (2-tail) = 0.6930,	accept Ho
f.	F-Ratio = 2.26694,	p (2-tail) = 0.1153,	accept Ho
g.	F-Ratio = 0.41691,	p (2-tail) = 0.6615,	accept Ho
h.	F-Ratio = 0.07823,	p (2-tail) = 0.9249,	accept Ho

Conclusion: There is no statistically significant difference in response between the sectors.

Respondents from each industry sector were asked to rate eight areas they aimed to develop new graduates in first year of employment. Responses from question 14 are presented in Table 6.1.8. ANOVA tests were performed to determine if there is any significant difference in responses between the sectors and results showed that the null hypothesis accepted.

Table 6.1.8 Areas Employers Aim to Develop New Graduates during their First Year of Employment

1=Not At All, 2=Not Too Important, 3=Important, 4=Fairly Important, 5=Very Important

Question 14. Rate the importance of areas you aim to develop your new graduates during their first year of employment.

	Areas of Development		size	mean	variance
a.	Knowledge of Organisation	sector one	13	4.92	0.08
		sector two	30	4.40	0.66
		sector three	7	4.71	0.24
b.	Business Presentation Skills	sector one	13	3.77	0.86
		sector two	30	4.03	0.65
		sector three	7	3.71	0.90
c.	Specific Technical Skills	sector one	13	3.77	0.69
		sector two	30	4.33	0.44
		sector three	7	4.29	0.57
d.	Oral Communication Skills	sector one	13	3.92	0.58
		sector two	30	4.10	0.71
		sector three	7	3.86	1.14
e.	Written Communication Skills	sector one	13	3.69	0.40
		sector two	30	4.07	0.69
		sector three	7	3.57	1.29
f.	Self-management Skills	sector one	13	4.23	0.36
		sector two	30	4.00	0.48
		sector three	7	4.14	0.48
g.	Interpersonal Skills	sector one	13	4.31	0.56
		sector two	30	4.17	0.70
		sector three	7	4.14	0.48
h.	Broad Based Skills	sector one	13	3.77	0.36
		sector two	29	3.79	0.74
		sector three	7	3.71	0.57

Table 6.1.8 continued

ANOVA Test
Ho: No difference in response between industry sectors.

a.	F-Ratio = 2.86596,	p (2-tail) = 0.0669,	accept Ho
b.	F-Ratio = 0.66165,	p (2-tail) = 0.5207,	accept Ho
c.	F-Ratio = 2.86692,	p (2-tail) = 0.0669,	accept Ho
d.	F-Ratio = 0.34063,	p (2-tail) = 0.7131,	accept Ho
e.	F-Ratio = 1.56168,	p (2-tail) = 0.2205,	accept Ho
f.	F-Ratio = 0.57200,	p (2-tail) = 0.5683,	accept Ho
g.	F-Ratio = 0.16324,	p (2-tail) = 0.8499,	accept Ho
h.	F-Ratio = 0.02884,	p (2-tail) = 0.9716,	accept Ho

Conclusion: There is no statistically significant difference in response between the sectors.

6.1.2 Summary of Industrial Groups' Response Regarding Quantitative Methods Education

The results of the study showed no difference in response between three main industrial groups, that is Manufacturing, Finance and Wholesale, regarding Quantitative Methods education. Hence, there is no statistical reason not to consider the responses from the industry group as a whole. The next section will test if the perceptions of business employers in relation to Quantitative Methods studies are consistent throughout the period from 1995 to 1999.

6.2.1 Business Employers Surveys: A Longitudinal Update 1995 - 1999

The first set of questionnaires was sent to business employers in 1995. They have been sent again in 1999, to determine if there were any changes in the responses in relation to Quantitative Methods studies over the five-year period.

The results showed almost no change since the first questionnaire in 1995. This again supported the claim from the literature review that Quantitative Methods in undergraduate business courses had not changed their coverage of topics much over the past twenty years, although the trend seemed to be incorporating more applications, case studies, microcomputer usage, report writing and less on tedious computations (Gunawardane 1991).

Also, topics and skill levels required in statistical and mathematical methods that were expected of business graduates remained unchanged. The perceptions of business employers regarding the education of Quantitative Methods were consistent throughout this period. Followings are the responses of industry at a five-year interval.

Tables 6.2.1 and 6.2.2 showed the background information of business employers for 1999. The majority of surveyed companies (88%) belonged to Private Business and Industry, other 5 (12%) companies were Commonwealth Government.

Table 6.2.1 Organisation Sector

Question 1. In what sector does your organisation belong?

	Frequency	Percentage
Private Business & Industry	37	88.1
Commonwealth Government	5	11.9
State Government	0	0.0
Local Government	0	0.0
Total	42	100.0

66.7% of the surveyed companies belonged to the Finance, Property and Business Services. Next group was Manufacturing with nearly twenty percent of total respondents. Other industry groups showed a very small percentage. As mentioned in the survey report of business employers in 1995, the majority of business graduates of Victoria University of Technology worked in the finance sector which is coincide with a large proportion of finance business employers in this survey.

Table 6.2.2 Industry Group

Question 2. To which industry group does ypur organisation belong?

	Frequency	Percentage
Agriculture, Forestry & Fishing	0	0.0
Manufacturing	7	16.7
Construction	0	0.0
Transport & Storage	0	0.0
Finance, Property & Business Services	28	66.7
Community Services	0	0.0
Mining	0	0.0
Electricity, Gas & Water	1	2.4
Wholesale & Retail Trade	1	2.4
Communication	2	4.8
Public Admin. & Defense	2	4.8
Ownership of Dwellings	0	0.0
Recreation, Personal & Other Services	1	2.4
Total	42	100.2*

* rounding error

Question three was not included in the original questionnaire. From Table 6.2.3, it can be seen that the majority of business employers considered the Academic conception of the curriculum as appropriate in today's Quantitative Methods education (83.3%). Less than twenty percent of the respondents thought that the Technology was an appropriate way to conceive in today's curriculum. No respondent had mentioned the Humanistic or Social Reconstructionist views as appropriate conceptions.

Table 6.2.3 Employers' Perception of Today's Quantitative Methods Curriculum

Question 3. Which of the following conception is appropriate in today's Quantitative Methods curriculum?

	Frequency	Percentage
Academic	35	83.3
Technology	7	16.7
Humanistic	0	0.0
Social Reconstructionist	0	0.0
Total	42	100.0

Question four aimed to determine if the perceptions of business employers in 1995 and 1999 differed, with regard to the response that business education in quantitative methods has made to the needs of the industry. Four key areas were presented in Table 6.2.4, and respondents were asked to rate their perceptions of current business courses on a Likert Scale (1=poorly, 3=adequately, 5=excellently). In all cases, the responses provided sufficient evidence to indicate that there was no significant difference in perception made by employers between 1995 and 1999 at a 95 % level of confidence. In this analysis, the Mann-Whitney U-test (Burns 1990) was used since the data were not normally distributed; and the statistical computer software package GBStat was used to analyze data.

Table 6.2.4 Response of Business Employers to the Needs of Industry

1=Poorly, 2=Fairly, 3=Adequately, 4=Well, 5=Excellently

Question 4. How well do you consider business education schools are responding to the needs of industry in Australia with respect to:

		Mean Score		Size	
		1995	1999	1995	1999
a	Liaison with employers & professional bodies	2.75	2.88	59	42
b	The structure & content of undergraduate courses	2.98	3.02	59	42
c	Provisions for academic staff development & industrial experience	2.61	2.86	54	42
d	Research, design & development activity	2.78	2.88	55	42

Table 6.2.4 continued

Hypothesis Test: Mann-Whitney U-Test
Ho: There is no significant difference in response between 1995 and 1999 in each key area.

a	U = 1106,	p(2-tail) = 0.3558,	accept Ho $p<0.05$.
b	U = 1184.5,	p(2-tail) = 0.7022,	accept Ho $p<0.05$.
c	U = 926.5,	p(2-tail) = 0.1236,	accept Ho $p<0.05$.
d	U = 1100,	p(2-tail) = 0.6835,	accept Ho $p<0.05$.

Conclusion: No significant difference between 1995 and 1999 in these four key areas.

As an adjunct to previous question which focussed upon the appropriateness of the current curricula in this area, the survey also sought employers' perceptions in question five about how well prepared students who had studied the quantitative methods area. On a scale of 1 to 5 (1=not prepared through to 5=excellently), business employers suggested in Table 6.2.5 that, on average, the rating of preparation of business students in both years (1995 and 1999) is around 3. A Mann-Whitney U-test was carried out to determine if there is significant difference in response between then and now, with the result that Ho was accepted ($p=0.8535$).

Table 6.2.5 Preparation of Undergraduate Business Students in the Quantitative Methods Area

1=Not Prepared 2=Fairly Prepared 3=Adequately 4=Well Prepared 5=Excellently

Question 5. How well prepared are undergraduate business students in the Quantitative Methods area?

	Mean	**Standard Deviation**	**Total Number**
1995	3.05	0.73	55
1999	3.08	0.76	40

Hypothesis Test - Mann-Whitney U-Test
Ho: There is no significant difference in response between 1995 an d1999.
U = 1076.5, p(2-tail)= 0.8535, accept Ho $p>0.05$.
Conclusion: No significant difference between 1995 and 1999 in the employers' responses.

Question six asked respondents to reveal their preference for the nature of Quantitative Education for business graduate career. Each respondent was asked to rate their opinion of the best type of Quantitative Educational Preparation. The results showed in Table 6.2.6. Note that no statistical test required here, as the results show that the employers rankings in 1995 and 1999 are exactly the same. This tells that these results are consistent through out the years.

Table 6.2.6 Best Quantitative Educational Preparation for a Quantitative Graduate Career

1=Not At All 2=Some 3=Average 4=Important 5=Very Important

Question 6. Rate the best quantitative educational preparation for a quantitative graduate career.

		size 1995	size 1999	mean rating 1995	mean rating 1999
a)	More Emphasis on the Teaching of a Wider Range of Quantitative Techniques.	56	40	3.02	3.23
b)	Education should be More Practically Oriented, More Case Study Based.	57	40	4.00	3.90
c)	Practical Experience while going through College, Work Experience Oriented.	57	40	4.05	3.93
d)	More Short Specialist Courses.	45	40	2.87	2.98
e)	More Emphasis on Software Applications Skills.	57	40	3.16	3.25

		Ranking 1995	Ranking 1999	$\lvert\delta\rvert$
a)	More Emphasis on the Teaching of a Wider Range of Quantitative Techniques.	4	4	0
b)	Education should be More Practically Oriented, More Case Study Based.	2	2	0
c)	Practical Experience while going through College, Work Experience Oriented.	1	1	0
d)	More Short Specialist Courses.	5	5	0
e)	More Emphasis on Software Applications Skills.	3	3	0

Note that the order of importance was determined by averaging the numerical responses given for each.

Question seven asked in what ways their organisations would be prepared to support business schools in Australia. The results from Table 6.2.7 showed that in 1995 and again 1999, business employers would encourage their own employees to attend post-graduate courses (88.3% and 71.4% respectively). Also, more than fifty percent of employers would provide financial support to employees who attend the course. Other major support was providing vacation work experience for students (50% and 54.8% respectively). The remaining support areas showed similar proportions in both 1995 and 1999 by business employers.

Table 6.2.7 Organisation's Support of Business Schools

Question 7. Would your organisation be prepared to support post graduate business schools in Australia in any of the following way?

	Percentage 1995	1999
Encourage own employees to attend	88.3	71.4
Provide financial support to employees who attend	66.1	54.8
Sponsor students, giving scholarships	13.1	19.1
Make financial donations for equipment/facilities	3.3	4.8
Give financial support for research projects	8.3	11.9
Participate in staff exchanges between industry and the business school	18.0	16.7
Provide vacation work experience for students	50.0	54.8

In question eight, business employers were asked whether they had any difficulty in recruiting suitable graduates. The responses from Table 6.2.8 showed that business employers had no difficulty to recruit suitable employees. As in 1999 survey, the proportion of 'No Difficulty' was even greater compared to 1995 survey.

Table 6.2.8 Difficulty Faced by Employers in Recruiting Suitable Graduates

Question 8. In the past five years, have you had difficulty in recruiting graduates in Quantitative area?

	Percent 1995	1999	
No difficult	72.3	95.0	n (1995) = 65
Difficult	27.7	5.0	n (1999) = 40
Total	100.0	100.0	

Results in Table 6.2.9 showed that business employers surveyed in 1999 indicated with a greater proportion than in 1995, that their expectation of the number of graduates employed with Quantitative Techniques in five years time would stay the same. Note that the percentage of respondents who would less number of Quantitative skilled graduates was very small, down from 15.4% in 1995 to only 2.5% in 1999.

Table 6.2.9 Number of Graduates Employed with Quantitative Techniques in Five Years Time

Question 9. Please indicate whether you expect the number of graduates employed with Quantitative Techniques in five years time, to be more, less or stay the same?

	Percentage 1995	Percentage 1999	
More	15.4	17.5	n (1995) = 13
Less	15.4	2.5	n (1999) = 40
Same	69.2	80.0	
Total	100.0	100.0	

When asked about whether there is a shortage in industry of employees with Quantitative Techniques abilities, the result of 1999 shown in Table 6.2.10 indicated that two-thirds of companies would foresee a shortage in the future, compared to 76.9% indicated in 1995.

Table 6.2.10 Shortage in Industry of Employees with Quantitative Techniques Abilities in the Future

Question 10. Do you foresee a shortage in industry of employees with quantitative techniques abilities in the future?

	Percent 1995	Percent 1999	
No	23.1	32.5	n (1995) = 52
Yes	76.9	67.5	n (1999) = 40
Total	100.0	100.0	

Business employers in both years were asked in question 11, to rate ways in which a shortage of employees with Quantitative Methods abilities could best be overcome. As seen from Table 6.2.11, the rankings of the suggested strategies similar. The Spearman's rho hypothesis test statistics also provided strong evidence to conclude that the rankings of employers between 1995 and 1999 were congruent.

Table 6.2.11 Best Ways that Shortages can be Overcome

1=Worst, 2=Bad, 3=Average, 4=Good, 5=Best

Question 11. Rate in order of preference the best ways that shortages of employees with quantitative skills can be overcome.

Ways	size 1995	size 1999	mean rating 1995	mean rating 1999
Train more people	48	27	3.92	3.85
Employ overseas workers	44	27	2.05	2.37
Migration policies to attract overseas skills	45	27	2.24	2.41
Bring in guest speakers.	45	27	2.82	2.70
More quantitative workshops.	46	27	3.48	3.30
Higher rewards.	46	27	3.26	3.07
Closer association between industry and institutes	47	27	4.15	3.74
Restructuring quantitative development programs	44	27	3.32	3.63

	Ranking 1995	Ranking 1999	$\lvert\delta\rvert$
Train more people	2	1	1
Employ overseas workers	8	8	0
Migration policies to attract overseas skills	7	7	0
Bring in guest speakers.	6	6	0
More quantitative workshops.	3	4	1
Higher rewards.	5	5	0
Closer association between industry and institutes	1	2	1
Restructuring quantitative development programs	4	3	1

Hypothesis Test – Spearman's rho
Ho: There is no significant relationship between 1995' and 1999's rankings.
Computed rho = 0.9524, Critical rho at 0.05 = 0.7380, Reject Ho.
Conclusion: The Rankings between 1995 and 1999 are in agreement.

Again business employers in both years were asked to rate in question 12, nine supplied criteria in order of descending importance in recruiting business students for a position in industry. The results from Table 6.2.12 did not show much diversity between 1995 and 1999. The difference in ranking was then tested using Spearman's rho, and this test indicated that the two groups rankings in agreement.

Table 6.2.12 Criteria in Recruiting Business Students

1=Not At All, 2=Not Too Important, 3=Important, 4=Fairly Important, 5=Very Importan

Question 12. Rate the following criteria you believe are most important in recruiting business students.

Criteria	size 1995	size 1999	mean rating 1995	mean rating 1999
Academic Results	63	42	3.65	3.76
Communication skills	63	42	4.63	4.50
Analytical skills	62	42	4.34	4.43
Personality	62	42	4.02	4.00
Motivation	63	42	4.56	4.43
Maturity	62	42	3.82	4.10
Flexibility / Adaptability	63	42	4.14	4.07
Extracurricular activities	62	42	2.84	2.88
Work experience	62	42	3.02	3.10

Criteria	Ranking 1995	Ranking 1999	$\lvert\delta\rvert$
Academic Results	7	7	0
Communication skills	1	1	0
Analytical skills	3	2.5	1.5
Personality	5	6	1
Motivation	2	2.5	0.5
Maturity	6	4	2
Flexibility / Adaptability	4	5	1
Extracurricular activities	9	9	0
Work experience	8	8	0

Hypothesis Test - Spearman's rho
Ho: There is no significant relationship between 1995' and 1999's rankings.
Computed rho = 0.9458, Critical rho at 0.05 = 0.6830, Reject Ho.
Conclusion: The rankings between 1995 and 1999 are in agreement.

As demonstrated skills in applying Quantitative Methods plays an important role in recruiting graduates, this question examined the attitudes of business employers toward the relative importance of a broad range of skills. They were asked to rate in question 13, eight skills which we suggested that every business student should possess. The results from Table 6.2.13 showed that these data presented sufficient evidence to suggest that a positive association existed between the rankings of importance of skills by business employers in both periods as provided by the Spearman's rho hypothesis test.

Table 6.2.13 Skills that Every Business Graduate Should Possess

1=Not At All, 2=Not Too Important, 3=Important, 4=Fairly Important, 5=Very Important

Question 13. Rate the skills that every business graduate should possess.

Skill	size 1995	size 1999	mean rating 1995	mean rating 1999
Communication Skills	63	42	4.71	4.52
Negotiating Skills	63	42	3.48	3.69
Motivation	63	42	4.44	4.29
Organization & Coordination	63	42	4.02	3.93
Data Analysis	63	42	3.68	3.83
Problem Solving	63	42	4.24	4.33
Computer Utilization	63	42	3.57	3.71
Application of Quantitative Techniques	63	42	3.35	3.52

Skill	Ranking 1995	Ranking 1999	$\|\delta\|$
Communication Skills	1	1	0
Negotiating Skills	7	7	0
Motivation	2	3	1
Organization & Coordination	4	4	0
Data Analysis	5	5	0
Problem Solving	3	2	1
Computer Utilization	6	6	0
Application of Quantitative Techniques	8	8	0

Hypothesis Test - Spearman's rho
Ho: There is no significant relationship between 1995' and 1999's rankings.
Computed rho = 0.9762, Critical rho at 0.05 = 0.7380, Reject Ho.
Conclusion: The rankings based upon rating of skills, between 1995 and 1999 are in agreement.

Question 14 asked business employers to rate eight prominent knowledge areas in order of importance. The responses (Table 6.2.14) in both years showed much greater diversity than with the rankings of skills, especially in the Statistics and Quantitative Methods area. However, other areas showed similar rankings and the Spearman's rho hypothesis test supported the evidence that the rankings of business employers in 1995 and 1999 were in agreement.

Table 6.2.14 Areas of Knowledge that Every Business Graduate Should Possess

Question 14. Rate the areas of knowledge that every business graduate should possess.

Areas of knowledge	size 1995	size 1999	mean rating 1995	mean rating 1999
Basic Skills in Management	62	42	3.55	3.29
Human Relations	62	42	3.92	3.74
Computer Capability	62	42	3.65	3.76
Accounting	59	42	3.64	3.48
Economics	61	42	3.23	3.26
Finance	59	42	3.56	3.50
Marketing	60	42	3.27	3.02
Statistics & Quantitative Methods	60	42	3.22	3.40

Areas of knowledge	Ranking 1995	Ranking 1999	$\lvert\delta\rvert$
Basic Skills in Management	5	6	1
Human Relations	1	2	1
Computer Capability	2	1	1
Accounting	3	4	1
Economics	7	7	0
Finance	4	3	1
Marketing	6	8	2
Statistics & Quantitative Methods	8	5	3

Hypothesis Test - Spearman's rho
Ho: There is no significant relationship between 1995' and 1999's rankings.
Computed rho = 0.7857, Critical rho at 0.05 = 0.7380, Reject Ho.
Conclusion: The rankings based upon rating of knowledge areas, between 1995 and 1999 are in agreement.

Business employers in 1995 and 1999 were asked to rate in question 15, areas they aimed to develop new graduates in first year of employment. Again the rankings from Table 6.2.15 did not show much diversity, and the Spearman's rho hypothesis test was carried out to determine if there is any significant difference between the periods. The result showed that the rankings of business employers in 1995 and 1999 were congruent.

Table 6.2.15 Areas Employers Aim to Develop New Graduates During First Year of Employment

1=Not At All, 2=Not Too Important, 3=Important, 4=Fairly Important, 5=Very Important

Question 15. Rate the areas you aim to develop your new graduates during their first year of employment.

Areas of Development	size 1995	size 1999	mean rating 1995	mean rating 1999
Knowledge of organization	64	42	4.53	4.43
Business presentation skills	64	42	3.94	3.98
Specific technical skills	64	42	4.13	0.75
Oral communication skills	64	42	4.02	0.83
Written communication skills	64	42	4.10	0.82
Self-management skills	64	42	4.10	0.65
Interpersonal skills	64	42	4.14	0.74
Broad based skills	64	42	3.93	0.79

Areas of Development	Ranking 1995	Ranking 1999	$\lvert\delta\rvert$
Knowledge of organisation	1	1	0
Business presentation skills	7	7	0
Specific technical skills	3	2	1
Oral communication skills	5	6	1
Written communication skills	6	4.5	1.5
Self-management skills	4	4.5	0.5
Interpersonal skills	2	3	1
Broad based skills	8	8	0

Hypothesis Test – Spearman's rho
Ho: There is no significant relationship between 1995' and 1999's rankings.
Computed rho = 0.9345, Critical rho = 0.7380, Reject Ho.
Conclusion: The rankings based upon rating of areas of development between 1995 and 1999 are in agreement.

Question 16 aimed to determine business employers' opinions in both periods of the contents of existing Quantitative Methods subjects include essential topics (Statistical and Mathematical Methods) and skill levels required in industry. Skill levels based on Bloom's Taxonomy of Educational Objective (1956). In Table 6.2.16, the skill levels were divided into *Low* and *High* Levels. A Two Sample Proportions test (Burns 1990) was carried out to determine if the proportion of *low* or *high* skill levels nominated by business employers in 1995 is different from that of 1999. The result from Table 6.2.16 showed no significant difference in all Statistical Methods topics.

Table 6.2.16 Statistical Methods and Skill Levels Required by Australian Business Employers

Question 16. Identify which Quantitative topics and skill levels, you as a business employer, desire your employees to have studied.

	Frequency					
	1995 * Skill Level			1999 Skill Level		
Topics	**Lo**	**Hi**	**N1**	**Lo**	**Hi**	**N2**
Presentation of Data	15	27	42	11	28	39
Introduction to Probability	23	13	36	26	11	37
Random Variables & Probability Distributions	23	12	35	28	9	37
Sampling & Estimation	20	19	39	21	16	37
Sampling Methods	20	19	39	23	15	38
Hypothesis Testing	21	11	32	24	11	35
Nonparametric Statistics	24	4	28	25	4	29
Linear Regression & Correlation	21	9	30	20	14	34
Multiple Regression Methods	23	6	29	25	8	33
Bayesian Decision Making	20	6	26	24	8	32
Time Series Analysis & Forecasting	15	17	32	21	16	37
Analysis of Variance	18	15	33	17	19	36
Statistical Quality Control	14	18	32	19	17	36

* **Skill Level** (Bloom 1956)

Lo = Awareness & Understanding
Hi = Application & Synthesis
N = Sample size

Hypothesis Test - Two Sample Proportions
Conclusion: No significant difference between 1995 and 1999.

Similarly, a Two Sample Proportion test was carried out to determine if the proportion of *low* or *high* skill levels nominated by business employers in Mathematical Methods is different in 1995 and 1999. The result, shown in Table 6.2.17, no significant difference in the topics indicated by Employers in both periods, except Elementary Algebra. And this was the only topic showed the significant difference in proportions in both *low* and *high* skill levels at the 95% level of confidence. It is noted that business employers in 1999 expected graduates to have a *higher* skill level in Elementary Algebra compared to four years ago.

Table 6.2.17 Mathematical Methods and Skill Levels Required by Australian Business Employers

Question 16. Identify which Quantitative topics and skill levels, you as a business employer, desire your employees to have studied.

	Frequency					
	1995			1999		
	*Skill Level			Skill Level		
Topics	**Lo**	**Hi**	**N1**	**Lo**	**Hi**	**N2**
# Elementary Algebra	24	11	35	13	24	37
Functions & Graphs	17	20	37	10	28	38
Matrix Algebra	22	8	30	24	11	35
Growth & Decay	21	6	27	24	10	34
Linear Programming	23	6	29	27	8	35
Nonlinear Programming	22	6	28	26	7	33
Game Theory	22	6	28	18	4	22
Inventory Control: Certainty	24	10	34	25	12	37
Inventory Models: Risk	24	9	33	24	13	37
Queuing Theory	20	6	26	25	7	32
Simulation Models	24	7	31	26	9	35
Network Analysis	23	7	30	29	8	37
Markov Models	23	5	28	29	6	35
Mathematics of Finance	18	19	37	14	24	38
Differential Calculus	26	5	31	26	7	33
Multivariate Differential Calculus	4	4	28	23	7	30
Integral Calculus	24	6	30	23	8	31
Sets & Probability	24	8	32	26	10	36
Differential Equations	21	8	29	20	11	31
Difference Equations	23	6	29	23	8	31

*** Skill Level (see Table 16)**

Hypothesis Test - Two Sample Proportions: # 0.05 level of significance.
Conclusion: No significant difference between 1995 and 1999.

6.2.2 Summary of Business Employers' Longitudinal Update

The results of the study showed no change the responses since the first questionnaire in 1995. This indicates that the perceptions of business employers in Australia regarding the Quantitative Methods studies are consistent through out this period. This also implies that a gap between the perceptions of business educators and employers with respect to Quantitative Methods education still exists after these years. The next section tests the alternative hypothesis that there is a difference in response between business employers and educators regarding Quantitative Methods education at VUT.

6.3.1 A Comparison between the Contents of Quantitative Methods Programs and the Expectations from Industry.

The first question aimed to determine if the perceptions of Employers and Educators differed with regard to the response that business education in quantitative methods has made to the needs of the business sector. Four key areas were presented, and respondents were asked to rate their perceptions of current business courses on a Likert scale (1= poorly, 2=just fairly, 3=adequately, 4=well, 5=excellently). In all cases the responses provided sufficient evidence to indicate that there was no significant difference in perception between the two groups at a 95% level of confidence. In this analysis, the Mann-Whitney U-test (Burns 1990) was used since the data were not normally distributed.

Table 6.3.1 Response of Business Education Schools to the Needs of Industry

1=Poorly, 2=Fairly, 3=Adequately, 4=Well, 5=Excellently

Question 1 (3). How well do you consider business education schools are responding to the needs of industry in Australia with respect to:

Ed - Educators
Emp- Employers

		Size Ed	Size Emp	Mean Score Ed	Mean Score Emp
a	Liaison with employers & professional bodies	13	59	2.73	2.75
b	The structure & content of undergraduate courses	13	59	3.27	2.98
c	Provisions for academic staff development & industrial experience	13	54	2.36	2.61
d	Research, design & development activity	13	55	2.55	2.78

Hypothesis Test: Mann-Whitney U-Test
Ho: There is no significant difference in response between Educators and Employers.

a U = 324, p (2-tail) = 0.9807, accept Ho
b U = 259, p (2-tail) = 0.2832, accept Ho
c U = 264.5, p (2-tail) = 0.5578, accept Ho
d U = 267, p (2-tail) = 0.53 , accept Ho

Conclusion: No significant difference between Educators' and Employers' perceptions of the performance of business education in these four key areas.

As an adjunct to question one which focused upon the appropriateness of the current curricula in this area, the survey also sought respondents' perceptions about how well prepared students who had studied these curricula appear to be. On a scale of 1 to 5 (1=not prepared, 5=excellently), educators suggested in Table 6.3.2 that, on average, the rating of preparation of business students is 2.46. By contrast, employers gave an average rating of 3.05. Consequently, a Mann-Whitney U-Test was carried out to determine if there is significant difference in response between the two groups, with the result that Ho was rejected (p, 2-tail = 0.0268).

Table 6.3.2 Preparation of Undergraduate Business Students in the Quantitative Methods Area

1=Not Prepared, 2=Fairly, 3=Adequately, 4=Well Prepared 5=Excellently

Question 2 (4). How well prepared are our undergraduate business students in the Quantitative Methods area?

	Size	Mean Score
Educators	13	2.46
Employers	55	3.05

Hypothesis Test - Mann-Whitney U-Test
Ho: There is no significant difference in response between Educators and Employers.
U = 216.5, p (2-tail) = 0.0268, Reject Ho.
Conclusion: There is a statistically significant difference in response between Educators and Employers.

The study also asked educators and employers to reveal their preference for the nature of quantitative education for business graduates. Each respondent was asked to rate their opinion of the best type of quantitative educational preparation. Their responses were indicated in Table 6.3.3. The results showed a substantial difference between educators' and employers' choices, although both groups indicated the option of 'More Short Specialist Courses' as being of the least importance. According to educators, the most important choice was 'More Practically Oriented Education', that is it should be more case study oriented, whereas employers considered 'Work Experience Whilst Going Through College' as most important. However, both groups agreed that the 'Emphasis of

Software Applications Skills' was more important than the 'Emphasis of Teaching a Wider Range of Quantitative Techniques'. The difference in rankings was tested using Spearman's rho (Burns 1990), and the results indicated that the educators' and employers' rankings were not in agreement.

Table 6.3.3 Best Quantitative Educational Preparation for Business Graduate Career

1=Not At All, 2=Not Too Important, 3=Important, 4=Fairly Important, 5=Very Important

Question 3 (5). Rate the best quantitative educational preparation for business graduate career.

Ed - Educators
Emp - Employers

		Size		Mean Score		Ranking		|δ|
		Ed	**Emp**	**Ed**	**Emp**	**Ed**	**Emp**	
a)	Education should be more practically oriented	13	57	4.15	4.01	1	2	1
b)	More emphasis on software applications skills	13	57	3.92	3.16	2	3	1
c)	More emphasis on the teaching of a wider range of QM	13	56	3.77	3.02	3	4	1
d)	Practical experience while going through college	13	57	3.62	4.05	4	1	3
e)	More short specialist courses	13	45	3.00	2.86	5	5	0

Hypothesis Test - Spearman's rho
Ho: There is no significant relationship between Educators' and Employers' rankings.
Computed rho = 0.4, Critical value of rho at 0.05 = 1, Accept Ho.
Conclusion: Educators' and Employers' rankings are not in agreement.

Each group was asked to rate nine supplied criteria in order of descending importance in recruiting business students for a position in industry. The difference in ranking was tested using Spearman's rho, and this test indicated that the two groups' rankings were related. Whilst Table 6.3.4 shows a diversity of opinion, this difference is not enough to indicate that the groups were not in agreement. Much of the apparent difference is in the order of the top five criteria, (Motivation, Maturity, Flexibility/Adaptability, Communication Skills and Analytical Skills) with the remaining criteria (Academic Results, Personality, Work Experience and Extracurricular Activities) being at the bottom of both lists.

Table 6.3.4 Criteria in Recruiting Business Graduates

1=Not At All 2=Not Too Important 3=Important 4=Fairly Important 5=Very Important

Question 4 (11). Rate the criteria you believe are most important in recruiting business graduates.

Ed-Educators
Emp - Employers

Criteria	Size Ed	Size Emp	Mean Rating Ed	Mean Rating Emp	Ranking Ed	Ranking Emp	$\lvert\delta\rvert$
Motivation	13	63	4.77	4.56	1	2	1
Maturity	13	62	4.54	3.82	2	6	4
Flexibility / Adaptability	13	63	4.38	4.14	3	4	1
Communication Skills	13	63	4.31	4.63	4.5	1	3.5
Analytical Skills	13	62	4.31	4.34	4.5	3	1.5
Academic Results	13	63	4.15	3.65	6	7	1
Personality	13	62	3.69	4.02	7	5	2
Work Experience	13	62	3.15	3.02	8	8	0
Extracurricular Activities	13	62	2.83	2.84	9	9	0

Hypothesis Testing - Spearman's rho
Ho: There is no significant relationship between Educators' and Employers' rankings.
Computed rho = 0.6875, Critical rho at 0.05 = 0.683, Reject Ho.
Conclusion: Educators' and Employers' rankings are not significantly different.

As demonstrated skills in applying Quantitative Methods plays an important role in recruiting graduates, this question examined the attitudes of educators and employers toward the relative importance of a broad range of skills. Both groups were asked to separately rate eight skills which we suggested that every business student should possess. Their responses are presented in Table 6.3.5. The results showed that these data presented sufficient evidence to suggest that a positive association existed between the rankings of importance of skills by educators and employers. It is interesting to note that Motivation and Communication skills were both in the top rankings (first and second), whilst Negotiating skills and Application of Quantitative Techniques were at the bottom of the scale. Hence, in terms of skills, the Spearman's rho hypothesis test showed that both educators' and employers' rankings were in agreement.

Table 6.3.5 Skills that Every Business Graduate Should Possess

1=Not At All 2=Not Too Important 3=Important 4=Fairly Important 5=Very Important

Question 5 (12). Rate the importance of skills that every business graduate should possess.

Ed - Educators
Emp - Employers

	Size		Mean Rating		Ranking		|δ|
Skills	**Ed**	**Emp**	**Ed**	**Emp**	**Ed**	**Emp**	
Motivation	13	63	4.69	4.44	1	2	1
Communication Skills	13	63	4.62	4.71	2	1	1
Organization & Coordination	13	63	4.54	4.02	3	4	1
Data Analysis	13	63	4.46	3.68	4.5	5	0.5
Computer Utilization	13	63	4.46	3.57	4.5	6	1.5
Problem Solving	13	63	4.38	4.24	6	3	3
Negotiating Skills	13	63	4.17	3.48	7	7	0
Application of Quantitative Techniques	13	63	4.08	3.35	8	8	0

Hypothesis Testing - Spearman's rho
Computed rho = 0.8274, Critical rho at 0.05 = 0.738, Reject Ho.

Ho: There is no significant relationship between Educators' and Employers' rankings.

Conclusion: Educators' and Practitioner's rankings are in agreement.

Both educators and employers were asked to rate eight prominent knowledge areas in order of importance. Their responses showed much greater diversity (Table 6.3.6) than with the ranking of skills. It can be seen that educators considered the Computer Capability area as the most important, whereas employers believed that Human Relations are more important than Computer Capability. Educators placed Statistics and Quantitative Methods as the second most important area of knowledge and Accounting as the least important, whereas employers put Accounting as the third most important area and Statistics and Quantitative Methods as the least important area. Similarly, Economics was ranked third by educators whereas employers ranked it at seventh. In conclusion, obviously the two groups showed a substantial difference in their perceptions of the importance of areas of knowledge. The Spearman's rho hypothesis test also supported the observation that the educators' and employers' rankings were not in agreement.

Table 6.3.6 Areas of Knowledge that Every Business Graduate Should Possess

1=Not At All 2=Not Too Important 3=Important 4=Fairly Important 5=Very Important

Question 6 (13). Rate the importance of areas of knowledge that every business graduate should possess.

Ed - Educators
Emp - Employers

Areas of Knowledge	Size Ed	Size Emp	Mean Rating Ed	Mean Rating Emp	Ranking Ed	Ranking Emp	$\lvert\delta\rvert$
Computer Capability	13	62	4.33	3.65	1	2	1
Statistics & Quantitative Methods	13	60	4.23	3.22	2	8	6
Economics	13	61	3.92	3.27	3	7	4
Finance	13	59	3.85	3.56	4.5	4	0.5
Human Relations	13	62	3.85	3.92	4.5	1	3.5
Basic Skills in Management	13	62	3.77	3.55	6.5	5	1.5
Marketing	13	60	3.77	3.23	6.5	6	0.5
Accounting	13	59	3.15	3.64	8	3	5

Hypothesis Testing - Spearman's rho
Ho: There is no significant relationship between Educators' and Employers' rankings.
Computed rho = -0.1071, Critical value at 0.05 = 0.7380, Accept Ho.
Conclusion: Educators' and Employers' rankings are not in agreement.

Respondents were asked to rate ways in which a shortage of employees with Quantitative Methods abilities could be best overcome. As seen from Table 6.3.7, both educators' and employers' rankings of the suggested strategies were in agreement. Both groups indicated the options of Train More People and Closer Association between Industry and Institutes as the most important factors in overcoming shortages in Quantitative Skilled Employees. The least Important options were Bring in Guest Speakers, Migration Policies to Attract Overseas skills and Bring in Overseas Workers. The Spearman's rho hypothesis test statistics also provided strong evidence to conclude that educators' and employers' perceptions were congruent.

Table 6.3.7 Best Ways that Shortages of Employees with Quantitative Abilities can be Overcome

1 = Worst, 2=Bad, 3 = Average, 4=Better Way, 5 = Best Way

Question 7 (10). If there is a shortage in industry of employees with Quantitative abilities, rate the best ways that shortages can be overcome.

Ed - Educators
Emp - Employers

	Options	Size Ed	Size Emp	Mean Rating Ed	Mean Rating Emp	Ranking Ed	Ranking Emp	$\lvert\delta\rvert$
a)	Train more people	13	48	4.54	3.92	1.5	2	0.5
b)	Closer association between industry & institutes	13	47	4.54	4.15	1.5	1	0.5
c)	Higher rewards	13	46	4.50	3.26	3	5	2
d)	More quantitative workshops	13	46	4.08	3.48	4	3	1
e)	Restructuring quantitative development programs	13	44	3.85	3.32	5	4	1
f)	Bring in guest speakers	13	45	3.58	2.82	6	6	0
g)	Migration policies to attract overseas skills	13	45	3.15	2.25	7	7	0
h)	Employ overseas workers	13	44	2.77	2.05	8	8	0

Hypothesis Test - Spearman's rho
Ho: There is no significant relationship between Educators' and Employers' rankings.
Computed rho = 0.9226, Critical value at 0.05 = 0.7380, Reject Ho.
Conclusion: Educators' and Employers' rankings are in agreement.

This question (Tables 6.3.8 and 6.3.9) aimed to determine respondents' opinions of whether the contents of existing Quantitative Methods subjects include essential topics (Statistical and Mathematical Methods) and skill levels that meet the needs of industry. According to the survey results, educators at VUT and Australian business employers had significantly different opinions relating to the Quantitative Methods contents.

Table 6.3.8 revealed that educators emphasized topics such as Sampling & Estimation, Hypothesis Testing, Nonparametric Statistics, Regression, Time Series and Statistical Quality Control at a *highe*r skill levels than employers. Topics that received the same weighting from both educators and employers include Presentation of Data, Introduction to Probability, Sampling Methods and Analysis of Variance. It is interesting to note that Bayesian Decision Making and Random Variables & Probability Distributions were the two topics that business employers and educators had different emphasis. 40 out of 51% of employers required their employees to study the Bayesian Decision. Making topic at *low* skill level only. Similarly, topic of Random Variables & Probability Distributions required by most employers at *low* skill level, but educators placed more emphasis in the teaching at a *higher* level.

Table 6.3.8 Statistical Methods and Skill Levels in Current Quantitative Methods Subjects

Question 13 (15). Identify Quantitative topics and skill levels that are offered and expected of students.

	Educators			Employers		
	Cited By %	* Skill Level Lo %	Hi %	Cited By %	Skill Level Lo %	Hi %
Presentation of Data	100	38	62	82	30	53
Introduction to Probability	100	62	38	71	45	26
Random Variables & Prob. Distributions	100	46	54	69	45	24
Sampling & Estimation [a]	100	23	77	76	39	37
Sampling Methods	100	46	54	76	39	37
Hypothesis Testing [b]	100	23	77	63	41	22
Nonparametric Statistics [b]	85	31	54	55	47	8
Linear Regression & Correlation [b]	100	15	85	59	41	18
Multiple Regression Methods [b]	77	15	62	57	45	12
Bayesian Decision Making	69	46	23	51	40	12
Time Series Analysis & Forecasting	100	31	69	63	30	33
Analysis of Variance	85	38	46	65	35	30
Statistical Quality Control	77	23	54	63	30	33

* Skill Level (Bloom 1956):
Lo = Awareness & Understanding
Hi = Application & Synthesis

Hypothesis test - Two Sample Proportions:
[a] at 0.10 level of significance
[b] at 0.05 level of significance

A Two Sample Proportions test (Burns 1990) was carried out to determine if the proportion of low or high skill levels nominated by educators is different from the proportion of skill levels nominated from business employers. Table 6.3.8 revealed that topic on Sampling & Estimation nominated by both groups showed a different proportion, both at *low* and *high* skill levels. Similarly, Hypothesis Testing, Non-parametric Statistics and Linear and Multiple Regression showed a significant difference of proportions between educators and business employers.

As indicated in Table 6.3.9, both educators and business employers required mathematical topics of Growth & Decay, Nonlinear Programming and Sets & Probability studied at the same level. Matrix Algebra, Integral Calculus, Differential and Difference Equations were the only topics that educators offered at *low* skill levels where employers expected their employees to master these topics at *high* skill levels. On the other hand, it seemed that educators placed more emphasis on topics as Elementary Algebra, Functions & Graphs and Linear Programming at *high* skill levels. The remaining topics in mathematics that most employers required are generally at *low* skill levels.

A Two Sample Proportions test was also carried out to determine if the proportion of *low* or *high* skill levels nominated by educators is different from the proportion of skill levels nominated from business employers. In mathematical methods (Table 6.3.9), Elementary Algebra and Multivariate Differential Calculus were the two topics that showed a difference of proportions between educators and business employers at a significance level of 0.10, whereas Linear Programming and Differential Calculus showed a significant difference in Proportions at the level of 0.05.

Table 6.3.9 Mathematical Methods and Skill Levels in Current Quantitative Methods Subjects

Question 13 (15). Identify Quantitative topics and skill levels that are offered and expected of students.

	Educators			Employers		
	Cited	* Skill Level		Cited	Skill Level	
	By	Lo	Hi	By	Lo	Hi
	%	%	%	%	%	%
Elementary Algebra [a]	92	38	54	69	47	22
Functions & Graphs	92	38	54	73	34	39
Matrix Algebra	54	54	0	59	43	16
Growth & Decay	62	46	15	53	41	12
Linear Programming [b]	69	23	46	57	46	12
Nonlinear Programming	38	31	8	55	44	12
Game Theory	62	38	23	55	44	12
Inventory Control: Certainty	54	23	31	67	48	19
Inventory Model: Risk	54	31	23	65	47	18
Queuing Theory	54	31	23	51	39	12
Simulation Models	46	23	23	61	47	14
Network Analysis	46	23	23	59	45	14
Markov Models	38	23	15	55	45	10
Mathematics of Finance	54	31	23	73	36	37
Differential Calculus [b]	54	23	31	61	51	10
Multivariate Differential Calculus[a]	31	15	15	55	47	8
Integral Calculus	38	38	0	59	47	12
Sets & Probability	69	54	15	63	47	16
Differential Equations	31	31	0	57	41	16
Difference Equations	31	31	0	57	45	12

*Skill level (see Table 6.3.8)
Hypothesis Test - Two Sample Proportions:
[b] at 0.05 level of significance
[a] at 0.10 level of significance

6.3.2 Summary of Perceptions of Business Employers and Educators regarding the Contents of Quantitative Methods Programs at VUT

The response rate and replies to the survey indicate that Quantitative Methods are regarded as an important decision making tool in many businesses, and Quantitative Methods studies are perceived as playing a critical role in the preparation of business graduates. Since educators have the responsibility to provide industry with the best prepared future employees, the university must continually examine their current programs to ensure that the Quantitative Methods contents and structure meet the needs of today's business. This study is one contribution to this process, and set out investigate if there is a gap between the perceptions of educators and business employers with respect to the Quantitative Methods preparation of business students.

The results of the study showed, in general, there was little difference in the perceptions of educators and employers regarding education in the School of Business and its response to the needs of industry, which ranged from liaison with employers and professional bodies, provision for academic staff development and industrial experience, to the structure and content of undergraduate courses and research activity. This indicates that the interaction between industry and university at the course development policy is well integrated.

However, in the area of preparation of undergraduate business students for Quantitative Methods, it was found that educators rated the University's performance lower than did business employers (mean scores=2.46/3.05). Also, the results of the study revealed that educators' and business employers' perceptions of Quantitative Education Preparation and the areas of knowledge were not in agreement (i.e. there is a large difference of opinion between the two groups on the need for 'Computer Capability' and 'Human Relations'). Furthermore, in relation to the content of the Quantitative Methods studies, educators had significantly different views from business employers about the Quantitative Methods topics and skill levels that should be required of business graduates. Emphasis on topics such as Hypothesis Testing, Nonparametric Statistics, Regression Methods, Linear Programming and Differential Calculus suggested that educators expected their students to master these topics at a higher skill level than the employers.

Educators also believed that the best Quantitative Education preparation lies in its curriculum; that is education should be more practically oriented and more case study based, whereas business employers considered Work Experience played a more important role in Quantitative Methods education. It is possible that educators also see the importance of Work Experience, but because it is quite difficult to obtain industrial placement for students during the co-op year, educators are compelled to focus more on the teaching aspects of the course.

With regard to specific areas of knowledge, educators paid more attention to Computer Capability, Quantitative Methods and Economics respectively, whereas business employers ranked Human Relations, Computer Capability and Accounting as the most three important areas that business graduates should possess. Surprisingly, the area of Quantitative Methods *per se* was considered by business employers as the least important area for graduates. This may well explain why they had a different view regarding the Quantitative Methods topics and skill levels that should be required of business graduates.

However, both educators and employers were in agreement in a number of areas such as 'criteria in recruiting business graduates', 'skills that every business graduate should possess' and 'preferences of the best way to overcome shortages in Quantitative Methods skilled employees'. When they were asked to rank the criteria they believe are the most important in recruiting business graduates for industry, the responses appeared to show a diversity; for example Maturity was considered as the second most important criteria to educators whereas employers ranked it as sixth. However, statistical tests indicated that their responses were congruent, implying that statistically there is no significant difference in the rankings between the two groups.

It is interesting to notice that educators listed Motivation, Maturity and Flexibility/Adaptability as the most important criteria, compared to employers who nominated Communication skills, Motivation and Analytical skills. It is also very interesting to see that although employers ranked Work Experience among the least important criteria in recruiting business graduates, their earlier belief was that Work Experience played an important role in the Quantitative Methods Education. In this regard, it appears that employers' responses contain a contradiction, indicating that further investigation is needed to see if there is a way in which these responses might be reconciled.

In relation to generic skills, both groups agreed that Motivation and Communication are the most important skills that every business graduate should possess. On the other hand, Negotiating skills and Application of Quantitative Techniques are the least important skills. This again showed a contradiction since in an earlier question educators considered Quantitative Methods as one of the most important areas of knowledge that every business graduate should possess. Finally, in relation to the shortage of employees with Quantitative Methods skills, both educators and employers showed similar preferences of the best ways to overcome these shortages. This shows a further need for follow up interviews with educators to resolve the apparent contradiction.

In summary, the study has revealed a number of different expectations of educators and employers relating Quantitative Methods studies, and in some cases educators placed a higher expectation on their students than the employers. In the next chapter, interviews with educators have been conducted in order to understand the meaning of these differences, and the interpretations will be developed.

CHAPTER SEVEN

Qualitative Analysis

7.1 Details of Interviews of Quantitative Methods Educators at VUT

As indicated in Chapter 4, this project uses a mixed methodology approach, where the results of a quantitative study have been illuminated by further investigation of a qualitative nature (Tashakkori & Teddlie 1998). In this phase of the work, we have used personal interviews with Quantitative Methods Educators to help reconcile some areas of apparent disagreement between the quantitative responses of Business Educators and Business Employers reported in Sections 5.1 and 5.2. We began by presenting the seven 'purposefully selected' (Kurzel 1992) Quantitative Methods Educators with a general preamble to the interview:

Preamble to Interview

Some time ago, we carried out a survey of University educators ('Educators') and Business Employers ('Employers') which investigated VUT graduates' preparation in quantitative methods for business purposes. The responses to this survey, which were completed by 13 'Educators' and 65 'Employers', have now been collated and statistically analyzed using SPSS. We are now examining in detail the outcomes of this analysis. We would like your assistance to interpret some of the differences and apparent contradictions in responses which we have observed.

Following a brief discussion of this preamble, we presented the Quantitative Methods Educators with summaries of the major areas of difference between the quantitative responses of Educators and Employers or where Educators' responses needed further elaboration. In all, six areas requiring clarification were found, and for each area we posed one interrogatory question that, for convenience, are presented together with each summary in this account. Responses by the Business Educators follow directly after each question, and some interim comments are made regarding the responses. In accord with ethical practice in qualitative analysis procedures, pseudonyms have been used in the responses section of this chapter for reasons of confidentiality.

Part 1.

For the question:
How well prepared are our undergraduate business students in the quantitative methods area?, analysis of the survey responses showed that:

Mean response (Educators) = 2.46
Mean response (Employers) = 3.05

where 1.00 = 'Not prepared' and 5.00 = 'Excellently prepared'.

A hypothesis test on these mean responses (Mann-Whitney U-test) indicated that **there is a statistically significant difference in response to this question** between the two groups.

We are interested in your interpretation of this difference in responses, particularly since it is educators who are responsible for the quantitative preparation of graduates. Intuitively, one might have expected that if a difference were to be found in the responses to this question, the means of the responses of the two groups would have been reversed.

Question 1.

How would you interpret these findings which suggest that educators think that graduates are less prepared in the quantitative methods area than do Business personnel?

Responses to Question One

Albert: Educators tend to have high expectations about what skills they have and they probably got, in many cases, a wrong view about the level of sophistication of quantitative analysis used in business. Let's take Regression. Employers do a demand model test if r square is good. Educators say we have to test the model, take more care whereas Employers just think that as long as they can do a regression model. Employers are more interested in getting results; Educators are more interested in getting theory and testing and testing...

Kelvin: Employers value tasks more than Educators. The reason is Business Employers are not aware of the latest development in Quantitative Methods techniques and Educators are more aware of those latest developments. Educators feel that students do not get enough materials.

Sigmund: Educators may be unaware of the requirements at the workplace.

Hayden: These are the responses we would have expected, as Educators try hard to train students with good Quantitative Methods background and because we have a high expectation of our students. In reality we have achieved higher than that, that is why Employers think highly of our graduates and as this is a good response, we need not to worry much. Personally, I think we need to put more effort to prepare our students so the rating will be close to 5 (very well-prepared). But the main problem is, I think, the lack of commitment on part of some students to put more effort in the study of Quantitative Methods.

Jamie: Teachers of Quantitative subjects have a higher expectation of the quantitative needs of business than do business employers (see also Q3).

Lachlan:	Employers are not well prepared themselves in the Quantitative Methods area, that is why they rated students higher in terms of preparation compared to Educators.
Iris:	Academic and industrial people have different expectations and students don't apply everything from what they learn. Educators' expectations are according to a theoretical norm, whereas employers' expectations base on applications of these Quantitative Methods techniques. Maybe the employers link these to their own knowledge or standard, that's why they think graduates are highly prepared in the quantitative methods area than the educators.

Interim Comments

The level of preparation of business students in the Quantitative Methods area is of central importance to this thesis, and the finding that Educators and Employers disagree on the level of preparation of students for business is of serious concern. Upon questioning, it appears that, in general, Business Educators' perceptions of why 'Educators' have higher expectations of their students' abilities is that the Business Educators themselves *are being continually exposed to different developments in Quantitative Methods*. It is suggested that this implicitly high standard, which leads to a low mean response of 2.46, may be *slightly unrealistic* in terms of what is actually required by business. It was also suggested that the level of preparation of educators in Quantitative Methods exacerbates the areas of weakness in their students whilst, in contrast, some employers may be more task oriented and thus perceive students to be relatively well prepared.

These observations highlight a tension in the underlying question of what specific role is required of Quantitative Methods education. On the one hand, educators appear to want to present sophisticated techniques of theory testing, whilst employers are content with establishing a correlation and finding a useable regression model.

Part 2. On the survey, we also asked the respondents to:

Rank in order of importance the best quantitative educational preparation for a business graduate career.

The responses for the two groups are given in the table:

	Ranking		
	Educator	**Employer**	$\lvert\delta\rvert$
Education should be more practically oriented, more case study based	1	2	1
More emphasis on software applications skills	2	3	1
More emphasis on the teaching of a wider range of Quantitative Techniques	3	4	1
Practical experience while going through college, work experience oriented	4	1	3
More short specialist courses	5	5	0

Analysis of this table using a Spearman rank test indicates that there is a statistically significant difference of the rankings of the two groups. We are interested in your interpretation of the reason for this difference. According to Educators, the most important point in the preparation of business graduates in the quantitative methods area was that 'the education should be more practically oriented, more case study based', whereas Business employers considered 'practical experience while going through college, work experience oriented' as the most important.

$\lvert\delta\rvert$ =difference between rankings

Question 2.

Why do you think that Educators rank these aspects of quantitative educational preparation so differently to Business employers?

Responses to Question Two

Albert: The main thing is that the number one choice is different; if you take that out then the rest looks the same. Where the main difference is Practical experience while going through college, work experience oriented in which Employers put as number One and Educators as Four. Educators thought that Practical experience is easy to do, coop year is terrific idea but it is hard to get students into it, the placement is the difficult. Personally, I would put Practical experience as one and two than four. I think if you take out Practical Experience, then the rankings are exactly the same. In this particular case Educators tend to shy away from organising more practical exposure.

Kelvin: For question in part two, what I feel is Employers may not be aware of the teaching methods that Educators are using in order to introduce the quantitative techniques. In the teaching methods, we use case study which is more practical oriented and the Employers may not be aware of these, and that is what they feel students should get some practical experience while going through college.

Sigmund:	Most (industry) people believe that what is not used is not important, so they do not look at the potential.
Hayden:	My personal view is I agree with Employers that Work Experience is the most important aspect of Quantitative educational preparation. From my experience, I have tried to get practical experience for my students, but it's not easy. So my guess is because Educators see the difficulty in getting practical experience for their students so they place more emphasis on other aspects. Again, it is difficult to get companies to allow students do the work experience.
Jamie:	I'm not sure they are so different because the 1 chosen by educators is about as close as we can realistically get to the 1 chosen by employers (note that the word 'practical' appears in both of them). If employers provided cadet ships consisting of 'sandwich' programs (i.e. mixture of work and study) the 1 selected by employers might have some chance of being attained. Being sensible with today's era of mass higher education the educators (chosen) 1 is about as close as I think we could reasonably expect to get.
Lachlan:	Educators see the importance of getting practical experience while going through college, but not as important as the education of Quantitative Methods, because it is not the task of the University to deliver work experience. It is the Educators' job to educate students and I think three years education is short enough to complete the course. I don't see much difference in first option, as both Educators and Employers placed high emphasis on the importance of Education, the only difference is found in the Work Experience.
Iris:	I am more inclined to the employers' responses, because what is learnt in practice is more important in the sense that it gives more confidence to students. I personally think that items 1 and 4 above go together; that is education should be more practically oriented and work experience oriented as these two complement each other.

Interim Comments

In this part, the main difference in responses between Employers and Educators was with items 1 and 4, that is 'Case-study based Orientation' and 'Practical Experience While Going Through College'. If these two were disregarded, the rankings of other items were essentially the same.

The interviewed staff commented upon this tension between case-study versus practical experience, suggesting that Educators see their responsibility in teaching Quantitative Methods theory to students, not to deliver work experience. As a consequence, Quantitative Methods Educators place high emphasis in the importance of basic education, such as case-study based material, emphasis on software applications skills and on teaching a wider range of Quantitative Techniques. In addition, Quantitative Methods Educators point out that a three-year undergraduate course is of such short duration, and this short time availability coupled with the difficulty in arranging work experience for their students nowadays, means they tend to shy away from increased practical experience and place more emphasis in the teaching of Quantitative Methods theory.

Part 3.

On the survey question **'What areas of knowledge should every business graduate possess'**, the following responses emerged:

	Ranking		
Areas of Knowledge	**Educator**	**Employer**	$\lvert\delta\rvert$
Computer Capability	**1**	**2**	**1**
Statistics & Quantitative Methods	2	8	6
Economics	3	7	4
Finance	4.5	4	0.5
Human Relations	**4.5**	**1**	**3.5**
Basic Skills in Management	6.5	5	1.5
Marketing	6.5	6	0.5
Accounting	8	3	5

A hypothesis test on these results (Spearman rank), indicated that **there is a statistically significant difference in the rankings** that Educators and Business employers assign to the areas of knowledge which graduates should possess.

Inspection of the table above indicates that there is a particularly large difference of opinion between the two groups on the need for 'Human Relations'. This difference, which also appears between Economics and Accounting and Statistics, represents a fundamental distinction between hardware and people skills. We would like to hear your interpretation of this difference in emphasis placed on these areas by the two groups.

Question 3.

Why do you think there is this difference in perception between Educators and Business employers of what areas of knowledge are important for business graduates?

Responses to Question Three

Albert: Employers put Human Relations as number one, Educators put it as 4.5. I guess that Educators are what they are, they teach important things all the time, whereas Employers know that if you don't have certain human relations skills it doesn't matter a damn hell if the things are in the work place. Employers are saying that is good that people need to know something, but if they can't work with other people, they can't communicate, then it is a waste. Interestingly, both groups ranked 'Computer Capability' very high and I am a bit surprised is so many Educators put it as number one; I would not put it as number one ... in the top three for sure...I would put Computer Capability along with Communication skills...we communicate by internet and word process. Employers considered Human Relations as important because without this skill you cannot do it...

Kelvin:	Educators feel that the 'Computer Capability' could be obtained only in the higher learning institution and also they feel human relationship basic skills could be obtained also in some other subjects. They feel the human relations could be obtained in the working environment as time passes. In 'Human Relations', we teach the *basics* in a summer subject (a communication subject) but the *experience* of the human relations could be obtained only in the working place. What we feel is as the time increases the student will become more comfortable with the human relations.
Sigmund:	Depends on the 'Employer' spoken to; they may not be the people who'd actually employ graduates. Quantitative analysis is only a small part of running a business, i.e. in terms of number of people involved. The people who completed the survey may be someone who is not from the area of Quantitative Methods; and what they don't need they don't feel important. That's why there is a mismatch.
Hayden:	With regards to Quantitative Methods, Educators have a better understanding of the needs of industry and organisations. For these techniques in the future, companies must use Quantitative Methods to get some advantages over their competition. Probably, Employers don't appreciate the value of these techniques. With regards to Human Relations, Employers are right. Educators do not appreciate enough of the importance of Human Relations in the workplace, so we have to train our students better in this area. With regards to Economics, again Educators gave it a high importance, Employers don't appreciate this; with Accounting, this is a day to day job and needs to be done that's why Employers place it high. Educators see this (Accounting) doesn't require high intellectual skills.
Jamie:	Quantitative studies educators in general I would suggest have never worked in 'business'. Those that have - probably in a very specialized area of business. Look at the 1, 2 and 3 of educators - I think it tells us a lot about 'us' - the question asks about 'every' business graduate, not those going on to research degrees in Economics. I wouldn't mind betting the ranking of Computer Capability isn't as close as it looks either - what a n employer means by Computer capability is probably a lot different to what an academic quantitative studies educator means.
Lachlan:	In this part I don't see significant difference in the ranking of Computer Capability, but for Statistics and Quantitative Methods, Educators ranked this as the second most important area whereas Employers ranked it as the last important area. The reason is due to Employers are not well trained in Statistics so they don't appreciate these at all. Also, in Accounting Educators see the importance of Accounting whereas Employers don't see its importance. With Human Relations, Employers showed that they cared more and they placed it as the highest important area. I don't know but I wonder if Employers in this sample would represent the whole population.
Iris:	I think Human Relations and Basic Skills in Management are important and should be put together. The reason for the difference in perception between Academic and Employers regarding the areas of knowledge is because it depends on who the practitioner is and the job they are doing.

Interim Comments

Regarding the 'areas of knowledge that every business graduate should possess', Quantitative Methods Educators apparently feel that Human Relationship basic skills could be most effectively obtained in the working environment as their time in the position increases. By contrast, Employers argue that it is essential that people know something about 'Human Relations' upon graduation. If graduates cannot work with other people, then it is a significant barrier to their working efficiency, and consequently Employers place it as the area of highest importance. On the other hand, one Educator does agree with Employers that Quantitative Methods Educators in general do not appreciate enough the importance of graduates having 'Human Relations' skills early in their career in the work place.

Quantitative Methods Educators also argued that Employers in this sample might not be able to represent the general population of employers, and their perspective is influenced strongly by their roles; for example these Employers might not be in the area of Quantitative Methods and this leads them to place high importance on skills in 'Human Relations'.

Part 4.

In part 3, Educators ranked **Statistics and Quantitative Methods** as the **second most important knowledge area** that every business graduate should possess. However, regarding the importance of skills as shown in the table below, the **Application of Quantitative Techniques** was ranked as the **least important skill.**

Skills	**Educators' Ranking**
Motivation	1
Communication	2
Organization & Coordination	3
Data Analysis	4.5
Computer Utilization	4.5
Problem Solving	6
Negotiating Skills	7
Application of Quantitative Techniques	**8**

Question 4.

Why do you think that Educators have indicated in the Areas of Knowledge, Statistics and Quantitative Methods is important to business graduates, but in terms of skills they think that the Application of Quantitative Techniques are not so important?

Responses to Question Four

Albert: This is hard isn't it? Thank you for giving me this question! To me it is a recognition that if you want to do anything scientific you need to know handle some Quantitative Techniques you need to understand what statistics operation research are about, in a sense that we think... have a feel for statistical arguments, statistical techniques, but it doesn't mean that you have to be an expert to do the job. Handle accounting problems, knowledge of computers, be able to negotiate, work with others... but they are not going to do any statistical analysis, even that they might see some statistical analysis and have to have an appreciation of what it is about. Difference between data analysis and Quantitative Techniques here? People think they need to know something about quantitative methods but they need not to be an expert to do the job. Example, in the year 2000, only one graduate ends up with Australian Bureau of Statistics. Most students end up somewhere else, and not likely to do complex analysis, and therefore need not to be expert in quantitative techniques.

Kelvin: Without the motivation students can't achieve anything in life. That is why Educators rank it as number one, and without communication without other skills it is very hard for him to get into the working place he wants to get in. The application of quantitative techniques is ranked low because it is the knowledge that can only apply only in a certain area, whereas other skills such as motivation, communication, organization and coordination apply in a larger area.

Sigmund: I really don't know!

Hayden: Firstly, Quantitative Methods is an important area and we train them to be capable of using these techniques. In doing Quantitative Techniques, other skills are also being used. Maybe some (staff) thought that the use of Application of Quantitative Techniques is less, that's why they thought from a practical point of view that Motivation, Communication... are more important. To me, these rankings are all important, the gap between these rankings are insignificant, they are not different...they simply rank them because they are asked to.

Jamie: Perhaps it's because we are differentiating between practice and theory. We know that the 'bulk' of business graduates will 'never' have to apply the stuff we teach them. How many practising accountants do you think could perform or would need to perform a hypothesis test 'after' graduation?

Lachlan: There are two things here: the first is that part three and four are different, they are not comparable. In part three it is the areas of knowledge and in part four it is the skills we are talking about; the second thing is within part four, Educators showed inconsistencies such as Data Analysis was ranked at a much higher level than the Application of Quantitative Techniques... and I wonder that we have a small sample of Educators here.

Iris: Maybe they think that knowledge is more important because once you have the knowledge then you can apply these techniques if you need it. I think people who response these didn't put too much thought in this, that's why it shows the contradiction.

Interim Comments

What appears to be emerging here is that there are two different issues being emphasized; one is the area of *knowledge* in Statistics and Quantitative Methods, the other is the *skill* to apply these Methods. The reason Educators place more emphasis in the *knowledge* area is because they believe business graduates should be equipped with a broad spectrum of techniques to be ready for any requirement in the workplace. However, they point out that the need for application of particular Quantitative Techniques only occurs in certain areas. In the workplace, the majority of business graduates would not use all the techniques which are considered as 'expertise in Quantitative Methods area', and as one Educator pointed out:

> ... out of 2000 graduates, only one may end up with the Australian Bureau of Statistics, most students end up somewhere else and not likely to do the analysis, they need not to be expert in Quantitative Techniques...

Therefore, whilst Educators believed that knowledge of Quantitative Methods techniques are important, once students have sufficient to access the particular Quantitative Technique, they can apply these techniques when the need arises. However, when commenting upon the range of *skills* required by a Quantitative Methods graduate, Educators placed motivation as the most important skill because, to them, without motivation, students can hardly 'achieve anything in life'.

What may be appearing here is the emergence of a hierarchy of skills acquisition, where the ability of a business graduate to be able to handle basic Quantitative Methods techniques is a *necessary* condition for making an application for a job, it may not be a *sufficient* condition to gain employment.

Part 5.

On the survey question relating the criteria used in recruiting business students, both Educators and Employers ranked **'Work Experience' among the least important criteria** (see table below).

Criteria	Ranking Educator	Employer	$\lvert\delta\rvert$
Motivation	1	2	1
Maturity	2	6	4
Flexibility / Adaptability	3	4	1
Communication Skills	4.5	1	3.5
Analytical Skills	4.5	3	1.5
Academic Results	6	7	1
Personality	7	5	2
Work Experience	**8**	**8**	**0**
Extracurricular Activities	9	9	0

However, when asked about **the best quantitative educational preparation for a business graduate career**, Employers indicated the course should be **Work Experience oriented**, as shown below:

	Educator	Employer	$\lvert\delta\rvert$
Education should be more practically oriented, more case study based	1	2	1
More emphasis on software applications skills	2	3	1
More emphasis on the teaching of a wider range of Quantitative Techniques	3	4	1
Practical experience while going through college, work experience oriented	**4**	**1**	**3**
More short specialist courses	5	5	0

Question 5.

With regard to the importance of Work Experience in a business graduate's career, it appears that Business employers' responses to these two questions contains a contradiction. Can you see any way in which these responses might be reconciled?

Responses to Question Five

Albert: I am a bit worried about Educators' ranking because they don't often employ graduates; so we look at Employers. Employers rank Work Experience as number Eight, Work Experience is different to Practical Experience while going through college in the sense that Work experience can be any Work experience like a job at McDonald or Supermarket, whereas Practical Experience while going through college, work experience oriented here means that there is a connection between the job and the course. So Employers are not contradicting themselves here as these two are different things, that is they rank Practical experience while going through college as the most important in education preparation whereas 'other work experience' do not count because there is no connection between the job and the course.

Kelvin:	Employers rank the Practical Experience as the highest one, the reason is when a student is exposed to the work related to what he studies, it gives him some sort of motivation with some sort of encouragement to his study; but he has to communicate at high level in order to achieve that job. That is what Educators rank motivation as the highest rank. And Employers rank communication as the highest one because when students go to the workforce and he or she has to communicate with his colleagues and also with people who are working with him so communication skill is an very important for the employers. So what I can see is motivation and communication skills are important for the student and the motivation gives some encouragement for the students to do the subject.
Sigmund:	What they (Employers) mean is the 'skill to do it' not the actual experience. For example, we teach WORDS, the skill of using WORDS, but in the real work situation students might not have to use WORDS.
Hayden:	There is no contradiction. Employers were saying we (Educators) should try to incorporate Work Experience in our courses. When it comes to recruiting, because (assume that) work experience has been included in the course, Employers would then consider other criteria. When recruiting them, a 'raw' graduate doesn't have work experience, so it's unfair to tell graduates to go somewhere and get experience. That's why they don't worry about work experience when it comes to recruiting students. Simply, we cannot expect the student to have work experience for their first job.
Jamie:	As mentioned in Q2, I think the main point is that both groups think that the best quantitative educational preparation is 'practically' based. By the time employers got around to responding this question they probably would have realized that seeking work experience generally in a business graduate is 'pie in the sky' stuff.
Lachlan:	Here Employers might misunderstood the terms: Work Experience and Practical Experience While Going Through College. But still, although Employers placed Work Experience among the least important criteria, personally I see that relevant work experience is important.
Iris:	The reason maybe because of the different structures of the questions. This question is exposed differently or with the 'criteria' used in recruiting business students, these are more practical.

Interim Comments

According to the Educators' viewpoint regarding the ranking of work experience, it is felt that Employers are not necessarily contradicting themselves. What Employers are saying is that in the graduates' *educational preparation*, Educators should certainly incorporate work experience in the courses so that students will have some chance to relate to what has been taught at University. However, when comes to *recruiting* business graduates, Employers consider more important criteria such as communication and motivation skills, because they know that a 'raw and fresh' graduate would not have significant appropriate work experience (referring to work related to the position appointment rather than just any type of work experience) to make an impact upon selection.

The essential point here is that 'Work Experience' is different to 'Practical Experience While Going Through College', so when recruiting business graduates, if Employers could not see a *specific* connection between the job and the course, then they would not regard graduates as having appropriate 'Work Experience'.

Part 6.

In the survey, we asked both Educators and Employers to **indicate both the Quantitative Methods topics and skill levels expected of business graduates**. A hypothesis test on these proportion responses (Two Sample Proportions) indicated that **there is a statistically significant difference in response to this question between the two groups.** We are interested in your interpretation of this difference in responses, as it seemed that Educators expected their students to master certain topics (marked with **bold** on Tables A and B following) at a higher skill level than the Business employers.

Question 6.

How would you interpret these findings which suggest that Employers only desire business graduates to master the indicated topics in general at a lower skill level than Educators (see Tables A and B below)?

Table A. **Statistical Methods required in the Quantitative Methods Courses at High Skill Levels***

	Educator %	Employer %	$\lvert \delta \rvert$
Presentation of Data	62	53	9
Introduction to Probability	38	26	12
Random Variables & Prob. Distributions	54	24	30
Sampling & Estimation	77	37	40
Sampling Methods	54	37	17
Hypothesis Testing	**77**	**22**	**55**
Nonparametric Statistics	**54**	**8**	**46**
Linear Regression & Correlation	**85**	**18**	**67**
Multiple Regression Methods	**62**	**12**	**50**
Bayesian Decision Making	23	12	11
Time Series Analysis & Forecasting	69	33	36
Analysis of Variance	46	30	16
Statistical Quality Control	54	33	21

*** Skill Levels**

Low level: Awareness and Understanding

High level: Application and Synthesis

Hypothesis test - Two Sample Proportions (at .05 level)

(continued over...)

Table B. Mathematical Methods required in the Quantitative Methods Courses at High skill levels

	Educator %	Employer %	$\lvert\delta\rvert$
Elementary Algebra	54	22	32
Functions & Graphs	54	39	15
Matrix Algebra	0	16	16
Growth & Decay	15	12	3
Linear Programming	**46**	**12**	**34**
Nonlinear Programming	8	12	4
Game Theory	23	12	11
Inventory Control: Certainty	31	19	12
Inventory Model: Risk	23	18	5
Queuing Theory	23	12	11
Simulation Models	23	14	9
Network Analysis	23	14	9
Markov Models	15	10	5
Mathematics of Finance	23	37	14
Differential Calculus	**31**	**10**	**21**
Multivariate Differential Calculus	15	8	7
Integral Calculus	0	12	12
Sets & Probability	15	16	1
Differential Equations	0	16	16
Difference Equations	0	12	12

Responses to Question Six

Albert: For topics such as Hypothesis Testing, Educators want more formal testing, Employers only want to see the results, they just look at the numbers. Nonparametric Statistics: Employers don't know this in the first place Linear and Multiple Regressions: Educators consider these topics useful for statistical tools, Employers have a different concepts, they don't know much about it, alien concepts to a lot of business. Employers mistrust the quantification and so on. Linear Programming: only big sophisticated companies would use this technique. Differential Calculus: this technique need year 12 or VCE mathematics, it is more important than Integral Calculus, and not many would not do this.

Kelvin: Educators rank higher in hypothesis testing, nonparametric statistics, regressions... compared to Employers because University is the place to train students for industry as well as for research. But the research requires more of statistical techniques that is why Educators teach these ones also and because most Educators are doing research and at university research are part of their work they have to do research using statistical techniques that is why they gave more important to these ones. University is a place for research and training students, because we don't know the direction students are going... industry or research, but later on students choose the direction in industry or doing research that is why we teach all these techniques here. But later on if the students go from industry to research then he or she will know all the importance of these techniques. Employers only interested in the outcome results.

Sigmund:	Again it depends on the 'Practitioner' himself, not only these (Quantitative) skills; extended to other skills... most of the skills are learnt on the job training. In Australia, some Executives have no degree, they learn from the job and rise the rank, they don't do much Quantitative skills, and delegate others (from small Quantitative unit) to do the job. That's why Employers don't require these skills at higher level.
Hayden:	Employers underestimate the practical usefulness of Quantitative techniques; most Employers would have done their degrees at different times and these are the current topics we have to train students to master these topics. At the moment, although industry not using these topics, but it is our job to promote these techniques. With Linear Programming, we introduce the whole topic so the whole thinking process can be developed, not so much with day to day basis. Again with other topics, we train them so when the need arises they are equipped themselves with what they already know. Linear Programming and Calculus have specific solutions to specific problems and cannot be applied to all.
Jamie:	Depending on who the employers were I would suspect many would not have much knowledge of what the various topics actually are. See responses to Q1 and Q3. Note also we are talking here about High Skill levels - see response to Q4. Personally, I would not place these topics with High skill levels, I think employers here are more realistic in relation to an overall picture. Educators expect graduates to master these topics with high skill levels because we want them to achieve high and only a small number of them would benefit from this. It is the end point that graduates go to at the end of their study, say for example, Economics students end up working in the field of Economics that would require higher numerical skills.
Lachlan:	This phenomenon again related to that Employers are not statisticians. These topics are considered to be more difficult compared to others, and because Employers are not well trained in this field, they are not familiar with these. Employers are not consistent, for example, I don't see if they don't need Hypothesis Testing...then why should they need Probability at all? In table B, Employers would not know the difference between Differential Equations and Difference Equations. Imagine our students one day will be Employers, they didn't learn these topic at school so they would not know about these. I am not surprised that Employers put Functions and Graphs as high, and I say they only know the basic Graphs rather than Functions. In general, there are huge gaps between Educators and Employers, and Employers are not fully aware of Quantitative Techniques available; like Marketing, if consumers don't know about the product then why look for it!
Iris:	Again, similar to question one these employers are not familiar with the benefits of applications of these concepts.

Interim Comments

Regarding the level of mastery with a range of topics in Quantitative Methods, Employers appear to have significantly lower expectations of graduates than Educators. This seems to be consistent with the findings in Part 1 of this chapter, where Employers had an apparently higher perception of the level of preparation of current graduates. The explanations given by Educator respondents to this situation, apparently fall into two categories. The first is related to the relative degree of familiarity with Quantitative Methods . Educators suggest that many Employers are not fully aware of the range of Quantitative Methods available, since they are, for the most part, not statisticians. The perception held by educators is that Employers are generally more interested in getting practical results, and consequently place little emphasis upon the mastery of techniques at a higher skill level. This is typified by one remark made by a respondent: ‘some Executives have no degree. They learn from the job and rise through the ranks, that is why they don’t require these skills at a higher level’.

The second category of explanation is related to the particular focus of the Academy. The university system is a place where education is pursued, and ideas are developed. Students are not only prepared for industry but also for research, and this certainly requires a more complete level of mastery of various topics. Furthermore, because students are being prepared for more than one industry, their academic preparation is required to promote all techniques at as high a skill level as possible, so that when a particular need arises, they might be well equipped.

7.2 Summary of Interviews of Business Educators at VUT

In summary, the difference in responses between business employers and educators at VUT on our survey of graduates’ preparation in Quantitative Methods appears to be due to the different emphasis that each group has placed on the stimulus questions. Educators in the area of Quantitative Methods see themselves as educators whose main responsibility is to prepare students to as high a level as possible in a range of Quantitative Methods techniques. Also, as they are more aware of the latest development in the Quantitative Methods area, these educators seem to place more emphasis on the knowledge of the more current techniques, thus have a higher academic expectation of graduates with Quantitative Methods skills than do business employers. Employers focus predominantly upon the pragmatic solution of problems at a relatively rudimentary level, which is a manifestation of their own training in the area and thus pressing need for results.

The next chapter will complete this study. A summary of the findings of the investigation will precede some theoretical and practical implications which we feel arise for Business Educators in Quantitative Methods. The work concludes with some suggestions for possible further research in the area.

CHAPTER EIGHT

Findings, Reflections and Recommendations

8.1 Structural Design Of This Chapter

The survey questions that were developed to elicit information from respondents, related to three focus questions as included in Figure 8.1. To assist and engage the analysis and discussion of the responses, these questions were organized into six sections. Figure 8.1 illustrates how the sections were organized around the focus questions, each of which contributed to an understanding of the main research question of how well the Quantitative training tertiary business graduates was responding to the needs of Australian industry.

Section one and section five provide key answers to the focus question 'Are business graduates adequately prepared with Quantitative Methods skills?' Sections one, two, three and four focused on the question of 'How business graduates are best prepared in Quantitative Methods education?' Section six related to the focus question of 'What Quantitative Methods are required in industry?' The survey questions which were developed in each section are summarized in the following paragraphs.

In section one: 'Business School and Quantitative Methods Education', business employers and educators were asked, in the survey, questions about: *their ideas regarding the most appropriate style of Quantitative Methods curriculum* (Table 6.2.3, and Tables 5.2.8 and 5.2.9); *how well the business school currently responds to the needs of industry* (Table 5.1.3 and Table 5.2.1) under the four headings of (a) Liaison with employers and professional bodies, (b) The structure and content of undergraduate courses, (c) Provisions for academic staff development and industrial experience, and (d) Research design and development activity; *the preparedness of undergraduate business students in the Quantitative Methods area* (Table 5.1.4 and Table 5.2.2); and their opinions on *the best quantitative educational program for a quantitative graduate career* (Table 5.1.5 and Table 5.2.3). In addition, business employers were asked about the *support of employers for postgraduate business schools in Australia* (Table 5.1.6). The survey questions grouped together in this section reflect the two focus questions (i) Are business graduates adequately prepared with Quantitative Methods skills? And (ii) How are business graduates best prepared in Quantitative methods education?

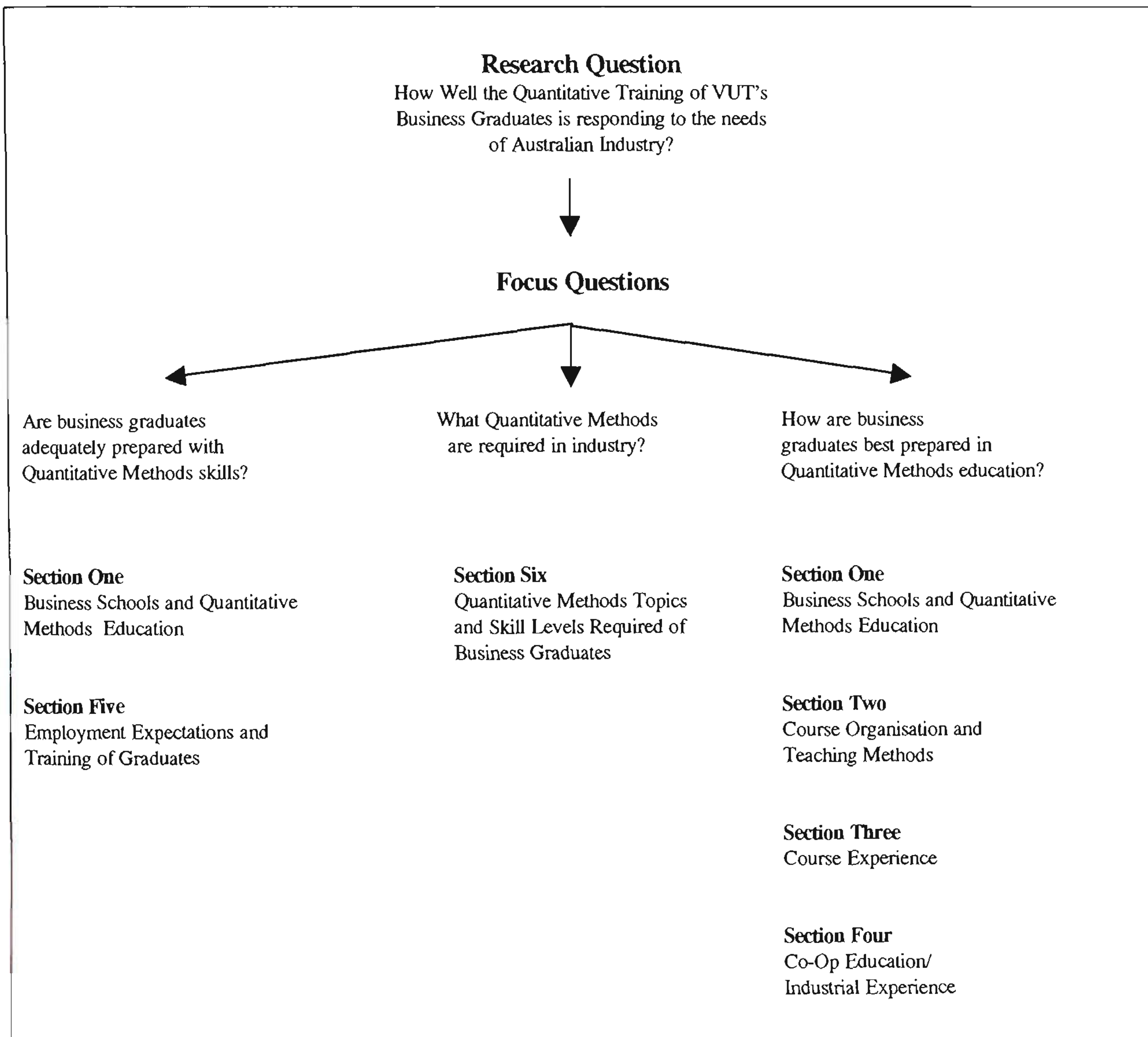


Figure 8.1 Correspondence between research question, focus questions and organisational section of the data collection instruments.

In section two: 'Course Organisation and Teaching Methods', educators in the quantitative area were asked, in the survey, questions about: *the philosophical approach they consider most appropriate to the current Quantitative Methods curriculum* (Table 5.28). Educators were also asked for their *preferred curriculum model when developing course material,* *mathematics prerequisites to enter business quantitative area* (Table 5.2.10) and *the percentage of class time devoted to various teaching techniques* (Table 5.2.11 and 5.2.12). When brought together, these opinions in this section contributed to the answer of the focus question 'How are business graduates best prepared in Quantitative Methods education?'

In sections three and four: 'Course Experience and Co-operative Education / Industrial Experience', both final-year business students and graduates were asked for *their study experiences including industrial experiences at VUT and in business industry* (Table 5.3.13 to Table 5.3.31). Questions posed in these sections reflect the focus question 'How are business graduates best prepared in Quantitative Methods education?' The survey questions related to issue of: *Quantitative Methods subjects students enrolled* (Table 5.3.13)*; main reason to select these subjects* (Table 5.3.14)*; overall evaluation of Quantitative Methods programs at VUT* (Table 5.3.17 and Table 5.3.18)*; level of difficulty of these subjects* (Table 5.3.20), *general comments on the Quantitative Methods programs and assessment of Quantitative Method staff at VUT* (Table 5.3.21 to Table 5.3.23). Regarding the Co-operative education, both students and graduates were asked to outline *their Co-operative experience* (Table 5.3.24) *and provide their perceptions on the nature of co-operation between school and industry* (Table 5.3.28).

Section five: 'Employment Expectations and Training of Business Graduates', consisted of questions regarding employment and training of graduates in the Quantitative area (Table 5.3.33 to Table 5.3.38) and here the target groups were business employers and graduates at VUT. Again, specific questions asked in this section reflected the focus question of whether business graduates are adequately prepared with Quantitative Methods skills. The type of survey questions used here related to issue of: *indication of difficulty in recruiting suitable graduates; change in the number of graduates employed with quantitative techniques; shortage of graduates in future if any; and criteria in recruiting graduates.*

Finally, in section six: 'Quantitative Methods Requirements in Industry', business employers, educators and graduates were asked in the survey questions to *identify particular quantitative topics and skill levels offered and expected to be achieved by* *graduates* (Table 5.1.15; Table 5.1.16; Table 5.2.14; Table 5.2.15 and Table 5.3.39). Answers to this focus question indicated those Quantitative Methods, which respondents perceived as being required by industry. The topics included statistics and mathematics methods, and the skill levels of knowledge desirable for graduates to acquire were based on Bloom's taxonomy of educational objectives.

The major findings, reflections and recommendations as they relate to each of the focus questions and sections examined in this study, are presented below.

8.2 Section One - Assessing the Business School and its Quantitative Methods Programs

8.2.1 Summary of Findings

Our first area of enquiry under this heading was into perceptions of the nature of the curriculum that was considered appropriate for Quantitative Methods students. Of the four choices presented to the respondents (Academic; Technology; Humanistic and Social Reconstructionist) the majority of business employers (84%) surveyed in 1999 considered an 'Academic Conception' or approach as most appropriate in today's Quantitative Methods course curriculum (Table 6.2.3). However, whilst less than 20 per cent of business employers regarded 'Technology' as an appropriate conception for the curriculum, the majority of Quantitative Methods educators at Victoria University of Technology voted for the Technological approach in the course curriculum (65%), with only a few (25) preferring the Academic conception (Table 5.2.8). Although the number of responses from educators involved in this study is relatively small (12) compared to the number of responses from industry (42), the concentration of the educators upon the *Technological approach in a University* compared with the concentration of an *Academic approach from Industry*, is, at least at first glance, an unusual result. We might have reasonable expected here that the emphases would have been reversed in line with the traditional observation that many Industries feel that Universities work in 'an ivory tower'. A second question posed to educators relating to the particular curriculum model that was used in developing QM subjects revealed that all respondents (13) appeared to reject the idea of basing curriculum development upon a particular model. Clearly, there are a number of issues here that we need to reflect upon, and this will be done in section 8.2.1.2.

The second area to be pursued under this section related to the way in which each of our surveyed groups perceived the way in which Business schools were currently responding to the needs of industry (Table 5.1.3 and Table 5.2.1). To allow us to probe more deeply into these perceptions, we posed the four questions detailed above, and asked for individual respondent's ratings on each question. On each of the questions, it was found that there were similar responses from business employers for the two surveys in 1995 and 1999, and these responses were comparable to those of the business educators.

In the areas of liaison with employers and professional bodies ('Adequately'), the structure and content of undergraduate courses ('Adequately'), and research design and development activity ('Adequately'), both groups appeared to agree that the response of the business school to the needs of industry was at an acceptable level but that there was certainly room for improvement. In contrast, both groups perceived that the provisions made for academic staff development and industrial experience was only 'Fair'. Whilst it is interesting for us to note the concordance in the drop of perception of how well provisions are made for staff development, the causes for these perceptions are not so easily determined. We reflect upon this finding later, in the context of other observations made by the two groups.

Regarding the preparedness for the work place of undergraduate business students in the Quantitative Methods area, it was found that there was a statistically significant difference in response between the two groups. In this instance, however, it was not that a difference in perception existed that was surprising, it was in the *nature of the individual responses*. It was the VUT educators who believed that their business students were 'not adequately' prepared (Table 5.2.2), whilst business employers found these students to be 'just' adequately prepared (Table 5.1.4) in this area. As in the situation that arose in investigating the nature of the curriculum model, we might have expected from general experience that it would have been the business employers who were concerned with the level of preparation of the students.

Given the general level of agreement between the two groups on questions to this point, it is somewhat of a surprise to see that there is a substantial difference (statistically) between educators' and employers' choices regarding their opinions on the best quantitative program educational program for a quantitative graduate career. We have shown that educators believe the best Quantitative educational preparation for a business graduate's career is for *education to be more practically oriented*, with more case studies involved (Table 5.2.3). In contrast, employers considered *work experience* whilst going through university is most important (Table 5.1.5). We note here that employers recognise that in the current graduates' educational preparation, some work experience is incorporated in the course so that students will have some chance to relate their first employment experience to what has been taught at university. However, their perception clearly is that there should be a change of focus on this aspect of the curriculum.

Finally, we thought it important to gauge how Business employers were prepared to support business schools, since this is an indirect measure of the level of satisfaction of employers with the current standard of graduate from business schools (Table 5.1.6). The options given in the Table indicate that employers were very keen to encourage their own employees to attend postgraduate courses, and, further, were willing to provide financial support to those who attend. We interpret this as being consistent with the earlier finding that the employers were satisfied with the content of Quantitative Methods courses. Also consistent with employers earlier views on the best style of Quantitative Methods education, we found that employers were also willing to provide vacation work experience for students, give scholarships to Quantitative Methods students, and are willing to participate in staff exchange between industry and the business schools. However, they are not very keen on providing financial support for research projects, or making donations for equipment and facilities.

8.2.2 Reflections

In the transmission of academic skills, the nature of the curriculum is clearly of prime importance, which has led us to begin this section of the investigation with some general considerations of what key stakeholders perceive to be an appropriate model for today's situation. However, as the responses have indicated, there appears to be some distinctly different ideas on theoretical curriculum models between the business employers and the educators. In addition, the practical translation of material into a curriculum poses another difficulty, as educators reject the notion of a particular curriculum model that can be used in developing QM curricula.

In trying to understand these responses, we noted that the VUT, as the name indicates, is a University of 'Technology' that had evolved from the Footscray Institute of Technology, a College of Advanced Education. We should note at this point that many of Australia's universities have had a similar transformation, an observation that will allow us to suggest later that results of this case study at VUT may be able to be applied more generally across the country. The vocational roots of VUT, and other similar Institutions, may explain why business educators at VUT voted for the Technological approach to curriculum development. Support for this notion is found in the literature review, where Paul Casey talked about the 'vocational mission of the university's which insisted that students, when they graduated, would immediately be able to be employed. Thus it is not improbable that the 'tribal memory' of the Technological genesis of the Quantitative Methods course is still imprinted within the area. The mechanism for this carry-over is, in fact, not hard to find. When educators rejected (100%) the idea of a particular curriculum model being used for developing Quantitative Methods subjects, they were echoing the reports that we had found from other Higher Education Institutes suggesting that curriculum writers often developed their work 'on a combination of what they had been taught and what other universities seemed to be doing'.

It is our contention that a tacit structural tension regarding the nature of the curriculum may be possible between the stakeholders. If the majority of Australian business industry considered the Academic approach as an appropriate direction for today's Quantitative

Methods area, then business educators at VUT may need to rethink their curriculum development approach otherwise the training of business graduates at VUT in particular may not meet the expectations of employers. In the worst case, this might reflect badly on the university's response to industry, and disadvantage its graduates, in terms of employment opportunities and the University's prestige in the business community. On the other hand, the reference that curriculum developers have to the procedures in other universities, through the medium of published textbooks, is a useful touchstone for more global practice. It might be, paradoxically, in the best interests of students not to have a curriculum too focused upon the needs of local industry, but to have a wider intellectual experience that will allow them more options in the future.

With regard to business education and its response to the needs of industry, both Quantitative Methods educators and business employers are aware that the relations between university and business community are only 'Adequate'. We believe it is important that the two groups are able to communicate ideas effectively regarding the content and nature of Quantitative Methods education, and for this to occur, opportunities for regular contact must exist. One of these opportunities is through the provision of academic staff development and industrial experience, and we suggest that there may be a moderating effect on the level of liaison between the groups if this latter provision is observed to be lacking. The depth of concern is, clearly, not critical here as the structure and content of the course and the research design and development activity, both of which will also impact on meeting the needs of industry, are perceived as being adequate. Nevertheless, clear channels of communication for exchange of professional ideas are essential in upgrading a course. In order to design an effective, efficient and appropriate curriculum that meets the needs of business it may be a perception that business staff requires increased opportunity to gain regular industrial experience.

The level of preparation of business students in Quantitative Methods area is quite important and the finding that educators and employers disagreed on the level of preparation is of serious concern. Interestingly, more light was thrown on this question during discussions with Quantitative Methods educators during the personal interviews. It appears that, in general, business educators' perceptions of why they have higher expectations of their students' abilities is that the business educators themselves are being continually exposed to different developments in Quantitative Methods such that they are more aware of the latest techniques, they want to present sophisticated tools of theory testing to students, and they see their main responsibility is to prepare graduates and train them with advanced Quantitative Techniques enabling them to work in a range of different work sectors. By comparison, educators see business employers as being more task oriented and are more intent on getting immediate, if relatively unsophisticated results; consequently educators see business employers as perceiving graduates to be relatively well prepared in this area.

The finding that educators tend to place more emphasis in the importance of delivering basic education than work experience appears to be based upon the pragmatic consideration that because a three-year undergraduate course is of such a short duration there is difficulty in organising appropriate work experience for all students. There is certainly no suggestion that educators have rejected work experience as being inappropriate or unhelpful. Perhaps the most important area of agreement here is that both groups suggest that an emphasis of software application skills is more important than an emphasis on teaching a wider range of Quantitative Techniques. Indeed, final-year business students and graduates provided similar responses in that education programs should be more case study based, and work experience reoriented with more emphasis on software applications skills.

8.2.3 Recommendations

It is recommended that:

- *To ensure the curriculum of the business school responds appropriately to the needs of industry, a balanced review of course program curricula in consultation with business employers and other university educators be carried out.*

- *To provide more academic staff development and industrial experience, intensive workshops collaborating with business industry be arranged during the non-teaching period.*

- *The nature of work experience incorporated in the course be further considered so that there will be less tension between perceptions of Case Studies versus Practical Experience between educators and business employers.*

- *Business school actively promotes programs in Quantitative Method that are case study based with an emphasis of software application skills and work experience related to the course taught at university. Short specialist courses could be offered at graduate levels to cater for those who work in business industry and need more in-depth knowledge of a particular area.*

8.3 Section Two - Course Organisation and Teaching Methods

8.3.1 Summary

The study indicated that courses in Quantitative Methods played a critical role in the preparation of business graduates, and that educators have the responsibility to provide education as well as to ensure the courses' contents and structure meet the needs of today's business. The study aimed to elicit the attitudes of Victoria University of Technology's business educators towards various aspects of the undergraduate Quantitative Methods programs in business.

Views on the most appropriate theoretical concept to underpin contemporary Quantitative course curriculum revealed that the majority of business educators in this survey voted for the 'Technological' approach (Table 5.2.8). Only two out of 13 respondents preferred the 'Academic' approach and three respondents believed that a combination of both 'Academic and Technological' approaches are more appropriate in today's curriculum.

It is apparent from Table 5.2.9 that Academic staff in undergraduate business courses at VUT claimed that no particular curriculum model was employed when developing Quantitative Methods subjects. Similar reports were also found in other Higher Education institutes as mentioned in the Literature Review section. This suggests that curriculum writers developed their own curriculum based on a combination of what they had been taught and on what other universities appear to be doing.

For students who entered courses in business Quantitative Methods, there were no prerequisites in mathematics required. Some respondents suggested knowledge of algebra and calculus would be helpful (Table 5.2.10). From the literature review, McAlevey and Sullivan (1992) noted that Calculus appeared as prerequisites in 54% of Australasian undergraduate business statistics subjects.

Except for Business Statistics, the percentage of class time devoted to lectures for each Quantitative Methods subject area by educators ranges from 40 to 70 percent (Table 5.2.11). Discussion took approximately 20 per cent of class time in most subjects, with the exception of Business Statistics and Statistics for Business and Marketing. For student presentations and testing, educators indicated they spent from 20 to 30 percent of class time in subjects such as Business Decision Methods, Economics & Business Analysis, Business Forecasting Methods and Business Decision Analysis. The only subject that required significant practical work, which was 50 per cent of class time, was Statistics for Business & Marketing. Business Statistics is a core subject in first year business courses, and because of the large number of students enrolled; five instructors were involved in this subject. Lecturers also indicated that from 80 to 90 per cent of class time is spent in lecturing and discussion. By comparison, those who were tutors spent from 60 to 85 percent of class time in discussion. Only one tutor expressed a preference for spending 95 percent of class time for student presentation and/or revision, with the remaining 5 per cent being used for testing.

Educators in Quantitative Methods area were asked to indicate which software package was used in their teaching. The results indicated SPSS was the most popular software used in most Quantitative Methods subjects (Table 5.2.13). SPSS was required in first year core subject Business Statistics, whilst in second year, SPSS was required in Statistics for Business & Marketing and Economic & Business Analysis; and SAS was required in Business Decision Methods and Applied Regression Analysis. The only subject that used SPSS in conjunction with EXCEL was Business Forecasting Methods in second year. There was no indication of any software package being required in third year subject Business Decision Analysis.

In this study, final-year students and business graduates reported that subjects in Quantitative Methods area were well-organized in relation to class size, course assessment, case studies and exam format. However, with the 'computing facilities' students reported that some software packages were dated and there was a lack of computer availability for completing case studies and assignments.

8.3.2 Reflections

Quantitative Methods is rapidly changing in the fast growing technology business environment. The present status of the undergraduate business course in Quantitative Methods area at Victoria University of Technology shows that there is a gap between expectations of educators in Quantitative Methods and business employers. This gap is largely measured by the education preparation for business graduates, the employment expectations and the existing contents of Quantitative Methods programs including essential Quantitative Methods topics and skill levels required in industry.

In order to narrow this gap, Quantitative Methods education must continually upgrade and revise its curriculum, especially the Quantitative Methods techniques, to meet the needs of today's business. A number of theories have emerged from the review of the literature. These are the directions or conceptions of curriculum and its models, the educational objectives and methods of instruction. However, before upgrading or revising the curriculum, the designers have to conceptualise what a piece of work is like at the end. In other words, it is essential to be clear about the directions or conceptions of curriculum.

From these, the type of curriculum will determine the style of upgrade that is most appropriate. From the review of literature, the directions or curriculum conceptions are organized into four major areas; these are academic, humanistic, social reconstructionist and technological conceptions. Questions regarding appropriate conceptions in today's Quantitative Methods course curriculum were raised with both business employers in Australia and academic staff at Victoria University of Technology and these were discussed in previous section.

In addition, together with the directions or conceptions of curriculum, its models and taxonomy of educational objectives, various training techniques used in Quantitative Methods classes such as the lecture, tutorials, workshop, team teaching, case study teaching methods and work experience are provided to help with the learning experiences such that they will bring the successful attainment of the course objectives.

Although no prerequisites in mathematics were required in entering undergraduate business courses at VUT, some Quantitative Methods educators suggested prior knowledge in Algebra and Calculus would be an advantage. In order to help non-traditional students make transition into the course easily, it might be helpful to ask students to attend bridging courses in mathematics before the start of the semester.

In relation to the increasing number of full-fee paying students at VUT, bridging courses such as mathematics can ensure a smooth learning adjustment experiences for first year international students in business courses, and can help them to reduce 'statistics anxiety' as well as to set the mood for future Quantitative Methods classes.

One of the significant changes in today's teaching is the involvement of electronic modes of delivery. This means that course material is delivered through computers, and students have access to lecture notes wherever they are at any time convenient to them. On-Line programs are a rapidly growing feature in higher education and are now an integral part of many subjects.

The outcome of the surveys indicated that business employers in Australia required the use of Microsoft Word, Lotus and Excel in business industry. As shown in Table 5.2.13, most Quantitative Methods subjects offered SPSS and SAS software packages to business students. In this respect, students usually gain good exposure to Microsoft Word and its related spreadsheet Excel, in many subjects during the degree. However, the use of SPSS and SAS software for structural programs is a key aspect of current Quantitative Methods courses, and it may be necessary to determine, in more detailed, what statistical software is being used in business. Business educators need to decide on what package should be taught in the course such that the course curriculum is both useful, practical and relevant to business industry, and provides a sound basis for students to develop statistical processes beyond these currently required in business.

8.3.3 Recommendations

It is recommended that:

- *To maintain the course quality for all students and to assist with the successful study of Quantitative Methods subjects, the business school should provide short bridging courses in algebra and calculus for students with non-mathematical academic backgrounds.*

- *To ensure the continuance of the status and teaching quality of the University in the market place, especially in Quantitative Methods area; the business school should ensure their full-fee paying overseas students have entrance requirements equivalent to Australian standards.*

- *Computer software program to be updated regularly in accordance with the curriculum requirements as well as the change in business environment. Further research into what software package(s) is required in each business sector, thus allowing students within their specialized fields to equip themselves with relevant computing skills.*

8.4 Section Three - Course Experience

8.4.1 Summary of Findings

First and second year Quantitative Methods subjects were the most sought after by business students and graduates. All respondents completed 'Business Statistics' as a first year core subject and two other popular selected Quantitative Methods subjects were 'Economic and Business Analysis' and 'Statistics for Business and Marketing' (Table 5.3.13). Course requirements were the main stimulus for both students and graduates to enroll in these subjects. Other reasons included potential future employment, part of a major study and general interest in the field. However, for whatever reason, both students and graduates agreed that Quantitative Methods subjects were not a soft option or easy to pass (Table 5.3.14). The programs were also perceived by both final year students and graduates as difficult, with a mean score of around 3.6 (1=very easy, 5=extremly difficult).

The study revealed that, regarding the supply and demand of graduates with Quantitative Techniques abilities, more than 60 percent of business employers could foresee a shortage in industry in the near future (Table 5.1.9).

Both final-year business students and graduates gave their teachers a rating of above average with regard to their knowledge of current technology (Table 5.3.15) and their competence in guiding students' learning (Table 5.3.16). The overall evaluation of the Quantitative Methods subjects was indicated a rating of 'satisfactory' by both students and graduates (Table 5.3.17). However, both groups emphasized a need to have sufficient numbers of computer laboratories, with suitable computer equipment and adequate funding to ensure up-to-date software programs installed for class use (Table 5.3.22 and Table 5.3.23)

The results showed in Table 5.3.21 that both final-year students and recent graduates indicated in the survey that 'Education should be more case study based' and 'Work Experience oriented', also 'More emphasis on Software Applications Skills' was considered important in the education of Quantitative Methods. It is noted that the survey also indicated that graduates agreed that although they considered themselves as adequately prepared for their professional work, the degree of relevance of Quantitative Methods topics towards their work was below average, mean score of 2.50 (Table 5.3.31).

8.4.2 Reflections

The results of the surveys for both students and graduates showed that Quantitative Methods subjects are among the most frequently required in the business undergraduate curriculum. However, both students and graduates also express that Quantitative Methods programs as difficult and these subjects are not a soft option. In addition, Quantitative Methods subjects are often rated by students as a boring, technical, difficult and confusing. Moreover, first year Business Statistics is a core subject that every business student has to pass. Therefore, it is important to assist students with the learning of this first year core subject and to set mood for future Quantitative Methods classes.

Interviews of business educators at Victoria University of Technology revealed that they have a higher expectation of their students and deliberately try hard to train students with good Quantitative Methods background and this has led to the perception that theses subjects are not easy to pass. In addition, high expectations from educators have led business graduates to achieve high and that is partly why business employers think highly of graduates regarding the Quantitative abilities.

Business employers (approximately 40%) also indicate that there is a shortage in industry in the near future regarding the supply and demand of graduates with Quantitative abilities. Business employers also consider computer capability as high as the trend of Quantitative Methods education is more towards the incorporation of more applications such as case studies and microcomputer usage. Similar preference is also reported in both final-year students and recent graduates that Quantitative Methods education should be more case study based and more emphasis on software applications skills.

Hence, it is essential that sufficient numbers of computer laboratories with up-to-date software programs need to be available to students for the learning experience. As the surveys of students and graduates stressed that computer facility for Quantitative Methods program needs to be fully accessible and software programs frequently updated. That means there should be sufficient computing equipment and appropriate, current update software packages in classroom and the technical support for computer maintenance. Students should also have access to computing labs late hours or weekends if necessary to complete their work assignments. Or there should be a separate room for students doing assignments in their own time without interruptions.

Lecturers at Victoria University of Technology in business degree course are viewed by both students and graduates as competent instructors in both guiding the students' learning and in the knowledge of current technology, and may be because of their competence in the Quantitative Methods area that business educators have higher expectations of students than business employers.

8.4.3 Recommendations

It is recommended that:

- *To attract more students to Quantitative Methods study, more individual assistance and workshops with small groups be offered to those educationally disadvantaged students, as both final-year students and graduates indicated in the study that these subjects were complicated, very technical, academically difficult and not easy to pass.*

- *Educators continue to attend training and development courses to upgrade their computer using knowledge to maintain this excellent teaching guidance.*

- *Computing facilities and software programs should be reviewed and upgraded regularly to prepare students for constant changing technology in business.*

- *Business school, especially educators in Quantitative Methods, meet with students to discuss teaching and learning issues in order to fully understand the obstacles students meet from their viewpoints.*

- *To ensure the quality and relevance of teaching, it is recommended that business schools carry out a study of views of final-year students and recent graduates regularly, perhaps at three-year intervals. Students' and graduates' evaluations of courses should be reviewed regularly to identify the strengths and weaknesses of their courses.*

8.5 Section Four - Cooperation Education / Industrial Experience

8.5.1 Summary of Findings

In a two-part question, respondents were asked to indicate firstly whether they had done the cooperation education year during their courses. Their responses, shown in Table 5.3.24, indicated that 40.4% of students completed their cooperative education year and 59.6% of the respondents completed their courses without having any co-operative education experience. In contrast, out of 60 business graduate respondents, only eight completed their co-operative education. A high percentage of them completed their courses with no co-operation year in between (86.7 %).

Those respondents who had participated in the co-operative program were then asked to reveal their opinions of the nature of their industrial placement. Table 5.3.25 showed that both student and graduate respondents strongly agreed that industrial work experience was valuable, with mean scores of 4.85 and (5.00) respectively, and the industrial placement was well integrated with the academic components of the course (mean scores of 3.55 and (3.75) respectively). However, in relation to Quantitative Methods education topics such as Understanding More Quantitative Methods Concepts and Learning to Tackle Real Problems during their Placement, respondents' responses were not so positive, as both groups have mean scores of *below average*.

Respondents were asked for their opinion on whether prior work experience was an important factor in the performance of graduates when they started work after graduating from university. There appeared to be little equivocation in the responses to this question as the majority of student respondents, 92%, shown in Table 5.3.26, believed that Prior Work Experience played an important role in the performance of graduates when they start work. This opinion is an important one as it supports the view expressed by graduate respondents (91.7%), that is the attainment of this prior work experience is an essential part of Quantitative Methods education.

Respondents were then asked for their opinion on the most acceptable method by which work experience should be obtained. The responses to this question were shown in Table 5.3.27. An analysis of responses showed that both student and graduate respondents believed work experience should be obtained 'as part of undergraduate course', 68.6% and (70.0%) respectively, or during vacation, 17.6% and (20.0%) respectively. Compared with 0% of the graduate respondents, 7.8% of student respondents suggested work experience after the completion of the course but prior to employment, and 5.9% of student respondents and (10.0%) of graduate respondents believed that work experience should be obtained on the job.

In general, the study showed that both final-year students and graduates agreed that work experience played an important role in the performance of graduates when they start work. Both groups also emphasized that this experience should be obtained as part of undergraduate courses but should not be taken after the course completion. However, regarding the cooperation between university and industry, both students and graduates gave a poor rating on this issue, which is not a desirable perspective on the part of the University.

Also, the results of the surveys of business employers and educators at VUT showed that business education schools are not responding well to the needs of industry with respect to 'Liaison with employers and professional bodies'. Ratings ranged from *poorly* to *excellently* with values of 1 to 5 assigned respectively, both business employers and educators gave mean scores of 2.75 and 2.73 respectively. Both final-year business students and graduates also expressed their concerns about the weak link between university and industry.

Respondents were asked for their perceptions of the cooperation between university and industry. The feedback to this question was not encouraging as shown in Table 5.3.28. The responses showed that on the scale of 1 to 5 (1=poorly, 5=excellently), on average the cooperation between business school and industry perceived by business student respondents at VUT was *below average* as reflected in a mean score of only 2.98. Similar responses had also found in the graduates' survey (mean score=2.66).

Of those who had paid work during the term and their work directly related to the use of Quantitative Methods techniques (17), on average these student respondents felt *adequately prepared* for work with Quantitative Methods skills (Table 5.3.30). Results from the study also showed that, on a scale of 1 to 5 on average, business graduate respondents rated themselves as *just enough prepared* for Workforce regarding the Quantitative Methods skills (mean score=3.12). However, when asked if these Quantitative Methods topics taught at school were relevant to their work, their responses were *below average*, with student respondents' mean score of 2.94 and graduate respondents' mean score of only 2.50 as shown in Table 5.3.30.

8.5.2 Reflections

As industrial placement has been proving more difficult to obtain in recent years, co-operative education has moved from a compulsory feature of the course to become an optional program. Although only a small number of graduates participated in this program which had been designed to enable business students to gain practical work experience related to their degree, their responses regarding this work experience were invaluable. Graduates found the placement to be well integrated with the academic components of the courses. Also, they claimed that they had understood more of the Quantitative Methods concepts and had learnt to tackle real problems during this work experience period.

Discussions with Quantitative Methods educators at Victoria University of Technology during the personal interviews stressed that 'Education should be more practically oriented, more case study based', whereas business employers considered ' Practical experience while going through college, work experience oriented' as the most important. However, business educators at Victoria University of Technology seemed to place more emphasis on the teaching theory to students and tend to stay away from 'work experience oriented'. This showed a large gap in opinion between education and business industry.

The benefit of offering work experience as part of the degree course to students is vast. As students learn Quantitative Methods via case study which is practical oriented and then have a chance to apply the techniques during the co-operative education year. These two learning and working experiences complement each other and fulfil the requirements of both educators and business employers. In addition, the working experience can provide an opportunity for students and the organizations to develop a close working relationship in which both students and potential employers can assess each other strengths that might lead to offering a long-term employment in the organization.

Hence it is essential that work experience should be incorporated in the course so that students have the chance to expose to the work related to what have been taught at school. Also, organisation of work experience with potential employers further enhances closer associations between University and industry and closes a gap of expectations between educators and business employers.

8.5.3 Recommendations

It is recommended that:

- *The business school continues to offer work experience as part of the degree course to students and emphasizes that industrial placement is a transition stage between education and real life work to give students idea and be familiar with the working* *environment as well as to get feed back about the relevance of Quantitative Methods techniques taught at school.*

- *To accomplish the mission of business school education, it is recommended that educators look more into this area in order to strengthen the bond between university and business community. This will in turn increase more understanding between two groups and to narrow the expectation gap between business employers and educators regarding Quantitative Methods education.*

- *Closer associations with business employers can further be improved as industry was prepared to support the idea of staff exchange between industry and university. Also, a stronger link may help to ensure that changes in curricula would keep pace with changes in technology in business.*

8.6 Section Five - Employment Expectations & Training

8.6.1 Summary of Findings

Most graduates in this study work in 'Private Business and Industry', in the areas of 'Wholesale & Retail Trade', 'Finance, Property & Business Services' and 'Manufacturing' (Table 5.3.33). With their work positions, these business graduates are likely to work in Sales & Marketing sector, attaining high positions as Managers and Executives. The same industry groups were also found in the employers' survey, with nearly half of business organisations being in the Finance, Property & Business Services, 20 percent belonged to Manufacturing and about ten per cent in Wholesale & Retail Trade (Table 5.3.34). Our statistical test of difference (ANOVA) showed that the means of these main groups (Table 6.1), in relation to Quantitative Methods education, showed no significant difference. Hence, to simplify the analysis, the industry group mentioned in this study refers to the combined results obtained from the sectors listed above.

The majority of business organsations (72.3%) reported that they had no difficulty in recruiting suitable graduates (Table 5.1.17). In relation to the shortage of employees with Quantitative Methods skills, both educators and business employers showed similar preferences of the best ways to overcome these shortages (Table 6.3.7). These include options of 'Train More People' and 'Closer Association between University and Industry'. Other low priority options were 'Bring in Guest Speakers', 'Migration Policies to Attract Overseas Skills' or 'Bring in Overseas Workers'. However, regarding the supply and demand of employees with Quantitative Techniques abilities, more than 60 percent of business employers could foresee a shortage in industry, compared with about 40 per cent who said there would be no shortage at all in the future (Table 5.1.9 and Table 6.2.10).

Both educators and employers were in agreement in areas such as 'criteria in recruiting business graduates' (Table 6.3.4) and 'skills that every business graduate should possess' (Table 6.3.5). Important criteria include Communication skills, Motivation, Maturity, Analytical skills, Flexibility and Adaptability, whereas, Academic Results, Personality, Work Experience and Extracurricular Activities were considered to be less important. With the generic skills, business employers expect every business graduate to have Communication, Motivation and Problem Solving skills. Organisation / Coordination, Data Analysis and Computer Utilization were also considered important. However, Application of Quantitative Techniques was considered as the least important skill. Similar findings were also reported in the educators' and business graduates' surveys.

With regard to specific areas of knowledge, educators and employers showed a substantial difference in their responses (Table 6.3.6). Educators considered Computer Capability, Quantitative Methods and Economics to be the three most important areas that every business graduate should possess, whereas, employers perceived Human Relations, Computer Capability and Accounting as important areas. However, knowledge of the area of Quantitative Methods was ranked as the least important area by business employers, and this might well explain why educators and employers had a different views regarding the Quantitative Methods topics and skill levels that should be required of business graduates. This has discussed in section six. It is also noted that business graduates had similar views to employers about critical areas of knowledge.

During the first year of employment (Table 5.3.38), business graduates were expected to develop in the following areas: Knowledge of Organisation, Interpersonal skills, Self-Management skills and Technical skills. Communication, both oral and written skills, Business Presentation and Broad-Based skills were also considered important in the first year of employment. The same expectation was also found in the report of business graduates relating to their first year employment.

Final-year business students (Table 5.3.30) who undertook Quantitative Methods study and appropriate industrial work at the same time, considered themselves as adequately prepared for their professional work. However, these students indicated that the degree of relevance of Quantitative Methods topics towards their work was below average. Similar results were also found in business graduates' survey (Table 5.3.31).

8.6.2 Reflections

In response to question relating the solution for shortage of employees with Quantitative Methods skills in industry, both educators' and employers' rankings of the suggested strategies were in agreement. Both groups indicated the options of 'Train More People' and 'Closer Association between Industry and Institutes' as the most important factors in overcoming shortages in Quantitative Skilled Employees. The least Important options were 'Bring in Guest Speakers', 'Migration Policies to Attract Overseas skills' and 'Bring in Overseas Workers'. The Spearman's rho hypothesis test statistics also provided strong evidence to conclude that educators' and employers' perceptions were congruent.

As 'Train more people' is considered to be the highest preference, business school might be better off to revise the Quantitative Methods programs that would attract more students or employees seeking further study in this area. In addition, learning activities such as the use of guest speakers and discussion of current events should be used to assist students in preparing for a changing world and to encourage them participate in understanding and analysing current business issues.

The findings of the study clearly indicate that verbal and written communications are vital in first year training of graduates. Whilst it is obvious that every graduate knows how to speak and write, the majority of business graduates, as reported in the graduates' survey, are likely to work in Sales and Marketing sector, attaining high positions as Managers and Executives. These high-ranking positions require managers able to communicate clearly and effectively. Hence, educators developing Quantitative Methods program need to consider 'Communication' subject as part of the course.

Regarding the 'Areas of Knowledge That Every Business Graduate Should Possess', business employers argue that it is essential that people know something about 'Human Relations' upon graduation. If graduates cannot work with other people, then it is a significant barrier to their working efficiency; hence employers place it as the area of highest importance. On the other hand, most educators feel that Human Relationship basic skills can be obtained effectively via working environment as time increases and they also argue that employers in this sample might not be able to represent the general population of employers, and their perspective is influenced strongly by their roles; for example these employers might not be in the area of Quantitative Methods and this leads them to place high importance on skills in 'Human Relations'. It is noted that the explanations from business educators at VUT are only one side of the story, further research needs to take place in the near future to ensure that Quantitative Methods education is relevant to business industry.

8.6.3 Recommendations

It is recommended that:

- *Business graduates are trained with essential Quantitative Methods techniques at High skill levels. This will mean that, in the future, if their roles to be are managers and executives, they will be more aware of these techniques and be able to better communicate with business educators regarding a common approach to meet the needs of Australian industry.*

- *As discussed in section three – Course Experience; since 'Train more people' is considered to be the highest preference, it is recommended that the business school continues promoting Quantitative Methods programs to attract more students so that the number of business graduates with Quantitative Methods skills always meet the demands from industry.*

- *Students are provided with opportunities to work cooperatively such as group assignment or group presentation, to enhance communication skills, to improve critical thinking and to engender problem solving abilities.*

- *Based on the findings of this study, it is recommended that interviews with business employers are necessary to investigate why they perceived 'Human Relations' as the most important area and 'Quantitative Methods' knowledge area as the least important.*

- *Further examination, by the business school, of the degree of relevance of Quantitative Methods topics is needed to ensure the curriculum is useful, practical and relevant to business industry.*

8.7 Section Six - Quantitative Methods Requirements in Industry

8.7.1 Summary of Findings

After investigating whether the contents of existing Quantitative Methods courses include essential topics (Statistical and Mathematical methods) and skill levels that meet the needs of industry, this study indicated that educators at Victoria University of Technology and business employers had significantly different opinions relating to the Quantitative Methods study contents (Table 6.3.8 and Table 6.3.9).

A Two-sample proportions test was carried out to determine if the proportion of *low* or *high* skill levels nominated by educators differs from the proportion of skill levels nominated from business employers. The findings from the study showed that topic on Sampling & Estimation nominated by both groups showed a significantly different proportion, both at *low* and *high* skill levels. Similarly, Hypothesis Testing, Nonparametric Statistics, Linear and Multiple Regression showed a significant difference of proportions between educators and employers. In Mathematics, Elementary Algebra and Multivariate Differential Calculus were the two topics that showed a difference of proportions between educators and business employers at a significant level of 0.10, whereas Linear Programming and Differential Calculus showed a significant difference in proportions at the level of 0.05.

Business graduates also reported that the primary Quantitative Methods topics required in industry were Presentation of Data, Sampling Methods & Estimation and Elementary Probability. In mathematical methods, Functions & Graphs, Mathematics of Finance, Elementary Algebra and Inventory were the most required methods. It is noted that Presentation of Data and Mathematics of Finance were the only methods required by business employers at high skill levels, that is application and synthesis.

Finally, looking forward to over the next five years (Table 5.3.32), more than half of the final year students in this study responded that they would be unlikely to engage in further study in Quantitative Methods, compared to nearly a third of respondents who had the intention to do a further course in the near future.

8.7.2 Reflections

Those Quantitative Methods topics investigated above appear to be only required by business employers at a lower skill level than demanded by educators. In seeking interpretations from educators for this considerable difference in skills requirement, various explanations were given. One of the main reasons was that the university has to provide a general, high level education for all students and to prepare them for the workforce in such a way that whether they end up working in industry or doing research, they should be well-equipped with a number of Quantitative Techniques that can be used when the need arises. Another explanation was that generally these employers were not specifically trained in Quantitative Methods field, and their main interest was obtaining results. In fact, many employers were not fully aware of the Quantitative Techniques available and this may contribute to the reason they tend to require graduates to master these techniques at a lower skill level.

One possible outcome of the reticence on the part of Quantitative Methods graduates to seek further development of their education, may be a relative lack of graduates qualified to assume lecturing positions in the future. Such a situation will clearly make the role of universities more difficult in this area, since the appointment of lecturers now requires a Masters degree or a PhD.

8.7.3 Recommendations

It is recommended that:

- *Educators liaise with business employers with a view to select an appropriate set of Quantitative Methods topics that are relevant to today's business.*

- *Business school maintains the course quality and prepare students both for research environment or working in industry. However, business educators need to continue to ensure that Quantitative Methods curriculum is comprehensive, practical and relevant to business industry and the direction of the curriculum approach is in accordance with business employers' expectations.*

- *Universities and industry cooperate to provide a range of postgraduate awards with the aim of attracting more PhD and Masters completions by Australian students. In addition, allocation of tutorial hours to higher degree students to give incentive to academic teaching life and to support them financially.*

8.8 Final Comments

This study has reinforced the notion that Quantitative Methods are regarded as an important decision making tool in many businesses, and that Quantitative Methods study is perceived as playing a critical role in the preparation of business graduates. Since university educators have, as one of their roles, the responsibility to provide industry with the best-prepared future employees, the university must continually examine its current programs to ensure that the Quantitative Methods study contents and structure meet the needs of today's business.

This study is one contribution to this process. It set out to investigate if there is a gap between the perceptions of business educators and employers with respect to the Quantitative Methods preparation of business students. The outcome of the surveys and interviews which have been analyzed and discussed in this study has resulted in some recommendations for an enhancing effective Quantitative Methods programs in undergraduate business course in Australia. It is suggested that the implementations of the recommendations will lead to a program of study that would more closely meet the needs of industry requirements as well as to narrowing the expectations gap between business employers and educators.

Although the empirical work of this study employed a case study method focusing upon one section of a course at Victoria University of Technology, arguments have been advanced about the similar background and experiences of Victoria University of Technology and other universities in Australia to suggest the contribution of the work is more generally applicable.

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Appendices

Appendix A

History Notes on 'Statistics and Quantitative Studies' at FIT

- The School of Business was established in 1980 and the department of Applied Economics began teaching statistics and quantitative studies from 1981.
- Paul Casey was Head of Department of Applied Economics in 1980.
- Robert Johnson was a senior lecturer in the Business Faculty from 1981-1986.
- Major in Quantitative Studies was introduced in 1989.
- Together Paul Casey and Robert Johnson developed the curriculum for Quantitative Methods in business courses.

Interview Questions

1. Can you check the information above to see if they are correct and make any comment or elaboration ?
2. Who was involved in this quantitative studies curriculum development ?
3. What was your rationale for the introduction of quantitative curriculum ?
4. There are four major groupings of conceptions:

   a) **Academic conception** enhances the individual's intellectual abilities through the study of worthwhile subjects.
   b) **Humanistic conception** is to enhance personal growth.
   c) **Social reconstructionist conception** claims that the school curriculum should effect social reform and help produce a better society for all.
   d) **Technological conception** seeks to produce a more effective and efficient resolution of objectives.

   What specific directions or conceptions of curriculum did you have in mind initially ?

5. Which of the following models had they been based on ?
   a) Rational/objectives models
   b) Cyclical models
   c) Dynamic/interaction models
   d) Other
   (see the attachment - The curriculum Process)

6. How did you begin to make decisions about which content to include ?
7. How did you make decision about the curriculum materials, e.g. textbook, notes?
8. How did you determine number of subjects, level of subjects and assessment ?
9. What were the prerequisite, if any, for students to enter these Quantitative Methods programs ?
10. What kinds of constraints such as time, number of subjects..., place on curriculum you develop ?

Appendix B

Appendix B contains transcript of interview with Paul Casey. The interview was conducted in August 30 1996, 10am, ANZ Collins Street, Melbourne. The interview was recorded and transcribed from a pocket cassette recorder. Following is transcript of the interview:

Interview With Paul Casey
30 August 1996
10am

CV: According to the archives of Victoria University of Technology, the School of Business was established in 1980 and the Department of Applied Economics began teaching statistics and quantitative studies from 1981. You were Head of Department of Applied Economics in 1980. Is this information correct ?

PC: I was appointed as lecturer in Business Statistics in 1969. In 1972, I was promoted to senior lecturer and in 1977, I was promoted to principal lecturer and Head of Department of Applied Economics. The School of Business was established when I first joined FIT. In 1969, I was the only lecturer in statistics. We were a very small group of 9 or 10 in the whole school of business. In my first year I was teaching statistics and I was also teaching Australian Politics because we were just a very small group we had to do a bit of everything, then we started to work on developing a degree course, when I joined there was only a diploma of accounting qualification.

From the time of my appointment, we started to put together a proposal to the Academic Board of Study for a degree course in business and I was the chairman of the group that started to put that course together. We did a lot of consultations, firstly with other universities and colleges around Australia and around the world. We wrote away to all and got information how they structured everything and what the contents their courses were and so on. We also did that with Australian institutions and colleges exist at a time.

What we had to do was to balance the needs, we had to come up with a concept of what a degree in business course should contain, then trying to balance some areas that we need to make decision about what would be the core contents and what would be the options. We had to do at the same time, because we were still operating on a three terms system there, we had to convince the institute that we had to convert to a semester system operation.

The imperative at that time for a degree course was it had to have a major in accounting as compulsory, at that time to get acceptance by Victorian Institute College (VIC), a business course should have a major in accounting, so the accounting people had to come up with at least a 6 semester units for each of the three years which covered the requirements of VIC and also the requirements of the Australian Society of Certified Practising Accountants (ASCPA).

Remember it was very small from the start, so we would not be different departments, we were just 'one' department of business, we had to split into separate departments with separate administrations and so on. We had also to establish what other elements would be core or compulsory elements and other options, so this development of a degree took a while, took 18 months for us to formulate because as you can imagine there was lots of arguments what should be in, what should be compulsory, what should be optional.

Myself, being a statistician, I was pushing hard for the quantitative side of begin, on the other hand there were people who were the sociology, politics were pushing hard for their units to begin. So we came up with a course structure which was virtually made one element of statistics course as a compulsory in the first year, there were two units of accounting, two units of economics, and I think there was one unit of sociology...it's been a long time now...
From then, in the second year 4 of the 8 units were compulsory and that was where people can have options they can go down various paths in the quantitative side, they can do a major in quantitative side or a major in something else, but they still have to do the core accounting in economics second year.

CV: What was your rationale for the introduction of quantitative curriculum ?

PC: The consultations with other universities and colleges, I suppose there was an element of our background in it, what we have done at university ourselves each of us was from different universities, I myself went to Monash, someone else went to Melbourne, some to Latrobe, so different influences, also looking at what other universities and colleges were doing, so everything start to come together, we did believe that each students had to do 2 quantitative units in their degree, one compulsory in the first year basic statistics and one semester unit in their third year, it was part of the accounting subject...

Once we had agreed to that, we were in the position to actually sit down and start to design the courses, so we moved from a committee stage to a sub-committee, where accounting people design their own, the quantitative people were the same, the economics people were the same... but

CV: Who were involved in this quantitative studies curriculum development ?

PC: Just myself, I think Bob Johnson started 2 or 3 years later in 1972. But by that time most of the course development was being done, except the second year units because nobody took the second year units, so we had not done any real development work on second year unit, but the work on basic statistics and the work on the quantitative methods units on third year had been effectively done.

CV: How did you make decisions about which content to include ?

PC: Now the content of those I suppose that grew out alot of what I had done myself at Monash University, I intent to mirror to some degree what the Monash course had. Basic statistics is very standard around the world, there is some basic elements that need to be done so there was't much changes, the third year quantitative unit I concentrate on O.R rather than econometrics, the reason for that is the mathematics is less complex and most of the students were not strong in mathematics therefore econometrics are much more difficult.

Econometrics is much more useful, but Operational Research is more necessary for the accounting and business degree students because it is essentially applied economics with industry applications.

CV: How did you make decisions about the course materials such as textbook ?

PC: What we did we used standard text, and ...It based on what I had used at the university, what I saw other universites and institutions were using, if I saw a book they were using I would get hold a copy of it and have a look at it and you know I still got hundreds of them at home, you go through them and try to select the one which was most used friendly for the students, what used friendly for me were different from what used friendly for the students. At the same time, we decide to develop a series of, uh.. there wasn't any case study but problem books and we did develop those for basic statistics and for quantitative which had problems in them and which had solutions in them, and various titles that were required, that sort of things.

You got to remember at that time, most of the work have to be done manually with the early days of calculators and the very early days of computers if we want to do any thing with computer we have to do it on punch cards and you put them in overnight and get the results or something in the morning.

The calculator was not compulsory at that time, I give you an example of what we set up in a basic statistics laboratory, I got a canon which was the best at that time, it was sort of plugged in type ... but what people were using was slide-rule and manual calculations

In the quantitative area one of the aspect you have to be familiar with the inverse matrix, you have to inverse the matrix 3 x 3 manually, once you get beyond 3 x 3 you have to spend a lot of time, now of course with computer they can invert 15 x 15 for you, so we have to limit the number of variables you can include in the problems, we limit the number of elements in the problems simply because of the calculations.

There were 2 one-hour lectures and 2 one-hour tutorials, that is four hours altogether.

CV: What specific directions or conceptions of curriculum did you have in mind initially when developing the course structure ?

PC: It was academic oriented, but the thing we have to keep in mind all the time was that our students when they graduated, we were not trying only to developing the academic approach thinking, but also a practical approach to doing a job, so our students when they graduated were immediately able to get out and get a job as challenged, so we tend to academic approach with a practical approach, a lot more applications, a lot more problem solvings, to give them sort of experience with problem solving where those at Melbourne University probably would spend a lot more time getting to understand the principal underline accounting, or the principal underline economics or quantitative analysis, we were actually more concerned about giving them problems and problems solving, so I say certainly academic but with a bias towards ability to get a job fairly quickly.

No work experience at that time, only a three-year course, more than half students were part-time students, why, that's the nature of the western suburb they have to get out and get a job, a lot of them can't afford to come full-time university, so they go and get a job and come along in the evenings.

The major in quantitative study was there right from the original conception of the degree, but it wasn't taught for a while, because being an option it relied on students ought into to take it and when I left in 1979 no student were ought to take the quantitative major, but it certainly was there and had been approved. The degree course was introduced in 1972 or 1973 I think ! That was accounting degree, the only degree was accepted at that time.

CV: Which of the following models did you base on when you develop the course ?

a) Rational/Objectives Models
b) Cyclical Models
c) Dynamic/Interacyion Models
d) Other

PC: No particular model, we essentially based on what others doing, I supposed the closest one would be the Walker model which is the Dynamic/interaction models.

CV: What were the prerequisite for students to enter these quantitative courses ?

PC: No mathematics prerequisite, only need good marks to enter basic statistics course...

Appendix C

Appendix C contains a collection of diagrammatic representation of curriculum models described by Print, 1987. Note that these models are on separate pages in the book and are then put together on the same page for the purpose of general viewing.

- Rational models, such as those of Tyler and Taba, follow a logical, sequential approach to curriculum development. In these models the statement of objectives is very important and the other curriculum elements follow in fixed order.
- Cyclical models are an elaboration of rational models in that they are essentially logical and sequential in approach. However, cyclical models view the curriculum process as a continuous activity that is constantly updating itself. The Nicholls and Wheeler models are examples.
- Dynamic models lie at the other end of the continuum from rational models. Here developers begin with any curriculum element, progress in any sequence of elements, interrelate between elements constantly and tend to relate more directly to perceived learner needs. The Walker and Skilbeck models are essentially descriptive of what happens in school-level curriculum development.

Figure 2.1 Continuum of curriculum models

Rational/objectives models	Cyclical models	Dynamic/interaction models
Tyler Taba	Wheeler Nicholls	Walker Skilbeck

Figure 2.2 **Tyler model of the curriculum process**

Objectives	What educational purposes should the school seek to attain?
↓ Selecting learning experiences	What educational experiences can be provided that are likely to attain these purposes?
↓ Organising learning experiences	How can these educational experiences be effectively organised?
↓ Evaluation	How can we determine whether those purposes are being attained?

Source: After Tyler, 1949

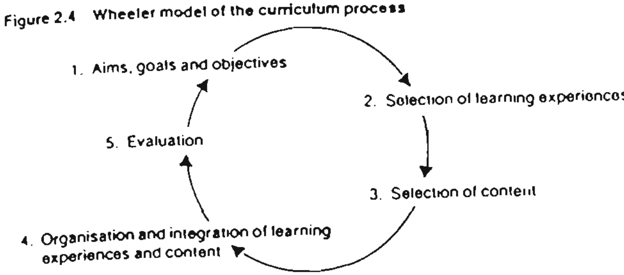
Figure 2.3 **Taba model of the curriculum process**

The order, as Taba perceives it, is

Step 1: Diagnosis of needs
Step 2: Formulation of objectives
Step 3: Selection of content
Step 4: Organisation of content
Step 5: Selection of learning experiences
Step 6: Organisation of learning experiences
Step 7: Determination of what to evaluate and ways and means of doing it

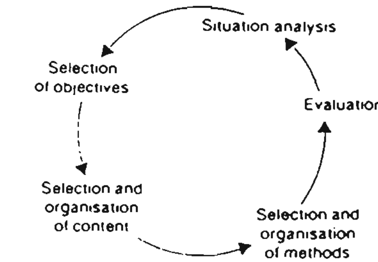
Source: After Taba, 1962

Figure 2.4 **Wheeler model of the curriculum process**



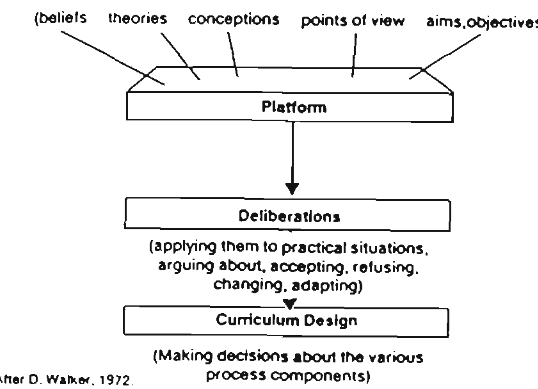
Source: After D.K. Wheeler, 1967

Figure 2.5 **Nicholls model of the curriculum process**



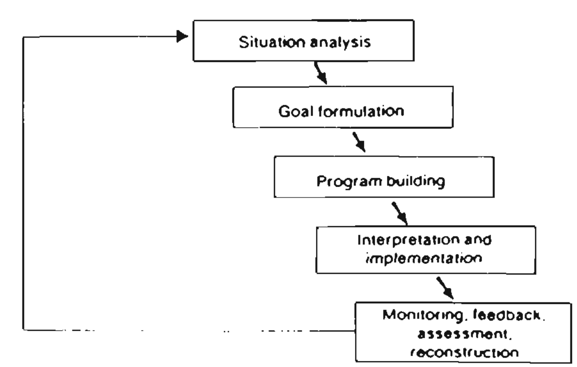
Source: After A. and H. Nicholls, 1978

Figure 2.6 **Walker model of the curriculum process**



Source: After D. Walker, 1972

Figure 2.7 **Skilbeck model of the curriculum process**



Source: After M. Skilbeck, 1976

Appendix D

Appendix D contains the current course structure of Bachelor of Business degree at Victoria University of Technology and this is extracted from a brochure printed by Faculty of Business for the course information in July 1996.

The current course structure of Bachelor of Business Degree at Victoria University

The Faculty of Business at Victoria University of Technology is one of the largest business faculties in Australia. There are twelve courses available and they are developed with the cooperation of the business community to enable students to link theory with practice and to ensure that the courses are relevant to the needs of industry. The course comprises three years of academic study and one year of optional cooperative education. The cooperation education is only compulsory for students of the Catering & Hotel Management, Hospitality & Tourism Management and Tourism Management courses.

Once students follow a particular course, they are required to take a core of seven compulsory business subjects, a sequential major of six designated specialist subjects, three support subjects and eight elective subjects. In the elective subjects, they are required to select another major of six sequential subjects or two minors of four sequential subjects as part of the required degree. It is believed that this structure will allow students to specialize in other business areas. Most of the elective subjects are offered within the faculty, but students are also allowed to take elective subjects offered by other faculties.

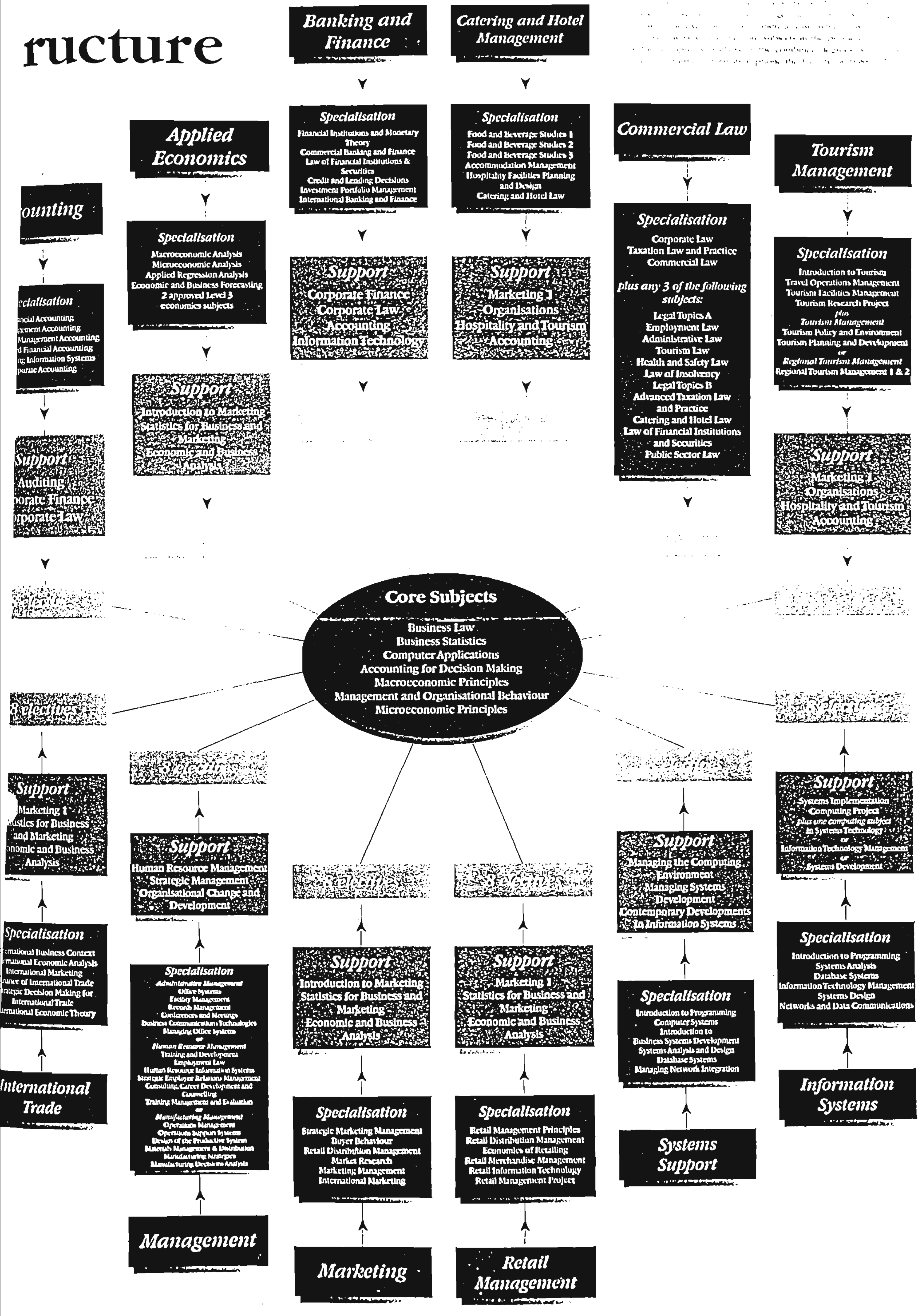
There are approximately twenty majors available in the business faculty, and among these is the Quantitative Studies. To be able to complete a major in this area, students are required to study six statistics and quantitative methods subjects out of seven. Following is the current course structure (1997) of the business program at Victoria University of Technology and the majors available:

Major in Statistics and Quantitative Methods

BEO1106	Business Statistics
BEO2254	Statistics for Business and Marketing
BEO2381	Business Decision Methods
BEO2258	Economic and Business Analysis
BEO2283	Applied Regression Analysis
BEO2284	Business Forecasting Methods
BEO3352	Business Decision Analysis

[redacted]
ructure

Legend



Appendix E

The Development of the Major in Quantitative Studies from 1989 to 1997

The initial seven units in the major study of Quantitative Studies were offered for three years, from 1989 to 1991. However, when Footscray Institute of Technology and Western Institute merged to form Victoria University of Technology in 1990, the course structure of Quantitative Studies was significantly changed. Only two units stayed the same: namely Basic Statistics and Business Decision Making. The other five were replaced by new units with different subject codes.

From 1992 to 1997, the course structure and contents were virtually unchanged, with only the subject codes and names being altered. The aim was to ensure that all campuses across the newly merged university offered the same course and taught the same curriculum (Thompson 1996; FIT/VUT Handbooks 1989-97). The following development of course structures which occurred during this time are illustrated below:

Major in Quantitative Studies

1989-1991

1) AE004
2) AE231
3) AE232
4) AE234
5) AE258
6) AE331
7) AE332

Major in Statistics and Quantitative Methods

1992		1993	1994-1997
8) AE004	----------------	15) BEO/BNO1106	---------22) BEO1106
9) AE253	----------------	16) BNA2253	---------23) BEO2283
10) AE254	----------------	17) BNA2254	---------24) BEO2254
11) AE255	----------------	18) BNA2255	---------25) BEO2381
12) AE258	----------------	19) BNA2258	---------26) BEO2258
13) AE351	----------------	20) BNA3351	---------27) BEO2284
14) AE352	----------------	21) BNA3352	---------28) BEO3352

Notes

1&8	Basic Statistics
2	Advanced Statistics
3	Intro to Quantitative Methods
4	Quantitative Decision Making
5	Business Decision Making
6	Elementary Econometrics
7	Advanced Quantitative Methods
9&16	Econometrics
10,17&24	Statistics for Business & Marketing
11&18	Quantitative Methods 1
12&19	Business Decision Making
13,20&27	Business Forecasting
14&21	Quantitative Methods 2
15&22	Business Statistics
23	Applied Regression Analysis
25	Business Decision Methods
26	Economic & Business Analysis

Appendix F

Appendix F contains the taxonomy of educational objectives by Bloom (1956) which classifies the educational goals into five levels. These levels are illustrated below:

Level 0 The topic is not required.

Level 1 **Awareness** involves the recall of specifics and universals, the recall of methods and processes, or the recall of a pattern, structure, or setting.

Level 2 **Understanding** refers to a type of apprehension such that the individual knows what is being communicated and can make use of the material or idea being communicated without necessarily relating it to other material or seeing its fullest implications.

Level 3 **Application** uses abstractions in particular and concrete situations, breaks down materials into its constituent elements or parts such that the relative hierarchy of parts is made clear and/or the relations between parts are made explicit.

Level 4 **Synthesis** puts parts together to form a whole. This involves the process of working with parts and arranging and combining them in such a way as to constitute a pattern or structure not clearly there before.

Appendix G

Appendix G contains Survey Questionnaire on Business Employers related to the Curricula of Quantitative Methods programs in Tertiary Business Schools. The cover and follow-up letters are also included.

PO Box 14428
MMC
Melbourne
Victoria 3000
Australia

Facsimile
(03) 689 4069

VICTORIA UNIVERSITY OF TECHNOLOGY

9 February 1995

Dear Employer,

This research project is designed to enhance the quality of quantitative courses in tertiary business education.

We would appreciate your assistance in this important project by completing and returning the enclosed questionnaire.

The main purpose of the research project is to determine whether the Australian curricula of quantitative studies of business courses are serving industrial needs. A comparison between the specific contents of business quantitative courses and the expectation from industry will be made to update curricula that are most suited to Australian industrial requirements.

We ask you to complete and return the questionnaire at your earliest convenience, in the reply-paid envelope provided for you. All your answers are kept strictly confidential and no individual or organisation will be identified in the report.

If you have any questions about the filling out of this questionnaire, please do not hesitate to contact me on (03) 688-4618 (W) or 827-2009 (H).

Thank you for your valuable time and your contribution to this significant research project.

Yours Sincerely,

[redacted]

Jo Vu
Department of Applied Economics
Victoria University of Technology
Footscray, Victoria 3011.

Campuses at
Footscray, Melton,
St Albans, Werribee,
and City

Survey of Business Employers 1995

Details of survey respondent:

Name of respondent
Contact phone number
Name of organisation

A. Background Information of Employer

1. In what sector does your organisation belong ?

Private Business & Industry	[ ]
Commonwealth Government	[ ]
State Government	[ ]
Local Government	[ ]
Other (specify)	

2. To which industry group does your organisation belong?

Agriculture, Forestry & Fishing	[ ]
Manufacturing	[ ]
Construction	[ ]
Transport & Storage	[ ]
Finance, Property & Business Services	[ ]
Community Services	[ ]
Mining	[ ]
Electricity, Gas & Water	[ ]
Wholesale & Retail Trade	[ ]
Communication	[ ]
Public Admin & Defence	[ ]
Ownership of Dwellings	[ ]
Recreation, Personal & Other Sevices	[ ]

B. Business Schools and their Curricula

3. How well do you consider business education schools are responding to the needs of industry in Australia with respect to:

(1=Poorly, 2=Fairly, 3=Adequately, 4=Well, 5=Excellently)

		1 2 3 4 5
a.	Liaison with employers & professional bodies	[ ][ ][ ][ ][ ]
b.	The structure & content of undergraduate courses	[ ][ ][ ][ ][ ]
c.	Provisions for academic staff development & industrial experience	[ ][ ][ ][ ][ ]
d.	Research, design & development activity	[ ][ ][ ][ ][ ]

4. How well prepared are undergraduate business students in the Quantitative Methods area?

Not Prepared	[ ]
Fairly	[ ]
Adequately	[ ]
Well	[ ]
Excellently	[ ]

5. Rate in order of importance the best quantitative educational preparation for a quantitative graduate career is:

(1 = Not At All, 2 = Not Too Important, 3 = Important, 4 = Fairly Important, 5 = Very Important)

		1 2 3 4 5
a.	More emphasis on the teaching of a wider range of Quantitative Techniques.	[ ][ ][ ][ ][ ]
b.	Education should be more practically oriented, more case study based.	[ ][ ][ ][ ][ ]
c.	Practical experience while going through college, work experience oriented.	[ ][ ][ ][ ][ ]
d.	More short specialist courses.	[ ][ ][ ][ ][ ]
e.	More emphasis on software applications skills.	[ ][ ][ ][ ][ ]
f.	Other (specify)	

6. Would your organisation be prepared to support business schools in Australia in any of the following ways:

a.	Sponsor students, giving scholarships	[ ]
b.	Make financial donations for equipment/facilities	[ ]
c.	Give financial support for research projects	[ ]
d.	Participate in staff exchanges between industry and the business school	[ ]
e.	Provide vacation work experience for students	[ ]
f.	Provide financial support to employees who attend postgraduate courses	[ ]
g.	Encourage own employees to attend postgraduate courses	[ ]

C. Employment & Training of Business Graduates

7. In the last five years, have you had difficulty in recruiting suitable graduates in Quantitative area?
If Yes please give reason.

8. Please indicate whether you expect the number of graduates employed with Quantitative Techniques in five years time, to be more, less, or stay the same.

More	[ ]
Less	[ ]
Same	[ ]

9. Do you foresee a shortage in industry of employees with Quantitative Techniques abilities, in the future?

No	[ ]	Go to Q13
Yes	[ ]	Go to Q12

10. Rate in order of preference the best ways that shortages can be overcome:

(1 = Worst, 2 = Bad, 3 = Average, 4 = Good, 5 = Best)

	1	2	3	4	5
. Train more people.	[ ]	[ ]	[ ]	[ ]	[ ]
. Employ overseas workers.	[ ]	[ ]	[ ]	[ ]	[ ]
. Migration policies to attract overseas skills.	[ ]	[ ]	[ ]	[ ]	[ ]
. Bring in guest speakers.	[ ]	[ ]	[ ]	[ ]	[ ]
. More quantitative workshops.	[ ]	[ ]	[ ]	[ ]	[ ]
. Higher rewards.	[ ]	[ ]	[ ]	[ ]	[ ]
. Closer association between industry and institutes.	[ ]	[ ]	[ ]	[ ]	[ ]
. Restructuring quantitative development programmes.	[ ]	[ ]	[ ]	[ ]	[ ]
. Other (specify)					

11. Rate in order of importance the criteria you believe are most important in recruiting business students:

(1 = Not At All, 2 = Not Too Important, 3 = Important, 4 = Fairly Important, 5 = Very Important)

Criteria	1	2	3	4	5
. Academic Results	[ ]	[ ]	[ ]	[ ]	[ ]
. Communication skills	[ ]	[ ]	[ ]	[ ]	[ ]
. Analytical skills	[ ]	[ ]	[ ]	[ ]	[ ]
. Personality	[ ]	[ ]	[ ]	[ ]	[ ]
. Motivation	[ ]	[ ]	[ ]	[ ]	[ ]
. Maturity	[ ]	[ ]	[ ]	[ ]	[ ]
. Flexibility / Adaptability	[ ]	[ ]	[ ]	[ ]	[ ]
. Extracurricular activities	[ ]	[ ]	[ ]	[ ]	[ ]
. Work experience	[ ]	[ ]	[ ]	[ ]	[ ]
. Other (specify)					

12. Rate in order of importance the skills that every business graduate should possess:
(1 = Not At All, 2 = Not Too Important, 3 = Important, 4 = Fairly Important, 5 = Very Important)

Skill	1 2 3 4 5
. Communication Skills	[ ][ ][ ][ ][ ]
. Negotiating Skills	[ ][ ][ ][ ][ ]
. Motivation	[ ][ ][ ][ ][ ]
. Organization & Coordination	[ ][ ][ ][ ][ ]
. Data Analysis	[ ][ ][ ][ ][ ]
. Problem Solving	[ ][ ][ ][ ][ ]
. Computer Utilization	[ ][ ][ ][ ][ ]
. Application of Quantitative Techniques	[ ][ ][ ][ ][ ]
. Other (specify)	

13. Rate in order of importance the areas of knowledge that every business graduate should possess:

(1 = Not At All, 2 = Not Too Important, 3 = Important, 4 = Fairly Important, 5 = Very Important)

Areas of knowledge	1 2 3 4 5
. Basic Skills in Management	[ ][ ][ ][ ][ ]
. Human Relations	[ ][ ][ ][ ][ ]
. Computer Capability	[ ][ ][ ][ ][ ]
. Accounting	[ ][ ][ ][ ][ ]
. Economics	[ ][ ][ ][ ][ ]
. Finance	[ ][ ][ ][ ][ ]
. Marketing	[ ][ ][ ][ ][ ]
. Statistics & Quantitative Methods	[ ][ ][ ][ ][ ]

14. Rate in order of importance the areas you aim to develop your new graduates during their first year of employment:

(1 = Not At All, 2 = Not Too Important, 3 = Important, 4 = Fairly Important, 5 = Very Important)

Areas of development	1	2	3	4	5
. Knowledge of organisation	[ ]	[ ]	[ ]	[ ]	[ ]
. Business presentation skills	[ ]	[ ]	[ ]	[ ]	[ ]
. Specific technical skills	[ ]	[ ]	[ ]	[ ]	[ ]
. Oral communication skills	[ ]	[ ]	[ ]	[ ]	[ ]
. Written communication skills	[ ]	[ ]	[ ]	[ ]	[ ]
. Self-management skills	[ ]	[ ]	[ ]	[ ]	[ ]
. Interpersonal skills	[ ]	[ ]	[ ]	[ ]	[ ]
. Broad based skills	[ ]	[ ]	[ ]	[ ]	[ ]
. Other (specify)					

D. <u>Quantitative Topics and Skill Levels Requirements</u>

15. Identify which quantitative topics and skill levels, you as a business employer, desire your employees to have studied:

Skill Levels:
0 = Not Required
1 = Awareness
2 = Understanding
3 = Application
4 = Synthesis

Topics	Level
A. Statistics	
. Presentation of Data	[ ]
. Introduction to Probability	[ ]
. Random Variables & Probability Distributions	[ ]
. Sampling & Estimation	[ ]
. Sampling Methods	[ ]
. Hypothesis Testing	[ ]
. Nonparametric Statistics	[ ]
. Linear Regression & Correlation	[ ]
. Multiple Regression Methods	[ ]
. Bayesian Decision Making	[ ]
. Time Series Analysis & Forecasting	[ ]
. Analysis of Variance	[ ]
. Statistical Quality Control	[ ]
B. Mathematics	
. Elementary Algebra	[ ]
. Functions & Graphs	[ ]
. Matrix Algebra	[ ]
. Growth & Decay	[ ]
. Linear Programming	[ ]
. Nonlinear Programming	[ ]
. Game Theory	[ ]
. Inventory Control: Certainty	[ ]
. Inventory Models: Risk	[ ]
. Queuing Theory	[ ]
. Simulation Models	[ ]
. Network Analysis	[ ]
. Markov Models	[ ]
. Mathematics of Finance	[ ]
. Differential Calculus	[ ]
. Multivariate Differential Calculus	[ ]
. Integral Calculus	[ ]
. Sets & Probability	[ ]
. Differential Equations	[ ]
. Difference Equations	[ ]

3 April 1995

Dear Employer,

A few weeks ago, we sent you the questionnaire relating the quantitative courses in tertiary business education. Perhaps, you either mislaid the questionnaire or it may have been miscarried in the mail.

In any event, we are enclosing another copy of the questionnaire and we ask you again to complete and drop it in the nearest postal box.

We really appreciate your help and your contribution to this research project.

Yours Sincerely,

[redacted]

Jo Vu
Department of Applied Economics
Victoria University of Technology
Footscray, Victoria 3011.

21 September 1999

Dear Employer,

Some five years ago, you kindly participated in our survey regarding the quality of Quantitative Methods courses in our undergraduate business degrees. The survey was intended to determine whether the curricula offered in quantitative studies in these degrees at Victoria University were meeting the expectations of employers of our graduates, and we received some eighty responses at that time.

Because this study has a longitudinal component, we are keen to observe if any changes in employers' perceptions of these courses have occurred over the five-year period. We therefore invite you to again participate in this study, and ask that you complete and return the included survey. A pre-paid envelope has been provided for this purpose. As with the first survey, all responses will be treated as confidential, and no individual or organisation will be identified in the report.

If you have any questions or concerns regarding this survey, please do not hesitate to contact me on 9 688 4618.

Once again we would like to take this opportunity to thank you for your time and contribution to this study.

Yours Sincerely,

[redacted]

Jo Vu

Address for correspondence:
Department of Applied Economics
Victoria University of Technology
Footscray Park
PO Box 14428 Melbourne City
Email: Jo.Vu@vu.edu.au

Survey of Business Employers 1999

Details of survey respondent:

Name of respondent
Contact phone number
Name of organisation

A. Background Information of Employer

1. In what sector does your organisation belong ?

Private Business & Industry	[ ]
Commonwealth Government	[ ]
State Government	[ ]
Local Government	[ ]
Other (specify)	

2. To which industry group does your organisation belong?

Agriculture, Forestry & Fishing	[ ]
Manufacturing	[ ]
Construction	[ ]
Transport & Storage	[ ]
Finance, Property & Business Services	[ ]
Community Services	[ ]
Mining	[ ]
Electricity, Gas & Water	[ ]
Wholesale & Retail Trade	[ ]
Communication	[ ]
Public Admin & Defence	[ ]
Ownership of Dwellings	[ ]
Recreation, Personal & Other Sevices	[ ]

B. Business Schools and their Curricula

3. Which of the following conception is appropriate in today's Quantitative Methods course curriculum?

Academic	[ ]
Technological	[ ]
Humanistic	[ ]
Social Reconstructionist	[ ]

4. How well do you consider business education schools are responding to the needs of industry in Australia with respect to:

(1=Poorly, 2=Fairly, 3=Adequately, 4=Well, 5=Excellently)

		1	2	3	4	5
a.	Liaison with employers & professional bodies	[ ]	[ ]	[ ]	[ ]	[ ]
b.	The structure & content of undergraduate courses	[ ]	[ ]	[ ]	[ ]	[ ]
c.	Provisions for academic staff development & industrial experience	[ ]	[ ]	[ ]	[ ]	[ ]
d.	Research, design & development activity	[ ]	[ ]	[ ]	[ ]	[ ]

5. How well prepared are undergraduate business students in the Quantitative Methods area?

Not Prepared	[ ]
Fairly	[ ]
Adequately	[ ]
Well	[ ]
Excellently	[ ]

6. Rate in order of importance the best quantitative educational preparation for a quantitative graduate career is:

(1 = Not At All, 2 = Not Too Important, 3 = Important, 4 = Fairly Important, 5 = Very Important)

		1 2 3 4 5
a.	More emphasis on the teaching of a wider range of Quantitative Techniques.	[ ][ ][ ][ ][ ]
b.	Education should be more practically oriented, more case study based.	[ ][ ][ ][ ][ ]
c.	Practical experience while going through college, work experience oriented.	[ ][ ][ ][ ][ ]
d.	More short specialist courses.	[ ][ ][ ][ ][ ]
e.	More emphasis on software applications skills.	[ ][ ][ ][ ][ ]
f.	Other (specify)	

7. Would your organisation be prepared to support business schools in Australia in any of the following ways:

a.	Sponsor students, giving scholarships	[ ]
b.	Make financial donations for equipment/facilities	[ ]
c.	Give financial support for research projects	[ ]
d.	Participate in staff exchanges between industry and the business school	[ ]
e.	Provide vacation work experience for students	[ ]
f.	Provide financial support to employees who attend postgraduate courses	[ ]
g.	Encourage own employees to attend postgraduate courses	[ ]

C. Employment & Training of Business Graduates

8. In the last five years, have you had difficulty in recruiting suitable graduates in Quantitative area?
   If Yes please give reason.

9. Please indicate whether you expect the number of graduates employed with Quantitative Techniques in five years time, to be more, less, or stay the same.

More	[ ]
Less	[ ]
Same	[ ]

10. Do you foresee a shortage in industry of employees with Quantitative Techniques abilities, in the future?

No	[ ]	Go to Q13
Yes	[ ]	Go to Q12

11. Rate in order of preference the best ways that shortages can be overcome:

    (1 = Worst, 2 = Bad, 3 = Average, 4 = Good, 5 = Best)

	1	2	3	4	5
. Train more people.	[ ]	[ ]	[ ]	[ ]	[ ]
. Employ overseas workers.	[ ]	[ ]	[ ]	[ ]	[ ]
. Migration policies to attract overseas skills.	[ ]	[ ]	[ ]	[ ]	[ ]
. Bring in guest speakers.	[ ]	[ ]	[ ]	[ ]	[ ]
. More quantitative workshops.	[ ]	[ ]	[ ]	[ ]	[ ]
. Higher rewards.	[ ]	[ ]	[ ]	[ ]	[ ]
. Closer association between industry and institutes.	[ ]	[ ]	[ ]	[ ]	[ ]
. Restructuring quantitative development programmes.	[ ]	[ ]	[ ]	[ ]	[ ]
. Other (specify)					

12. Rate in order of importance the criteria you believe are most important in recruiting business students:

(1 = Not At All, 2 = Not Too Important, 3 = Important, 4 = Fairly Important, 5 = Very Important)

Criteria	1	2	3	4	5
. Academic Results	[ ]	[ ]	[ ]	[ ]	[ ]
. Communication skills	[ ]	[ ]	[ ]	[ ]	[ ]
. Analytical skills	[ ]	[ ]	[ ]	[ ]	[ ]
. Personality	[ ]	[ ]	[ ]	[ ]	[ ]
. Motivation	[ ]	[ ]	[ ]	[ ]	[ ]
. Maturity	[ ]	[ ]	[ ]	[ ]	[ ]
. Flexibility / Adaptability	[ ]	[ ]	[ ]	[ ]	[ ]
. Extracurricular activities	[ ]	[ ]	[ ]	[ ]	[ ]
. Work experience	[ ]	[ ]	[ ]	[ ]	[ ]
. Other (specify)					

13. Rate in order of importance the skills that every business graduate should possess:
(1 = Not At All, 2 = Not Too Important, 3 = Important, 4 = Fairly Important, 5 = Very Important)

Skill	1	2	3	4	5
. Communication Skills	[ ]	[ ]	[ ]	[ ]	[ ]
. Negotiating Skills	[ ]	[ ]	[ ]	[ ]	[ ]
. Motivation	[ ]	[ ]	[ ]	[ ]	[ ]
. Organization & Coordination	[ ]	[ ]	[ ]	[ ]	[ ]
. Data Analysis	[ ]	[ ]	[ ]	[ ]	[ ]
. Problem Solving	[ ]	[ ]	[ ]	[ ]	[ ]
. Computer Utilization	[ ]	[ ]	[ ]	[ ]	[ ]
. Application of Quantitative Techniques	[ ]	[ ]	[ ]	[ ]	[ ]
. Other (specify)					

14. Rate in order of importance the areas of knowledge that every business graduate should possess:

(1 = Not At All, 2 = Not Too Important, 3 = Important, 4 = Fairly Important, 5 = Very Important)

Areas of knowledge	1	2	3	4	5
. Basic Skills in Management	[ ]	[ ]	[ ]	[ ]	[ ]
. Human Relations	[ ]	[ ]	[ ]	[ ]	[ ]
. Computer Capability	[ ]	[ ]	[ ]	[ ]	[ ]
. Accounting	[ ]	[ ]	[ ]	[ ]	[ ]
. Economics	[ ]	[ ]	[ ]	[ ]	[ ]
. Finance	[ ]	[ ]	[ ]	[ ]	[ ]
. Marketing	[ ]	[ ]	[ ]	[ ]	[ ]
. Statistics & Quantitative Methods	[ ]	[ ]	[ ]	[ ]	[ ]

15. Rate in order of importance the areas you aim to develop your new graduates during their first year of employment:

(1 = Not At All, 2 = Not Too Important, 3 = Important, 4 = Fairly Important, 5 = Very Important)

Areas of development	1	2	3	4	5
. Knowledge of organisation	[ ]	[ ]	[ ]	[ ]	[ ]
. Business presentation skills	[ ]	[ ]	[ ]	[ ]	[ ]
. Specific technical skills	[ ]	[ ]	[ ]	[ ]	[ ]
. Oral communication skills	[ ]	[ ]	[ ]	[ ]	[ ]
. Written communication skills	[ ]	[ ]	[ ]	[ ]	[ ]
. Self-management skills	[ ]	[ ]	[ ]	[ ]	[ ]
. Interpersonal skills	[ ]	[ ]	[ ]	[ ]	[ ]
. Broad based skills	[ ]	[ ]	[ ]	[ ]	[ ]
. Other (specify)					

D. Quantitative Topics and Skill Levels Requirements

16. Identify which quantitative topics and skill levels, you as a business employer, desire your employees to have studied:

Skill Levels:
0 = Not Required
1 = Awareness
2 = Understanding
3 = Application
4 = Synthesis

Topics	Level
A. Statistics	
. Presentation of Data	[ ]
. Introduction to Probability	[ ]
. Random Variables & Probability Distributions	[ ]
. Sampling & Estimation	[ ]
. Sampling Methods	[ ]
. Hypothesis Testing	[ ]
. Nonparametric Statistics	[ ]
. Linear Regression & Correlation	[ ]
. Multiple Regression Methods	[ ]
. Bayesian Decision Making	[ ]
. Time Series Analysis & Forecasting	[ ]
. Analysis of Variance	[ ]
. Statistical Quality Control	[ ]

B. <u>Mathematics</u>

. Elementary Algebra	[ ]
. Functions & Graphs	[ ]
. Matrix Algebra	[ ]
. Growth & Decay	[ ]
. Linear Programming	[ ]
. Nonlinear Programming	[ ]
. Game Theory	[ ]
. Inventory Control: Certainty	[ ]
. Inventory Models: Risk	[ ]
. Queuing Theory	[ ]
. Simulation Models	[ ]
. Network Analysis	[ ]
. Markov Models	[ ]
. Mathematics of Finance	[ ]
. Differential Calculus	[ ]
. Multivariate Differential Calculus	[ ]
. Integral Calculus	[ ]
. Sets & Probability	[ ]
. Differential Equations	[ ]
. Difference Equations	[ ]

Appendix H

Appendix H contains Survey Questionnaire on Quantitative Methods Educators at Victoria University of Technology. The cover letter and follow-up letter are also included.

5 August 1998

Dear Colleague,

This research project is designed to enhance the quality of quantitative courses in tertiary business education.

We would appreciate your assistance in this important project by completing and returning the enclosed questionnaire.

The main purpose of the research project is to determine whether the Australian curricula of quantitative studies of business courses are serving industrial needs. A comparison between the specific contents of business quantitative courses and the expectation from industry will be made to update curricula that are most suited to Australian industrial requirements.

We ask you to complete and return the questionnaire at your earliest convenience, in the envelope provided for you. All your answers are kept strictly confidential and no individual or organisation will be identified in the report.

If you have any questions about the filling out of this questionnaire, please do not hesitate to contact me on (03) 9 688 4618.

Thank you for your valuable time and your contribution to this significant research project.

Yours Sincerely,

[redacted]

Jo Vu
Department of Applied Economics
Footscray Campus
Room A503c, Mail Box #77.

30 September 1998

Dear Colleague,

A few weeks ago, I sent you the questionnaire relating the quantitative courses in tertiary business education. Perhaps, you either mislaid the questionnaire or it may have been miscarried in the mail.

In any event, I am enclosing another copy of the questionnaire and I ask you again to complete and drop it in the internal mail box.

I really appreciate your help and your contribution to this research project.

Yours Sincerely,

[redacted]

Jo Vu
Department of Applied Economics
Victoria University of Technology
Footscray Campus
Mail Box #77
Phone Extension: 4618

Survey of Business Educators

A. Academic Background

Your Formal Academic Qualifications

. Highest Qualification:

. Specialized Field or Discipline Area:

a) Business Statistics	[ ]
b) Statistics for Business and Marketing	[ ]
c) Business Decision Methods	[ ]
d) Economic and Business Analysis	[ ]
e) Applied Regression Analysis	[ ]
f) Business Forecasting Methods	[ ]
g) Business Decision Analysis	[ ]

B. Business School and Quantitative Educational Preparation

1. How well do you consider business education schools are responding to the needs of industry in Australia with respect to:

(1 = Poorly, 2 = Fairly, 3 = Adequately, 4 = Well, 5 = Excellently)

		1 2 3 4 5
a.	Liaison with employers & professional bodies	[ ][ ][ ][ ][ ]
b.	The structure & content of undergraduate courses	[ ][ ][ ][ ][ ]
c.	Provisions for academic staff development & industrial experience	[ ][ ][ ][ ][ ]
d.	Research, design & development activity	[ ][ ][ ][ ][ ]

2. How well prepared are our undergraduate business students in the Quantitative Methods area?

Not Prepared	[ ]
Fairly	[ ]
Adequately	[ ]
Well	[ ]
Excellently	[ ]

3. Rate in order of importance the best quantitative educational preparation for a business graduate career is:

(1 = Not At All, 2 = Not Too Important, 3 = Important, 4 = Fairly Important, 5 = Very Important)

	1 2 3 4 5
. More emphasis on the teaching of a wider range of Quantitative Techniques	[ ][ ][ ][ ][ ]
. Education should be more practically oriented, more case study based	[ ][ ][ ][ ][ ]
. Practical experience while going through college, work experience oriented	[ ][ ][ ][ ][ ]
. More short specialist courses	[ ][ ][ ][ ][ ]
. More emphasis on software applications skills	[ ][ ][ ][ ][ ]
. Other (specify)	[ ][ ][ ][ ][ ]

4. Rate in order of importance the criteria you believe are most important in recruiting business students:

(1=Not Al All, 2=Not Too Important, 3=Important, 4=Fairly Important, 5=Very Important)

Criteria	1 2 3 4 5
. Academic Results	[ ][ ][ ][ ][ ]
. Communication Skills	[ ][ ][ ][ ][ ]
. Analytical Skills	[ ][ ][ ][ ][ ]
. Personality	[ ][ ][ ][ ][ ]
. Motivation	[ ][ ][ ][ ][ ]
. Maturity	[ ][ ][ ][ ][ ]
. Flexibility/Adaptability	[ ][ ][ ][ ][ ]
. Extracurricular Activities	[ ][ ][ ][ ][ ]
. Work Experience	[ ][ ][ ][ ][ ]
. Other (specify)	

5. Rate in order of importance the skills that every business student should possess:
(1=Not At All, 2=Not Too Important, 3=Important, 4=Important, 5=Very Important)

Skill	1	2	3	4	5
. Communication Skills	[ ]	[ ]	[ ]	[ ]	[ ]
. Negotiating Skills	[ ]	[ ]	[ ]	[ ]	[ ]
. Motivation	[ ]	[ ]	[ ]	[ ]	[ ]
. Organization & Coordination	[ ]	[ ]	[ ]	[ ]	[ ]
. Data Analysis	[ ]	[ ]	[ ]	[ ]	[ ]
. Problem Solving	[ ]	[ ]	[ ]	[ ]	[ ]
. Computer Utilization	[ ]	[ ]	[ ]	[ ]	[ ]
. Application of Quantitative Techniques	[ ]	[ ]	[ ]	[ ]	[ ]
. Other (specify)	[ ]	[ ]	[ ]	[ ]	[ ]

6. Rate in order of importance the areas of knowledge that every business graduate should possess:
(1 = Not At All, 2 = Not Too Important, 3 = Important, 4 = Fairly Important, 5 = Very Important)

Areas of Knowledge	1	2	3	4	5
. Basic Skills in Management	[ ]	[ ]	[ ]	[ ]	[ ]
. Human Relations	[ ]	[ ]	[ ]	[ ]	[ ]
. Computer Capability	[ ]	[ ]	[ ]	[ ]	[ ]
. Accounting	[ ]	[ ]	[ ]	[ ]	[ ]
. Economics	[ ]	[ ]	[ ]	[ ]	[ ]
. Finance	[ ]	[ ]	[ ]	[ ]	[ ]
. Marketing	[ ]	[ ]	[ ]	[ ]	[ ]
. Statistics & Quantitative Methods	[ ]	[ ]	[ ]	[ ]	[ ]

7. If there is a shortage in industry of employees with Quantitative abilities, rate in order of preference the best ways that shortages can be overcome:

(1 = Worst, 2 = Bad, 3 = Average, 4 = Good, 5 = Best)

	1	2	3	4	5
. Train more people	[ ]	[ ]	[ ]	[ ]	[ ]
. Employ overseas workers	[ ]	[ ]	[ ]	[ ]	[ ]
. Migration policies to attract overseas skills	[ ]	[ ]	[ ]	[ ]	[ ]
. Bring in guest speakers	[ ]	[ ]	[ ]	[ ]	[ ]
. More quantitative workshops	[ ]	[ ]	[ ]	[ ]	[ ]
. Higher rewards	[ ]	[ ]	[ ]	[ ]	[ ]
. Closer association between industry and institutes	[ ]	[ ]	[ ]	[ ]	[ ]
. Restructuring quantitative development programmes	[ ]	[ ]	[ ]	[ ]	[ ]

C. <u>Quantitative Course Organization and Teaching Methods</u>

8. Which of the following conception is appropriate in today's Quantitative Methods course curriculum?

Academic	[ ]
Technological	[ ]
Humanistic	[ ]
Social Reconstructionist	[ ]

9. Is there any particular curriculum model that can be based on when developing Quantitative Methods subjects?

10. Are there any prerequisites in mathematics for students entering business Quantitative Methods programs (please give details)?

11. Indicate the approximate percentage of class time as an instructor devoted to each of the following teaching techniques (please note that these activities should add up to 100%):

	%
a. Lecture	[ ]
b. Discussion	[ ]
c. Student Presentation and/or Recitation	[ ]
d. Testing	[ ]
e. Other (specify)	[ ]

12. Indicate the statistical packages that are required in your discipline area:

	Package Used
a) Business Statistics (e.g. GB-Stat)	
b) Statistics for Business and Marketing	
c) Business Decision Methods	
d) Economic and Business Analysis	
e) Applied Regression Analysis	
f) Business Forecasting Methods	
g) Business Decision Analysis	

D. Quantitative Topics and Skill Levels Requirements

13. Identify quantitative topics and skill levels that are offered and should be achieved by students in your discipline area:

Skill Levels: 0 = Not Required
1 = Awareness
2 = Understanding
3 = Application
4 = Synthesis

I. Statistics

. Presentation of Data [ ]
. Introduction to Probability [ ]
. Random Variables & Prob. Distributions [ ]
. Sampling & Estimation [ ]
. Sampling Methods [ ]
. Hypothesis Testing [ ]
. Nonparametric Statistics [ ]
. Linear Regression & Correlation [ ]
. Multiple Regression Methods [ ]
. Bayesian Decision Making [ ]
. Time Series Analysis & Forecasting [ ]
. Analysis of Variance [ ]
. Statistical Quality Control [ ]

II. Mathematics

. Elementary Algebra [ ]
. Functions & Graphs [ ]
. Matrix Algebra [ ]
. Growth & Decay [ ]
. Linear Programming [ ]
. Nonlinear Programming [ ]
. Game Theory [ ]
. Inventory Control: Certainty [ ]
. Inventory Model: Risk [ ]
. Queuing Theory [ ]
. Simulation Models [ ]
. Network Analysis [ ]
. Markov Models [ ]
. Mathematics of Finance [ ]
. Differential Calculus [ ]
. Multivariate Differential Calculus [ ]
. Integral Calculus [ ]
. Sets & Probability [ ]
. Differential Equations [ ]
. Difference Equations [ ]

Appendix I

Appendix I contains Interview Questionnaire on Quantitative Methods Business Educators at Victoria University of Technology. The cover letter is also included.

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Footscray

Department of
Applied Economics
Faculty of Business

VICTORIA UNIVERSITY OF TECHNOLOGY

1 July 1999

Dear Colleague,

Six months ago you kindly participated in a questionnaire survey regarding the quality of Quantitative Methods courses in our undergraduate business education. The questionnaire was intended to determine whether the curricula of quantitative studies of business courses at Victoria University are serving industrial needs.

A comparison between the contents of Quantitative Methods courses and the expectations from industry was made. The results of the survey showed there were a number of significant differences in response between Academic staff involved in teaching Quantitative Methods and Practitioners who use these methods in their business practice. In order to understand these differences, we would like you to participate in an interview to give your opinion and help us to interpret this difference between Academic and Practitioner's expectations.

In order to prepare for an interview, a copy of the interview questions including a summary of the differences in responses between the two groups is enclosed. Once again, I would like to take this opportunity to say thank you for your participation and I will either ring you or drop into your office to arrange an interview time, at your convenience, which should take no longer than 40 minutes.

Yours Sincerely,

[redacted]

Jo Vu
Department of Applied Economics
Footscray Campus
Room A503c, Mail Box #77
email address: Jo Vu@Bus_AppEco@VUT

Preamble

Some time ago, we carried out a survey of University educators ('Educators') and Business Employers ('Employers') which investigated VUT graduates' preparation in quantitative methods for business purposes. The responses to this survey, which were completed by 13 'Educators' and 65'Employers', have now been collated and statistically analysed using SPSS. We are now examining in detail the outcomes of this analysis. We would like your assistance to interpret some of the differences and apparent contradictions in responses which we have observed.

Interview Guide

Part 1.

For the question

> **How well prepared are our undergraduate business students in the quantitative methods area?**

analysis of the survey responses showed that

Mean response (Educator) = **2.46**
Mean response (Employer) = **3.05**

where 1.00 = 'Not prepared' and 5.00 = 'Excellently prepared'.

A hypothesis test on these mean responses (Mann-Whitney U-test) indicated that **there is a statistically significant difference in response to this question** between the two groups.

We are interested in your interpretation of this difference in responses, particularly since it is educators who are responsible for the quantitative preparation of graduates. Intuitively, one might have expected that if a difference were to be found in the responses to this question, the means of the responses of the two groups would have been reversed.

Question 1.

How would you interpret these findings which suggest that educators think that graduates are less prepared in the quantitative methods area than do Business personnel?

Part 2. On the survey, we also asked the respondents to:

Rank in order of importance the best quantitative educational preparation for a business graduate career

The responses for the two groups are given in the table:

	Ranking	
	Educator	Employer
Education should be more practically oriented, more case study based	1	2
More emphasis on software applications skills	2	3
More emphasis on the teaching of a wider range of Quantitative Techniques	3	4
Practical experience while going through college, work experience oriented	4	1
More short specialist courses	5	5

Analysis of this table using a Spearman rank test indicates that there is a statistically significant difference of the rankings of the two groups. We are interested in your interpretation of the reason for this difference. According to Educators, the most important point in the preparation of business graduates in the quantitative methods area was that 'the education should be more practically oriented, more case study based', whereas business employers considered 'practical experience while going through college, work experience oriented' as the most important.

Question 2.

Why do you think that educators rank aspects of quantitative educational preparation so differently to business employers?

Part 3.

On the survey question `**What areas of knowledge should every business graduate possess?**', the following responses emerged:

Areas of Knowledge	Ranking: Educator	Ranking: Employer
Computer Capability	**1**	2
Statistics & Quantitative Methods	2	8
Economics	3	7
Finance	4.5	4
Human Relations	**4.5**	1
Basic Skills in Management	6.5	5
Marketing	6.5	6
Accounting	8	3

A hypothesis test on these results (Spearman rank), indicated that **there is a statistically significant difference in the rankings** that educators and business employers assign to the areas of knowledge which graduates should possess.

Inspection of the table above indicates that there is a particularly large difference of opinion between the two groups on the need for 'Computer Capability' and 'Human Relations'. This difference, and those between Economics, Accounting and Statistics, represents a fundamental distinction between hardware and people skills. We would like to hear your interpretation of this difference in emphasis placed on these areas by the two groups.

Question 3.

Why do you think there is this difference in perception between educators and business employers of what areas of knowledge are important for business graduates?

Part 4.

In part 3, Educators ranked **Statistics and Quantitative Methods** as the **second most important knowledge area** that every business graduate should possess. However, regarding the importance of skills as shown in the table below, the **Application of Quantitative Techniques** was ranked as the **least important skill.**

Skills	Educators' Ranking
Motivation	1
Communication	2
Organization & Coordination	3
Data Analysis	4.5
Computer Utilization	4.5
Problem Solving	6
Negotiating Skills	7
Application of Quantitative Techniques	8

Question 4.

Why do you think that Educators have indicated that in the Areas of Knowledge, Statistics and Quantitative Methods is important to business graduates, but in terms of Skills they think that the Application of Quantitative Techniques is not so important?

Part 5.

On the survey question relating to the criteria used in recruiting business students, both Educators and Employers ranked **'Work Experience' among the least important criteria** (see table below).

	Ranking	
Criteria	Educator	Employer
Motivation	1	2
Maturity	2	6
Flexibility / Adaptability	3	4
Communication Skills	4.5	1
Analytical Skills	4.5	3
Academic Results	6	7
Personality	7	5
Work Experience	**8**	**8**
Extracurricular Activities	9	9

However, when asked about **the best quantitative educational preparation for a business graduate career**, Employers indicated the course should be **Work Experience oriented**, as shown below:

	Educator	Employer
Education should be more practically oriented, more case study based	1	2
More emphasis on software applications skills	2	3
More emphasis on the teaching of a wider range of Quantitative Techniques	3	4
Practical experience while going through college, work experience oriented	**4**	**1**
More short specialist courses	5	5

Question 5.

With regard to the importance of Work Experience in a business graduate's career, it appears that Business employers responses to these two questions contains a contradiction. Can you see any way in which these responses might be reconciled ?

Part 6.

In the survey, we asked both Educators and Employers to **indicate both the Quantitative Methods topics and skill levels expected of business graduates**. A hypothesis test on these proportion responses (Two Sample Proportions) indicated that **there is a statistically significant difference in response to this question between the two groups.**

We are interested in your interpretation of this difference in responses, as it seemed that Educators expected their students to master certain topics (marked with **bold** on Tables A and B following) at a higher skill level than the Business employers.

Question 6.

How would you interpret these findings which suggest that Employers only desire business graduates to master the indicated topics in general at a lower skill level than Educators (see tables A and B below).

Table A. Statistical Methods required in the Quantitative Methods Subjects at **High** Skill Levels*

	Educator %	Employer %
Presentation of Data	62	53
Introduction to Probability	38	26
Random Variables & Prob. Distributions	54	24
Sampling & Estimation	77	37
Sampling Methods	54	37
Hypothesis Testing	**77**	**22**
Nonparametric Statistics	**54**	**8**
Linear Regression & Correlation	**85**	**18**
Multiple Regression Methods	**62**	**12**
Bayesian Decision Making	23	12
Time Series Analysis & Forecasting	69	33
Analysis of Variance	46	30
Statistical Quality Control	54	33

* Skill Levels

Low level: Awareness and Understanding
High level: Application and Synthesis

Hypothesis test - Two Sample Proportions (at .05 level)

Table B. Mathematical Methods required in the Quantitative Methods Subjects at **High** skill levels

	Educator %	Employer %
Elementary Algebra	54	22
Functions & Graphs	54	39
Matrix Algebra	0	16
Growth & Decay	15	12
Linear Programming	**46**	**12**
Nonlinear Programming	8	12
Game Theory	23	12
Inventory Control: Certainty	31	19
Inventory Model: Risk	23	18
Queuing Theory	23	12
Simulation Models	23	14
Network Analysis	23	14
Markov Models	15	10
Mathematics of Finance	23	37
Differential Calculus	**31**	**10**
Multivariate Differential Calculus	15	8
Integral Calculus	0	12
Sets & Probability	15	16
Differential Equations	0	16
Difference Equations	0	12

Interview With Jim Bates
23 August 1999
4pm

CV: These questions based on the interview guide prepared for academic staff. For question one, how would you interpret these findings which suggest that Academic staff think that graduates are less prepared in the quantitative methods than do Business personnel?

JB: Teachers of Quantitative subjects have a higher expectation of the quantitative needs of business than do business practitioners (see also Q3).

CV: Why do you think that Academic staff rank aspects of quantitative educational preparation so differently to Business practitioners?

JB: I'm not sure they are so different the 1 chosen by academics is about as close as we can realistically get to the 1 chosen by practitioners (note that the word 'practical' appears in both of them). If practitioners provided cadetships consisting of 'sandwich' programs (i.e. mixture of work and study) the 1 selected by practitioners might have some chance of being attained. Being sensible with todays era of mass higher education the academics (chosen) 1 is about as close as I think we could reasonably expect to get.

CV: Why do you think there is difference in perception between the Academic staff and Business practitioners of what areas of knowledge are important for business graduates?

JB: Quantitative studies academic staff in general I would suggest have never worked in 'business', those htat have - probably in a very specialised area of business. Look at the 1, 2 and 3 of academics - I think it tells us alot about 'us' - the question asks about 'every' business graduate, not those going on to reasearch degrees in Economics. I wouldn't mind betting the ranking of Computer Cabability isn't as close as it looks either - what a practitioner means by Computer capability is probably a lot different to what an academic quantitative studies academic means.

CV: Why do you think that Academic staff have indicated that in the Area of Knowledge, Statistics and Quantitative Methods is important to business graduates, but in terms of skills they think that the Application of Quantitative Techniques are Not so important?

JB: Perhaps it's because we are differentiating between practice and theory. We know that the 'bulk' of business graduates will 'never' have to apply the stuff we teach them. How many practising accountants do you think could perform or would need to perform a hypothesis test 'after' graduation?

CV: With regard to the importance of Work Experience in a business graduate's career, it appears that Business practitioners responses to these questions contains a contradiction. Can you see any way in which these responses might be reconciled?

JB: As mentioned in Q2, I think the main point is that both groups think that the best quantitative educational preparation is 'practically' based. By the time practitioners got around to responding this question they probably would have realised that seeking work experience generally in a business graduate is 'pie in the sky' stuff.

CV: How would you interpret these findings which suggest that Practitioners only desire business graduates to master the indicated topics in general at a Lower skill level than Academic staff?

JB: Depending on who the practitioners were I would suspect many would not have much knowledge of what the various topics actually are.
See responses to Q1 and Q3
Note also we are talking here about High Skill levels - see response to Q4.
Personally, I would not place these topics with High skill levels, I think practitioners here are more realistic in relation to an overall picture. Academics expect graduates to master these topics with high skill levels because we want them to achieve high and only a small number of them would benefit from this. It is the end point that graduates go to at the end of their study, say for example, Economics students end up working in the field of Economics that would require higher numerical skills.

Interview With Segu Zuhair
19 August 1999
12 noon

CV: These questions based on the interview guide prepared for academic staff. For question one, how would you interpret these findings which suggest that Academic staff think that graduates are less prepared in the quantitative methods than do Business personnel?

SZ: Academic staff may be unaware of the requirements at the workplace

CV: Why do you think that Academic staff rank aspects of quantitative educational preparation so differently to Business practitioners?

SZ: Most (industry) people believe that what is not used is not important, so they do not look at the potential.

CV: Why do you think there is difference in perception between the Academic staff and Business practitioners of what areas of knowledge are important for business graduates?

SZ: Depends on the 'Practitioner' spoken to; they may not be the people who'd actually employ graduates. Quantitative analysis is only a small part of running a business, i.e. in terms of number of people involved. The people who completed the survey may be someone who is not from the area of Quantitative Methods; and what they don't need they don't feel important. That's why there is a mismatch.

CV: Why do you think that Academic staff have indicated that in the Area of Knowledge, Statistics and Quantitative Methods is important to business graduates, but in terms of skills they think that the Application of Quantitative Techniques are Not so important?

SZ: I really don't know!

CV: With regard to the importance of Work Experience in a business graduate's career, it appears that Business practitioners responses to these questions contains a contradiction. Can you see any way in which these responses might be reconciled?

SZ: What they (Practitioners) mean is the 'skill to do it' not the actual experience. For example, we teach WORDS, the skill of using WORDS, but in the real work situation students might not have to use WORDS.

CV: How would you interpret these findings which suggest that Practitioners only desire business graduates to master the indicated topics in general at a Lower skill level than Academic staff?

SZ: Again it depends on the 'Practitioner' himself, not only these (Quantitative) skills; extended to other skills... most of the skills are learnt on the job training. In Australia, some Executives have no degree, they leran from the job and rise the rank, they don't do much Quantitative skills, and delegate others (from small Quantitative unit) to do the job. That's why Practitioners don't require these skills at higher level.

Interview With Hubert Fernando
12 August 1999
2pm

CV: These questions based on the interview guide prepared for academic staff. For question one, how would you interpret these findings which suggest that Academic staff think that graduates are less prepared in the quantitative methods than do Business personnel?

HF: These are the responses we would have expected, as Academics try hard to train students with good Quantititative Methods background and because we have a high expectation of our students. In reality we have achieved higher than that, that is why Practitioners think high of our graduates and this is a good response, we need not to worry much. Personally, I think we need to put more effort to prepare our students so the rating will be closed to 5 (very well-prepared), but the problem is, I think, the lack of committment on part of some students to put more effort in the study of Quantitative Methods.

CV: Why do you think that Academic staff rank aspects of quantitative educational preparation so differently to Business practitioners?

HF: My personal view is I agree with Practitioners that Work Experience is the most important aspect of Quantitative educational preparation. From my experience, I have tried to get practical experience for my students but it's not easy, so my guess is because Educators see the difficulty in getting practical experience for their students so they place more emphasis on other aspects. Again, it is difficult to get companies to allow students do the work experience.

CV: Why do you think there is difference in perception between the Academic staff and Business practitioners of what areas of knowledge are important for business graduates?

HF: With regards to Quantitative Methods, Academic staff have a better understanding of the needs of industry and organisations. For these techniques in the future, companies must use Quantitaitve Methods to get some advantages of competition. Probably, Practitioners don't appreciate the value of these techniques. With regards to Human Relations, Practitioners are right Academics do not appreciate enough of the importance of Human Relations in the workplace, so we have to train our students better in this area. With regards to Economics, again Academics gave high importance, Pratitioners don't appreciate this; with Accounting, this is a day to day job and need to be done that's why Practitioners place it high, Academics see this (Accounting) doesn't require high intellectual skills.

CV: Why do you think that Academic staff have indicated that in the Area of Knowledge, Statistics and Quantitative Methods is important to business graduates, but in terms of skills they think that the Application of Quantitative Techniques are Not so important?

HF: Firstly, Quantitative Methods is an important area and we train them to be capable of using these techniques. In doing Quantitative Techniques, other skills are also being used. Maybe some (staff) thought that the use of Application of Quantitative Techniques is less, that's why they thought from a practical point of view that Motivation, Communication... are more important. To me, these rankings are all important, the gap between these rankings are insignificant, they are not different...they simply rank them because they are asked to.

CV: With regard to the importance of Work Experience in a business graduate's career, it appears that Business practitioners responses to these questions contains a contradiction. Can you see any way in which these responses might be reconciled?

HF: No contradiction, Practitioners were saying we (Academics) should try to incorporate Work Experience in our courses. When come to recruiting, because (assume that) work experience has been included in the course, Practitioners would then consider other criteria. When recruiting them, a 'raw' graduate dosen't have work experience, so it's unfair to tell graduates to go somewhere and get experience. That's why they don't worry about work experience when come to recruiting students. Simply, we cannot expect the student to have work experience for their first job.

CV: How would you interpret these findings which suggest that Practitioners only desire business graduates to master the indicated topics in general at a Lower skill level than Academic staff?

HF: Practitioners underestimate the practical usefulness of Quantitative techniques; most Practitioners would have done their degrees at different times and these are the current topics we have to train students to master these topics. At the moment, although industry not using these topics, but it is our job to promote these techniques. With Linear Programming, we introduce the whole topic so the whole thinking process can be developed, not so much with day to day basis. Again with other topics, we train them so when the need arises they are equipped themselves with what they already know. Linear Programming and Calculus have specific solutions to specific problems and cannot be applied to all.

Interview With Alan Morris
4 August 1999
2pm

CV: These questions based on the interview guide prepared for academic staff. For question one, how would you interpret these findings which suggest that Academic staff think that graduates are less prepared in the quantitative methods than do Business personnel?

AM: Academics tend to have high expectations about what skills they have and they probably got, in many cases, a wrong view about the level of sophistication of quantitative analysis used in business. Let's say Regression, Practitioners do a demand model test if r square is good , Academics say we have to test the model, take more care whereas Practitioners just think that as long as they can do a regression model. Practitioners are more interested in getting results; Academics are more interested in geeting theory and testing and testing...

CV: Why do you think that Academic staff rank aspects of quantitative educational preparation so differently to Business practitioners?

AM: the main thing is the number one choice is different; if you take that out then the rest looks the same
Where the main difference is Practical experience while going through college, work experience oriented in which Practitioners put as number One and Academics as Four
Academics thought that Practical experience is easy to do, coop year is terrific idea bu tit is hard to get students into it, the placement is the difficult
Personnally, I would put Practical experience as one and two than four...
I think if you take out Practical Experience, then the rankings are exactly the same
In this particular case Academics are shy away from

CV: Why do you think there is difference in perception between the Academic staff and Business practitioners of what areas of knowledge are important for business graduates?

AM: P put Human Relations as number one, A put it as 4.5
I guess that A are what they are, they teach important things all the time, I guess P know that if you don't have certain human relations skills it doesn't matter a damn hell of the things are in the work place
P is saying that is good that people need to know something but if they can't work with other people, they can't communicate then it is a waste
Interestingly, both groups ranked Computer Capability very high and I am a bit surprised is so many Academics put it as number one; I would not put it as number one ... in the top three for sure... they would put their course... I would put Computer Capability along with Communication skills...we communicate internet word process
P considered Human Relations as important because without this skill you cannot do it...

CV: Why do you think that Academic staff have indicated that in the Area of Knowledge, Statistics and Quantitative Methods is important to business graduates, but in terms of skills they think that the Application of Quantitative Techniques are Not so important?

AM: this is hard isn't it? thank you for giving me this question
To me it is a recognition that if you want to do anything scientific you need to know handle some QT you need to understand what statis operation research are about, in a sense that we think... have a feel for statistical arguments, statistical techniques, but it doesn't mean that you have to be an expert to do the job.
Handle accounting problems, knowledge of computers, be able to negotiate, work with others... but they are not going to do any statistical analysis, even that they might see some statistical analysis and have to have an appreciation of what it is about.
Difference between data analysis and Quantitative Techniques here?
people think they need to know something about quantitative methods but they need not to be an expert to do the job
Example, 2000 only one ends up with ABS, most students end up somewhere else and not likely to to do the analysis, need not to be expert in QT

CV: With regard to the importance of Work Experience in a business graduate's career, it appears that Business practitioners responses to these questions contains a contradiction. Can you see any way in which these responses might be reconciled?

AM: I am a bit worried about Academics' ranking because they don't often employ graduates; so we look at Practitioners. Practitioners rank Work Experience as number Eight,
Work Experience is different to Practical Experience while going through college in the sense that Work experience can be any Work experience like a job at Mc Donald or Supermarket, whereas Practical Experience while going through college, work experience oriented here means that there is a connection between the job and the course.
So Practitioners are not contradicting themselves here as these two are different things, that is they rank Practical experience while going through college as the most important in education preparation whereas 'other work experience' do not count because there is no connection between the job and the course.

CV: How would you interpret these findings which suggest that Practitioners only desire business graduates to master the indicated topics in general at a Lower skill level than Academic staff?

AM:

Topic such as Hypothesis Testing: Academics want more formal testing, Practitioners only want to see the results, they just look at the numbers...
Nonparametric Statistics: Practitioners don't know this in the first place
Linear and Multiple Regressions: Academics consider these topics useful for statistical tools, Practitioners have a different concepts, they don't know much about it, alien concepts to a lot of business. Practitioners mistrust the quantification and so on...
Linear Programming: only big sophisticated companies would use this technique
Differential Calculus: this technique need year 12 or VCE maths, it is more important than Integral Calculus, and not many would not do this.

Interview With Kulen
5 August 1999
3pm

CV: These questions based on the interview guide prepared for academic staff. For question one, how would you interpret these findings which suggest that Academic staff think that graduates are less prepared in the quantitative methods than do Business personnel?

KN: Practitioners value more than Academics, the reason is Business Practitioners are Not aware of the latest development in Quantitative Methods techniques than Academics are more aware of those latest developments. Academics feel that stdudents do not get enough materials.

CV: Why do you think that Academic staff rank aspects of quantitative educational preparation so differently to Business practitioners?

KN: For question in part two, what I feel is Practitioners may not be aware of the teaching methods that Academics are using in order to introduce the quantitative techniques. In the teaching methods, we use case study which is more practical oriented and the Practitioners may not be aware of these that is what they feel students should get some practical experience while going through college.

CV: Why do you think there is difference in perception between the Academic staff and Business practitioners of what areas of knowledge are important for business graduates?

KN: Academics feel that the computer cabability could be obtained only in the higher learning institution and also they feel human relationship basic skills could be obtained also in some other subjects. They feel the human relations could be obtained in the working environment as the time increases. Human relations we teach the basics in summer subject, in communication subject but the experience of the human relations could be obtained only in the working place. What we feel is as the time increases the student will become more available with the human relations.

CV: Why do you think that Academic staff have indicated that in the Area of Knowledge, Statistics and Quantitative Methods is important to business graduates, but in terms of skills they think that the Application of Quantitative Techniques are Not so important?

KN: Without the motivation students can't achieve anything in life that is why Academics rank it as number one, and without communication without other skills it is very hard for him to get into the working place he wants to get in. The application of quantitative techniques is ranked low because it is the knowledge that can only apply only in a certain area, whereas other skills such as motivation, communication, organization and coordination apply in a larger area.

CV: With regard to the importance of Work Experience in a business graduate's career, it appears that Business practitioners responses to these questions contains a contradiction. Can you see any way in which these responses might be reconciled?

KN: Practitioners rank the Practical Experience as the highest one, the reason is when a student is exposed to the work related to what he studies, it gives him some sort of motivation with some sort of encouragement to his study; but he has to communicate at high level in order to achieve that job. That is what Academics rank motivation as the highest rank. And Practioners rank communication as the highest one because when students go to the workforce and he or she has to communicate with his colleagues and also with people who are working with him so communication skill is an very important for the practitioners. So what I can see is motivation and communication skills are important for the student and the motivation gives some encouragement for the students to do the subject.

CV: How would you interpret these findings which suggest that Practitioners only desire business graduates to master the indicated topics in general at a Lower skill level than Academic staff?

KN: Academics rank higher in hypothesis testing, nonparametric statistics, regressions... compared to Practitioners because University is the place to train students for industry as well as for research. But the research requires more of statistical techniques that is why Academics teach these ones also and because most Academics are doing research and at university reseach are part of their work they have to do research using statistical techniques that is why they gave more important to these ones. University is a place for research and training students, because we dont' know the direction students are going... industry or research, but later on students choose the direction in industry or doing research that is why we teach all these techniques here. But later on if the students go from industry to research then he or she will know all the importance of these techniques. Practitioners only interested in the outcome results.

Interview With Laszlo Konya
10 August 1999
12noon

CV: These questions based on the interview guide prepared for academic staff. For question one, how would you interpret these findings which suggest that Academic staff think that graduates are less prepared in the quantitative methods than do Business personnel?

LK: Practitioners are not well prepared themselves in the Quantitative Methods area, that why they rated students higher in terms of preparation compared to Academics.

CV: Why do you think that Academic staff rank aspects of quantitative educational preparation so differently to Business practitioners?

LK: Academics see the importance of getting practical experience while going through college, but not as important as the education of Quantitative Methods, because it is not the task of the University to deliver work experience. It is the Academics'job to educate students and I think three years education is short enough to complete the course. I don't see any much difference in first option, as both Academics and Practitioners placed high in the importance of Education, the only difference is found in the Work Experience.

CV: Why do you think there is difference in perception between the Academic staff and Business practitioners of what areas of knowledge are important for business graduates?

LK: In this part I don't see significant difference in the ranking of Computer Capability, but for Statistics and Quantitative Methods, Academics ranked this as the second most important area whereas Practitioners ranked it as the last important area. The reason is due to Practitioners are not well trained in Statistics so they don't appreciate these at all. Also, in Accounting Academics see the importance of Accounting whereas Practitioners don't see its importance. With Human Relations, Practitioners showed that they cared more and they placed it as the highest important area, I don't know but I wonder if Practitioners in this smaple would represent the whole population.

CV: Why do you think that Academic staff have indicated that in the Area of Knowledge, Statistics and Quantitative Methods is important to business graduates, but in terms of skills they think that the Application of Quantitative Techniques are Not so important?

LK: There are two things here: the first is that part three and four are different, they are not comparable. In part three it is the areas of knowledge and in part four it is the skills we are talking about; the second thing is within part four, Academics showed inconsistencies such as Data Analysis was ranked at a much higher level than the Application of Quantiative Techniques... and I wonder that we have a small sample of Academics here.

CV: With regard to the importance of Work Experience in a business graduate's career, it appears that Business practitioners responses to these questions contains a contradiction. Can you see any way in which these responses might be reconciled?

LK: Here Practitioners might misundertood the terms: Work Experience and Practical Experience While Going Through College. But still, although Practitioners placed Work Experience among the least important criteria, personnally I see that relevant work experience is important.

CV: How would you interpret these findings which suggest that Practitioners only desire business graduates to master the indicated topics in general at a Lower skill level than Academic staff?

LK: This phenonmenon again related to that Practitioners are not statisticians. These topics are considered to be more difficult compared to others, and because Practitioners are not well trained in this field, they are not familiar with these. Practitioners are not consistent, for example, I don't see if they don't need Hypothesis Testing...then why should they need Probability at all? In table B, Practitioners would not know the difference between Differential Equations and Difference Equations. Imagine our students one day will be Practitioners, they did't learn these topic at school so they would not know about these. I am not surprised that Practitioners put Functions and Graphs as high, and I say they only know the basic Graphs rather than Functions. In general, there are huge gaps between Academics and Practitioners, and Practitioners are not fully aware of Quantitative Techniques available; like Marketing, if consumers don't know about the product then why look for it!

Interview With Inka
28 June 2000
11am

CV: These questions based on the interview guide prepared for academic staff. For question one, how would you interpret these findings which suggest that Academic staff think that graduates are less prepared in the quantitative methods than do Business personnel?

IH: Academic and industrial people have different expectations and students don't apply everything from what they learn. Academic's expectations are according to the norm, theoretical norm, whereas practitioner's expectations base on applications of these Quantitative Methods techniques. Maybe the practitioners link these to their own knowledge or standard, that's why they think graduates highly in the quantitative methods area than the academics.

CV: Why do you think that Academic staff rank aspects of quantitative educational preparation so differently to Business practitioners?

IH: I am more inclined to the practitioners'responses, because what is learnt in practice is more important in the sense that it gives more confidence to students. I personnally think that items 1 and 4 above go together, that is education should be more practically oriented and work experience oriented as these two complement each other.

CV: Why do you think there is difference in perception between the Academic staff and Business practitioners of what areas of knowledge are important for business graduates?

IH: I think Human Relations and Basic Skills in Management are important and should be put together. The reason for the difference in perception between Academic and Practitioners regarding the areas of knowledge is because it depends on who the practitioner is and the job they are doing.

CV: Why do you think that Academic staff have indicated that in the Area of Knowledge, Statistics and Quantitative Methods is important to business graduates, but in terms of skills they think that the Application of Quantitative Techniques are Not so important?

IH: Maybe they think that knowledge is more important because once you have the knowledge then you can apply these techniques if you need it. I think people who response these didn't put too much thought in this, that's why it showss the contradiction.

CV: With regard to the importance of Work Experience in a business graduate's career, it appears that Business practitioners responses to these questions contains a contradiction. Can you see any way in which these responses might be reconciled?

IH: The reason maybe because of the different structures of the questions. This question is exposed differently or with the 'criteria' used in recruiting business students, these are more practical.

CV: How would you interpret these findings which suggest that Practitioners only desire business graduates to master the indicated topics in general at a Lower skill level than Academic staff?

IH: Again, similar to question one these practitioners are not familiar with the benefits of applications of these concepts.

Appendix J

Appendix J contains Survey Questionnaire on Final Year Business Students who enrolled in programs of Quantitative Methods at Victoria University of Technology. The cover letter and follow-up letter are also included.

Footscray (03) 688 4000

PO Box 14428 Facsimile
MMC (03) 689 4069
Melbourne
Victoria 3000
Australia

Telephone
(03) 688 4471
Facsimile
(03) 688 4804

15 March 1999

VICTORIA UNIVERSITY OF TECHNOLOGY

Dear Student,

This research project is designed to enhance the quality of quantitative courses in tertiary business education.

We would appreciate your assistance in this important project by completing and returning the enclosed questionnaire.

The main purpose of the research project is to determine whether the Australian curricula of quantitative studies of business courses are serving industrial needs. A comparison between the specific contents of business quantitative courses and the expectation from industry will be made to update curricula that are most suited to Australian industrial requirements.

We ask you to complete and return the questionnaire at your earliest convenience, in the envelope provided for you. All your answers are kept strictly confidential and no individual will be identified in the report.

If you have any questions about the filling out of this questionnaire, please do not hesitate to contact me on (03) 9 688 4618.

Thank you for your valuable time and your contribution to this significant research project.

Yours Sincerely,

[redacted]

Jo Vu
Department of Applied Economics
Footscray Campus
Room A503c, Mail Box #77.

Survey of Final Year Business Students

A. Details of Your Course

1. Full title of qualification expected when you complete your course

2. Enrolment mode

   . Full-time [ ]
   . Part-time [ ]
   . Other (specify) [ ]

3. How long has it taken you to reach the final year of your course? (please answer as full-time equivalent years)

B. Background Information

4. Age (years) [ ]

5. Sex . Male [ ]
   . Female [ ]

6. Main Language Spoken at Home

   . English [ ]
   . Non-English [ ]

7. Your permanent Residence

   . In Australia [ ]
   . Elsewhere [ ]

8. Method of qualifying to enter the course

   . Year 12 School Certificate [ ]
   . Tertiary Orientation or other bridging course [ ]
   . Partially completed tertiary course [ ]
   . Completed tertiary course [ ]
   . TAFE certificate [ ]
   . Other (specify) [ ]

9. Where did you do your final year of secondary education?

. Government (State) high school [ ]
. Independent school [ ]
. Technical school [ ]
. TAFE college [ ]
. Other (specify) [ ]

10. What was your first preference when you first applied this course?

. Business course [ ]
. Non-business course [ ]

C. Course Experience

11. Which of the following Quantitative Methods subjects have you done?

. Business Statistics [ ]
. Statistics for Business and Marketing [ ]
. Business Decision Methods [ ]
. Economic and Business Analysis [ ]
. Applied Regression Analysis [ ]
. Business Forecasting Methods [ ]
. Business Decision Analysis [ ]

12. What was the main reason that you enrolled in one of those subjects above?

. It was part of course requirements [ ]
. It was interesting [ ]
. It was my major subject [ ]
. It suited my timetable [ ]
. It was a soft option (easy to pass) [ ]
. It was potentially useful to gain employment [ ]
. Other (specify) [ ]

13. How in general would you rate the Academic staff in Quantitative Methods subjects?

a) for their knowledge of current technology

Very Poor				Very Good
[ ]	[ ]	[ ]	[ ]	[ ]

b) for their competence in guiding your learning

Very Poor				Very Good
[ ]	[ ]	[ ]	[ ]	[ ]

14. In general, what is your overall evaluation of your Quantitative Methods subjects?

Very dissatisfied				Very satisfied
[ ]	[ ]	[ ]	[ ]	[ ]

15. Overall in your Quantitative Methods subjects, how satisfied have you been with the following?

	Very dissatisfied				Very satisfied
. Lecture class size	[ ]	[ ]	[ ]	[ ]	[ ]
. Tutorial class size	[ ]	[ ]	[ ]	[ ]	[ ]
. Other (e.g. workshop) class size	[ ]	[ ]	[ ]	[ ]	[ ]
. Number of lecture hours	[ ]	[ ]	[ ]	[ ]	[ ]
. Number of tutorial hours	[ ]	[ ]	[ ]	[ ]	[ ]
. Number of other classes hours	[ ]	[ ]	[ ]	[ ]	[ ]
. Course assessment procedures	[ ]	[ ]	[ ]	[ ]	[ ]
. Exam paper format	[ ]	[ ]	[ ]	[ ]	[ ]
. Computing facilities	[ ]	[ ]	[ ]	[ ]	[ ]
. Text reading material	[ ]	[ ]	[ ]	[ ]	[ ]
. Computer software package	[ ]	[ ]	[ ]	[ ]	[ ]

16. How much emphasis has been given to it in your Quantitative Methods subjects, relating the content of the subjects below:

1 = Little or no emphasis... 5 = A great deal of emphasis

	1	2	3	4	5
. Quantitative Methods skills	[ ]	[ ]	[ ]	[ ]	[ ]
. Software applications skills	[ ]	[ ]	[ ]	[ ]	[ ]
. Calculator application skills	[ ]	[ ]	[ ]	[ ]	[ ]
. Problem solving skills	[ ]	[ ]	[ ]	[ ]	[ ]
. Skills in reading statistical tables	[ ]	[ ]	[ ]	[ ]	[ ]
. Knowledge of interaction between Quantitative Methods and related disciplines	[ ]	[ ]	[ ]	[ ]	[ ]

17. How difficult were the Quantitative Methods subjects in general?

Very easy				Extremely difficult
[ ]	[ ]	[ ]	[ ]	[ ]

18. Rate in order of importance the best quantitative educational preparation for a business graduate career is:

1=not at all, 2=not too important, 3=important, 4=fairly important, 5=very important

	1	2	3	4	5
. More emphasis on the teaching of a wider range of Quantitative Techniques	[ ]	[ ]	[ ]	[ ]	[ ]
. Education should be more practically oriented, more case study based	[ ]	[ ]	[ ]	[ ]	[ ]
. Practical experience while going through college, work experience oriented	[ ]	[ ]	[ ]	[ ]	[ ]
. More short specialist courses	[ ]	[ ]	[ ]	[ ]	[ ]
. More emphasis on software applications skills	[ ]	[ ]	[ ]	[ ]	[ ]
. Other (specify)					

19. Please comment on the Quantitative Methods subjects in general

a) On reflection the best things about the subjects are

b) The worst things about the subjects are

D. Your Industrial Experience/Present Employment and Future Plans

20. Did you complete the cooperative education year?

if Yes, please indicate how much you agree with each of the following statements about your industrial placement.

1 = Strongly disagree... 5 = Strongly agree

	1	2	3	4	5
(a) Industrial work experience is generally valuable	[ ]	[ ]	[ ]	[ ]	[ ]
(b) My industrial placement was well integrated with the academic components of the course	[ ]	[ ]	[ ]	[ ]	[ ]
(c) During my placement, I learnt to tackle real Quantitative Methods problems	[ ]	[ ]	[ ]	[ ]	[ ]
(d) I understand more of Quantitative Methods concepts than from the course work	[ ]	[ ]	[ ]	[ ]	[ ]

21. Do you think that prior work experience plays an important role in the performance of graduates when they start work?

. Yes [ ] Go to 22
. No [ ] Go to 23

22. When do you think this work experience should be obtained?

. As part of undergraduate course [ ]
. Vacation employment as part of undergraduate course [ ]
. After graduation as part of the course [ ]
. On the job [ ]

23. How well is the cooperation between business schools and the industry?

Poorly			Excellently	
[ ]	[ ]	[ ]	[ ]	[ ]

24. Are you currently employed during term?

. Yes [ ] Go to Q25
. No [ ] Go to Q26

25. If you have had paid work during term, in general is that work directly related to the use of Quantitative Methods?

if Yes,

a) how adequately are you prepared in terms of Quantitative Methods skills?

Not Prepared				Very Well Prepared
[ ]	[ ]	[ ]	[ ]	[ ]

b) to what degree are the Quantitative Methods topics taught relevant to your work?

Not Relevant				Extremely Relevant
[ ]	[ ]	[ ]	[ ]	[ ]

26. Looking forward over five to ten years, are you likely to engage in further study in Quantitative Methods after the completion of the degree(s) for which you are now enrolled?

Thank you for your assistance.

PO Box 14428
MMC
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Australia

Facsimile
(03) 689 4069

Telephone
(03) 688 4471

Facsimile
(03) 688 4804

VICTORIA UNIVERSITY OF TECHNOLOGY

12 April 1999

Dear Student,

A few weeks ago, we sent you the questionnaire relating the quantitative courses in tertiary business education. Perhaps, you either mislaid the questionnaire or it may have been miscarried in the mail.

In any event, we are enclosing another copy of the questionnaire and we ask you again to complete and drop it in the nearest postal box.

We really appreciate your help and your contribution to this research project.

Yours Sincerely,

[redacted]

Jo Vu
Department of Applied Economics
Victoria University of Technology
Footscray, Victoria 3011.

Appendix K

Appendix K contains Survey Questionnaire on Business Graduates who completed business degree courses in Quantitative Methods at Victoria University of Technology and now currently working in industry.

PO Box 14428
MMC
Melbourne
Victoria 3000
Australia

Facsimile
(03) 689 4069

VICTORIA UNIVERSITY OF TECHNOLOGY

27 September 1999

Dear Graduate,

My name is Jo Vu, and I am a Ph.D. student in the Faculty of Business at VUT. As part of my research studies, I am interested in determining whether the curricula of Quantitative Methods studies in the Business courses at VUT are meeting the expectations of our graduates and their employers. One outcome of this work will be that VUT will be able to more confidently update the current curricula so that they are more closely suited to the needs of Australian business organisations.

To help you express your viewpoint and share your experiences as a graduate of VUT, we invite you to participate in this study by completing the enclosed survey. A pre-paid envelope has been provided for this purpose. All responses will be treated as confidential, and no individual or organisation will be identified in the final report.

I would like to take this opportunity to thank you for your time and contribution to this survey and if you have any questions or concerns regarding this survey, please do not hesitate to contact me on 9 688 4618.

Yours sincerely,

[redacted]

Jo Vu
Department of Applied Economics
Footscray Park campus
Room A503c, Phone 9688 4618
Email address: Jo.Vu@vu.edu.au

Survey of Business Graduates

A. Details of Your Degree Course

1. Full title of qualification

   ____

2. Your particular field of specialisation

   ____

3. Enrolment mode

   . Full-time [ ]
   . Part-time [ ]
   . Other (specify) [ ]

4. How long has it taken you to complete your degree course? (please answer as full-time equivalent years)

   ____

B. Background Information

5. Age (years) [ ]

6. Gender . Male [ ]
   . Female [ ]

7. Main Language Spoken at Home

   . English [ ]
   . Non-English [ ]

8. Your permanent Residence

   . In Australia [ ]
   . Elsewhere [ ]

9. Method of qualifying to enter the course

   . Year 12 School Certificate [ ]
   . Tertiary Orientation or other bridging course [ ]
   . Partially completed tertiary course [ ]
   . Completed tertiary course [ ]
   . TAFE certificate [ ]
   . Other (specify) [ ]

10. Where did you do your final year of secondary education?

. Government (State) high school [ ]
. Independent school [ ]
. Technical school [ ]
. TAFE college [ ]
. Other (specify) [ ]

11. What was the highest level of mathematics you have attempted when you first applied this course?

. Year 10 [ ]
. Year 11 [ ]
. Year 12 [ ]
. TAFE [ ]
. Degree [ ]
. Other [ ]

C. Course Experience and Industrial Placement

12. Which of the following Quantitative Methods subjects have you done?

. Business Statistics [ ]
. Statistics for Business and Marketing [ ]
. Business Decision Methods [ ]
. Economic and Business Analysis [ ]
. Applied Regression Analysis [ ]
. Business Forecasting Methods [ ]
. Business Decision Analysis [ ]

13. What was the main reason that you enrolled in one of those subjects above?

. It was part of course requirements [ ]
. It was interesting [ ]
. It was my major subject [ ]
. It suited my timetable [ ]
. It was a soft option (easy to pass) [ ]
. It was potentially useful to gain employment [ ]
. Other (specify) [ ]

14. How in general would you rate the Academic staff in Quantitative Methods subjects?

a) for their knowledge of current technology

Very Poor				Very Good
[ ]	[ ]	[ ]	[ ]	[ ]

b) for their competence in guiding your learning

Very Poor				Very Good
[ ]	[ ]	[ ]	[ ]	[ ]

15. In general, what is your overall evaluation of your Quantitative Methods subjects?

Very dissatisfied				Very satisfied
[ ]	[ ]	[ ]	[ ]	[ ]

16. Overall in your Quantitative Methods subjects, how satisfied have you been with the following?

	Very dissatisfied				Very satisfied
. Lecture class size	[ ]	[ ]	[ ]	[ ]	[ ]
. Tutorial class size	[ ]	[ ]	[ ]	[ ]	[ ]
. Other (e.g. workshop) class size	[ ]	[ ]	[ ]	[ ]	[ ]
. Number of lecture hours	[ ]	[ ]	[ ]	[ ]	[ ]
. Number of tutorial hours	[ ]	[ ]	[ ]	[ ]	[ ]
. Number of other classes hours	[ ]	[ ]	[ ]	[ ]	[ ]
. Course assessment procedures	[ ]	[ ]	[ ]	[ ]	[ ]
. Exam paper format	[ ]	[ ]	[ ]	[ ]	[ ]
. Computing facilities	[ ]	[ ]	[ ]	[ ]	[ ]
. Text reading material	[ ]	[ ]	[ ]	[ ]	[ ]
. Computer software package	[ ]	[ ]	[ ]	[ ]	[ ]

17. How much emphasis has been given to it in your Quantitative Methods subjects, relating the content of the courses below:

1 = Little or no emphasis... 5 = A great deal of emphasis

	1	2	3	4	5
. Quantitative Methods skills	[ ]	[ ]	[ ]	[ ]	[ ]
. Software applications skills	[ ]	[ ]	[ ]	[ ]	[ ]
. Calculator application skills	[ ]	[ ]	[ ]	[ ]	[ ]
. Problem solving skills	[ ]	[ ]	[ ]	[ ]	[ ]
. Skills in reading statistical tables	[ ]	[ ]	[ ]	[ ]	[ ]
. Knowledge of interaction between Quantitative Methods and related disciplines	[ ]	[ ]	[ ]	[ ]	[ ]

18. How difficult were the Quantitative Methods subjects in general?

Very easy				Extremely difficult
[ ]	[ ]	[ ]	[ ]	[ ]

19. Rate in order of importance the best quantitative educational preparation for a business graduate career:

1=not at all, 2=not too important, 3=important, 4=fairly important, 5=very important

	1	2	3	4	5
. More emphasis on the teaching of a wider range of Quantitative Techniques	[ ]	[ ]	[ ]	[ ]	[ ]
. Education should be more practically oriented, more case study based	[ ]	[ ]	[ ]	[ ]	[ ]
. Practical experience while going through college, work experience oriented	[ ]	[ ]	[ ]	[ ]	[ ]
. More short specialist courses	[ ]	[ ]	[ ]	[ ]	[ ]
. More emphasis on software applications skills	[ ]	[ ]	[ ]	[ ]	[ ]
. Other (specify)					

20. Please comment on the Quantitative Methods subjects in general

a) On reflection the best things about the subjects are

b) The worst things about the subjects are

21. Did you complete the cooperative education year?

if Yes, please indicate how much you agree with each of the following statements about your industrial placement.

1 = Strongly disagree... 5 = Strongly agree

	1	2	3	4	5
(a) Industrial work experience is generally valuable	[ ]	[ ]	[ ]	[ ]	[ ]
(b) My industrial placement was well integrated with the academic components of the course	[ ]	[ ]	[ ]	[ ]	[ ]
(c) During my placement, I learnt to tackle real Quantitative Methods problems	[ ]	[ ]	[ ]	[ ]	[ ]
(d) I understand more of Quantitative Methods concepts than from the course work	[ ]	[ ]	[ ]	[ ]	[ ]

22. Do you think that prior work experience plays an important role in the performance of graduates when they start work?

. Yes [ ] Go to 23
. No [ ] Go to 24

23. When do you think this work experience should be obtained?

. As part of undergraduate course [ ]
. Vacation employment as part of undergraduate course [ ]
. After graduation as part of the course [ ]
. On the job [ ]

24. In your opinion how well is the cooperation between our business school and the industry?

Poorly Excellently
[ ] [ ] [ ] [ ] [ ]

D. Employment and Expectations

25. In what sector does your organisation belong?

. Private Buisness & Industry [ ]
. Commonwealth Government [ ]
. State Government [ ]
. Local Government [ ]
. Other (specify) [ ]

26. To which industry group does your organisation belong?

. Agriculture, Forestry & Fishing [ ]
. Manufacturing [ ]
. Construction [ ]
. Transport & Storage [ ]
. Finance, Property & Business Services [ ]
. Community Services [ ]
. Mining [ ]
. Electricity, Gas & Water [ ]
. Wholesale & Retail Trade [ ]
. Communication [ ]
. Public Admin. & Defence [ ]
. Ownership of Dwellings [ ]
. Recreation, Personal & Other Services [ ]

27. What is your job title and in brief, what are your duties?

28. Rate in order of importance the areas of knowledge that every business graduate should possess:

(1 = Not At All... 3 = Important... 5 = Very Important)

Areas of Knowledge	1	2	3	4	5
. Basic Skills in Management	[ ]	[ ]	[ ]	[ ]	[ ]
. Human Relations	[ ]	[ ]	[ ]	[ ]	[ ]
. Computer Capability	[ ]	[ ]	[ ]	[ ]	[ ]
. Accounting	[ ]	[ ]	[ ]	[ ]	[ ]
. Economics	[ ]	[ ]	[ ]	[ ]	[ ]
. Finance	[ ]	[ ]	[ ]	[ ]	[ ]
. Marketing	[ ]	[ ]	[ ]	[ ]	[ ]
. Statistics & Quantitative Methods	[ ]	[ ]	[ ]	[ ]	[ ]

29. Rate in order of importance the skills that every business graduate should possess:

(1 = Not At All... 3 = Important... 5 = Very Important)

Skills	1	2	3	4	5
. Communication Skills	[ ]	[ ]	[ ]	[ ]	[ ]
. Negotiations Skills	[ ]	[ ]	[ ]	[ ]	[ ]
. Motivation	[ ]	[ ]	[ ]	[ ]	[ ]
. Organization & Coordination	[ ]	[ ]	[ ]	[ ]	[ ]
. Data Analysis	[ ]	[ ]	[ ]	[ ]	[ ]
. Problem Solving	[ ]	[ ]	[ ]	[ ]	[ ]
. Computer Utilization	[ ]	[ ]	[ ]	[ ]	[ ]
. Application of Quantitative Techniques	[ ]	[ ]	[ ]	[ ]	[ ]
. Other (specify)	[ ]	[ ]	[ ]	[ ]	[ ]

30. In what areas are you expected to develop during your first year of employment?

(1 = Not At All... 3 = Important... 5 = Very Important)

Areas of Development	1	2	3	4	5
. Knowledge of Organisation	[ ]	[ ]	[ ]	[ ]	[ ]
. Business Presentation Skills	[ ]	[ ]	[ ]	[ ]	[ ]
. Specific Technical Skills	[ ]	[ ]	[ ]	[ ]	[ ]
. Oral Communication Skills	[ ]	[ ]	[ ]	[ ]	[ ]
. Written Communication Skills	[ ]	[ ]	[ ]	[ ]	[ ]
. Self-management Skills	[ ]	[ ]	[ ]	[ ]	[ ]
. Interpersonal Skills	[ ]	[ ]	[ ]	[ ]	[ ]
. Broad Based Skills	[ ]	[ ]	[ ]	[ ]	[ ]
. Other (specify)	[ ]	[ ]	[ ]	[ ]	[ ]

31. a) How adequately are you prepared in terms of Quantitative Methods skills?

Not Prepared				Very Well Prepared
[ ]	[ ]	[ ]	[ ]	[ ]

b) To what degree are the Quantitative Methods topics taught relevant to your work?

Not Relevant				Extremely Relevant
[ ]	[ ]	[ ]	[ ]	[ ]

E. Quantitative Techniques in Business

32. Identify Quantitative Topics and Skill Levels required in your work:

Skill Levels:

0 = Not Required
1 = Awareness
2 = Understanding
3 = Application
4 = Synthesis

Topics	**Level**
A. Statistics	
. Presentation of Data	[ ]
. Introduction to Probability	[ ]
. Random Variables & Probability Distributions	[ ]
. Sampling & Estimation	[ ]
. Sampling Methods	[ ]
. Hypothesis Testing	[ ]
. Nonparametric Statistics	[ ]
. Linear Regression & Correlation	[ ]
. Multiple Regression Methods	[ ]
. Bayesian Decision Making	[ ]
. Time Series Analysis & Forecasting	[ ]
. Analysis of Variance	[ ]
. Statistical Quality Control	[ ]

B. Mathematics

. Elementary Algebra	[ ]
. Functions & Graphs	[ ]
. Matrix Algebra	[ ]
. Growth & Decay	[ ]
. Linear Programming	[ ]
. Nonlinear Programming	[ ]
. Game Theory	[ ]
. Inventory Control: Certainty	[ ]
. Inventory Models: Risk	[ ]
. Queuing Theory	[ ]
. Simulation Models	[ ]
. Network Analysis	[ ]
. Markov Models	[ ]
. Mathematics of Finance	[ ]
. Differential Calculus	[ ]
. Multivariate Differential Calculus	[ ]
. Integral Calculus	[ ]
. Sets & Probability	[ ]
. Differential Equations	[ ]
. Difference Equations	[ ]

Thank You for your Participation

Appendix L

This appendix contains the statistical test results of the industry groups using software package GBStat.

Hypothesis Testing - ANOVA at 95% level of significance
Null Hypothesis: Means are NOT different between industry groups
Alternative: Means are different between industry groups

Conclusion: There is statistically NO significant difference in response between the industry groups

Question number in the survey of employers	Question	F-ratio	F-critical	Conclusion / Comments
Question 5	How well do you consider business education are responding to the needs of industry?	a) F=2.51889 b) F=0.02279 c) F=0.42869 d) F=0.39864	a) F=3.21 b) F=3.21 c) F=3.23 d) F=3.225	Accept Ho
Question 6	How well prepared are undergraduate business students in the Quantitative Methods area?	F=0.33468	F=3.215	Accept Ho
Question 7	The best in Quantitative Educational preparation for a graduate career is:	a) F=2.77564 b) F=1.38575 c) F=0.36354 d) F=1.85981 e) F=1.02882	a) F=3.22 b) F=3.22 c) F=3.22 d) F=3.22 e) F=3.22	Accept Ho
Question 12	The best ways the shortages of employees with Quantitative Techniques abilities are:	a) F=0.89163 b) F=0.92041 c) F=0.14243 d) F=0.48559 e) F=0.05174 f) F=0.73357 g) F=1.17942 h) F=0.10333	a) F=3.26 b) F=3.27 c) F=3.27 d) F=3.27 e) F=3.27 f) F=3.26 g) F=3.26 h) F=3.26	Accept Ho
Question 13	Criteria in recruiting business stduents	a) F=0.59706 b) F=1.19317 c) F=1.94964 d) F=1.66409 e) F=0.12956 f) F=1.4792 g) F=1.21808 h) F=0.15276 i) F=0.30892	a) F=3.195 b) F=3.19 c) F=3.195 d) F=3.195 e) F=3.19 f) F=3.195 g) F=3.19 h) F=3.20 i) F=3.195	Accept Ho

Question 14	Skills that every business graduate should possess	a) F=1.35772 b) F=0.25707 c) F=2.56837 d) F=1.37965 e) F=3.76628* f) F=0.17661 g) F=0.09307 h) F=0.23603	a) F=3.19 b) F=3.19 c) F=3.19 d) F=3.19 e) F=3.19 f) F=3.19 g) F=3.19 h) F=3.19	* Reject Ho at .05 level
Question 15	Areas of knowledge that every business graduate should possess	a) F=1.81352 b) F=0.08474 c) F=0.84256 d) F=2.48728 e) F=0.36965 f) F=2.26694 g) F=0.41691 h) F=0.07823	a) F=3.195 b) F=3.195 c) F=3.195 d) F=3.205 e) F=3.20 f) F=3.205 g) F=3.20 h) F=3.20	Accept Ho
Question 16	Areas aimed to develop new graduates during their first year of employment	a) F=2.86596 b) F=0.66165 c) F=2.86692 d) F=0.34063 e) F=1.56168 f) F=0.572 g) F=0.16324 h) F=0.02884	a) F=3.195 b) F=3.195 c) F=3.195 d) F=3.195 e) F=3.195 f) F=3.195 g) F=3.195 h) F=3.20	Accept Ho

NB: Three main industry groups include Manufacturing, Finance and Wholesale/Retail Trade.

Appendix M

Permission to conduct the research by the Faculty of Business Human Research Ethics Committee. Letter of Approval.

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VICTORIA UNIVERSITY OF TECHNOLOGY
Securing your Future

Associate Professor Lindsay Turner
Department of Applied Economics
Footscray Park Campus

9 September 1999

Dear Lindsay

Project BHREC 99/17: ***Quantitative Requirements in Undergraduate Business Courses: the Case Study of Victoria University***

I am pleased to be able to tell you that the Faculty of Business Human Research Ethics Committee has confirmed the provisional approval given by the Executive to this project.

Best wishes for successful research!

Yours sincerely

[redacted]

(Dr) Jean Dawson
Secretary, Human Research Ethics Committee
Faculty of Business

cc. Associate Professor James Sillatoe
Ms Jo Chau Vu