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ABSTRACT

This report describes the development and application of a model to study the movement of students in, through, and out of higher education in Australia. The model is designed to project the number of students, graduates, and dropouts by age, gender, and broad field of study. The model also estimates the probability of a student completing a program, the average time a student takes to complete a program, and the average time a student stays in the system. Among findings are the following: (1) female students and younger students have a greater probability of completing a program than males or older students; (2) engineering students are least likely and law students most likely to complete their programs; (3) the probability of completing a master's degree is about 67 percent, regardless of age; (4) male students are more likely than female students to complete research degrees; the latter are more likely to complete other graduate programs; and (5) total Australian undergraduate enrollment is projected to increase by 4.8 percent and graduate enrollment by 12.6 percent between 1995 and 2001. Individual sections of the report describe the model's background and structure and the data used in its application. Extensive data analysis tables are included. Two appendices provide additional methodological detail and data analysis. (Contains 19 references.) (DB)

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Chandra Shah and Gerald Burke

Monash University-ACER

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Executive Summary

The report outlines the development of a model to study the movement of students in, through and out of higher education in Australia. It provides a means for projecting the number of students, graduates and dropouts by age, gender and broad field of study. The model also provides estimates of the probability of a student completing a course, the average time a student takes to complete a course and the average time a student stays in the system. Data from the student course enrolment file and completion file that DEETYA maintains are used to estimate the model.

Some general conclusions that can be drawn from the results for Australian undergraduate students are:

- a female student has a higher chance of completing a course than a male student who commences at the same age;
- the probability of completing a course for an Australian student varies from 58 percent for one who commences the course at an age between 25 and 34 years, to 74 percent for one who commences it at an age of 20 years;
- a 20-year-old has the highest chance of completing a course, with the chances for a female being 79 percent and that for a male 69 percent;
- an Engineering student has the least chance of completing a course while a Law student commencing at the same age has the highest chance of doing so (if an analysis of students doing Medicine was possible then we would expect their results to be similar to that for Law);
- a student who commences a course in Business or Engineering at an age of 24 years or more has a 50 percent or less chance of completing it;
- a student who commences a course in Architecture or Science at an age over 29 years has less than 50 percent chance of completing it;
- a female student takes less time, on average, to complete a course than a male student who commences at the same age, with the difference in the times as much as 0.7 years; and
- a student who commences a course at an age of 21 years takes, on average, the shortest time (3.1 years) to complete it.

Some of the variation may be related to the student's mode of study, that is, full-time, part-time or external. Another factor which may affect results is credit transfer from prior courses. These issues could be matters for further research.

The conclusions for postgraduate students are:

- the probability of completing a Research degree varies from 40 percent for someone who commences it at an age of under 23 years to 60 percent for one who commences it at an age of 23 or 24 years;
- the probability of completing a Master's by Coursework degree is almost 67 percent irrespective of the age at which it is commenced;
- the probability of completing an Other Postgraduate course varies from 67 percent for someone who commences it at an age of between 27 and 34 years to 79 percent for one who commences it at an age of under 23 years;
- in general, male students have a better chance of completing a Research degree than female students who commence the degree at the same age;
- female students have a better chance of completing an Other Postgraduate course than male students who commence the course at the same age;
- the mean time to complete a Research degree varies from 4.4 years for those persons who commence it at an age of 25 or 26 years to 6 years for those who commence at an age less than 23 years;
- the mean time to complete a Master's by Coursework degree increases from 2.7 years to 3.1 years as the age at which the student commences the course goes up;
- the mean time to complete an other Postgraduate course increases from 1.5 years to 2.1 years as the age at which the student commences the course goes up; and
- in general, male students take, on average, a shorter time to complete a Research or Master's by Coursework degree than females who commence the course at the same age.

Part of the variation in the results may be explained by field of study. Student's mode of study is another matter for further research. It must be noted that Research degree includes both doctorates and Master's by research, and the reported averages are likely to be underestimates for doctorates and overestimates for Master's by research.

Projections of student intake, total enrolment, course completions and dropouts for undergraduates by sex and field of study up to the year 2001 are presented in the report. Similar projections are made for postgraduate students by level of course but not by field of study. The undergraduate projections show variation by field of study, and that for postgraduates the variation is by level of course.

The undergraduate projections reflect:

- the 1993 to 1994 dynamics of students' progress through the system;
- the demographic changes projected to occur between 1995 and 2001;
- a constant school retention rate as calculated from the 1993 and 1994 school enrolment data;
- a constant proportion, based on the 1994 data, of Year 12 students continuing into higher education; and
- a constant proportion, based on the 1994 data, of non-school-leavers entering higher education.

Under this scenario the projections up to the year 2001 can be summarised as follows:

- total course commencements are projected to decline from 1995 to 1998 and then slowly rise until 2001, with a total increase in numbers of 1.3 percent;
- the increase in the number of Australian course commencements between 1995 and 2001 is projected to be 0.9 percent, with male and female numbers projected to increase by 0.4 and 1.2 percent, respectively;
- the total Australian enrolment is projected to increase by 4.8 percent between 1995 and 2001;
- the number of Australian students enrolled in Education (Initial training) are projected to decline by 1.2 percent, while in Law they are projected to increase by 13.4 percent between 1995 and 2001;
- the number of course completions by Australian students is projected to increase by 5.4 percent between 1995 and 2001, with females making up nearly 60 percent of all completions in 2001;
- course completions by Australian students in Education (Initial training) are projected to decline by 7.3 percent, while in Law they are projected to increase by 20.1 percent; and
- the number of Australian dropouts is projected to increase by 3.4 percent between 1995 and 2001.

The postgraduate projections reflect:

- the 1993 to 1994 dynamics of students' progress through the system;
- the demographic changes projected to occur between 1995 and 2001; and
- a constant proportion, based on the 1994 data, of a particular age group entering post graduate courses.

Under this scenario the projections for the period between 1995 and 2001 can be summarised as follows:

- total course commencements are projected to increase by 2.5 percent, with male and female commencement numbers going up by 2.7 and 1.5 percent, respectively;
- the total number of students enrolled is projected to increase by 12.6 percent, with those enrolled for Research, Master's by Coursework and Other Postgraduate courses projected to increase by 18.4, 15.2 and 7.3 percent, respectively;
- total course completions are projected to increase by 15.6 percent;
- total Research degree completions are projected to increase by 38.2 percent, with male and female completions increasing by 34.0 and 45.4 percent, respectively;
- total Master's by Coursework degree completions are projected to increase by 22.3 percent, with male and female completions increasing by 18.8 and 26.5 percent, respectively; and
- the total number of dropouts is projected to increase by 5.8 percent.

An evaluation of the model was carried out by comparing the retrospective predictions of total enrolment numbers for 1989 to 1994 and completion numbers for 1989 to 1993 made with it with the actual numbers for these years. This suggests that it provides predictions for aggregate student enrolments with a high degree of accuracy given the annual intake. A less degree of accuracy is attained for course completions for some fields of study. Where considerable change is occurring in the structure of courses the model provides less accurate predictions.

In this report, the model to project student intake is based on projected demographic changes, a constant Year 12 retention rate and a constant participation rate for non-school-leaver intakes. However, it would be relatively easy to obtain projections based on another set of assumptions, or even using a different model of student intakes. A considerable amount of simulation of the system under varying conditions is possible.

With the existing data and the current model further analysis can be performed. For example, analysis can be done for each State, though some field of study estimates for small states may not be reliable. Some analysis by the student's enrolment status, that is, full-time, part-time or external, can also be carried out. However, existing data does not allow the estimation of completions and dropouts by enrolment states because the completions file does not include that variable. The estimates that are reported can be converted to obtain approximate EFTSUs.

A great deal more work can be undertaken if full cohort data were available for at least a pair of years, say 1994 and 1995 and the student enrolment file was linked to the

completions file. In particular, it would then be possible to model those students who transfer from one course to another. A much clearer picture would emerge about the pathways of students and the proportion of a generation achieving a university qualification.

1 Background

1.1 INTRODUCTION

The report outlines the development of a model to study the movement of students in, through and out of higher education in Australia. It provides a means for projecting the number of students, graduates and dropouts by age, gender and broad field of study. The model also provides estimates of the probability of a student completing a course, the average time a student takes to complete a course and the average time a student stays in the system.

Despite the collection and maintenance of a large and extensive database on higher education by the Department of Employment, Education, Training and Youth Affairs (DEETYA), little model building or analysis of the higher education system has been done in Australia. Prior to March 1996 DEETYA was the Department of Employment, Education and Training (DEET). The recent studies which have looked at the system in varying degrees of detail are Sloan et al. (1990) and Cullen and Smart (1992), both of which will be briefly reviewed later. The Finn Report (1991) includes projections of student numbers prepared with a DEET model designed largely for projecting total Equivalent Full-time Student Units (EFTSU).

The model developed in this study is an input-output model. Markov processes of probability theory provide a theoretical underpinning for the models. Input-output models, or Markov chain models are commonly used in economics, marketing, manpower planning, health and demographic accounting.

Most of the literature on the application of input-output models in education appeared in the sixties and seventies. Gani (1963) used this type of model to project enrolment for, and award of, bachelor degrees in Australian universities. Pollard (1970a, 1970b) also used a version of this model to look at the higher education in Australia. Stone (1971, 1972a) has written extensively on their use in economics, health and education planning. He also applied the model to accounting of pollution; see Stone (1972b). The input-output model was used to study the supply of secondary school teachers in Victoria by Burke (1976).

There are several reasons for modeling the higher education sector using an input-output model. The model provides a consistent method of accounting for all students found in the various stages of the higher education system at the beginning and end of a given period, and the numbers flowing into, through and out of the system during that time. It allows projections to be made based in part on the demographic changes and in part on the assumed form for the structure of the system. The assumed form can be the continuation of the present structure or the structure to be expected if certain policy changes were to be implemented. Thus, the supply of graduates coming into the labour market by age, gender and field of study can be estimated.

The model can be used to answer *what if* questions. For example, it allows us to investigate the effect of a change in government policy regarding the number of school leavers who are admitted into higher education. The model also provides useful statistics on such things as the average and the standard deviation of the time a student spends doing a course. It provides the same statistics for the time a student takes to complete a course. Moreover, estimates of the probability of a student completing or dropping out of a course can be derived from the analysis of an input-output model.

There appear to be few recent applications of this form of model. The reason seems to lie in the lack of data on student flows on which to base the estimates for the model's parameters. The main data on which the current study is based are discussed in chapter 3. These data are stock data at a particular point in time and not flow data which ideally are needed to estimate an input-output model. However, as discussed in chapter 3 the data are so detailed that it is possible with a reasonable degree of accuracy to infer the flows for the major course levels and for a number of fields of study. This work on inferring flows from stock data represents the main contribution of this study to modelling student flows through the higher education system.

A model providing information on the projections of graduates in different fields of study, and by age and gender, can be linked to a similar model for demand projections of skilled labour and a model for the projection of migrant skilled labour to identify future bottlenecks in the labour requirements of the economy. The model developed in this report will form part of the study: *Medium Term Supply and Demand Projections for Major Australian Professions*. This study is funded by a large ARC grant and the research for it is jointly undertaken with the Centre for Policy Studies and the Centre for Population and Urban Research, both of Monash University.

1.2 Higher Education Enrolment and Completions, 1989 to 1994

The five years between 1989 and 1994 have been a period of rapid expansion and structural change in higher education in Australia. Data published in DEET (1995a) show total student numbers grew by just under 33 percent from 1989 to 1994, with overseas student numbers increasing by over 82 percent in this period. By 1994 the latter group made up about 8 percent of all students.

Higher degree by research numbers increased by over 110 percent in the five years to 1994, while Higher degree by coursework and Other postgraduate numbers saw growth of about 133 and 24 percent, respectively. The postgraduate students made up about 20 percent of all students in 1994. In comparison undergraduates, who in 1994 comprised 80 percent of all students, have seen their numbers grow by only about 26 percent between 1989 and 1994.

The growth in student numbers has not been uniform across all fields of study during this period. It varied from about 82 percent for Law and Legal Studies to a slight decline for Education. Apart from Veterinary Science, numbers in all other fields of study increased by between 30 and 50 percent.

Undergraduate completions increased by just under 42 percent in the years 1989 to 1993. Research degree completions rose by over 50 percent and Coursework higher degree completions increased by over 180 percent over this period.

Further details of the changes in enrolment and completions between 1989 and 1994 are given in Appendix B. The model developed in this study will help in describing the type of changes recently experienced in more detail, and particularly the likely changes in the next few years. The next section briefly reviews three studies that considered projections of student numbers in higher education in Australia recently.

1.3 A Brief Review of Previous Studies

DEET Model

The DEET model (unpublished) used in the early 1990s was primarily designed for projecting total EFTSU for budget purposes. It assumed an increase in school leaver entry from about 24 percent of the age cohort in 1990 to nearly 30 percent by the year 2001. This was based on the assumption that school retention rates would reach 80 percent, and that nearly 40 percent of

those students undertaking the final year of secondary schools would transfer to higher education.

In this model *constant age-entry* rates were assumed for non-school leaver entrants, who form the majority of all entrants. They made up about 55 percent of all students commencing undergraduate courses in 1994. Total student numbers are estimated by a *pipeline* assumption, which is:
0.75 of students remain to second year;
0.75×0.75 to third year; and
0.75×0.75×0.75 to fourth year and none to fifth.
This implies that on average a student remains in the system for 2.734 years.

DEET made projections of the student intake and the total number of students in the system for each state and territory. They did not make projections of the number of students dropping out or those completing courses. They did not make projections by field of study, age or gender.

Sloan et al. (1990)
In their study of the academic labour market, Sloan et al. (1990) developed a model for projecting national student undergraduate and postgraduate numbers by field of study. Their model divides the commencing undergraduate student intake into three categories to be projected separately:

- school leavers;
- mature age; and
- overseas.

The school leavers intake was estimated as a proportion of the previous year's Year 12 student population. Various scenarios were considered for this *transfer rate*, as well as that for the retention rate from the first year of secondary school to Year 12. The mature age intake assumed a *constant age-entry*. This means that the mature age student intake is a constant proportion of the population aged between 19 and 39 years. High and a low growth rate scenarios were envisaged for the overseas student intake.

Sloan et al (1990) projected the numbers dropping out of courses by applying an aggregate *exit rate* in each field of study. In their model the *exit rate* is the total number of students who exit the system (before completion) in a year expressed as a percentage of the total stock of undergraduate students in that year. They also use a *completion rate* which is the proportion of the student stock completing their course at the end of a year. Note that this rate is applied

to the total stock of students and not to students in the final year of their course. These exit and completion rates will be affected by changes in the composition of the stock of students. For example a sharp increase in the number of first year students, who have a relatively high dropout rate, will tend to push up the measured *exit rate* and reduce the *completion rate*. They estimated the average undergraduate *exit rate* of 14.7 percent and a *completion rate* of 19.3 percent.

The commencing postgraduate student numbers were also assumed to be in three categories:

- transfers from undergraduate completions;
- others (based on the population aged 19 to 39 years); and
- overseas sources.

For all postgraduate courses an average exit rate of 13.8 percent and a completion rate of 32.8 percent was estimated. The corresponding rates for just higher degrees were 10.1 and 19.3 percent.

Sloan et al. (1990) used the student number projections to derive Equivalent Full-time Student Unit (EFTSU) projections by field of study. From this projections were made of EFTSU by Academic Organisation Unit (AOU) which were then used to estimate the supply and demand of academic staff in universities. Their study does not consider projections by age or gender.

Cullen and Smart (1992)

Cullen and Smart (1992) set access targets for school leavers, the under 30 age group, the over 30 age group and those entering with credits from other post-secondary awards. They linked research degree intakes to undergraduate completions. Intakes to other postgraduate courses were linked to the stock of graduates in the community. The analysis was entirely done in terms of EFTSUs.

They made separate assumptions to estimate the average time a student spends doing a course and the average completion rate for it. Their completion rate is the proportion of a cohort who commences a course that eventually completes it. This is similar to the *probability of completion* which we consider later in this study. Note that this is not the same as the definition used by Sloan et al. whose completion rate was the number of students completing a course in say 1994 expressed as a percentage of all students enrolled in that course in 1994. On the basis of these estimates they then estimated the cost per completion of a course. According to Cullen and Smart (1992), the average time spent doing a degree program by an undergraduate student who commenced as a school-leaver was 2.72 years. The average time a student spent doing a postgraduate research degree was 3.58 years and that for doing Master's coursework the figure was 2.16 years. The completion rate for each of the three level of

courses was estimated to be 66 percent. Cullen and Smart (1992) do not report the methodology used to obtain the results.

1.4 Outline of Study

In chapter 2 we describe in matrix notation an input-output model for the higher education sector and a model for projecting student intake into the system. This chapter also contains a discussion on the data requirements for estimating these models. chapter 3 contains the initial analysis of enrolment and completions data used for estimating the input-output models. The age profiles and the gender balance of students in various fields of study and levels of course are considered. Furthermore, the distribution of time in the system and time to completion are also analysed by field of study and level of course. At the end of this chapter the school enrolment data and the population projections by age and sex are discussed.

The results from fitting and estimating the input-output models are presented and discussed in chapter 4. Separate models are fitted for all persons, males and females. Undergraduate and postgraduate students are considered separately. The analysis for undergraduates provides estimates for total students as well as estimates disaggregated by broad field of study. The postgraduate data is disaggregated at level of course: Research degree, Master's by Coursework and Other Postgraduate courses. At the end of this chapter the estimated models are evaluated for stability over time by considering their prediction accuracy retrospectively. Finally, in chapter 5 we draw some conclusions and discuss directions for future work in this area.

2 The Structure of the Model

2.1 Introduction

The model for analysing the flow of students through the higher education system can be broken into two parts. The first part concerns the modelling of the system as an input-output model. It allows for the estimation of the transition probabilities among the various stages of the system. Given the current state of the system and the projection of intake into its various stages, the model can be used to make projections of the total number in the system, the number dropping out and the number completing. In the second part a simple model is developed for making projections of intake into various stages.

In section 2.2 we outline the input-output model in the context of the higher education system using matrix formulation. The matrix notation allows for a more compact presentation. In section 2.3 the model for making projections of intake into the system is outlined. Minimum data requirements for estimating the model and for making projections are discussed in section 2.4. A simplified numerical example is presented for illustrative purposes in the last section.

2.2 The Input-Output Model

An input-output model, for demographic accounting assumes that the system can be divided into a finite number of mutually exclusive and exhaustive states in terms of some criterion of interest. In general, the states can be divided into two classes, transient and absorbing. Elements of the population cannot remain in a transient state permanently. On the other hand an element reaching an absorbing state remains in it permanently.

In the context of the higher education sector the primary classification of the transient states is by age of the student. The secondary classification of these states is by the student's year of enrolment in the course. For example, a student in his/her second year of enrolment is not necessarily doing the second year level subjects of the course because he/she may be repeating some first year subjects which he/she has failed in the previous year. Students often do combinations of subjects from different year levels in a given year. A typical state of the system is *being a 20-year-old and in second year of enrolment in the course.* There are two absorbing states in the system, dropout and completion. The dropout state refers to those students who withdraw from the course before completing.

There are a number of ways of analysing movements of a population; see Bartholomew et al. (1991). A broad division can be drawn between models in which movement from state i to state j depends largely on the places available in state j and those in which it depends on the numbers in state i. A model looking at human resources planning and career structure of employees in an organisation would be of the first type because there may be a ceiling put on the number of employees who can be of a particular class, for example, supervisors. The problem being looked at in this report is of the second type since it is assumed no restrictions are placed on the movement from one transient state to another once a student is in the system.

Suppose $\mathbf{n}(t)$ is a vector of student numbers in each of the transient states at time t. Then

$$\mathbf{n}(t) = \mathbf{Z}(t)\mathbf{c} + \mathbf{d}(t) \tag{2.1}$$

and

$$\mathbf{n}(t+1) = \mathbf{Z}'(t)\mathbf{c} + \mathbf{b}(t+1), \tag{2.2}$$

where $\mathbf{Z}(t)$ is a square matrix whose elements z_{ij} represent the number of students who were in state i at time t but are in state j at time t+1, $\mathbf{d}(t)$ is a vector of student numbers leaving the system from various states, while $\mathbf{b}(t)$ is a vector of the number of students commencing the course in the time period t to t+1, and $\mathbf{c}$ is a unit vector. Throughout this study the time period will be one year.

Equation (2.1) tells us that the number of students at the beginning of a year is made up of those who will survive into the next year plus those who will leave the system during the year. On the other hand equation (2.2) says that the number of students at the beginning of the next year is made up of those who commence in the new year and those who survived from the previous year.

Since there are two absorbing states, dropout and completion, the vector $\mathbf{d}(t)$ can be written as

$$\mathbf{d}(t) = \mathbf{D}(t)\mathbf{c}\,, \tag{2.3}$$

where $\mathbf{D}(t)$ is a matrix of departures. Now suppose we define

$$\mathbf{Q}(t) = \tilde{\mathbf{n}}^{-1}(t)\mathbf{Z}(t)\,, \tag{2.4}$$

where $\tilde{\mathbf{n}}^{-1}(t)$ is a diagonal matrix with $\tilde{n}_{ii} = n_i$. Then the element q_{ij} of $\mathbf{Q}(t)$ represents the proportion of students in state i at time t who are in state j at time t+1. $\mathbf{Q}(t)$ is known as the matrix of transition proportions.

Rearranging (2.4) we obtain

$$\mathbf{z}(t) = \tilde{\mathbf{n}}(t)\mathbf{Q}(t)\,. \tag{2.5}$$

Substituting (2.5) into (2.2) we get

$$\mathbf{n}(t+1) = \mathbf{Q}'(t)\tilde{\mathbf{n}}(t)\mathbf{c} + \mathbf{b}(t+1) \tag{2.6}$$

or

$$\mathbf{n}(t+1) = \mathbf{Q}'(t)\mathbf{n}(t) + \mathbf{b}(t+1)\,. \tag{2.7}$$

If it can be assumed that $\mathbf{Q}(t)$ is constant over time, then

$$\mathbf{n}(t+1) = \mathbf{Q}'\mathbf{n}(t) + \mathbf{b}(t+1) \tag{2.8}$$

can be used to make projections of student numbers in each state in future periods. Obviously it is assumed that estimates, or forecasts, of vector **b** for future periods are available. A model for projecting **b** is developed in the next section.

If we define

$$\mathbf{R}(t) = \tilde{\mathbf{n}}^{-1}(t)\mathbf{D}(t) \tag{2.9}$$

then r_{ij} of $\mathbf{R}(t)$ represent the proportion of students who are in state i at time t who depart into absorbing state j at time t+1. Thus, if it can be assumed that **R**(t) is time invariant, then

$$\mathbf{D}(t) = \tilde{\mathbf{n}}(t)\mathbf{R} \tag{2.10}$$

can be used make projection of the number of students who dropout and those who complete the course.

Other useful information can be gleaned from the above formulation if **Q** and **R** are regarded as probability matrices and not merely matrices of proportions. Under the assumption of constant **Q** and **R**, for example, the element N_{ij} of the matrix

$$\mathbf{N} = (\mathbf{I} - \mathbf{Q})^{-1} \tag{2.11}$$

can be interpreted as the mean time (in years) that a student starting in state i is in state j before departing the system. The matrix **N** is known as the fundamental matrix of an absorbing Markov chain. Many other theorems applicable to such chains can be applied to it.

The variance of the time a student starting in state i is in state j before departing the system is given by the ij^{th} element of the matrix

$$\mathbf{N}_2 = \mathbf{N}(2\mathbf{N}_{dg} - \mathbf{I}) - \mathbf{N}_{sq}, \tag{2.12}$$

where $\mathbf{N}_{dg}$ is a diagonal matrix whose leading diagonal is identical to that of matrix **N** and the $\mathbf{N}_{sq}$ matrix is formed by squaring each element of matrix **N**.

Furthermore, it is possible to calculate the mean and the variance of the time to depart from the system given an initial starting state. These are given by the elements of the matrices

$$\mathbf{T} = \mathbf{Nc} \tag{2.13}$$

and

$$\mathbf{T}_2 = (2\mathbf{N} - \mathbf{I})\mathbf{T} - \mathbf{T}_{sq} \tag{2.14}$$

respectively. It is also possible to obtain the probability of a student either dropping out or completing a course given that he/she started in state i. These probabilities are given in the i^{th} row of the matrix

$$\mathbf{B} = \mathbf{NR}. \tag{2.15}$$

The information on the expected time and its variance to enter a particular absorbing state given an initial starting state, can be obtained by considering the *reduced* form of the system. The reduced system is formed by replacing $\mathbf{D}(t)$ and $\mathbf{n}(t)$ in the above formulation by $\mathbf{D}^*(t)$ and $\mathbf{n}^*(t)$, respectively. $\mathbf{D}^*(t)$ consists of just one column of $\mathbf{D}(t)$, that representing the absorbing state of interest. The i^{th} element of $\mathbf{n}^*(t)$ is given by

$$n_i^* = n_i - \sum_{j \neq k} D_{ij}, \tag{2.16}$$

where the absorbing state of interest is in column k of $\mathbf{D}(t)$. A new **Q** and **N** can now be defined and equations (2.13) and (2.14) used to complete the analysis.

2.3 A Model for Projecting Student Intake

The framework that we use to model student intake is conceptually similar to that used by Sloan et al. (1990). Different models are used for undergraduate and postgraduate students. The models are partly driven by demographic changes and partly by the assumption of continuity of the structure of the system as it exists currently.

Undergraduates

The model aims to project the vector $\mathbf{b}(t)$ for $t = 1995,\ldots,2001$. The element in the i^{th} row of this vector, $b_i(j,k,t)$, represents the number of k-year-old students, in their j^{th} year of enrolment at time t. Also suppose $b(k,t)$ is the number of k-year-old students who commence a course at time t. Since by definition students are only allowed to enter the system in their first year of enrolment, it necessarily follows that

$$b_i(j,k,t) = \begin{cases} b(k,t) & \text{if } j = 1 \\ 0 & \text{if } j \neq 1 \end{cases}.$$

It is assumed that k-year-old entrants to undergraduate courses at time t are made up of:

- school-leavers, $S(k,t)$,
- non-school-leavers, $N(k,t)$, and
- overseas, $O(k,t)$, students.

Hence, we can decompose the number of k-year-olds entering a course at time t as

$$b(k,t) = S(k,t) + N(k,t) + O(k,t). \tag{2.17}$$

If it can be assumed that the number of school-leavers of a given age who gain entry into a course is a fixed proportion of the number of Year 12 students of the same age in the previous year then

$$S(k,t) = Y_{12}(k,t-1) \times \frac{S(k,t-1)}{Y_{12}(k,t-2)}, \tag{2.18}$$

where $Y_{12}(k,t)$ is the number of k-year-old students in Year 12 at time t. It should be noted that the above formulation requires age of Year 12 students and school-leavers to be defined on the same date. The assumption that school-leaver entrants remains a fixed proportion of the Year 12 student population is arbitrary. Alternative assumptions can be investigated. Data for the last five years show the proportion to fall sharply in 1992 and rise in 1994 and 1995, but still remain below the 1991 level.

The projection of the number of Year 12 students is achieved by using grade progression ratios for each age group. Thus, the number of Year 12 students in period t is estimated by

$$Y_{12}(k,t) = Y_{11}(k-1,t-1) \times G_k(11,12), \tag{2.19}$$

where $Y_{11}(k,t)$ is the number of k-year-old Year 11 students and

$$G_k(11,12) = \frac{Y_{12}(k,t-1)}{Y_{11}(k-1,t-2)} \tag{2.20}$$

is the grade progression ratio for k-year-olds from Year 11 to Year 12. The number of Year 12 students in period $t+n$ is then estimated by

$$Y_{12}(k,t+n) = Y_{12-n-1}(k-n-1,t-1) \times \prod_{i=0}^{n} G_{k-i}(11-i,12-i). \tag{2.21}$$

It should be emphasised that the grade progression ratios are estimates of the net flow of pupils from one grade to another.

The non-school-leaver component is projected on the basis of *constant age-entry*. If $P(k,t)$ represents the projection of the number of k-year-olds in the population at time t, then the projection of the number of non-school-leavers commencing a course at time t is given by

$$N(k,t) = P(k,t) \times \frac{N(k,t-1)}{P(k,t-1)}. \tag{2.22}$$

The projection of the number of overseas fee-paying students allows a uniform growth across all age groups of:

- 3 percent for 1995;
- 2 percent for 1996 to 1998; and
- 1 percent for 1999 to 2001.

These assumptions are based on the view that the recent rapid growth in their numbers will not be sustained. One reason for this is the uncertainty in the likely number coming from Malaysia and Hong Kong, the major sources of overseas students. These countries are rapidly building up their own higher education sectors.

Postgraduates

The projection of the number of commencing postgraduate students at various course levels is on the basis of *constant age-entry* too. Therefore, an identical equation to (2.22) can be used to generate the projections. Thus,

$$b(k,t) = P(k,t) \times \frac{b(k,t-1)}{P(k,t-1)}. \tag{2.23}$$

2.4 DATA REQUIREMENTS

Cohort analysis is one way of acquiring information on student flows that is necessary for the input-output model, but it depends on tracking the same group of students over a number of years. Besides it may not adequately represent current behaviour. The way we have defined the states of the system means that it is possible to estimate the input-output model with stock data of student enrolment in two successive years, including the number of completions in the first of these years.

Flow statistics from one transient state to another can be inferred if data are available on each student's age and year of enrolment. This is a consequence of the way a transient state is defined. Moreover, since there are only two absorbing states and information on the flow into one of them, namely the completion state, is available, the flow into the other can be inferred.

Furthermore, if data are available on each student's sex, mode of study (full-time, part-time or external), level of course, field of study, if the student is overseas fee-paying or not and if the student is new to higher education or not, then differences in the behaviour of different groups of students can be investigated.

The model for projecting the number of commencing students requires data on school enrolment and population projections at the appropriate level of disaggregation. It is possible to estimate the school grade progression ratios and the expected number of Year 12 students coming through if school enrolment data by age, grade and gender is available for at least the current year and one year prior to that.

Therefore, minimum data requirements are:

- higher education course enrolment records for two consecutive years and course completions records during the first of these two years by course type, sex, field of study, age, overseas fee-paying indicator and year of enrolment;
- school enrolment records for the last two years by age, sex and grade; and
- resident population projections by age and sex until the year 2001.

If data over a longer period is available, then it may be possible to estimate the parameters of the model with a higher degree of reliability. Finally, it is important to ensure consistency between and within all three data sets. For example, age has to be defined identically in all three bodies of data. This can be achieved by having a common date with respect to which age is calculated. Furthermore, there has to be consistency between the enrolment and completions data so that students flowing from one state in one year are all accounted for the following year.

2.4 A NUMERICAL ILLUSTRATION

By way of a summary, we present a small numerical example simple enough for the development of the main results from the input-output matrix to be followed. The illustration is hypothetical and relates to a system consisting of three age groups - 18, 19 and 20 - and two classes of enrolment - A and B. Class A can relate to the first year of enrolment and B to second or higher year of enrolment. Therefore, there are six transient states. A typical state is *being a 18-year-old in Class A (or first) year of enrolment.* The state relating to 20-year-olds in Class B is a special case and is to be interpreted *as being 20 years or older and in Class B (or second or higher) year of enrolment.* There are two absorbing states, dropout and completion.

From hypothetical data on enrolment in 1993 and 1994 and completions in 1993, the input-output matrix as shown in Table 2.1 is constructed. For example, it shows that of the 330 18-year-olds who commenced the course in 1993, 250 progressed on to being 19 years of age and in Class B (the second year of enrolment), 50 dropped out of the course and 30 completed the course. There are 650 commencing students in 1994 of whom 350 are 18-year-olds, 200 are 19-year-olds and 100 20-year-olds.

Table 2.1 Input-Output Matrix Showing the Flow of Students (Hypothetical Example)

	Age:Year of Enrolment	Enrolment in 1994							
		18:A	19:A	19:B	20:A	20:B	Dropouts	Completions	Total
Enrolment in 1993	18:A			250			50	30	330
	19:A					150	30	10	190
	19:B					20	10	180	210
	20:A					70	10	10	90
	20:B					10	10	20	40
Commencements 1994		350	200		100				650
Total		350	200	250	100	250	110	250	

Table 2.2 shows the matrix of transition proportions, **Q** (defined in equation (2.4)) and matrix **R** (defined in equation (2.9)) representing the proportions moving to absorbing states. The proportions are calculated by dividing entries in each row by the corresponding row total in Table 2.1.

Table 2.2 Matrix of Transition Proportions (Hypothetical Example)

Age:Year of Enrolment	Matrix Q					Matrix R	
	18:A	19:A	19:B	20:A	20:B	Dropout	Completion
18:A	0.00	0.00	0.76	0.00	0.00	0.15	0.09
19:A	0.00	0.00	0.00	0.00	0.79	0.16	0.05
19:B	0.00	0.00	0.00	0.00	0.10	0.05	0.86
20:A	0.00	0.00	0.00	0.00	0.78	0.11	0.11
20:B	0.00	0.00	0.00	0.00	0.25	0.25	0.50

Assuming that the model can reasonably be approximated as a Markov chain, we can use equation (2.11) to calculate the fundamental matrix, **N**. This is given in Table 2.3. The table also includes matrix **T** and **B**, calculated using equations (2.13) and (2.15). As an example we shall interpret the entries in the first row of Table 2.3. Given a student enters the system as an 18-year-old, he/she spends, on average, one year as an 18-year-old in Class A enrolment, 0.76 years as a 19-year-old in Class B enrolment and 0.10 years as a 20-year-old in Class B enrolment. The sum of all entries in row one gives us the average time he/she spends in the system, which in this case is 1.85 years. The probability of an 18-year-old completing the course is 0.79.

Table 2.3 Expected Time in System and Probability of Absorption (Hypothetical Example)

Initial State	Matrix N					Matrix T	Matrix B	
	Expected Time in State					Expected Time in System	Probability of Dropping Out	Probability of Completing
	18:A	19:A	19:B	20:A	20:B			
18:A	1.00	0.00	0.76	0.00	0.10	1.85	0.21	0.79
19:A	0.00	1.00	0.00	0.00	1.05	2.05	0.42	0.58
19:B	0.00	0.00	1.00	0.00	0.13	1.13	0.08	0.92
20:A	0.00	0.00	0.00	1.00	1.04	2.04	0.37	0.63
20:B	0.00	0.00	0.00	0.00	1.33	1.33	0.33	0.67

Table 2.4 shows the projected number of commencing students for the years 1995 to 2000. In this illustrative example the numbers are not obtained from any model, but simply made up. The projections of number in the system and total number of dropouts and completions are given in Table 2.5. These were derived using equations (2.8) and (2.10). Thus, the table includes the numbers in each state of the system in each year from 1994 to 2000, for example, in the year 1997 there are 258 19-year-olds in Class B of enrolment. The total number in the system in each year is also given, for example, 1195 students are enrolled in 1997. Finally, the table shows the number of students who complete or drop out of the course each year. For example, 184 students drop out and 436 complete the course in 1997.

Table 2.4 Projected Intake of Students, 1995 to 2000 (Hypothetical Example)

Age:Year of Enrolment	Year					
	1995	1996	1997	1998	1999	2000
18:1	360	340	320	300	330	350
19:1	210	180	190	180	210	220
19:2						
20:1	120	100	90	90	100	130
20:2						
Total	690	620	600	570	640	700

Table 2.5 Projections of Total Enrolment, Dropouts and Completions, 1994 to 2000 (Hypothetical Example)

Age:Year of Enrolment	Year						
	1994	1995	1996	1997	1998	1999	2000
18:1	350	360	340	320	300	330	350
19:1	200	210	180	190	180	210	220
19:2	250	265	273	258	242	227	250
20:1	100	120	100	90	90	100	130
20:2	250	322	365	337	329	317	345
Total	1150	1277	1258	1195	1141	1185	1295
Dropouts	170	177	191	184	177	184	200
Completions	393	422	459	436	418	406	444

Note: The figures for 1994 are actual numbers

3 Data

3.1 Introduction

As outlined in chapter 2 the estimation of the input-output model and the making of projections of the number of students at various stages of the higher education system requires data on:

- course enrolment and completions in higher education;
- school enrolment; and
- population projections.

It is possible to estimate the model with data from just two consecutive years. In this report we use course enrolment in higher education and school enrolment data from 1993 and 1994, and course completions data in higher education from 1993. The population estimates are for 1993 and 1994 and projections for 1995 to 2001. The three data sets are described and their initial analysis reported in the following sections.

3.2 Course Enrolment and Completions Data

Data on course enrolment and completions is used to estimate the matrix of transition proportions. It was obtained from unpublished records kept by DEET. Course enrolment and completions data are stored on separate files as aggregated records. These aggregated files are derived from unit record files provided by each university funded by DEET. DEET releases only aggregated data to safeguard confidentiality of individual students.

Specially compiled course enrolment files for 1993 and 1994 and a course completions file for 1993 were obtained from DEET. These files are different from the files that DEET normally makes available in one significant respect. In the specially compiled files the course commencement date (month and year) of students is included instead of just the year since commencement (one, two, three or three plus).

A vast amount of information is stored on each file. However, not all the variables that are included in the enrolment files are included in the completions file. For example, variables indicating whether a student commenced the course as a school-leaver or not and that indicating the mode of attendance, that is full-time, part-time or external, are not included in the completions file. This means that the analysis that can be performed will be limited by what is contained in the completions file.

The course enrolment files contain information on thirty two variables, and the course completions file on only thirteen of these. At this stage the analysis is restricted to looking at the system at the national level, although the model is equally applicable at the state/territory level. Only the following seven variables are used to estimate the input-output model:

- course level;
- field of study;
- gender;
- course commencement date (month and year);
- school-leaver status;
- age;
- fee-paying overseas status.

The 1993 enrolment file has over 355,000 records while the 1994 file has over 370,000 records. The 1993 completions file has just under 86,000 records. SAS software was used to read and interrogate the data files on an Alpha machine. A variable giving the year of enrolment in the system since course commencement, Y, was generated from the course commencement date. In order to be consistent with DEET's definition of a commencing student the following definition was used for this variable:

$$Y = \begin{cases} Ref\_year - Year + 1 & \text{if } 1 \le month \le 3 \\ Ref\_year - Year & \text{if } 4 \le month \le 12 \end{cases},$$

where *Ref_year* is the year of the data file, *Year* is the year in which the course was commenced and *month* is the month in which the course was commenced. It should be noted that DEET defines a commencing student as one who is in his/her first year of a particular course at a particular institution. This means that a student who for some reason changes course or begins another degree after having completed one, is classified as a commencing student for a second time even though he/she may not be new to the university or faculty.

Preliminary analysis of the data revealed that students' age ranged from zero to ninety-eight! There is no reasonable explanation than coding error for the existence of students of age zero or 98. There was also some doubt about students who were in their nineties, and therefore, anybody whose age was zero or over 89 years was excluded from the analysis. This process

resulted in the removal of 240 students in the 1993 enrolment file, 54 in the 1994 enrolment file and 25 in the 1993 completions file.

A value of negative one for *Y* in the 1993 course completions file implies the commencement date of between April 1994 and December 1994 for these students. A coding error is the most likely explanation for such a value of *Y*. There were a number of students whose commencement and completion times were between April 1993 and December 1993 (*Y* equal to zero). Similarly *Y* equal to zero in the enrolment file for 1994 indicates that some students' commencement date is after March 1994.

In order to be consistent with the data in the enrolment file for 1993, students for whom the variable *Y* is less than one are excluded from further analysis. This resulted in the removal of 122 students (109 undergraduates and 13 postgraduates) from the 1994 enrolment file and 598 (300 undergraduates and 298 postgraduates) from the 1993 completions file. Since the number of such students is relatively small, their exclusion is unlikely to significantly affect the estimation of the models. Moreover, by not excluding them the model building exercise can become unnecessarily complex.

Undergraduates

According to DEET (1995a) there are two categories of undergraduates, *Bachelor* and *Other Undergraduates*. Six courses of varying length are included under these two categories. We have defined undergraduates as those students enrolled for the following three courses:

- Bachelor's honours;
- Bachelor's pass; and
- Diploma.

These three courses generally take three to four years of full-time study and tend to form a homogeneous group among the undergraduate courses. They comprised over 95 percent of all undergraduate enrolment in 1993 and 1994. A number of diploma courses have been converted to Bachelor courses in recent years, most notably in the nursing and teaching area.

The data on undergraduates is examined by four characteristics:

- gender;
- age;
- broad field of study; and
- number of years of enrolment in the course.

The number of years of enrolment has six categories - one, two, three, four, five and six or more.

Eleven broad fields of study are considered. These are:

- Agriculture and animal husbandry;
- Architecture and building;
- Arts, humanities and social sciences;
- Business, administration and economics;
- Education - Initial training;
- Education - Other;
- Engineering and surveying;
- Health;
- Law;
- Medicine, dentistry and veterinary science; and
- Science.

These fields are the same as those defined by DEET (1995a) with two exceptions. First, Education has been split into two fields of study - Initial training and the Other. The initial training part of Education is of importance in its own right because a high proportion of the supply of new graduate teachers come from this category. This field will be referred to as Education (I) and the rest of education as Education (O). Secondly, medicine (not medical science) and dentistry (not dental therapy) has been taken out of Health and combined with veterinary science to form one field which from now on will be referred to as Medicine. Combining medicine, dentistry and veterinary science into one field makes statistical sense because all three courses generally take about five years to complete.

As an initial analysis, tables were constructed to show

- the age profile; and
- distribution of the number of years of enrolment

of male and female students enrolled in 1993 and 1994 and of those who completed the course in 1993. This was done for each broad field of study. Moreover, the gender balance in each group defined by age and field of study, and number of years of enrolment and field of study, was investigated. In general, there was no significant difference between 1993 and 1994 in the age profiles, and the distribution by number of years of enrolment. Thus, only the analysis for students enrolled in 1994 is reported.

The age profile of students enrolled in undergraduate courses in 1994 is given in Table 3.1. The Australian category does not include students who are full fee-paying and from overseas. Only Australian students are included in the data for each broad field of study. Overall 34 percent of male students are under 20 years of age compared to 37 percent of female students. Similar percentages in the 20-24 age group are 41 and 35, and in the over 24 age group 26 and 28, for male and female students, respectively.

Table 3.1 Age Distribution of Undergraduates who were Enrolled in a Course in 1994, by Sex and Field of Study

	All		Australian		Agriculture		Architecture		Arts		Business		Education (I)	
Age in Years	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female
Under 18	7	8	7	9	6	9	6	8	6	8	7	9	5	9
18	13	14	14	15	13	16	13	16	12	14	14	15	12	16
19	14	15	14	15	16	17	14	17	13	14	14	16	15	18
20	13	13	13	13	13	14	13	13	11	11	12	13	15	16
21	11	9	11	9	11	10	11	11	9	7	10	9	12	11
22	8	6	7	6	7	5	9	10	6	5	6	6	7	5
23	5	4	5	4	4	3	7	7	5	3	4	4	4	3
24	4	3	3	3	2	2	4	5	4	2	4	3	3	2
25-29	11	9	10	9	10	7	11	7	12	9	12	10	9	6
30-34	7	6	7	7	7	6	5	4	8	7	8	6	6	5
Over 34	8	12	9	13	11	9	5	3	15	19	9	8	12	9
Total	100	100	100	100	100	100	100	100	100	100	100	100	100	100
Under 20	34	37	36	38	34	43	34	40	31	36	35	41	32	43
20-24	41	35	39	34	37	35	44	46	34	29	37	35	41	37
Over 24	26	28	25	28	28	22	22	14	35	35	29	24	27	20

	Education (O)		Engineering		Health		Law		Medicine		Science	
Age in Years	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female
Under 18	0	1	9	12	6	7	5	6	7	7	9	13
18	1	1	17	19	13	14	8	11	11	12	16	19
19	1	1	17	20	14	15	11	12	14	15	16	18
20	2	4	16	18	12	12	11	13	14	14	14	15
21	5	8	13	13	9	7	11	13	16	15	11	10
22	5	8	8	7	7	5	10	10	14	14	7	5
23	5	7	5	3	5	3	6	6	9	8	4	3
24	5	7	3	1	4	3	3	3	4	3	3	2
25-29	23	18	7	3	11	10	12	9	6	6	9	6
30-34	16	11	3	1	8	9	8	6	3	3	5	4
Over 34	37	35	2	1	10	15	14	11	1	1	6	5
Total	100	100	100	100	100	100	100	100	100	100	100	100
Under 20	2	3	43	51	34	36	24	30	32	34	41	50
20-24	22	34	45	43	37	30	42	44	57	55	39	36
Over 24	76	64	13	6	30	34	34	26	10	10	20	15

Table 3.2 Age Distribution of Undergraduates who Completed a Course in 1993, by Sex and Field of Study

	All		Australian		Agriculture		Architecture		Arts		Business		Education (I)	
Age in Years	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female
Under 18	0	0	0	0	0	0	0	0	0	0	0	0	0	0
18	0	1	0	1	0	1	0	0	1	1	1	1	0	1
19	7	12	7	12	4	6	8	10	8	13	10	14	6	16
20	17	21	18	22	17	21	17	20	18	23	21	26	18	27
21	19	17	19	17	21	29	18	21	16	16	20	21	18	18
22	13	10	13	9	14	15	13	13	10	8	11	10	11	8
23	9	6	8	6	8	4	11	9	7	5	7	6	5	5
24	6	4	5	4	6	4	8	9	4	3	5	4	4	3
25-29	13	10	12	9	11	10	15	10	12	8	12	8	11	6
30-34	7	6	7	6	8	5	6	3	9	6	7	4	9	5
Over 34	9	13	10	14	10	4	5	4	15	17	8	6	17	12
Total	100	100	100	100	100	100	100	100	100	100	100	100	100	100
Under 20	7	12	8	13	4	7	8	10	8	14	10	15	6	16
20-24	64	58	64	58	66	74	66	72	55	54	64	67	56	60
Over 24	29	30	28	30	29	19	25	18	36	32	26	18	37	24

	Education (O)		Engineering		Health		Law		Medicine		Science	
Age in Years	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female
Under 18	0	0	0	0	0	0	0	0	0	0	0	0
18	0	0	0	0	0	0	0	0	0	0	1	1
19	0	0	2	4	7	12	2	4	1	2	11	15
20	4	6	18	25	18	21	6	9	1	2	23	28
21	4	7	27	33	14	13	17	18	11	13	22	22
22	5	7	19	18	9	7	21	22	31	32	12	11
23	5	7	11	7	6	5	15	12	25	25	7	6
24	4	6	6	4	4	3	6	7	13	11	5	4
25-29	20	18	11	6	16	12	12	11	12	10	10	8
30-34	17	11	4	1	9	10	7	7	3	3	5	3
Over 34	41	37	2	1	16	18	12	9	2	2	4	3
Total	100	100	100	100	100	100	100	100	100	100	100	100
Under 20	0	0	2	5	8	12	3	4	1	2	11	16
20-24	22	33	81	87	52	49	66	68	81	82	70	70
Over 24	78	66	17	8	41	39	32	27	17	15	19	14

The age profile of students vary a great deal by sex and also across fields of study. Except for the Education (O) field of study, in each field of study the proportion of females who are under 20 is higher than the proportion of males. For example, 43 percent of the females studying Education (I) are under 20 years old, but only 32 percent of the males studying Education (I) are in this age group. On the other hand in each field of study, except Medicine, the proportion of males who are 25 to 29 is higher than the proportion of females. In Medicine the proportion of males and females is the same in this age group.

Table 3.2 shows the age profile of students who completed courses in 1993. Most students tend to have finished the course when they were between 20 and 24 years of age. These data also have a pattern of variation which closely resembles that observed for the enrolment data.

The percentage breakdown by gender for students enrolled in 1994 is given in Table 3.3. For example, in Arts 25 percent of the under 18 age group is male and 75 percent is female. The aggregate figures indicate females outnumber males significantly in the younger age groups (20 years and younger) and the older age groups (30 years and over). However, this pattern is not uniform across all fields of study. Females seem to dominate across all age groups in Arts, Education (I) and Health, while male show dominance in Architecture and Engineering. In Science and Business males and females are in almost equal proportions in the younger age groups, but males are in higher proportions in the older age groups. Females are more numerous or equally as numerous as males in all age groups, except the over 24, in Law. In general, in Medicine there is a balance in the gender composition, except in the age groups between 21 and 29 when males are in higher numbers. Table 3.4 gives the gender balance in course completions. Once again, the pattern of variation is a reflection of that observed for the enrolment data..

Table 3.5 shows the variation in the number of years of enrolment (time in the system) for students by gender and field of study for 1994. For example, 31 percent of all female students in Architecture are in their first year of enrolment. On comparing with the data for 1993, which is not included in this report, 1994 data shows a significant increase in the percentage of both male and female students who are in the fourth or higher year of enrolment in Education (I), thus reflecting a reduced number commencing this field of study in 1994. Some differences between fields of study reflect the variation in the course length, for example, Engineering and Medicine are courses of longer duration, and thus, a higher proportion of students are in the fourth and fifth year of enrolment in these fields of study. Overall a female is less likely to be in her fourth or higher year of enrolment than a male is.

Table 3.3 Gender Distribution of Undergraduates who were Enrolled in a Course in 1994, by Age and Field of Study

	All		Australian		Agriculture		Architecture		Arts		Business		Education (I)	
Age in Years	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female
Under 18	41	59	41	59	52	48	57	43	25	75	49	51	18	82
18	43	57	43	57	57	43	60	40	28	72	52	48	20	80
19	44	56	43	57	61	39	61	39	29	71	51	49	22	78
20	45	55	45	55	61	39	63	37	31	69	53	47	24	76
21	49	51	49	51	63	37	64	36	35	65	56	44	27	73
22	51	49	51	49	69	31	62	38	36	64	57	43	32	68
23	52	48	51	49	69	31	66	34	39	61	58	42	31	69
24	52	48	50	50	66	34	63	37	39	61	60	40	34	66
25-29	50	50	49	51	69	31	74	26	38	62	59	41	33	67
30-34	46	54	45	55	67	33	73	27	33	67	60	40	31	69
Over 34	36	64	35	65	68	32	73	27	26	74	58	42	30	70
Total	45	55	45	55	63	37	64	36	31	69	55	45	26	74

	Education (O)		Engineering		Health		Law		Medicine		Science	
Age in Years	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female
Under 18	11	89	83	17	16	84	43	57	52	48	49	51
18	16	84	85	15	17	83	41	59	50	50	52	48
19	18	82	84	16	17	83	47	53	50	50	54	46
20	12	88	84	16	19	81	46	54	52	48	55	45
21	15	85	86	14	21	79	47	53	54	46	58	42
22	15	85	89	11	24	76	51	49	53	47	62	38
23	17	83	92	8	22	78	49	51	54	46	65	35
24	17	83	93	7	25	75	50	50	57	43	65	35
25-29	25	75	94	6	20	80	57	43	54	46	66	34
30-34	29	71	94	6	17	83	57	43	48	52	64	36
Over 34	23	77	93	7	13	87	55	45	52	48	63	37
Total	21	79	87	13	18	82	50	50	52	48	57	43

Table 3.4 Gender Distribution of Undergraduates who Completed a Course in 1993, by Age and Field of Study

	All		Australian		Agriculture		Architecture		Arts		Business		Education (I)	
Age in Years	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female
Under 18	67	33	67	33	**	**	**	**	0	100	67	33	**	**
18	31	69	31	69	0	100	40	60	27	73	43	57	6	94
19	29	71	29	71	60	40	56	44	21	79	44	56	10	90
20	36	64	36	64	64	36	57	43	26	74	48	52	16	84
21	43	57	43	57	61	39	58	42	30	70	52	48	22	78
22	48	52	48	52	67	33	60	40	35	65	56	44	28	72
23	50	50	49	51	79	21	67	33	39	61	58	42	25	75
24	50	50	49	51	75	25	56	44	38	62	60	40	32	68
25-29	47	53	46	54	71	29	70	30	39	61	62	38	34	66
30-34	42	58	41	59	76	24	73	27	38	62	64	36	33	67
Over 34	32	68	32	68	85	15	64	36	28	72	61	39	28	72
Total	40	60	40	60	68	32	61	39	30	70	54	46	22	78

	Education (O)		Engineering		Health		Law		Medicine		Science	
Age in Years	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female
Under 18	**	**	100	0	0	100	**	**	**	**	100	0
18	**	**	75	25	10	90	50	50	100	0	45	55
19	0	100	74	26	10	90	36	64	39	61	47	53
20	14	86	84	16	13	87	40	60	39	61	51	49
21	14	86	85	15	16	84	48	52	52	48	56	44
22	15	85	88	12	18	82	49	51	56	44	60	40
23	15	85	92	8	19	81	56	44	57	43	61	39
24	16	84	93	7	19	81	49	51	62	38	62	38
25-29	23	77	93	7	14	86	52	48	61	39	64	36
30-34	29	71	95	5	14	86	52	48	57	43	65	35
Over 34	22	78	95	5	14	86	57	43	58	43	64	36
Total	21	79	88	12	15	85	50	50	57	43	56	44

Note: ** Indicates no students were in the age category

Table 3.5 Distribution of Time in System for Undergraduates who were Enrolled in a Course in 1994, by Sex and Field of Study

	All		Australian		Agriculture		Architecture		Arts		Business		Education (I)	
Time in Years	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female
1	33	35	33	35	38	41	31	31	36	36	32	34	34	33
2	23	25	23	24	23	24	23	23	24	23	22	23	25	26
3	18	20	18	20	20	18	18	20	18	19	18	19	21	22
4	13	11	13	12	12	11	12	11	11	11	13	12	14	14
5	6	5	7	5	5	3	7	7	5	5	7	6	4	3
Over 5	6	4	6	5	3	3	9	7	6	7	8	5	2	1
Total	100	100	100	100	100	100	100	100	100	100	100	100	100	100
Over 3	25	20	26	21	19	16	28	25	23	23	27	23	20	18

	Education (O)		Engineering		Health		Law		Medicine		Science	
Time in Years	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female
1	43	43	29	30	37	37	17	18	29	30	35	36
2	27	29	22	23	26	27	17	19	22	23	24	24
3	12	12	18	21	22	23	16	17	19	17	18	20
4	10	10	16	16	10	9	16	16	14	15	13	12
5	2	2	8	7	3	2	16	15	10	10	6	5
Over 5	5	4	7	3	2	1	18	14	6	6	5	3
Total	100	100	100	100	100	100	100	100	100	100	100	100
Over 3	17	16	31	26	15	13	50	46	31	30	23	20

The variation in the time to complete a course is given in Table 3.6. Overall 38 percent of females took three years to complete a course compared to 29 percent of males who took the same time. In general, a higher proportion of males took four or more years to complete their course than females across all fields of study. In particular, in Health and Education (I) the difference in this proportion between the two gender groups is quite large.

Table 3.7 shows the gender balance of undergraduate students enrolled in 1994 at each year of enrolment. For example, of all Arts students in their first year of enrolment 31 percent are male and 69 percent female. In general, at the fifth and higher year of enrolment males outnumber females, except in Arts, Education (I), Education (O) and Health.

The gender balance of undergraduate students who completed a course in 1993 is given in Table 3.8. For example, 34 percent of those students who completed a course in three years were male and 66 percent were female. The table shows that, in general, females make up a significantly larger proportion of the students who finish the course in four years or less, while males make up a higher proportion of those who take five or more years. However, there is considerable variation from this across fields of study. For example, males heavily outnumber females in Agriculture, Architecture and Engineering at all levels of completion times, while females outnumber males in Health.

Postgraduates

Three groups of postgraduate students are analysed. These are:

- Research (includes Higher Doctorate, Doctorate by Research and Master's by Research);
- Master's by Coursework; and
- Other Postgraduate (includes Postgraduate Qualifying, Graduate/Postgraduate Diploma new and extension area, Graduate Certificate and Bachelor's Postgraduate).

Unlike the analysis for undergraduate students postgraduates are not analysed by field of study. because there are unlikely to be enough students in each cell of the input-output matrix for reliable estimation of the model parameters. Further work in this area may be undertaken at a later date.

Table 3.6 Distribution of Completion Time for Undergraduates who Completed a Course in 1993, by Sex and Field of Study

Time to	All		Australian		Agriculture		Architecture		Arts		Business		Education (I)	
Completion	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female
1	7	9	6	8	4	2	2	3	8	5	6	4	6	6
2	9	13	8	12	3	4	8	9	9	9	6	6	17	10
3	29	38	28	38	30	26	31	32	38	40	30	37	32	48
4	28	25	28	25	40	44	25	29	24	25	30	31	35	29
5	14	9	15	9	15	18	14	13	9	9	13	12	7	4
Over 5	14	8	14	8	8	7	20	14	12	12	15	10	4	2
Total	100	100	100	100	100	100	100	100	100	100	100	100	100	100
Over 3	56	41	57	42	64	68	59	57	46	46	59	53	46	35

Time to	Education (O)		Engineering		Health		Law		Medicine		Science	
Completion	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female
1	16	17	2	1	10	15	2	2	2	2	9	10
2	42	40	5	4	13	18	2	5	8	6	7	6
3	22	24	10	12	38	39	3	5	14	19	31	36
4	10	9	36	50	26	22	2	3	21	25	30	32
5	4	3	29	26	8	5	21	24	32	30	15	11
Over 5	6	6	19	7	4	2	69	61	23	18	9	6
Total	100	100	100	100	100	100	100	100	100	100	100	100
Over 3	20	19	84	83	39	29	93	88	76	73	53	48

Table 3.7 Gender Distribution of Undergraduates who were Enrolled in a Course in 1994, by Time in the System and Field of Study

	All		Australian		Agriculture		Architecture		Arts		Business		Education (I)	
Time in Years	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female
1	44	56	43	57	61	39	64	36	31	69	53	47	26	74
2	44	56	43	57	62	38	64	36	31	69	53	47	25	75
3	44	56	43	57	65	35	61	39	30	70	54	46	24	76
4	48	52	48	52	66	34	67	33	32	68	56	44	26	74
5	53	47	53	47	70	30	64	36	30	70	59	41	30	70
Over 5	53	47	53	47	63	37	68	32	29	71	64	36	34	66
Total	45	55	45	55	63	37	64	36	31	69	55	45	26	74

	Education (O)		Engineering		Health		Law		Medicine		Science	
Time in Years	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female
1	22	78	86	14	18	82	50	50	49	51	56	44
2	20	80	86	14	17	83	49	51	48	52	57	43
3	22	78	85	15	17	83	51	49	52	48	54	46
4	22	78	87	13	18	82	52	48	49	51	58	42
5	20	80	88	12	25	75	54	46	50	50	62	38
Over 5	24	76	94	6	27	73	58	42	52	48	67	33
Total	21	79	87	13	18	82	52	48	50	50	57	43

Table 3.8 Gender Distribution of Undergraduates who Completed a Course in 1993, by Completion Time and Field of Study

Time to	All		Australian		Agriculture		Architecture		Arts		Business		Education (I)	
Completion	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female
1	35	65	34	66	76	24	59	41	39	61	63	37	21	79
2	33	67	32	68	65	35	58	42	31	69	52	48	32	68
3	34	66	33	67	71	29	61	39	29	71	48	52	16	84
4	43	57	42	58	66	34	58	42	30	70	53	47	26	74
5	53	47	53	47	65	35	62	38	30	70	56	44	31	69
Over 5	54	46	54	46	73	27	69	31	32	68	64	36	35	65
Total	40	60	40	60	68	32	61	39	30	70	54	46	22	78

Time to	Education (O)		Engineering		Health		Law		Medicine		Science	
Completion	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female
1	20	80	90	10	11	89	57	43	48	52	55	45
2	22	78	90	10	11	89	39	61	56	44	58	42
3	20	80	85	15	15	85	41	59	44	56	52	48
4	23	77	84	16	17	83	53	47	46	54	54	46
5	26	74	89	11	24	76	53	47	52	48	64	36
Over 5	20	80	95	5	26	74	60	40	56	44	66	34
Total	21	79	88	12	15	85	57	43	50	50	56	44

The age profile of male and female students enrolled for each level of course for 1994 is given in Table 3.9. For example, it shows that 41 percent of all male Research students were under 31 years old, 33 percent were between 31 and 39 while 25 percent were over 39. The age profile for male Other Postgraduate students is almost identical. The age profile for male Master's by Coursework students show a higher proportion of them in the 31 to 39 age group then in the under 31 group.

Thirty-two percent of female Research students are over 39 years old, substantially higher than the corresponding figure for males. The age profile for females at both the Research and Master's by Coursework level is quite similar. However, the age profile for Other Postgraduate level students is substantially different. Students at this level tend to be younger with 47 percent of them under 31 years old.

Table 3.10 shows the age profile of students who completed postgraduate level courses in 1993. Apart from the fact that students are older, especially the Research level students, the profiles are a reflection of the pattern for the enrolment data

Table 3.9 Age Distribution of Postgraduates who were Enrolled in a Course in 1994, by Sex and Level of Course

	Research		Master's by Coursework		Other Postgraduate	
Age in Years	Male	Female	Male	Female	Male	Female
Under 23	5	5	3	5	8	13
23-24	10	10	6	7	9	11
25-26	10	9	8	8	8	8
27-28	8	7	9	8	8	8
29-30	8	8	10	8	8	7
31-32	9	7	10	8	8	6
33-34	8	7	9	8	8	6
35-39	17	15	20	17	18	16
40-44	12	14	13	15	13	13
Over 45	13	18	11	16	11	12
Total	100	100	100	100	100	100
Under 31	41	39	37	37	42	47
31-39	33	29	39	32	34	29
Over 39	25	32	24	30	24	24

Table 3.10 Age Distribution of Postgraduate Students who Completed a Course in 1993, by Sex and Level of Course

	Research		Master's by Coursework		Other Postgraduate	
Age in Years	Male	Female	Male	Female	Male	Female
Under 23	1	1	3	5	10	18
23-24	4	3	5	6	10	11
25-26	9	9	8	8	8	8
27-28	10	10	9	9	8	7
29-30	12	11	11	9	8	6
31-32	11	9	10	8	8	6
33-34	10	8	9	7	7	6
35-39	19	18	21	18	17	15
40-44	12	15	14	15	13	13
Over 45	12	17	11	17	11	11
Total	100	100	100	100	100	100
Under 31	36	34	35	36	43	50
31-39	39	34	41	33	32	26
Over 39	24	32	24	32	24	23

The gender balance of postgraduate students enrolled in 1994 is given in Table 3.11. There are more male Research students than females in all age categories. At the Master's level there are more females than males in the under 23 and over 45 age groups, while in all other groups there are either more males or there is more or less a gender balance. Females outnumber males in all age groups at the Other Postgraduate level courses with the difference quite large in the younger age groups.

Table 3.11 Gender Distribution of Postgraduates who were Enrolled in a Course in 1994, by Age and Level of Course

	Research		Master's by Coursework		Other Postgraduate	
Age in Years	Male	Female	Male	Female	Male	Female
Under 23	58	42	45	55	31	69
23-24	60	40	49	51	37	63
25-26	62	38	52	48	42	58
27-28	61	39	56	44	42	58
29-30	61	39	58	42	46	54
31-32	63	37	60	40	47	53
33-34	63	37	59	41	47	53
35-39	62	38	57	43	45	55
40-44	56	44	51	49	42	58
Over 45	51	49	45	55	41	59
Total	59	41	54	46	42	58

Table 3.12 shows the gender balance of postgraduates who completed a course in 1993. In general, the pattern in this table is not too dissimilar to that for the enrolment data in Table 3.11. One difference is that for the Research and Master's by Coursework level courses the proportion of females completing is smaller than the corresponding proportion enrolled in each age category apart from the under 23 age.

Table 3.12 Gender Distribution of Postgraduates who Completed a Course in 1993, by Age and Level of Course

	Research		Master's by Coursework		Other Postgraduate	
Age in Years	Male	Female	Male	Female	Male	Female
Under 23	54	46	42	58	28	72
23-24	65	35	53	47	38	62
25-26	64	36	56	44	40	60
27-28	65	35	59	41	42	58
29-30	67	33	61	39	44	56
31-32	68	32	64	36	46	54
33-34	70	30	63	37	46	54
35-39	65	35	61	39	45	55
40-44	59	41	56	44	41	59
Over 45	55	45	46	54	41	59
Total	64	36	57	43	40	60

Table 3.13 shows the variation in the time in the system for students enrolled in postgraduate courses in 1994. There is little difference in the pattern of variation between males and females within each level of course.

Table 3.13 Distribution of Time in the System for Postgraduates who were Enrolled in a Course in 1994, by Sex and Level of Course

	Research		Master's by Coursework		Other Postgraduate	
Time in Years	Male	Female	Male	Female	Male	Female
1	33	35	48	49	61	62
2	27	25	29	28	26	27
3	19	19	13	13	8	7
4	11	11	6	6	3	3
5	5	6	2	3	1	1
Over 5	5	4	2	2	1	1
Total	100	100	100	100	100	100
4 or more	21	21	10	10	5	4

The distribution of time to complete a course for those who completed a course in 1993 is given in Table 3.14. It shows, for example, 71 percent of the males who completed Research degrees took four or more years to do so. The variation in time to complete a course is similar for males and females for each level of course.

Table 3.14 Distribution of Completion Time for Postgraduates who Completed a Course in 1993, by Sex and Level of Course

	Research		Master's Coursework		Other Postgraduate	
Completion Time	Male	Female	Male	Female	Male	Female
1	4	4	17	18	42	43
2	10	12	35	34	35	36
3	16	18	26	25	14	14
4	21	19	13	13	5	4
5	21	19	5	5	2	2
Over 5	30	28	4	5	2	1
Total	100	100	100	100	100	100
Over 3	71	67	22	23	9	7

Table 3.15 shows the gender distribution of students who were enrolled in a course in 1994. For example, 58 percent of Research students in their first year of enrolment were male, while the corresponding figure at the Other Postgraduate level is only 41 percent. In general, males tend to dominate at all stages of enrolment at the research level, while females tend to do the same at the Other Postgraduate level. The gender balance is less uneven at the Master's by Coursework level than for the other two levels.

Table 3.15 Gender Distribution of Postgraduates who were Enrolled in a Course in 1994, by Time in the System and Level of Course

	Research		Master's by Coursework		Other Postgraduate	
Time in Years	Male	Female	Male	Female	Male	Female
1	58	42	53	47	41	59
2	61	39	55	45	41	59
3	59	41	53	47	43	57
4	59	41	55	45	45	55
5	57	43	49	51	48	52
Over 5	61	39	56	44	51	49
Total	59	41	54	46	42	58

Finally, the gender breakdown of those who completed a course in 1993 is given in Table 3.16. Males outnumber females at the Research and Master's by Coursework levels while the reverse is true at the Other Postgraduate level.

Table 3.16 Gender Distribution of Postgraduates who Completed a Course in 1993, by Course Completion Time and Level of Course

	Research		Master's by Coursework		Other Postgraduate	
Time in Years	Male	Female	Male	Female	Male	Female
1	64	36	55	45	40	60
2	58	42	58	42	40	60
3	60	40	58	42	41	59
4	65	35	57	43	45	55
5	65	35	54	46	44	56
Over 5	65	35	55	45	49	51
Total	64	36	57	43	40	60

3.3 SCHOOL ENROLMENT DATA

The data on school enrolment are required to estimate grade progression ratios, which in turn are used for projecting the number of students finishing Year 12 of secondary school. The school enrolment data for Australia by age, gender and grade for 1992 to 1994 was obtained from ABS (1993, 1994a, 1995a). For the purposes of making projections of higher education commencements up to the year 2001, data are required only on pupils in Year 6 or above in 1994. Pupils in Year 6 in 1994 will reach Year 12 in the year 2000. The ABS data had to be modified in a number of ways to make it consistent with the DEET higher education data. These modifications are described below.

Year 7 Aggregation

The ABS data contains two separate entries for Year 7 pupils. This is to distinguish the two structures of primary and secondary education that exist in Australia. In New South Wales, Victoria, the Australian Capital Territory and Tasmania Year 7 is included as part of the secondary education system, while in South Australia, Western Australia, Queensland and the Northern Territory it is part of the primary education system. For the purposes of this study the two entries for Year 7 were added to create just a single entry.

Ungraded Pupils

A number of pupils, both at the primary and secondary level, are ungraded. Some of these are in special education. The number of males who are ungraded is about 1.4 percent of the total number for both 1993 and 1994. The corresponding figure for females is substantially lower at about just 1 percent. In this study we distribute the ungraded pupils in a particular age group proportionally into grades using the shares of each grade in that age group as the proportion. An alternative procedure omitting these students could be considered.

Age Reference Date

The age reference date for the ABS data is first of July. However, for the DEET data on course enrolment and completions for higher education this date is 31st of December. In order to have a consistent definition of age the school enrolment data were adjusted. The adjustment process involved moving half the pupils in each age category into the next one.

The enrolment data, after it was adjusted as described above, for males, females and persons for 1994 is given in Table 3.17. The percentage of students who are female in Years 6 to 12 is slightly lower than those who are male: there were 49.4 percent female students in 1994. However, female students made up 52.1 percent of the Year 12 population.

The comparison of the school enrolment figures for 1993 and 1994 show an increase in the number of students in Years 6, 7 and 8 in 1994, but a decline for Years 10, 11 and 12. Consequently we can expect a decline in Year 12 numbers for the next three years and then the numbers to pick up assuming constant retention rates.

Grade Progression and Retention Rates

The grade progression rate is simply the proportion of students from one grade level who progress to the next level in the following year. The retention rate is defined as the proportion of the Year 6 cohort students who progress on to Year 12. The overall retention rate, that is, the proportion of the Preparatory grade cohort students who progress to Year 12, would not be much different to the retention rate as almost all Preparatory students are expected to progress to Year 6. Since only stock data on student enrolment is available it is only possible to estimate these rates by the net grade progressions.

Table 3.18 gives the net grade progression rates and estimates of the retention rate. The difference in these rates for males and females are significant. Female progression rates are higher than that for males. Using the 1992 and 1993 stock data on student enrolment the retention rate for males and females is estimated to be 71 and 81 percent, respectively. However, these figures decline to 67 and 78 percent, respectively, when the 1993 and 1994 stock data are used.

Table 3.17 Full-time Students in Year 6 to 12, by Age and Grade, All Schools, 1994

Age at 31.12.1994	Year 6	Year 7	Year 8	Year 9	Year 10	Year 11	Year 12	Total
				Males				
9	23	1	0	0	0	0	0	24
10	7784	37	4	0	0	0	0	7825
11	55017	7501	36	2	0	0	0	62555
12	58448	53689	7589	26	1	0	1	119755
13	11459	57349	53065	7414	30	1	1	129319
14	277	11451	56225	51267	7654	41	1	126916
15	15	350	11097	53955	48621	6953	43	121033
16	13	27	418	10574	50811	40253	6126	108223
17	10	12	42	563	10617	41846	33504	86593
18	2	11	5	80	976	9739	35136	45948
19	0	4	1	15	233	1654	9090	10996
Over 19	2	5	8	15	323	1611	4013	5977
Total	133051	130437	128489	123910	119266	102098	87914	825166
				Females				
9	22	1	0	0	0	0	0	23
10	8202	17	3	0	0	0	0	8222
11	54877	8007	46	2	0	0	0	62931
12	54508	53979	8182	36	1	0	0	116706
13	7960	53680	53226	8203	34	1	0	123103
14	160	7878	52283	51466	8535	48	0	120370
15	13	199	7446	50205	50064	8038	43	116008
16	7	18	272	7229	48406	43720	7472	107124
17	4	10	27	367	7383	42349	38902	89042
18	0	9	6	59	674	7528	37880	46154
19	1	3	3	21	185	1213	7450	8875
Over 19	2	2	13	30	292	1581	3754	5673
Total	125754	123804	121506	117617	115574	104477	95499	804231
				Persons				
9	45	1	0	0	0	0	0	46
10	15986	54	7	0	0	0	0	16047
11	109893	15508	82	3	0	0	0	125487
12	112956	107668	15772	62	2	0	1	236460
13	19420	111030	106291	15617	64	2	1	252423
14	437	19329	108508	102734	16189	90	1	247286
15	28	549	18542	104159	98685	14991	86	237041
16	20	45	690	17803	99217	83973	13598	215347
17	14	22	69	930	18000	84195	72405	175635
18	2	20	10	139	1650	17267	73016	92103
19	1	7	3	37	418	2867	16540	19871
Over 19	4	8	21	44	615	3192	7766	11650
Total	258805	254241	249995	241527	234839	206576	183413	1629397

Table 3.18 Estimates of Grade Progression and Retention Rates, All Schools

		Grade Progression Rate						
		Year 6 to Year 7	Year 7 to Year 8	Year 8 to Year 9	Year 9 to Year 10	Year 10 to Year 11	Year 11 to Year 12	Retention Rate Year 6-12
1992 to 1993	Males	1.00	1.01	0.99	0.97	0.86	0.85	0.71
	Females	1.00	1.01	1.00	0.98	0.91	0.90	0.81
	Persons	1.00	1.01	1.00	0.98	0.88	0.88	0.76
1993 to 1994	Males	1.00	1.00	0.99	0.96	0.84	0.83	0.67
	Females	1.00	1.01	1.00	0.98	0.90	0.89	0.78
	Persons	1.00	1.00	0.99	0.97	0.87	0.86	0.72

Year 12 Students Projections

On the basis of the grade progression ratios, estimated from the school enrolment data for 1993 and 1994, projections of student numbers in Year 12 by age and gender were made for the years 1995 to 2000. These are given in Table 3.19. The actual numbers for 1992 to 1994 are also included. Figure 3.1 shows time series plots of these projections. The number of Year 12 students is expected to decline until about 1997 and then slowly increase until the year 2000. However, this pattern of variation is not uniform across all age groups and gender. The over 19 female numbers are expected to continue to decline right up to the year 2000. In the under 18 and 18 year age group more female Year 12 students are projected in each year than male students, while in the 19 and over 19 age groups more male than female students are projected.

Table 3.19 Projection of Year 12 Enrolment, by Age and Sex, All Schools, 1995-2000

Age at 31 Dec.		Actual			Projections					
		1992	1993	1994	1995	1996	1997	1998	1999	2000
Under 18	Males	41873	40693	39673	38347	37692	37722	38859	39499	40661
	Females	48382	47269	46416	45133	44783	44517	45751	46563	47562
	Persons	90255	87962	86090	83480	82475	82239	84610	86062	88222
18	Males	37798	36776	35136	34167	33931	34163	35074	35774	36489
	Females	39667	38951	37880	37292	37556	37688	38897	40019	40617
	Persons	77465	75728	73016	71459	71486	71851	73971	75793	77106
19	Males	10719	10055	9090	8465	8133	7917	8070	8289	8287
	Females	8951	8326	7450	7066	6911	6762	6921	7277	7191
	Persons	19670	18382	16540	15530	15044	14679	14991	15566	15478
Over 19	Males	4942	4631	4013	3656	3378	2894	2511	2747	2785
	Females	4419	4040	3754	3246	2938	2458	2447	2253	2094
	Persons	9361	8671	7766	6902	6316	5352	4957	5000	4879
Total	Males	95333	92155	87912	84634	83134	82696	84514	86309	88222
	Females	101419	98587	95499	92738	92188	91425	94016	96111	97464
	Persons	196752	190742	183411	177372	175322	174121	178529	182420	185686

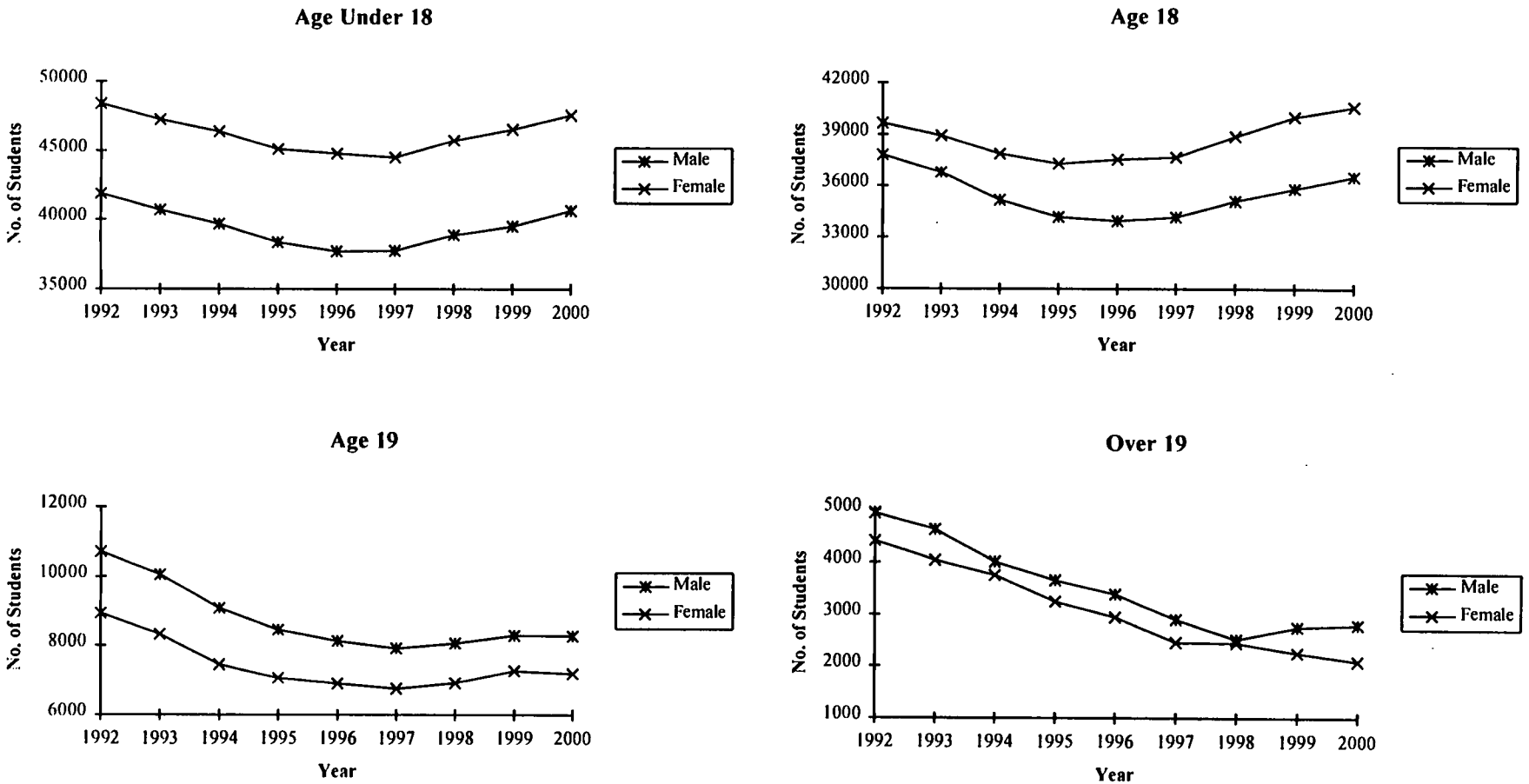

Figure 3.1 Projections of Year 12 Students, by Age and Sex, 1995 to 2000

3.4 Population Data

The population estimates for Australia by age and gender for 1993 and 1994 were obtained from ABS (1995b) and the projections for the years 1995 to 2041 from ABS (1994b). The age reference date for these data is 30th June. The adjustment process, similar to that used for the school enrolment data, was also used on these data in order to have the date at which a student's age is calculated consistent with that used in DEET's files on higher education enrolment and completions.

Figures 3.2 and 3.3 show the variation over time and difference between male and female population by various age groups of importance for this study. The plots reflect the decline in births in the 1970s and the consequent decline in the number of 15 to 17-year-olds from 1992 to 1994. The numbers of 15 to 17 year olds are projected to increase steadily after 1994, reflecting a slight recovery in births from 1980. The effect of the low birth rate also shows up in the plots of all age groups up to 24. There is a slump in the number of 30 to 34-year-olds from 1994 until 1999, due to the decline in births around the mid 1960s.

3.5 Concluding Remarks

An exploratory analysis of the higher education, schools and population data showed pattern of variation by gender, age, field of study and level of course. The data on population projections show the effect of low births which occurred in the 1970s. In the next chapter, input-output models are fitted to the data. The results of estimating these models are presented and discussed.

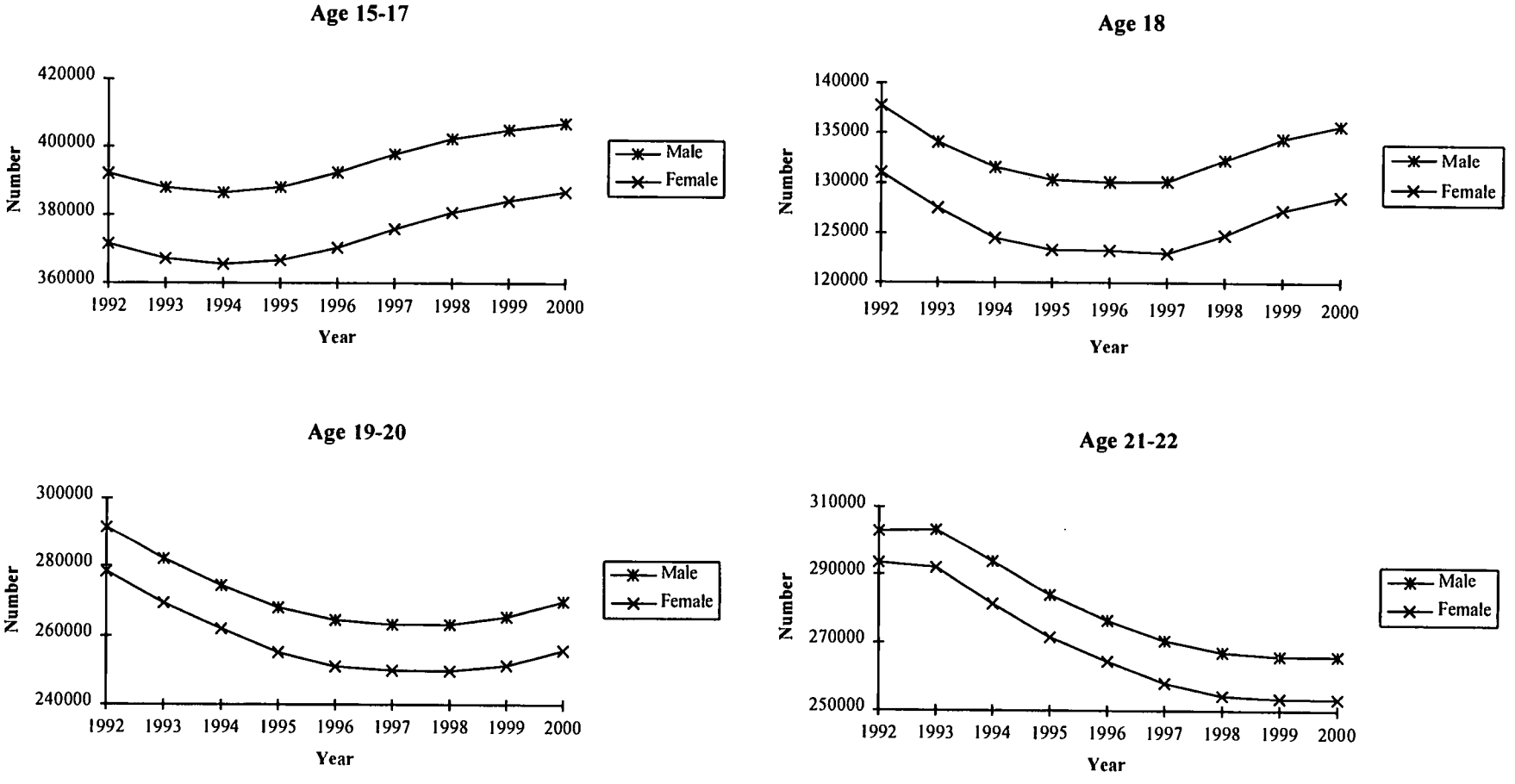

Figure 3.2 Projections of Australia's Population of those between 15 and 22 Years by Sex and Selected Age Groups, 1995 to 2000

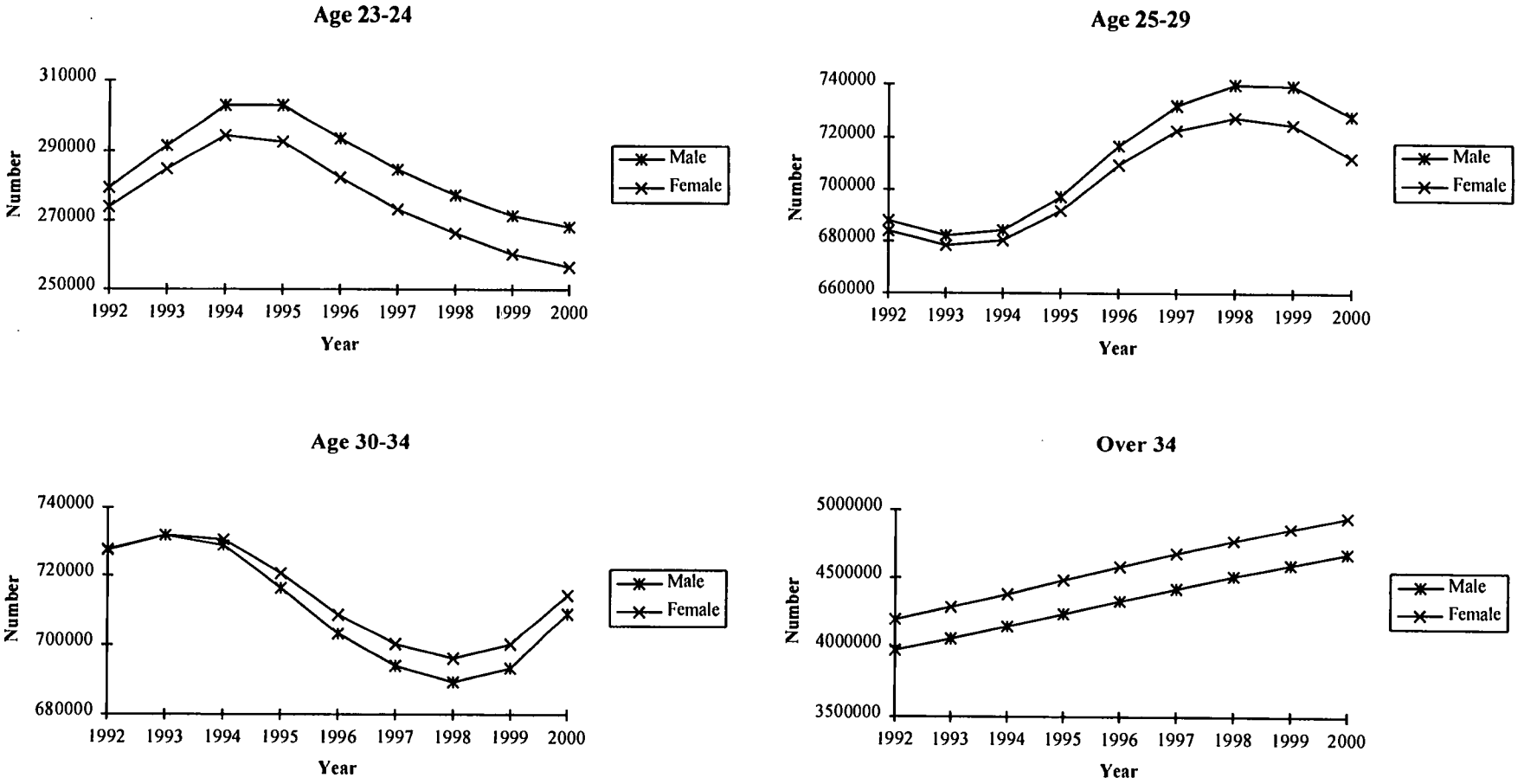

Figure 3.3 Projections of Australia's Population of those over 22 Years by Sex and Selected Age Groups, 1995 to 2000

4 Analysis

4.1 INTRODUCTION

The movement of students through the higher education system is likely to vary by the characteristics of the students and by field and level of study. Aggregate models provide useful information towards the understanding of the dynamics of the system. However, they alone cannot provide the details necessary to understand the behaviour of particular groups of students. Thus, whenever possible a separate input-output model is estimated for each group of students defined by sex, field of study and level of course. The disaggregation is limited by the need to ensure that there are sufficient number of student movements from one state of the system to another from which transition proportions can be estimated.

The general model building procedure is described in section 4.2. The results from fitting and estimating input-output models to various groups of students at the undergraduate and postgraduate level are given in sections 4.3 and 4.4. The groups at the undergraduate level are defined by field of study, and that at the postgraduate level by level of course. For each of these groups three models are estimated, one for all persons in the group and one each for males and females.

Two sets of results are reported. The first set contains the summary statistics that emanate from approximating the input-output model as a regular Markov chain. For example, estimates are derived of the probability of a student completing a course given the student's age at course commencement and the average time to completion. The second set of results are a summary of the projections of the number of students at various stages of the system until the year 2001. Only projections based on one set of assumptions are included. Future work will include sensitivity analysis and alternate models for projecting the number of commencing students.

4.2 MODEL BUILDING

The procedure described below is general in nature and applies to all the input-output models that are developed and estimated. As a first step to constructing an input-output model the transient states must be defined. We define these states by age and year of enrolment in course. To ensure that all transition proportions are defined there must be at least one student in each transient state in 1993.

Next, tables showing the age of students by the time, in years, that they have been enrolled are extracted from each of the DEET course enrolment files of 1993 and 1994 and the course completions file for 1993. Data in these three cross-tabulations provide the basis for constructing the input-output matrix.

Students in a given transient state in 1993 move to another transient state in 1994, complete the course or drop out. The only unknown quantity is the number who drop out. However, this can be calculated because the other two quantities are known. Careful attention has to be paid when considering movements to and from states defined by grouped ages and multiple year of enrolment, such as *being between 25 and 29 years of age and in the sixth or higher year of enrolment*.

In theory the above process should result in an input-output matrix with a non-negative quantity in each cell. In practice, it was found that some of the movements into the dropout *absorbing* state were negative. This means that the compilation of the enrolment and completions data files is not consistent. There are two possible causes for these negative values. First, it could be a data recording error, and resources are not available, at this stage, to confirm whether indeed this is the case. The second possibility, which is more likely, is that there is a variation across institutions in the way completions data are recorded. Anecdotal evidence suggests that some institutions record a student as having completed a course when that student has satisfied all the requirements for the course, while others only record a completion when the student applies for graduation. There may also be other reasons why there is a lack of consistency between the enrolment and completions data.

The negative dropout values are a nuisance because they prevent a complete analysis of the dynamics of the system. In general, the negative values were very small in absolute terms and were more often than not associated with movement from transient states defined by an older age group and year of enrolment which was usually more than 3. It was decided to perturb some of the completions figures in order to eliminate the negative dropout numbers. The procedure for perturbing, which is ad hoc in nature, is described in the Appendix to this

report. A consequence of the perturbation is that the time to completion statistics may be slightly deflated. Since the magnitude and the number of perturbation is small, we assume the bias will be negligible.

The next step in the model building involves the calculation of the matrix of transition proportions, **Q**, and the matrix **R** of proportions moving into the absorbing states. The model can now be estimated as outlined in Chapter 2.

4.3 UNDERGRADUATES

Students were divided into eleven age groups. Associated with each age group there are up to six *year of enrolment* categories. The resulting model consists of 51 transient states. These are marked by a cross in Table 4.1.

Although a typical state such as *being a 20-year-old and in the second year of enrolment* means precisely that, the last state in each row in Table 4.1 is to be interpreted differently. For example, *being under 18 years of age and in the first year of enrolment* means being under 18 years old and in the first or higher year of enrolment, and *being a 22-year-old and in the sixth year of enrolment* means being 22 years old and in the sixth or higher year of enrolment. This sort of aggregation is necessary to contain the size of the input-output model. It is unlikely that there will be many under 18-year-olds in their second year of enrolment, and even less likely that there will be many in the third or higher year of enrolment.

Table 4.1 Transient States of the Model for Undergraduates Defined Using Age and Year of Enrolment as Criteria

	Year of Enrolment in Course					
Age	1	2	3	4	5	6
Under 18	X					
18	X	X				
19	X	X	X			
20	X	X	X	X		
21	X	X	X	X	X	
22	X	X	X	X	X	X
23	X	X	X	X	X	X
24	X	X	X	X	X	X
25-29	X	X	X	X	X	X
30-34	X	X	X	X	X	X
Over 34	X	X	X	X	X	X

Note: A cross indicates that the transient state is included in the model

Three models, one each for males, females and persons, were estimated for each of the following groups of undergraduates:

- all students;
- Australian students (includes permanent residents); and
- Australian students by nine fields of study.

Models for students doing Agriculture, Education (O) and Medicine could not be estimated satisfactorily as there was too much inconsistency between the course enrolment and completions data. The consequence of the inconsistency was that the movement between 1993 and 1994 of a large number of students could not be reconciled. Australian students were considered on their own because they make up the bulk of the students and they are also the primary concern of this study. Models for all students were estimated for use as a benchmark for other models.

Probability of Completing Course

Table 4.2 shows the estimates of the probability of a student completing a course given his/her age at course commencement. For example, an Australian male student who starts as an undergraduate at the age of 18 years has a 58 percent chance of eventually completing the course, while an Australian female student of the same age has a 66 percent chance of completing. There is considerable variation in these probabilities between males and females, across age groups and fields of study. However, there is hardly any difference in the estimated probabilities for all students and just Australian students. This may be due to the behaviour of the overseas fee-paying students not being significantly different to that of Australian students, and even if the behaviour was different the number of overseas fee-paying students is relatively small to have much impact on the estimated probabilities.

If we concentrate on the results for the Australian group, there is a clear indication that females have a higher chance of completing a course than males irrespective of what age the course is commenced at. However, the difference in the probabilities between male and female completion of a course varies with the age at which the course is commenced. This difference can be as high as 10 percentage points, for example, if the course is commenced at an age of 20 years. In general, as the age at which a course is commenced increases, the chances of completing the course diminish for both gender groups. For both males and females the highest chance of completing a course is if the commencement age is 20 years, at which age the probability for a female completing is 79 percent and that for a male 69 percent. Among the females, those aged between 25 and 29 years have the least chance of completing the course, while the corresponding age for males is 30 to 34 years.

Table 4.2 Probability of Completing an Undergraduate Course by Age at Course Commencement

Age at Course	All			Australian			Architecture			Arts			Business		
Commencement	Male	Female	Person	Male	Female	Person	Male	Female	Person	Male	Female	Person	Male	Female	Person
Under 18	0.62	0.66	0.64	0.62	0.66	0.64	0.68	0.69	0.69	0.55	0.64	0.61	0.64	0.63	0.64
18	0.59	0.66	0.63	0.58	0.66	0.62	0.69	0.73	0.71	0.54	0.63	0.61	0.60	0.66	0.62
19	0.64	0.73	0.69	0.63	0.72	0.68	0.56	0.64	0.60	0.65	0.69	0.68	0.63	0.66	0.64
20	0.69	0.78	0.73	0.69	0.79	0.74	0.65	0.74	0.71	0.67	0.81	0.77	0.78	0.73	0.76
21	0.67	0.73	0.70	0.67	0.73	0.70	0.72	0.87	0.72	0.62	0.74	0.70	0.65	0.64	0.63
22	0.60	0.69	0.65	0.59	0.69	0.64	0.56	0.87	0.60	0.63	0.62	0.62	0.53	0.54	0.54
23	0.59	0.67	0.63	0.57	0.66	0.62	0.62	0.72	0.70	0.56	0.62	0.59	0.52	0.50	0.51
24	0.57	0.64	0.61	0.56	0.63	0.60	0.65	0.79	0.64	0.56	0.60	0.59	0.49	0.44	0.47
25-29	0.54	0.61	0.58	0.54	0.61	0.58	0.52	0.58	0.52	0.55	0.56	0.56	0.46	0.43	0.45
30-34	0.51	0.62	0.58	0.52	0.62	0.58	0.37	0.64	0.42	0.58	0.59	0.59	0.40	0.39	0.40
Over 34	0.51	0.63	0.59	0.53	0.63	0.60	0.36	0.64	0.42	0.55	0.60	0.59	0.36	0.32	0.34

	Education (I)			Engineering			Health			Law			Science		
	Male	Female	Person	Male	Female	Person	Male	Female	Person	Male	Female	Person	Male	Female	Person
Under 18	0.50	0.67	0.64	0.54	0.55	0.54	0.63	0.65	0.65	0.83	0.80	0.81	0.61	0.61	0.61
18	0.52	0.66	0.63	0.50	0.60	0.52	0.61	0.64	0.63	0.95	0.95	0.95	0.57	0.65	0.61
19	0.47	0.69	0.63	0.60	0.70	0.62	0.64	0.83	0.79	1.00	1.00	1.00	0.57	0.62	0.59
20	0.54	0.68	0.63	0.54	0.66	0.55	0.72	0.86	0.83	0.95	0.91	0.91	0.71	0.85	0.76
21	0.56	0.64	0.62	0.60	0.42	0.58	0.82	0.81	0.80	0.81	0.80	0.81	0.74	0.88	0.80
22	0.48	0.68	0.64	0.44	0.48	0.45	0.70	0.74	0.72	1.00	1.00	1.00	0.65	0.83	0.72
23	0.52	0.69	0.64	0.54	0.59	0.55	0.61	0.78	0.75	0.88	0.75	0.83	0.58	0.61	0.59
24	0.52	0.60	0.56	0.53	0.27	0.50	0.61	0.75	0.72	0.52	0.75	0.62	0.53	0.61	0.56
25-29	0.58	0.62	0.60	0.48	0.33	0.47	0.68	0.72	0.71	0.67	0.71	0.69	0.50	0.56	0.52
30-34	0.68	0.61	0.63	0.50	0.42	0.50	0.56	0.73	0.70	0.58	0.68	0.62	0.42	0.52	0.45
Over 34	0.68	0.73	0.71	0.41	1.00	0.44	0.60	0.73	0.71	0.64	0.66	0.65	0.37	0.46	0.40

The comparison of the probabilities across fields of study reveal that, in general, Engineering students have the least chance of completing and Law the highest. If it was possible to model the behaviour of students in Medicine, then we would expect them to also have a very high chance of completing a course. Some estimates of the probabilities, if calculated on the basis of movements of only a small number of students, may not be all that reliable. For example, there are not all that many older females doing Engineering or Architecture, and hence, the estimates relating to these groups may be unstable.

In general, females have a higher chance than males of completing a course in Architecture, Arts, Education (I), Health and Science. In the other fields of study this pattern is not nearly as uniform across different course commencement ages. In Business the differences between the male and female chances are relatively small, with the maximum of only 5 percentage points for students commencing the course at the age of 20 years.

A person commencing a course in Business or Engineering at an age of 24 years or more has a 50 percent or less chance of completing it, and a person commencing a course in Architecture or Science at an age over 29 years has a less than even chance of completing it. In all other fields of study a person has better than even chance of completing a course irrespective of the age of the student when the course was commenced.

Time in the System

The estimates of the mean and the standard deviation of the time spent in the system (number of years of enrolment in a particular course) by a student is given in Tables 4.3 and 4.4, respectively. A number of factors affect these estimates, but at this stage it is not possible to isolate, or measure, the impact of any one of them because of lack of data. The factors which are likely to have an impact are:

- the number of part-time students enrolled in the course;
- the length of the course;
- the number of students with credit for prior subjects or qualification; and
- the attrition rate from the course, though this is considered separately below.

Table 4.3 shows that the mean time in the system varies by the age of the student when he/she commenced a course, gender and field of study. The mean time is 3.2 years for persons starting a course when they are 18 years old. In general, there is a steady decline in the mean time as the age at which a course is commenced increases, until around a course commencement age of 21 to 22 years when the minimum mean time in the system of 2.6 years is reached. A steady increase in the mean time can be observed as course

commencement age increases above 23 years. This pattern repeats, more or less, for each field of study.

Australian male students spend, on average, a longer time in the system than females. This pattern of variation is not uniform across all fields of study. For example, the mean time in the system for male students in Arts who commence a course at the age of 23 years or more is shorter than that for females who commence at the same age. Architecture, Engineering and Law courses are of longer duration and this is reflected in the higher mean time in the system for students doing these courses.

The standard deviation of the time in the system also varies with course commencement age and fields of study. In general, the standard deviation is higher for students who begin their courses at an older age. A possible reason for this is that there are likely to be a relatively higher number of part-time students in the older age groups.

Time to Completion

The factors which are likely to have an impact on the mean time to complete a course are:

- the number of part-time students enrolled in the course;
- the length of the course; and
- the number of students with credit for prior subjects or qualifications.

The mean and the standard deviation of the time taken by a student to a complete a course is given in Tables 4.5 and 4.6, respectively. For example, it takes, on average, 4.4 years for an Australian male, commencing studies at the age of 18 years, to finish a bachelor's course, while for a female of the same age this time is 3.9 years.

For both male and female Australian students the minimum average time to course completion is achieved if the course is commenced at the age of 21 years. Overall females take less time on average to complete a course than males, with the difference for some age groups, such as those commencing a course at the age of 21 years, being as much as 0.7 years.

Females who commence a course in Health at an age between 21 and 23 years take, on average, the shortest time to complete an undergraduate degree, while females who commence an Engineering course at the age of over 34 years take the longest time. However, there may not be all that many females over 34 studying a course in Engineering.

The standard deviation of the time to complete a course follows a pattern similar to that for the standard deviation of the time in the system, that is, it is higher for students who begin their courses at an older age.

Table 4.3 Mean Number of Years in the System for Undergraduates by Age at Course Commencement

Age at Course	All			Australian			Architecture			Arts			Business		
Commencement	Male	Female	Person	Male	Female	Person	Male	Female	Person	Male	Female	Person	Male	Female	Person
Under 18	3.4	3.1	3.2	3.4	3.1	3.2	3.7	3.5	3.6	3.0	2.9	3.0	3.2	3.0	3.1
18	3.3	3.1	3.2	3.3	3.1	3.2	3.6	3.6	3.6	3.0	3.0	3.0	3.2	3.1	3.2
19	3.2	3.0	3.1	3.2	3.0	3.0	3.6	3.7	3.6	3.0	2.9	2.9	3.0	2.9	2.9
20	2.9	2.7	2.8	2.9	2.6	2.7	3.4	3.8	3.5	2.6	2.8	2.7	2.9	2.7	2.8
21	2.8	2.4	2.6	2.8	2.4	2.6	3.9	3.6	3.8	2.6	2.6	2.6	2.9	2.7	2.8
22	2.7	2.5	2.6	2.7	2.5	2.6	2.6	3.0	2.8	2.7	2.7	2.7	2.8	2.9	2.8
23	2.8	2.5	2.7	2.8	2.6	2.7	3.2	2.9	3.1	2.7	2.9	2.8	3.0	3.0	3.0
24	2.8	2.6	2.7	2.9	2.7	2.8	3.3	2.5	3.0	2.7	3.1	2.9	3.1	3.0	3.1
25-29	2.8	2.6	2.7	2.9	2.7	2.8	3.1	2.9	3.0	2.8	3.0	3.0	3.1	3.0	3.1
30-34	2.9	2.9	2.9	3.0	2.9	2.9	2.7	3.5	2.8	3.1	3.4	3.3	3.1	3.1	3.1
Over 34	2.8	2.9	2.8	2.8	2.9	2.9	2.7	2.9	2.7	3.0	3.6	3.4	2.9	2.8	2.9

	Education (I)			Engineering			Health			Law			Science		
	Male	Female	Person	Male	Female	Person	Male	Female	Person	Male	Female	Person	Male	Female	Person
Under 18	2.9	2.9	2.9	3.7	3.6	3.7	3.1	3.0	3.0	4.6	4.2	4.4	3.1	3.0	3.1
18	2.9	2.9	2.9	3.7	3.7	3.7	3.0	2.9	2.9	4.5	4.5	4.5	3.0	3.0	3.0
19	2.6	2.9	2.8	3.7	3.8	3.7	2.8	2.7	2.7	4.5	4.2	4.3	2.9	2.9	2.9
20	2.5	2.2	2.3	3.3	3.0	3.2	2.7	2.3	2.4	3.1	3.4	3.3	2.7	2.7	2.7
21	2.4	2.2	2.2	3.1	2.6	3.1	2.8	2.1	2.2	2.8	2.8	2.8	2.5	2.4	2.5
22	2.5	2.4	2.4	2.9	3.0	2.9	2.3	2.0	2.0	2.7	3.0	2.8	2.7	2.6	2.6
23	2.5	2.5	2.4	3.4	3.3	3.4	2.4	2.1	2.1	2.9	2.8	2.9	2.7	2.5	2.6
24	2.3	2.4	2.3	3.4	2.2	3.3	2.5	2.1	2.2	2.9	3.4	3.1	2.7	2.8	2.7
25-29	2.4	2.5	2.4	3.3	2.4	3.2	2.5	2.3	2.3	3.6	3.5	3.5	2.9	2.9	2.9
30-34	2.4	2.5	2.4	3.4	3.1	3.3	2.3	2.4	2.4	3.4	3.7	3.5	3.0	3.2	3.1
Over 34	2.2	2.4	2.4	2.8	5.5	3.0	2.1	2.4	2.3	3.6	4.0	3.8	2.9	3.2	3.0

Table 4.4 Standard Deviation of the Number of Years in the System for Undergraduates by Age at Course Commencement

Age at Course	All			Australian			Architecture			Arts			Business		
Commencement	Male	Female	Person	Male	Female	Person	Mal(	Female	Person	Male	Female	Person	Male	Female	Person
Under 18	1.8	1.6	1.7	1.8	1.6	1.7	2.1	1.8	2.0	1.7	1.7	1.7	1.7	1.5	1.6
18	1.8	1.6	1.7	1.8	1.6	1.7	2.0	2.0	2.0	1.8	1.7	1.7	1.7	1.6	1.6
19	1.8	1.6	1.7	1.9	1.7	1.8	2.1	2.2	2.2	1.8	1.8	1.8	1.7	1.6	1.6
20	1.8	1.7	1.8	1.8	1.7	1.8	2.1	2.4	2.1	1.7	2.0	1.9	1.8	1.7	1.7
21	1.8	1.7	1.8	1.9	1.7	1.8	2.5	1.9	2.2	1.9	2.1	2.0	2.0	1.8	2.0
22	1.9	1.8	1.8	1.9	1.8	1.9	1.8	1.8	1.8	2.0	2.2	2.2	2.1	2.1	2.1
23	2.0	1.9	1.9	2.1	1.9	2.0	2.1	2.0	2.0	2.1	2.5	2.3	2.3	2.2	2.3
24	2.0	2.0	2.0	2.1	2.0	2.1	2.1	2.1	2.0	2.1	2.5	2.4	2.3	2.3	2.3
25-29	2.1	2.0	2.0	2.1	2.1	2.1	2.1	2.4	2.0	2.2	2.6	2.4	2.3	2.3	2.3
30-34	2.1	2.2	2.2	2.2	2.2	2.2	1.9	3.3	2.0	2.3	2.8	2.6	2.4	2.4	2.4
Over 34	2.1	2.1	2.1	2.1	2.2	2.1	1.8	3.1	1.9	2.4	2.7	2.6	2.3	2.2	2.3

	Education (I)			Engineering			Health			Law			Science		
	Male	Female	Person	Male	Female	Person	Male	Female	Person	Male	Female	Person	Male	Female	Person
Under 18	1.7	1.3	1.4	2.0	1.9	1.9	1.5	1.2	1.2	1.9	2.0	2.0	1.7	1.6	1.7
18	1.5	1.4	1.4	2.1	1.8	2.1	1.5	1.2	1.3	1.6	1.6	1.6	1.7	1.6	1.7
19	1.5	1.6	1.5	2.1	1.8	2.1	1.5	1.2	1.3	1.4	1.5	1.5	1.8	1.7	1.8
20	1.5	1.4	1.4	2.0	1.5	1.9	1.4	1.3	1.3	1.8	1.7	1.8	1.9	1.7	1.8
21	1.3	1.6	1.4	2.0	1.6	2.0	1.4	1.3	1.3	1.6	1.6	1.6	1.7	1.7	1.7
22	1.5	1.6	1.5	2.1	1.9	2.1	1.4	1.2	1.3	1.7	1.9	1.8	1.9	1.9	1.9
23	1.3	1.6	1.5	2.2	2.4	2.3	1.4	1.3	1.3	2.0	1.9	1.9	2.0	1.9	2.0
24	1.3	1.6	1.5	2.3	1.9	2.3	1.4	1.3	1.3	2.1	2.0	2.1	2.1	2.1	2.1
25-29	1.4	1.6	1.5	2.4	2.0	2.3	1.4	1.3	1.3	2.1	2.0	2.0	2.1	2.2	2.1
30-34	1.4	1.5	1.4	2.5	2.7	2.5	1.4	1.4	1.4	2.1	2.2	2.2	2.3	2.6	2.4
Over 34	1.3	1.4	1.4	2.4	3.7	2.5	1.3	1.4	1.3	2.1	2.3	2.2	2.3	2.7	2.4

Table 4.5 Mean Number of Years to Complete an Undergraduate Course by Age at Course Commencement

Age at Course	All			Australian			Architecture			Arts			Business		
Commencement	Male	Female	Person	Male	Female	Person	Male	Female	Person	Male	Female	Person	Male	Female	Person
Under 18	4.4	3.9	4.1	4.4	3.9	4.1	4.7	4.2	4.5	4.1	3.9	3.9	4.1	3.9	4.0
18	4.4	3.9	4.1	4.4	3.9	4.1	4.5	4.4	4.4	4.1	3.8	3.9	4.2	3.9	4.1
19	4.1	3.6	3.8	4.1	3.6	3.8	4.9	4.9	4.9	3.9	3.6	3.7	3.7	3.6	3.7
20	3.6	3.1	3.3	3.5	3.0	3.2	4.3	4.6	4.4	3.3	3.2	3.2	3.3	3.2	3.2
21	3.5	2.9	3.2	3.5	2.8	3.1	4.8	3.8	4.5	3.4	3.1	3.2	3.7	3.5	3.7
22	3.6	3.0	3.3	3.6	3.1	3.3	3.6	3.3	3.6	3.5	3.6	3.6	4.0	4.2	4.1
23	3.8	3.2	3.5	3.9	3.3	3.6	4.2	3.5	3.8	3.8	4.0	4.0	4.5	4.6	4.5
24	3.9	3.4	3.6	4.1	3.5	3.8	4.2	3.0	3.8	3.9	4.3	4.1	4.8	5.0	4.9
25-29	4.1	3.5	3.8	4.2	3.7	3.9	4.5	4.0	4.3	4.0	4.5	4.3	4.9	5.0	5.0
30-34	4.2	3.8	4.0	4.3	3.9	4.0	4.5	4.8	4.5	4.2	4.9	4.7	5.3	5.4	5.3
Over 34	4.1	3.8	3.9	4.1	3.8	3.9	4.4	3.9	4.3	4.4	5.0	4.8	5.3	5.4	5.3

	Education (I)			Engineering			Health			Law			Science		
	Male	Female	Person	Male	Female	Person	Male	Female	Person	Male	Female	Person	Male	Female	Person
Under 18	4.2	3.6	3.7	5.1	4.9	5.1	3.9	3.6	3.6	5.3	5.0	5.1	4.2	4.0	4.1
18	4.1	3.7	3.8	5.3	4.8	5.2	3.8	3.5	3.6	4.7	4.7	4.7	4.2	3.9	4.1
19	3.8	3.5	3.5	4.9	4.7	4.8	3.6	3.0	3.1	4.5	4.2	4.3	4.0	3.8	3.9
20	3.5	2.7	2.9	4.4	3.8	4.4	3.3	2.5	2.6	3.2	3.6	3.4	3.3	3.0	3.1
21	3.2	2.8	2.8	4.2	3.9	4.1	3.2	2.3	2.5	3.3	3.3	3.3	3.0	2.6	2.8
22	3.5	2.9	3.0	4.6	4.4	4.6	2.8	2.3	2.4	2.7	3.0	2.8	3.4	2.9	3.2
23	3.2	3.0	3.1	4.7	4.6	4.7	3.0	2.3	2.4	3.2	3.4	3.2	3.8	3.3	3.6
24	3.1	3.2	3.2	4.9	4.5	4.9	3.2	2.5	2.6	4.4	4.1	4.2	4.0	3.8	3.9
25-29	3.1	3.2	3.2	5.0	4.4	5.0	3.0	2.7	2.7	4.6	4.3	4.5	4.3	4.1	4.2
30-34	2.9	3.2	3.1	5.1	5.3	5.1	3.0	2.8	2.9	4.7	4.7	4.7	4.9	4.9	4.9
Over 34	2.7	2.9	2.8	4.9	5.5	4.9	2.7	2.8	2.8	4.6	5.1	4.8	5.1	5.3	5.2

Table 4.6 Standard Deviation of Number of Years to Complete an Undergraduate Course by Age at Course Commencement

Age at Course	All			Australian			Architecture			Arts			Business		
Commencement	Male	Female	Person	Male	Female	Person	Male	Female	Person	Male	Female	Person	Male	Female	Person
Under 18	1.4	1.2	1.3	1.4	1.2	1.3	1.9	1.7	1.8	1.5	1.4	1.5	1.4	1.2	1.3
18	1.5	1.3	1.4	1.5	1.3	1.4	1.8	1.9	1.8	1.7	1.5	1.6	1.5	1.2	1.4
19	1.7	1.5	1.6	1.7	1.6	1.7	2.0	2.1	2.0	1.7	1.8	1.8	1.7	1.5	1.6
20	1.9	1.8	1.8	1.9	1.8	1.9	2.0	2.7	2.1	1.9	2.1	2.0	1.9	1.7	1.8
21	2.0	1.8	1.9	2.1	1.9	2.0	2.4	2.2	2.3	2.3	2.2	2.2	2.2	2.0	2.1
22	2.1	2.0	2.0	2.2	2.0	2.1	2.2	2.1	2.1	2.1	2.5	2.4	2.4	2.3	2.3
23	2.2	2.1	2.1	2.2	2.1	2.2	2.3	2.3	2.2	2.3	2.6	2.5	2.5	2.4	2.5
24	2.2	2.1	2.2	2.3	2.2	2.2	2.4	2.5	2.4	2.3	2.7	2.5	2.4	2.4	2.4
25-29	2.2	2.2	2.2	2.3	2.2	2.2	2.3	2.9	2.3	2.3	2.7	2.5	2.4	2.4	2.4
30-34	2.4	2.3	2.4	2.4	2.4	2.4	2.4	3.6	2.5	2.5	2.8	2.7	2.4	2.5	2.5
Over 34	2.4	2.3	2.3	2.4	2.3	2.4	2.4	3.5	2.5	2.6	2.7	2.7	2.4	2.6	2.5

	Education (I)			Engineering			Health			Law			Science		
	Male	Female	Person	Male	Female	Person	Male	Female	Person	Male	Female	Person	Male	Female	Person
Under 18	1.3	0.9	1.0	1.5	1.4	1.5	1.1	0.8	0.9	1.1	1.4	1.3	1.3	1.2	1.2
18	1.1	1.0	1.0	1.7	1.4	1.6	1.1	0.9	1.0	1.5	1.5	1.5	1.4	1.3	1.4
19	1.2	1.6	1.4	1.9	1.6	1.8	1.3	1.2	1.2	1.4	1.5	1.5	1.8	1.6	1.8
20	1.4	1.5	1.5	2.0	1.4	2.0	1.2	1.3	1.4	1.8	1.7	1.8	2.1	1.8	2.0
21	1.3	1.7	1.5	2.1	1.8	2.1	1.3	1.4	1.4	1.5	1.5	1.5	2.0	1.9	1.9
22	1.5	1.7	1.5	2.3	2.1	2.3	1.4	1.3	1.3	1.7	1.9	1.8	2.3	2.1	2.2
23	1.3	1.7	1.5	2.4	2.4	2.4	1.4	1.4	1.4	2.1	1.8	2.0	2.4	2.3	2.4
24	1.4	1.7	1.5	2.5	2.4	2.5	1.4	1.4	1.4	1.9	1.9	1.9	2.5	2.4	2.5
25-29	1.4	1.7	1.5	2.5	2.5	2.5	1.5	1.4	1.4	1.8	1.8	1.8	2.6	2.4	2.5
30-34	1.4	1.5	1.5	2.8	3.0	2.9	1.5	1.4	1.4	1.9	2.0	1.9	2.8	2.8	2.8
Over 34	1.4	1.4	1.4	3.1	3.7	3.1	1.4	1.4	1.4	2.0	2.0	2.0	2.9	2.9	2.9

Projections

Projections by age and field of study were made of:

- the number of commencing students, 1995 to 2001;
- the total enrolment, 1995 to 2001;
- the number of course completions, 1994 to 2001; and
- the number of dropouts, 1994 to 2001.

It should be noted that for 1994 the number of commencing students and the total enrolment are actual figures. For 1995, the projections of the number of commencing students were adjusted to approximate the preliminary 1995 commencing numbers (see DEET (1995b)). Thereafter they are based on the method as set out in section 2.2. This method is driven by demographic changes and school enrolment changes only. In brief, this method assumes:

- a constant school retention rate as calculated from the 1993 and 1994 school enrolment data;
- a constant proportion, based on the 1994 data, of Year 12 students continuing into higher education;
- a constant proportion, based on the 1994 data, of non-school-leavers entering higher education; and
- the demographic changes projected to occur between 1995 and 2001.

In this report only aggregate projections by field of study are included because of the constraint of space. Projections by age are available on request.

Table 4.7 contains the projections of the number of commencing students from 1995 to 2001. During this period course commencement numbers are projected to increase by 1.3 percent. Fee-paying overseas students make up about a third of this growth because the growth in the number of Australian students is 0.9 percent for this period. Male and female course commencement numbers are projected to increase at the rate of 0.17 and 0.26 percent per year, respectively.

The number of commencing students are projected to decline from 1995 to 1998, and then to slowly increase until the year 2001. The 1995 levels are projected to be reached by the year 2000. The average annual growth rate in commencement numbers is 0.22 percent over the six year period. There is considerable variation in the growth by field of study. The Education (I) and Health commencement numbers are projected to increase most, while male numbers for courses in Architecture are projected to decline.

Among Australian students male and female commencement numbers are projected to grow by 0.4 and 1.2 percent, respectively, between 1995 and 2001. These projections are plotted as time series in Figure 4.1.

Table 4.7 Projections of Undergraduate Commencements, 1995 to 2001

	Year								Percentage Change	
	1994	1995	1996	1997	1998	1999	2000	2001	1995-2001	Average
Males										
All	66391	70535	69328	68811	68716	69428	70294	71245	1.0	0.17
Australians	60032	64045	62768	62157	61984	62655	63417	64297	0.4	0.07
Architecture	1845	1964	1922	1900	1892	1911	1932	1958	-0.3	-0.05
Arts	11339	12122	11911	11808	11768	11866	12008	12160	0.3	0.05
Business	14119	15073	14779	14639	14612	14778	14944	15146	0.5	0.08
Education (I)	2874	3075	3028	3007	3003	3032	3070	3111	1.2	0.19
Engineering	8840	9367	9124	9008	8974	9100	9234	9390	0.2	0.04
Health	2961	3172	3116	3089	3077	3101	3136	3174	0.1	0.01
Law	2215	2381	2349	2334	2332	2352	2375	2403	0.9	0.15
Science	12482	13275	12971	12822	12776	12928	13093	13288	0.1	0.02
Females										
All	84883	91034	89698	89430	89141	90397	91518	92447	1.6	0.26
Australians	79210	85208	83815	83456	83099	84273	85331	86225	1.2	0.20
Architecture	1051	1122	1098	1091	1084	1100	1115	1128	0.5	0.09
Arts	25475	27413	26978	26878	26771	27159	27506	27802	1.4	0.23
Business	12447	13334	13091	13020	12955	13136	13303	13440	0.8	0.13
Education (I)	8217	8814	8651	8607	8565	8696	8815	8916	1.2	0.19
Engineering	1395	1486	1449	1440	1429	1460	1486	1505	1.3	0.21
Health	13328	14436	14267	14236	14201	14378	14539	14672	1.6	0.27
Law	2350	2522	2484	2472	2463	2491	2520	2546	1.0	0.16
Science	9856	10541	10306	10241	10172	10358	10515	10642	1.0	0.16
Persons										
All	151274	161569	159026	158241	157857	159825	161813	163692	1.3	0.22
Australians	139242	149253	146583	145612	145083	146928	148749	150522	0.9	0.14
Architecture	2896	3086	3020	2991	2976	3011	3047	3086	0.0	0.00
Arts	36814	39535	38889	38685	38539	39026	39514	39962	1.1	0.18
Business	26566	28407	27870	27659	27566	27914	28247	28586	0.6	0.10
Education(I)	11091	11889	11679	11615	11568	11728	11885	12027	1.2	0.19
Engineering	10235	10853	10572	10447	10403	10559	10720	10895	0.4	0.06
Health	16289	17607	17383	17325	17278	17480	17675	17846	1.4	0.22
Law	4565	4904	4833	4806	4795	4843	4894	4949	0.9	0.15
Science	22338	23816	23277	23063	22949	23286	23608	23930	0.5	0.08

Notes: (a) Commencements for 1994 are actual numbers

(b) Commencements for 1995 have been adjusted to approximate preliminary DEET (1995b) estimates

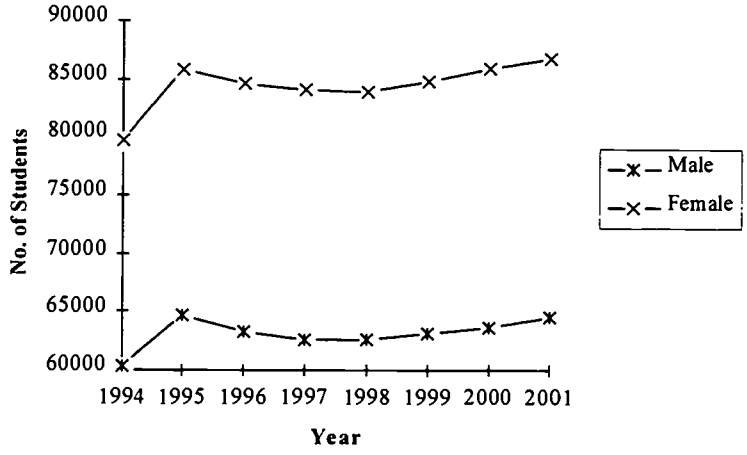

Figure 4.1 Projections of Australian Undergraduate Commencements, 1995 to 2001 (Commencements for 1994 are Actual Numbers and the Projections for 1995 are Adjusted to Approximate Preliminary DEET (1995b) Estimates)

The projections of the total number of students in the system by field of study are given in Table 4.8. Overall total student numbers are projected to increase by 5.5 percent between 1995 and 2001. Male and female numbers are projected to increase by 5.0 and 5.8 percent, respectively.

The total number of Australian students is projected to increase by 4.8 percent over this period. The average annual rate of increase for Australian males and females is projected to be 0.7 and 0.9 percent, respectively. In the year 2001 female students are projected to make up 55.6 percent of all Australian enrolment. Female proportion of enrolment for 1994 was 55.3 percent. The projections of both male and female Australian student numbers are plotted in Figure 4.2.

Total enrolment in all fields of study, except Education (I), are projected to increase between 1995 and 2001. In each case the percentage increase in female numbers is higher than the percentage increase in male numbers. Male and female enrolment in Education (I) are projected to decline by 3.2 and 0.4 percent, respectively. The highest percentage increase in enrolment is projected to be for Law. Male and female Law enrolment are projected to increase by 10.8 and 15.8 percent, respectively.

Table 4.8 Projections of Total Undergraduate Enrolment, 1995 to 2001

	Year								Percentage Change	
	1994	1995	1996	1997	1998	1999	2000	2001	1995-2001	Average
Males										
All	199960	205674	208893	210748	211507	212362	213829	215983	5.0	0.8
Australians	184498	189132	191536	192816	193207	193812	195018	196929	4.1	0.7
Architecture	6020	6245	6383	6462	6487	6520	6562	6617	6.0	1.0
Arts	31801	33011	33737	34130	34235	34345	34587	34937	5.8	0.9
Business	44380	44970	45325	45477	45426	45494	45749	46188	2.7	0.4
Education (I)	8561	8244	8022	7915	7870	7861	7904	7978	-3.2	-0.5
Engineering	30344	31309	31714	31911	32021	32146	32342	32673	4.4	0.7
Health	8106	8262	8311	8331	8311	8301	8340	8416	1.9	0.3
Law	7764	8169	8451	8654	8817	8917	8978	9051	10.8	1.7
Science	35885	36992	37519	37751	37796	37895	38149	38550	4.2	0.7
Females										
All	241649	248616	252891	255762	256635	258100	260336	263111	5.8	0.9
Australians	228348	234450	238091	240532	241128	242357	244370	246958	5.3	0.9
Architecture	3377	3532	3640	3697	3715	3744	3774	3819	8.1	1.3
Arts	71831	75806	78324	79867	80491	81212	82079	83072	9.6	1.5
Business	36832	37687	38231	38565	38612	38778	39077	39469	4.7	0.8
Education (I)	24958	24052	23595	23491	23421	23481	23670	23944	-0.4	-0.1
Engineering	4696	4935	5017	5067	5088	5119	5168	5228	5.9	1.0
Health	36617	36512	36461	36678	36711	36852	37150	37539	2.8	0.5
Law	7909	8493	8951	9305	9530	9664	9747	9839	15.8	2.5
Science	27327	28622	29299	29739	29855	30033	30311	30669	7.2	1.2
Persons										
All	441609	454290	461784	466510	468142	470462	474165	479094	5.5	0.9
Australians	412846	423582	429627	433348	434335	436169	439388	443887	4.8	0.8
Architecture	9397	9777	10023	10159	10202	10264	10336	10436	6.7	1.1
Arts	103632	108817	112061	113997	114726	115557	116666	118009	8.4	1.4
Business	81212	82657	83556	84042	84038	84272	84826	85657	3.6	0.6
Education (I)	33519	32296	31617	31406	31291	31342	31574	31922	-1.2	-0.2
Engineering	35040	36244	36731	36978	37109	37265	37510	37901	4.6	0.7
Health	44723	44774	44772	45009	45022	45153	45490	45955	2.6	0.4
Law	15673	16662	17402	17959	18347	18581	18725	18890	13.4	2.1
Science	63212	65614	66818	67490	67651	67928	68460	69219	5.5	0.9

Note: Enrolment for 1994 are actual numbers

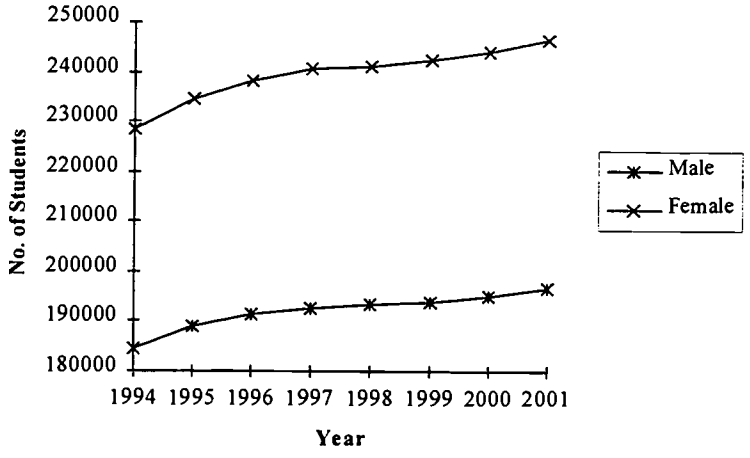

Figure 4.2 Projections of Total Australian Undergraduate Enrolment, 1995 to 2001 (Enrolment for 1994 are Actual Numbers)

The actual number of course completions for 1994 are not available, and therefore, had to be projected. Table 4.9 shows that total number of course completions are projected to increase by 6.5 percent over the period 1995 to 2001. Male and female course completions are projected to increase by 6.2 and 6.7 percent, respectively.

Course completions by Australian students is projected to increase by 5.4 percent. The average annual growth in male and female course completions by Australian students is projected to be 0.8 and 1.0 percent, respectively. Female course completions are projected to be nearly 60 percent of all Australian course completions in the year 2001. Course completion projections for males and females are plotted in Figure 4.3.

Once again there is considerable variation in the growth in completions across fields of study. There are projected to increase across all fields of study except Education (I) and Health. Education (I) completions are projected to decrease by 7.3 percent while Health completions show almost no change. Course completions in Law are projected to have an increase of 20.1 percent, which is the highest increase for any field of study. Male and female Law completions are projected to increase by 15.1 and 25.0 percent, respectively.

ERRATA

This page replaces page 59 in *Student Flows in Australian Higher Education.*

Table 4.9 Projections of Undergraduate Course Completions, 1994 to 2001

	Year								Percentage Change	
	1994	1995	1996	1997	1998	1999	2000	2001	1995-2001	Average
Males										
All	38405	38511	39065	40028	40610	40714	40733	40896	6.2	1.0
Australians	35357	35243	35556	36315	36781	36818	36781	36903	4.7	0.8
Architecture	1055	1072	1108	1142	1163	1171	1172	1178	9.9	1.6
Arts	6189	6217	6390	6641	6721	6716	6712	6749	8.6	1.4
Business	8482	8220	8245	8421	8474	8418	8391	8425	2.5	0.4
Education (I)	2001	1855	1757	1701	1704	1692	1680	1690	-8.9	-1.5
Engineering	4298	4440	4505	4574	4684	4727	4711	4703	5.9	1.0
Health	1940	1946	1945	1977	1984	1978	1967	1972	1.3	0.2
Law	1567	1615	1671	1711	1788	1841	1853	1859	15.1	2.4
Science	7029	7066	7145	7322	7418	7401	7376	7402	4.8	0.8
Females										
All	55959	55849	56721	58347	59015	59120	59178	59588	6.7	1.1
Australians	52576	52253	52878	54331	54901	54948	54951	55318	5.9	1.0
Architecture	684	687	719	752	762	765	764	772	12.4	2.0
Arts	14473	14828	15593	16398	16699	16799	16856	17025	14.8	2.3
Business	7414	7239	7328	7535	7615	7607	7602	7661	5.8	0.9
Education (I)	6847	6193	5808	5769	5771	5743	5728	5770	-6.8	-1.2
Engineering	686	769	795	804	828	832	830	828	7.7	1.2
Health	10493	10148	9882	10026	10075	10058	10057	10128	-0.2	0.0
Law	1579	1646	1718	1844	1960	2029	2050	2058	25.0	3.8
Science	5762	5929	6099	6355	6479	6492	6489	6522	10.0	1.6
Persons										
All	94364	94360	95786	98375	99625	99834	99911	100484	6.5	1.1
Australians	87933	87496	88434	90646	91682	91766	91732	92221	5.4	0.9
Architecture	1739	1759	1827	1894	1925	1936	1936	1950	10.9	1.7
Arts	20662	21045	21983	23039	23420	23515	23568	23774	13.0	2.1
Business	15896	15459	15573	15956	16089	16025	15993	16086	4.1	0.7
Education (I)	8848	8048	7565	7470	7475	7435	7408	7460	-7.3	-1.3
Engineering	4984	5209	5300	5378	5512	5559	5541	5531	6.2	1.0
Health	12433	12094	11827	12003	12059	12036	12024	12100	0.0	0.0
Law	3146	3261	3389	3555	3748	3870	3903	3917	20.1	3.1
Science	12791	12995	13244	13677	13897	13893	13865	13924	7.1	1.2

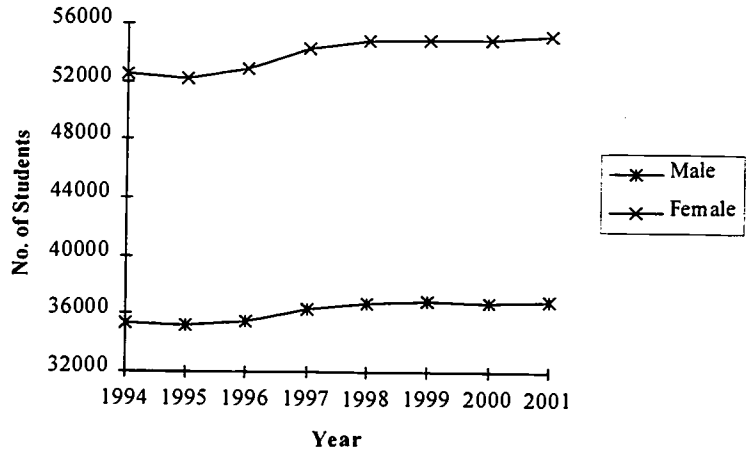

Figure 4.3 Projections of Australian Undergraduate Course Completions, 1994 to 2001

Finally, Table 4.10 shows projections of the number of dropouts from the system between 1994 and 2001. Once again, 1994 figures for the number of dropouts are projected. The total number of dropouts is projected to increase by 4.0 percent over this period, with the male percentage slightly lower than this and that for the females slightly higher.

The number of Australian dropouts is projected to grow by 3.4 percent. The number of male and female students dropping out is projected to increase by 3.1 and 3.8 percent, respectively. Females are projected to make up 52.4 percent of all Australian dropouts by the year 2001. The projected Australian male and female dropout numbers are plotted in Figure 4.4.

As expected the number of dropouts also show variation by field of study. Only male dropout numbers in Education (I) are projected to fall between 1995 and 2001. Overall, the percentage increase in the number of dropouts is highest for Law, and unlike all other fields of study Law female dropouts are projected to increase by a lower percentage than male dropouts.

Table 4.10 Projections of Undergraduate Dropouts, 1994 to 2001

	Year								Percentage Change	
	1994	1995	1996	1997	1998	1999	2000	2001	1995-2001	Average
Males										
All	26415	27607	27887	27923	27960	28110	28355	28672	3.9	0.6
Australians	24053	25122	25318	25278	25268	25392	25601	25894	3.1	0.5
Architecture	685	714	717	720	720	719	725	738	3.4	0.6
Arts	4722	4968	5023	5030	5033	5054	5093	5149	3.6	0.6
Business	6000	6203	6245	6244	6245	6273	6316	6382	2.9	0.5
Education (I)	1391	1384	1360	1338	1336	1342	1351	1369	-1.1	-0.2
Engineering	4102	4280	4301	4288	4281	4310	4352	4397	2.7	0.5
Health	1081	1125	1127	1125	1118	1123	1131	1145	1.8	0.3
Law	411	448	460	463	466	470	473	475	6.0	1.0
Science	5141	5380	5436	5406	5405	5441	5503	5568	3.5	0.6
Females										
All	28107	29578	29841	29920	29922	30163	30494	30807	4.2	0.7
Australians	26531	27921	28135	28168	28145	28370	28679	28978	3.8	0.6
Architecture	286	303	308	313	310	314	320	325	7.3	1.2
Arts	8964	9637	9737	9749	9735	9834	9951	10060	4.4	0.7
Business	5069	5302	5356	5370	5362	5396	5448	5493	3.6	0.6
Education (I)	2875	2917	2893	2874	2861	2884	2915	2950	1.1	0.2
Engineering	565	593	601	604	601	609	614	625	5.4	0.9
Health	4052	4169	4141	4143	4157	4185	4221	4262	2.2	0.4
Law	359	388	392	394	395	400	403	406	4.6	0.8
Science	3484	3697	3705	3701	3700	3745	3798	3842	3.9	0.6
Persons										
All	54522	57185	57728	57843	57882	58273	58849	59479	4.0	0.7
Australians	50584	53043	53453	53446	53413	53762	54280	54872	3.4	0.6
Architecture	971	1017	1025	1033	1030	1033	1045	1063	4.5	0.7
Arts	13686	14605	14760	14779	14768	14888	15044	15209	4.1	0.7
Business	11069	11505	11601	11614	11607	11669	11764	11875	3.2	0.5
Education (I)	4266	4301	4253	4212	4197	4226	4266	4319	0.4	0.1
Engineering	4667	4873	4902	4892	4882	4919	4966	5022	3.1	0.5
Health	5133	5294	5268	5268	5275	5308	5352	5407	2.1	0.4
Law	770	836	852	857	861	870	876	881	5.4	0.9
Science	8625	9077	9141	9107	9105	9186	9301	9410	3.7	0.6

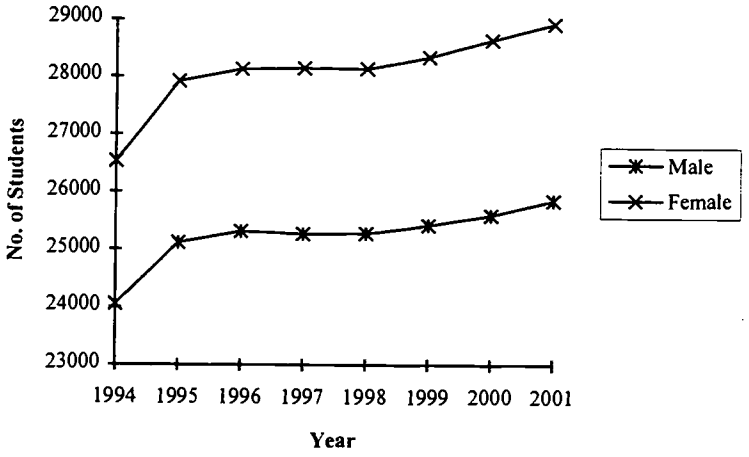

Figure 4.4 Projections of Australian Undergraduate Dropouts, 1994 to 2001

4.4 POSTGRADUATES

A different model is required for postgraduate students because their age profile is different to that for undergraduates. Postgraduate students' age profile is more uniform between the 22 to 45 year range. Ten age groups are considered. Associated with each age group there are up to six year of enrolment categories. The resulting model consists of 45 transient states. These are marked by a cross in Table 4.11. The states in this model are to be interpreted in the same way as that for the undergraduates' model.

Table 4.11 Transient States for the Model for Postgraduates Defined Using Age and Year of Enrolment as Criteria

	Year of Enrolment in Course					
Age	1	2	3	4	5	6
Under 23	X					
23-24	X	X				
25-26	X	X	X			
27-28	X	X	X	X		
29-30	X	X	X	X	X	
31-32	X	X	X	X	X	X
33-34	X	X	X	X	X	X
35-39	X	X	X	X	X	X
40-44	X	X	X	X	X	X
Over 44	X	X	X	X	X	X

Note: A Cross indicates that the transient state is included in the model

Three models, one each for males, females and persons, were estimated for the following three groups of postgraduate students defined by the level of the course:

- Research (includes Higher Doctorate, Doctorate by Research and Master's by Research);
- Master's by Coursework; and
- Other Postgraduate (includes Postgraduate Qualifying, Graduate/Postgraduate Diploma new and extension area, Graduate Certificate and Bachelor's Postgraduate).

Analysis by fields of study is not contemplated at this stage as the number of students in some fields of study are unlikely to be sufficient for reliable estimates of the model parameters to be made.

Probability of Completing Course

Table 4.12 gives the probability of a student completing one of the three levels of course given his/her age at course commencement. For example, a male who commences a Research degree at the age of 23 or 24 years has a 61 percent chance of completing the degree, while a female of the same age has a 56 percent chance of completing it. In general, the chances of completing an Other Postgraduate course are the best and those of completing a Research degree the worst.

It is estimated that a person starting a Research degree at the age of 23 or 24 years has the best chance of completing it. However, there are some big differences between the chances for males and females who commence a course at the same age. For example, females commencing a course at the age of 31 or 32 years have only a 49 percent chance of completing the degree while males commencing at the same age have a 59 percent chance. Among those who are under 40 years old, males have a better chance of completing the course than females who commence at the same age. Only females who commence a degree at the age of 23 or 24 years have a better than even chance of completing it. Among males only those who commence a course at an age less than 23 years, or 40 years or more, have a worse than even chance of completing it.

A person's chances of completing a Master's by Coursework degree are approximately 67 percent irrespective of the age at which the course is commenced, except those who commence at an age of over 44 years have a 70 percent chance of completion. The difference between the male and female chances of completing a course vary by the age at which the course is commenced. Amongst those starting a course at an age of 25 or 26 years, the difference in the chances of completing the course are 7 percentage points in favour of the males. However, the difference is nearly 10 percentage points in favour of females among those who commence a course at an age of 40 years or more.

The probability of completing an Other Postgraduate course vary between 67 percent and 79 percent depending on the age at which a person commences the course. A female has a better chance of completing a course than a male who commences the course at the same age. The difference between the male and female chances of completing a course vary by the age at which the course is commenced, and is between 1 and 12 percentage points. For both males and females the chances of completing a course are best if the course is commenced at an age of 24 years or less.

Table 4.12 Probability of Completing an Postgraduate Course by Age at Course Commencement

Age at Course	Research			Master's by Coursework			Other Postgraduate		
Commencement	Male	Female	Person	Male	Female	Person	Male	Female	Person
Under 23	0.40	0.39	0.40	0.63	0.66	0.66	0.71	0.83	0.79
23-24	0.61	0.56	0.60	0.65	0.67	0.66	0.73	0.82	0.78
25-26	0.54	0.46	0.52	0.69	0.62	0.66	0.63	0.75	0.70
27-28	0.58	0.45	0.53	0.67	0.64	0.66	0.61	0.72	0.67
29-30	0.61	0.48	0.56	0.66	0.71	0.68	0.63	0.74	0.68
31-32	0.59	0.49	0.55	0.69	0.68	0.69	0.63	0.70	0.67
33-34	0.55	0.44	0.50	0.66	0.66	0.66	0.62	0.73	0.67
35-39	0.52	0.45	0.49	0.68	0.64	0.66	0.67	0.74	0.71
40-44	0.49	0.49	0.49	0.62	0.73	0.67	0.68	0.72	0.70
Over 44	0.46	0.46	0.46	0.65	0.74	0.70	0.68	0.69	0.69

Time in the System

Tables 4.13 and 4.14 contain the mean and the standard deviation, respectively, of the time in the system for postgraduates. Factors which are likely to affect the estimates are:

- the field of study;
- the number of part-time students;
- the length of the course;
- number of students with credit for prior subjects or qualifications; and
- the attrition rate from the course.

The mean time in the system for a person doing a Research degree varies by the age at which the course is commenced. The minimum mean time is 3.1 years for a person commencing at an age of 25 or 26 years, and the maximum mean time is 3.9 years for a person commencing at an age of 23 or 24 years. There is not much difference between the mean times for males and females. In general the standard deviation of the time in the system is least for those who commence a course when they are around the age of 25 to 28 years.

The mean time in the system tends to increase, but only very slightly, as the course commencement age increases for those doing Master's by Coursework. The mean time varies between 2.1 and 2.5 years. Although females stay in the system longer, on average, than males who commence the course at the same age, the difference in the times is small. The standard deviation of the time in the system is slightly higher, and more variable with course commencement age, for females than it is males.

For a person doing an Other Postgraduate course, the mean time in the system increases from mean of 1.4 years for someone who commences the course at an age of under 23 years to an average of 1.8 years for one who commences at an age of over 44 years. In general, females are in the system for a slightly longer time than males. In general, the standard deviation of the time in the system is slightly higher for males than females.

Table 4.13 Mean Number of Years in the System for Postgraduates by Age at Course Commencement

Age at Course	Research			Master's by Coursework			Other Postgraduate		
Commencement	Male	Female	Person	Male	Female	Person	Male	Female	Person
Under 23	3.4	3.5	3.4	2.1	2.2	2.1	1.4	1.4	1.4
23-24	3.9	3.8	3.9	2.2	2.3	2.2	1.6	1.6	1.6
25-26	3.2	3.1	3.1	2.2	2.2	2.2	1.7	1.6	1.6
27-28	3.2	3.1	3.2	2.3	2.3	2.3	1.6	1.7	1.7
29-30	3.4	3.3	3.4	2.3	2.5	2.4	1.7	1.8	1.7
31-32	3.4	3.5	3.4	2.3	2.4	2.4	1.7	1.8	1.7
33-34	3.4	3.2	3.3	2.3	2.4	2.3	1.7	1.8	1.7
35-39	3.5	3.4	3.4	2.3	2.4	2.4	1.7	1.8	1.8
40-44	3.6	3.6	3.6	2.3	2.7	2.5	1.7	1.8	1.8
Over 44	3.7	3.7	3.7	2.4	2.5	2.4	1.7	1.8	1.8

Table 4.14 Standard Deviation of the Number of Years in the System for Postgraduates by Age at Course Commencement

Age at Course	Research			Master's Coursework			Postgraduate Diploma		
Commencement	Male	Female	Person	Male	Female	Person	Male	Female	Person
Under 23	2.7	2.7	2.7	1.5	1.7	1.6	1.0	0.8	0.9
23-24	2.3	2.4	2.3	1.5	1.7	1.5	1.2	1.0	1.1
25-26	1.8	1.9	1.8	1.5	1.6	1.5	1.3	1.0	1.1
27-28	2.0	1.9	2.0	1.5	1.7	1.6	1.3	1.0	1.1
29-30	2.1	2.0	2.1	1.5	1.9	1.6	1.3	1.0	1.1
31-32	2.2	2.1	2.1	1.5	1.8	1.6	1.3	1.1	1.1
33-34	2.2	2.2	2.2	1.5	1.7	1.6	1.1	1.1	1.1
35-39	2.2	2.2	2.2	1.5	1.7	1.6	1.1	1.1	1.1
40-44	2.2	2.3	2.3	1.5	1.9	1.7	1.0	1.0	1.0
Over 44	2.2	2.4	2.3	1.6	1.8	1.7	1.0	1.0	1.0

Time to Completion

The mean and the standard deviation of the time to complete a postgraduate course are given in Tables 4.15 and 4.16. Factors which are likely to affect the estimates are:

- the field of study;
- the number of part-time students;
- the length of the course; and
- number of students with credit for prior subjects or qualifications.

The mean time to complete a Research degree varies from 4.4 years for those who commence the course at the age of 25 or 26 years to 6 years for those who commence under the age of 23 years. The mean time sharply decreases as the age at which the course is commenced increases until a minimum is reached for those who commence at an age around 25 to 26 years, and then the mean time gradually increases with commencement age. A female's mean time to complete a course is longer than that for a male who commences at the same age with the maximum difference of half a year for those who commence at the age of 31 or 32 years. The pattern in the standard deviations of the time to complete a course is very similar to that for the standard deviations for the time in the system. We would expect the mean time to completion for doctorate students to be higher than the figures reported here, and the mean time to completion for Master's by Research to be lower.

In general, the mean time to complete a Master's by Coursework degree increases with the age at which the course is commenced, and varies between 2.7 and 3.1 years. A female's mean time to complete a course is slightly longer than that of a male commencing the course at the same age. Once again, the pattern of the standard deviations of the time to complete a course follow that for the time in the system although they are marginally higher.

There is an increase in the average time to complete an Other Postgraduate course as the age at which a course is commenced increases. The shortest mean time of 1.5 years is taken by a person who commences at an age of under 23 years, while those who commence at an age of 29 years or more take, on average, 2.1 years. In general females mean time is marginally shorter than that for males. The standard deviation of the time to complete a course does not vary much with course commencement age for females and persons. However, the standard deviation for males show considerable variation with course commencement age, and it is also higher than that for females who commence the course at the same age.

Table 4.15 Mean Number of Years to Complete a Postgraduate Course by Age at Course Commencement

Age at Course	Research			Master's by Coursework			Other Postgraduate		
Commencement	Male	Female	Person	Male	Female	Person	Male	Female	Person
Under 23	6.0	6.1	6.0	2.7	2.8	2.7	1.6	1.5	1.5
23-24	4.9	5.0	4.9	2.7	2.9	2.8	1.8	1.7	1.7
25-26	4.4	4.6	4.4	2.7	2.9	2.8	2.0	1.8	1.9
27-28	4.4	4.7	4.5	2.8	3.0	2.8	2.0	2.0	2.0
29-30	4.5	4.9	4.6	2.9	3.1	2.9	2.1	2.0	2.1
31-32	4.6	5.1	4.8	2.8	3.1	2.9	2.1	2.1	2.1
33-34	4.8	5.1	4.9	2.8	3.0	2.9	2.1	2.1	2.1
35-39	5.0	5.1	5.0	2.9	3.1	3.0	2.1	2.1	2.1
40-44	5.2	5.3	5.2	3.0	3.2	3.1	2.0	2.1	2.1
Over 44	5.4	5.6	5.5	3.0	3.0	3.0	2.0	2.1	2.1

Table 4.16 Standard Deviation of Number of Years to Complete a Postgraduate Course by Age at Course Commencement

Age at Course	Research			Master's Coursework			Other Postgraduate		
Commencement	Male	Female	Person	Male	Female	Person	Male	Female	Person
Under 23	2.8	2.8	2.8	1.8	1.9	1.8	1.1	0.9	1.0
23-24	2.2	2.2	2.2	1.5	1.7	1.6	1.4	1.1	1.2
25-26	1.7	1.7	1.7	1.5	1.8	1.6	1.6	1.1	1.2
27-28	1.8	1.7	1.8	1.6	1.9	1.7	1.6	1.1	1.2
29-30	2.0	1.9	1.9	1.6	1.9	1.7	1.6	1.1	1.2
31-32	2.0	2.0	2.0	1.6	1.9	1.7	1.4	1.1	1.2
33-34	2.1	2.2	2.1	1.6	1.8	1.7	1.3	1.1	1.2
35-39	2.1	2.2	2.1	1.6	1.8	1.7	1.2	1.1	1.1
40-44	2.2	2.3	2.2	1.6	1.9	1.8	1.1	1.0	1.1
Over 44	2.3	2.2	2.3	1.7	1.9	1.8	1.1	1.0	1.1

Projections

Projections by age and level of course were made of:

- the number of commencing students, 1995 to 2001;
- the total enrolment, 1995 to 2001;
- the number of course completions, 1994 to 2001; and
- the number of dropouts, 1994 to 2001.

The 1994 intake and the total enrolment of students are actual figures. The 1995 projections of the intake are adjusted to approximate the preliminary DEET (1995b) estimates. Thereafter they are based on the method as set out in section 2.2. In brief, this method assumes:

- a constant proportion, based on the 1994 data, of the population in a given age group commencing postgraduate courses; and
- the demographic changes projected to occur between 1995 and 2001.

In this report only aggregate projections by course level are included. Projections by age are available on request. The projections of intake by level of course and gender for 1995 to 2001 are given in Table 4.17. The table shows that Master's by Coursework has the highest growth in course commencements between 1995 and 2001. The projected increase in commencement numbers for Research, Master's by Coursework and Other Postgraduate courses are 2.6, 3.2 and 2.0 percent respectively. Projections of the total postgraduate course commencements by gender are plotted in Figure 4.5.

Male and female course commencements in Research degrees is projected to increase by 0.4 and 0.3 percent per year. The proportion of female commencements goes down from 46.9 percent of all commencements in 1995 to 42.4 percent by the year 2001. The percentage increase in the Other Postgraduate course commencements for males is projected to be nearly three times that for females over this period. However, females are still projected to make up 58.0 percent of all Other Postgraduate course commencements in the year 2001.

Table 4.17 Projections of Postgraduate Commencements, 1995 to 2001

	Year								Percentage Change	
	1994	1995	1996	1997	1998	1999	2000	2001	1995-2001	Average
					Males					
Research	5975	6619	6652	6679	6706	6733	6759	6782	2.5	0.4
Master's Coursework	9497	10520	10582	10645	10709	10767	10818	10854	3.2	0.5
Other Postgraduate	13685	15164	15244	15315	15384	15446	15505	15555	2.6	0.4
Total	29157	32304	32479	32640	32800	32947	33082	33192	2.7	0.5
					Females					
Research	4373	4854	4880	4897	4909	4922	4937	4952	2.0	0.3
Master's Coursework	8353	9279	9350	9405	9444	9476	9505	9524	2.6	0.4
Other Postgraduate	19406	21489	21560	21598	21616	21633	21656	21677	0.9	0.1
Total	32132	35622	35790	35899	35970	36031	36097	36152	1.5	0.2
					Persons					
Research	10348	11471	11533	11582	11633	11682	11731	11775	2.6	0.4
Master's Coursework	17850	19790	19920	20045	20166	20270	20359	20426	3.2	0.5
Other Postgraduate	33091	36641	36800	36926	37051	37168	37275	37370	2.0	0.3
Total	61289	67903	68252	68553	68849	69120	69365	69571	2.5	0.4

Notes: (a) Commencements for 1994 are actual numbers

(b) Commencements for 1995 have been adjusted to approximate preliminary DEET (1995b) estimates

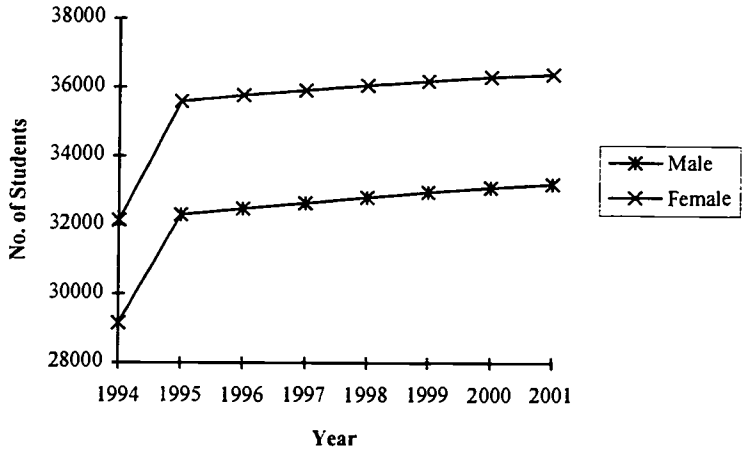

Figure 4.5 Projections of Postgraduate Commencements, 1995 to 2001 (Enrolment for 1994 are Actual Numbers and the Projections for 1995 are Adjusted to Approximate Preliminary DEET (1995b) Estimates)

Table 4.18 contains the projections of the total postgraduate enrolment by level of course and gender. Research degree enrolment are projected to increase by 18.4 percent between 1995 and 2001. The corresponding increases for Master's by Coursework and Other Postgraduate courses are 15.2 and 7.3 percent, respectively. The average annual growth in enrolment numbers in Research and Master's by Coursework is projected to be higher for females than for males. Figure 4.6 shows the projections of total postgraduate enrolment by gender.

Table 4.18 Projections of Total Postgraduate Enrolment, 1995 to 2001

	Year								Percentage Change	
	1994	1995	1996	1997	1998	1999	2000	2001	1995-2001	Average
					Males					
Research	18344	19979	21138	21947	22509	22878	23128	23308	16.7	2.6
Master's Coursework	19952	21788	22922	23570	23968	24233	24438	24586	12.8	2.0
Other Postgraduate	22336	23939	24712	25075	25302	25470	25608	25730	7.5	1.2
Total	60632	65706	68772	70592	71779	72581	73174	73624	12.1	1.9
					Females					
Research	12640	13989	14946	15595	16029	16296	16459	16584	18.6	2.9
Master's Coursework	17216	19451	20832	21641	22117	22427	22649	22810	17.3	2.7
Other Postgraduate	31471	34256	35532	36001	36218	36346	36436	36509	6.6	1.1
Total	61327	67696	71310	73237	74364	75069	75544	75903	12.1	1.9
					Persons					
Research	30984	33973	36117	37637	38691	39395	39878	40213	18.4	2.9
Master's Coursework	37168	41210	43708	45178	46086	46689	47135	47462	15.2	2.4
Other Postgraduate	53807	58174	60213	61085	61584	61929	62193	62427	7.3	1.2
Total	121959	133357	140038	143900	146361	148013	149206	150102	12.6	2.0

Note: Enrolment for 1994 are actual numbers

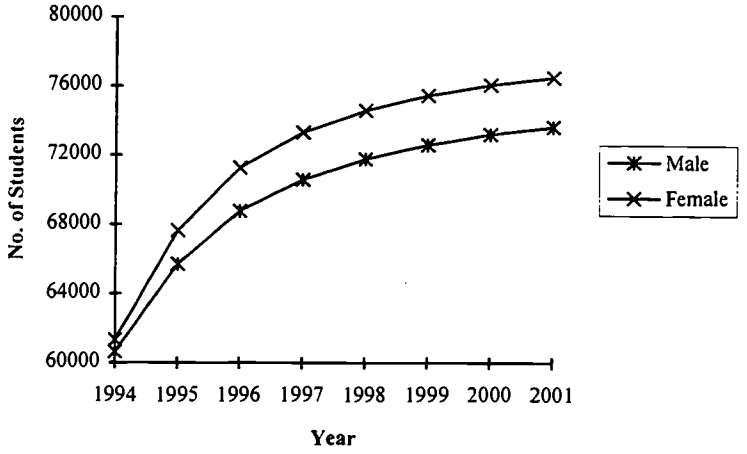

Figure 4.6 Projections of Total Postgraduate Enrolment, 1995 to 2001 (Enrolment for 1994 are Actual Numbers)

Projections of postgraduate completions for the period 1994 to 2001 are given in Table 4.19. Research degree completions are projected to increase by a massive 38.2 percent over this period and that for Master's by Coursework by 22.3 percent. By contrast the increase in Other Postgraduate completions is a modest 8.8 percent. The growth in completions of Research and Master's by Coursework degrees is higher for females than for males. However, the female share of Research degree completions is projected to be still only 39.1 percent in 2001. The projections of the total postgraduate completions by gender are plotted in Figure 4.7.

Table 4.19 Projections of Postgraduate Course Completions, 1994 to 2001

	Year								Percentage Change	
	1994	1995	1996	1997	1998	1999	2000	2001	1995-2001	Average
					Males					
Research	2291	2605	2869	3066	3242	3370	3439	3490	34.0	5.0
Master's Coursework	5548	5995	6444	6744	6911	7006	7070	7121	18.8	2.9
Other Postgraduate	8987	9443	9862	10032	10129	10195	10243	10289	9.0	1.4
Total	16826	18043	19175	19842	20282	20571	20752	20900	15.8	2.5
					Females					
Research	1338	1544	1736	1888	2022	2129	2196	2245	45.4	6.4
Master's Coursework	4438	5050	5578	5925	6127	6251	6328	6390	26.5	4.0
Other Postgraduate	13957	15035	15785	16053	16176	16244	16292	16337	8.7	1.4
Total	19733	21629	23099	23866	24325	24624	24816	24972	15.5	2.4
					Persons					
Research	3629	4149	4605	4954	5264	5499	5635	5735	38.2	5.5
Master's Coursework	9986	11045	12022	12669	13038	13257	13398	13511	22.3	3.4
Other Postgraduate	22944	24478	25647	26085	26305	26439	26535	26626	8.8	1.4
Total	36559	39672	42274	43708	44607	45195	45568	45872	15.6	2.4

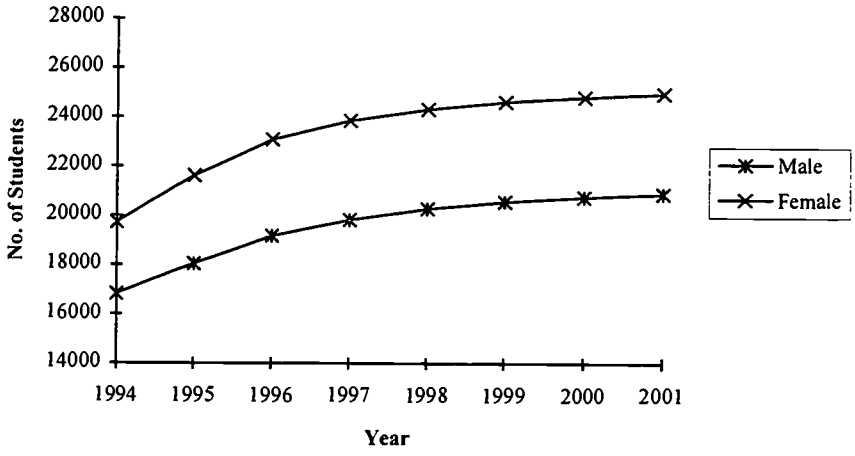

Figure 4.7 Projections of Postgraduate Course Completions, 1994 to 2001

Table 4.20 contains the projections of the number of postgraduate dropouts. The growth in the number of Research degree dropouts is projected to be 11.2 percent between 1995 and 2001. The percentage increase in the number of dropouts for Master's by Coursework degree is less than half of this. Although the overall average annual dropout rate for females is slightly lower for females than that for males, this rate for Research degree students is higher for females than for males. Finally, Figure 4.8 shows the projections of the number of postgraduate dropouts by gender for 1994 to 2001.

Table 4.20 Projections of Postgraduate Dropouts, 1994 to 2001

	Year								Percentage Change	
	1994	1995	1996	1997	1998	1999	2000	2001	1995-2001	Average
					Males					
Research	2692	2891	2999	3077	3123	3148	3167	3182	10.1	1.6
Master's Coursework	3136	3454	3551	3571	3596	3612	3633	3651	5.7	0.9
Other Postgraduate	4577	5028	5095	5121	5149	5171	5192	5207	3.6	0.6
Total	10405	11373	11645	11769	11868	11931	11992	12040	5.9	1.0
					Females					
Research	2157	2352	2460	2541	2590	2611	2631	2647	12.5	2.0
Master's Coursework	2624	2923	2998	3022	3039	3054	3059	3065	4.9	0.8
Other Postgraduate	4759	5252	5315	5344	5370	5393	5409	5425	3.3	0.5
Total	9540	10527	10773	10907	10999	11058	11099	11137	5.8	0.9
					Persons					
Research	4849	5243	5459	5618	5713	5759	5798	5829	11.2	1.8
Master's Coursework	5760	6377	6549	6593	6635	6666	6692	6716	5.3	0.9
Other Postgraduate	9336	10280	10410	10465	10519	10564	10601	10632	3.4	0.6
Total	19945	21900	22418	22676	22867	22989	23091	23177	5.8	0.9

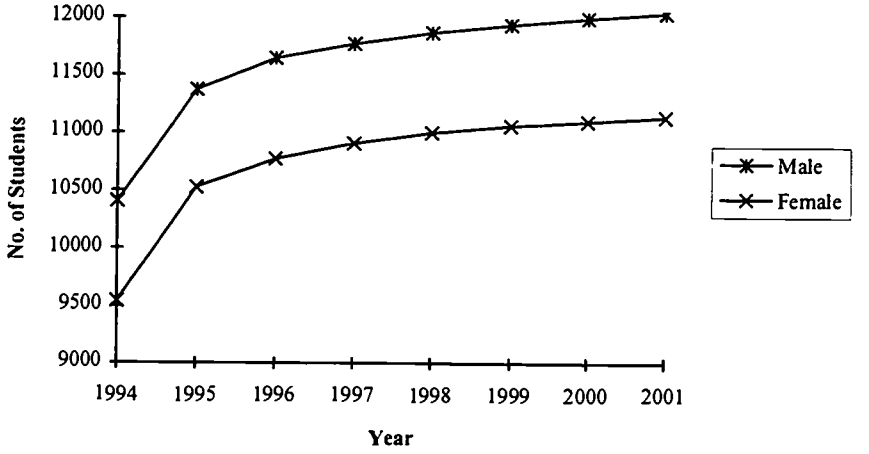

Figure 4.8 Projections of Postgraduate Dropouts, 1995 to 2001

4.5 A SUMMARY OF PROJECTIONS

Table 4.21 summarises the projections for the whole higher education sector. It also includes projections for the Others category. This category is made up of Associate Diploma, Other Award, Enabling and Non-award courses together with students who were not included in the analysis for reasons stated in section 3.2. The commencements and total enrolment projections for the Others category are held constant at the 1994 level, and the completions projections at the 1993 level, for sake of convenience. However, dropout numbers for any year are not available. As has been stated earlier these projections are based on a set of assumptions for undergraduates and another set for postgraduates. They are largely driven by demographic changes.

Table 4.21 Summary of Projections of Commencements, Total Enrolment, Completions and Dropouts, All Courses, 1994 to 2001

Course Level	Year								Percentage Change	
	1994	1995	1996	1997	1998	1999	2000	2001	1995-2001	Average
Commencements										
Undergraduate	151274	161569	159026	158142	157908	159747	161449	163151	1.0	0.2
Postgraduate	61289	67903	68252	68553	68849	69120	69365	69571	2.5	0.4
Others	12662	12662	12662	12662	12662	12662	12662	12662	0.0	0.0
Total	225225	242134	239940	239357	239419	241529	243476	245384	1.3	0.2
Total Enrolment										
Undergraduate	441609	454290	461784	466413	468126	470374	473759	478285	5.3	0.9
Postgraduate	121959	133357	140038	143900	146361	148013	149206	150102	12.6	2.0
Others	21828	21828	21828	21828	21828	21828	21828	21828	0.0	0.0
Total	585396	609475	623650	632141	636315	640215	644793	650215	6.7	1.1
Completions										
Undergraduate	94364	94360	95786	98364	99613	99805	99844	100356	6.4	1.0
Postgraduate	36559	39672	42274	43708	44607	45195	45568	45872	15.6	2.4
Others	3960	3960	3960	3960	3960	3960	3960	3960	0.0	0.0
Total	134883	137992	142020	146032	148180	148960	149372	150188	8.8	1.4
Dropouts										
Undergraduate	54522	57185	57728	57821	57882	58258	58778	59341	3.8	0.6
Postgraduate	19945	21900	22418	22676	22867	22989	23091	23177	5.8	0.9
Others	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Total	74467	79085	80146	80497	80749	81247	81869	82518	4.3	0.7

Notes: (a) Commencements and total enrolment for 1994 are actual numbers

(b) Commencements for 1995 have been adjusted to approximate preliminary DEET (1995b) estimates

(c) Others include Associate Diploma, Other award, Enabling and Non-award courses, and those remove from the analysis as discussed in section 3.2

(d) Completions for Others are set at the 1993 level for sake of convenience

4.6 MODEL EVALUATION

The question of the stability over time of the estimated matrix of transition proportions, **Q**, is important. All projections that are made assume this matrix to remain invariant over the projection period. The calculation of the fundamental matrix, **N**, also assumes that that **Q** is invariant over time. If data for previous years with the necessary detail were available then it is possible to test statistically if **Q**, is stable over time. Data are available for 1989 to 1992, but without the detail necessary to re-estimate **Q**. However, we can assess the stability of the estimated **Q** indirectly by considering the accuracy of total enrolment predictions retrospectively. These predictions are made conditional on the actual intake of students for

for the base year is used to initialise the recursive formula in equation (4.1)) and the year for which the prediction is made. Once again we can expect the accuracy of the predictions to deteriorate as this time period becomes longer.

The data for 1989 to 1992 that are available are in a more aggregated form than that for 1993 and 1994. In particular, they do not contain the course commencement date and students over 29 years in age are sorted in ten-year wide classes. A variable indicating the year of enrolment in a course by a student is given instead of the course commencement date. The value of this variable is one, two, three or four plus only. Thus, in order to conform with the structure of the input-output model a redistribution of students into the states of the model was done based on average proportions for 1993 and 1994. A summary of the data for 1989 to 1994 is described in Appendix B.

The calculations for the accuracy measures for predicting total enrolment for the years 1990 to 1994 are given in Table 4.22. The mean absolute percentage error (MAPE) for 1-step-ahead predictions for all undergraduates is 0.81 percent, with the figure for males 0.72 percent and that for females 0.91 percent. In general, the accuracy diminishes as the prediction horizon increases, although there are some exceptions to this rule when one looks at the results for some fields of study. This pattern of results is likely due to the factors affecting prediction accuracy that were discussed earlier in this section. It should be noted that the 5-step-ahead MAPE and MPE are based on a single prediction and as such are not really averages. Comparing just the 1-step-ahead MAPEs for males and females, overall male enrolment is more accurately predicted than that of females.

Three fields of study results, that of Business, Health and Law, stand out as not so accurate compared to the others. Part of the reason for the lack of accuracy may be due to the administrative adjustment in some fields of study classification in 1987 that affected just these three broad fields of study; see DEET (1995a). Other factors contributing to the lack of accuracy may be the volatility in the number of students commencing and the total number enrolled in courses in these fields of study. As indicated in Tables B1 and B2 in Appendix B, there has been considerable increase in both the number commencing and the total enrolment of students taking courses in Law between 1989 and 1994. The corresponding data for Business show quite a bit of volatility in this period. The number of course commencements in Health has also been dropping since 1992. The growth in total enrolment in Health reached a peak of 13.7 percent in 1989, but since then the growth in numbers has been dropping, and, in fact, numbers declined by 3.7 percent in 1994.

Most of the values for MPE, a notable exception being Arts, are negative. This systematic pattern suggests possible bias in the predictions. The models consistently underestimate actual enrolment. However, as the absolute errors, in general, are not large this bias may not be significant.

Table 4.22 Prediction Accuracy for Undergraduate Total Enrolment, 1990 to 1994

	Mean Absolute Percentage Error					Mean Percentage Error				
	1-step	2-step	3-step	4-step	5-step	1-step	2-step	3-step	4-step	5-step
Males										
All	0.72	1.04	1.26	1.27	0.97	-0.68	-1.04	-1.26	-1.27	-0.97
Australian	0.74	0.95	1.17	1.19	0.92	-0.55	-0.95	-1.17	-1.19	-0.92
Architecture	0.77	1.00	1.35	1.52	1.16	-0.76	-1.00	-1.35	-1.52	-1.16
Arts	0.59	0.31	0.10	0.17	0.14	0.20	0.09	0.10	0.17	0.14
Business	1.79	2.50	3.07	3.21	2.62	-1.79	-2.50	-3.07	-3.21	-2.62
Education (I)	1.01	0.52	0.74	0.92	0.83	0.75	-0.25	-0.63	-0.92	-0.83
Engineering	0.61	0.76	1.11	1.29	1.13	-0.21	-0.76	-1.11	-1.29	-1.13
Health	2.90	3.75	4.31	4.39	3.17	-2.90	-3.75	-4.31	-4.39	-3.17
Law	5.07	6.05	6.79	6.68	5.27	-5.07	-6.05	-6.79	-6.68	-5.27
Science	0.87	0.77	0.63	0.51	0.34	-0.06	-0.41	-0.63	-0.51	-0.34
Females										
All	0.91	1.56	2.01	1.98	1.58	-0.91	-1.56	-2.01	-1.98	-1.58
Australian	0.83	1.42	1.85	1.85	1.49	-0.75	-1.42	-1.85	-1.85	-1.49
Architecture	1.33	1.85	0.90	0.14	0.15	0.56	1.12	0.59	0.14	0.15
Arts	0.84	0.82	1.03	1.20	0.86	0.77	0.82	1.03	1.20	0.86
Business	2.59	3.67	4.56	4.70	3.58	-2.59	-3.67	-4.56	-4.70	-3.58
Education (I)	0.50	0.98	1.91	2.10	1.96	0.39	-0.98	-1.91	-2.10	-1.96
Engineering	0.34	0.53	0.87	1.16	1.09	-0.34	-0.53	-0.87	-1.16	-1.09
Health	3.54	4.73	5.24	4.69	3.20	-3.54	-4.73	-5.24	-4.69	-3.20
Law	5.33	6.21	7.10	7.29	5.65	-5.33	-6.21	-7.10	-7.29	-5.65
Science	0.28	0.20	0.12	0.17	0.18	0.14	-0.07	-0.12	-0.17	-0.18
Persons										
All	0.81	1.33	1.67	1.66	1.30	-0.81	-1.33	-1.67	-1.66	-1.30
Australian	0.79	1.21	1.55	1.56	1.23	-0.66	-1.21	-1.55	-1.56	-1.23
Architecture	0.97	0.84	0.66	0.93	0.69	-0.30	-0.25	-0.66	-0.93	-0.69
Arts	0.71	0.59	0.74	0.88	0.64	0.59	0.59	0.74	0.88	0.64
Business	2.14	3.02	3.74	3.88	3.06	-2.14	-3.02	-3.74	-3.88	-3.06
Education (I)	0.59	0.79	1.59	1.80	1.67	0.48	-0.79	-1.59	-1.80	-1.67
Engineering	0.56	0.73	1.08	1.27	1.12	-0.22	-0.73	-1.08	-1.27	-1.12
Health	3.43	4.56	5.08	4.63	3.19	-3.43	-4.56	-5.08	-4.63	-3.19
Law	5.20	6.14	6.94	6.98	5.46	-5.20	-6.14	-6.94	-6.98	-5.46
Science	0.62	0.53	0.41	0.36	0.27	0.03	-0.26	-0.41	-0.36	-0.27

Table 4.23 contains the accuracy measures of predicting undergraduate course completions for the years 1989 to 1993. MAPE for 1-step-ahead predictions for all undergraduates is 3.54 percent, with the figure for males 2.68 percent and that for females 4.17 percent. For Australian students MAPE for 1-step-ahead predictions is 2.59 percent. However, just as in the case for total enrolment, there is considerable variation in this statistic across fields of

study. It ranges from 1.7 percent for Science to just over 14.7 percent for Law. Also, the inaccuracy in predicting completions in Business, Health and Law is considerably above that for other fields of study. This may well be explained by the fact that the average annual increase in completions for these three fields of study between 1989 and 1993 was 12.7, 16.2 and 12.3 percent, respectively; see Table B3 in Appendix B.

The MPE results indicate possible bias in the predictions of completions generated from some of the models, but the direction of the bias is not as consistent as that evidenced for total enrolment predictions. Overall the models are less accurate in predicting completions than in predicting total enrolment.

Table 4.23 Prediction Accuracy for Undergraduate Completions, 1989 to 1993

	Mean Absolute Percentage Error					Mean Percentage Error				
	1-step	2-step	3-step	4-step	5-step	1-step	2-step	3-step	4-step	5-step
					Males					
All	2.68	1.03	1.59	1.44	2.21	2.68	0.67	-0.40	-1.44	-2.21
Australian	1.93	0.87	1.70	1.36	1.93	1.76	0.60	-0.22	-1.36	-1.93
Architecture	3.82	4.43	4.38	3.84	2.28	-3.03	-4.43	-4.38	-3.84	-2.28
Arts	4.11	2.22	2.07	0.45	0.54	4.11	2.11	1.43	0.40	0.54
Business	11.74	5.11	4.29	3.40	5.32	11.74	4.34	1.00	-3.40	-5.32
Education (I)	16.65	6.70	4.87	0.38	0.48	-16.65	-5.88	-4.39	-0.38	0.48
Engineering	4.53	2.14	0.68	0.69	0.13	-4.37	-0.49	0.58	-0.01	-0.13
Health	6.64	2.24	3.82	6.46	8.07	6.64	-0.02	-3.82	-6.46	-8.07
Law	17.21	13.46	10.75	5.53	17.55	17.21	9.85	6.35	-4.60	-17.55
Science	1.34	1.54	1.90	1.82	0.62	-1.23	-1.31	-1.90	-1.82	-0.62
					Females					
All	4.17	2.84	1.91	1.44	2.86	4.17	2.80	0.58	-1.44	-2.86
Australian	3.19	2.59	1.73	1.27	2.54	3.19	2.59	0.60	-1.27	-2.54
Architecture	8.16	3.19	2.98	2.28	0.00	6.31	1.58	1.87	2.28	0.00
Arts	4.38	4.46	4.03	3.72	3.81	4.38	4.46	4.03	3.72	3.81
Business	13.43	6.68	5.12	4.65	9.19	13.43	4.84	0.17	-4.65	-9.19
Education (I)	8.97	4.94	3.68	2.04	0.49	-8.97	0.66	0.68	1.80	-0.49
Engineering	6.74	5.49	3.38	1.18	1.58	-4.83	-1.28	3.24	0.76	1.58
Health	13.62	8.19	7.65	8.94	9.58	13.62	4.50	-2.92	-8.94	-9.58
Law	12.54	13.45	8.39	5.17	18.22	12.04	5.26	3.91	-5.17	-18.22
Science	2.21	1.96	1.36	1.59	0.57	0.72	1.96	1.36	1.59	0.57
					Persons					
All	3.54	2.08	1.77	1.44	2.60	3.54	1.91	0.18	-1.44	-2.60
Australian	2.59	1.84	1.72	1.31	2.30	2.59	1.76	0.27	-1.31	-2.30
Architecture	3.38	2.35	2.06	1.51	1.40	0.08	-2.35	-2.06	-1.51	-1.40
Arts	4.29	3.74	3.24	2.71	2.81	4.29	3.74	3.24	2.71	2.81
Business	12.49	5.80	4.56	4.00	7.12	12.49	4.54	0.61	-4.00	-7.12
Education (I)	10.89	5.32	3.62	1.52	0.28	-10.89	-0.87	-0.50	1.30	-0.28
Engineering	4.76	2.39	0.96	0.46	0.09	-4.43	-0.57	0.86	0.09	0.09
Health	12.39	7.14	6.94	8.57	9.35	12.39	3.66	-3.11	-8.57	-9.35
Law	14.73	13.45	9.59	5.26	17.88	14.73	7.62	5.16	-4.88	-17.88
Science	1.70	1.05	0.84	0.49	0.10	-0.41	0.07	-0.50	-0.36	-0.10

Table 4.24 gives MAPE and MPE of predicting postgraduate enrolment for 1990 to 1994. The MAPE of 1-step-ahead predictions of the total enrolment is 1.79 percent, with the figure for males 2.36 percent and that for females 1.18 percent. Male enrolments for Research degrees are more accurately predicted than that for females while female enrolments are more accurately predicted for the other two course levels. A likely reason for large inaccuracies in predicting the total enrolment in Research and Master's by Coursework courses is the very high growth in the number of students commencing and the total enrolment in these courses that occurred between 1989 and 1994; see Tables B4 and B5 in Appendix B. The MPE results suggest some bias in the results. The negative sign for MPE implies that the predictions are underestimates of the observed values.

Table 4.24 Prediction Accuracy for Postgraduate Total Enrolment, 1990 to 1994

	Mean Absolute Percentage Error					Mean Percentage Error				
	1-step	2-step	3-step	4-step	5-step	1-step	2-step	3-step	4-step	5-step
				Males						
Research	3.22	3.67	3.83	2.95	2.16	-3.22	-3.67	-3.83	-2.95	-2.16
Master's by Coursework	2.92	3.14	3.09	2.81	1.76	-2.92	-3.14	-3.09	-2.81	-1.76
Other Postgraduate	1.94	1.84	1.07	0.46	0.44	-1.35	-1.17	-0.40	0.46	0.44
Total	2.36	2.51	2.26	1.62	1.07	-2.36	-2.51	-2.26	-1.62	-1.07
				Females						
Research	4.41	5.90	6.94	6.34	4.83	-4.41	-5.90	-6.94	-6.34	-4.83
Master's by Coursework	1.02	1.00	0.57	0.22	0.03	-1.00	-0.98	-0.45	-0.22	-0.03
Other Postgraduate	0.82	0.65	0.13	0.02	0.02	-0.25	-0.49	-0.07	-0.02	-0.02
Total	1.18	1.65	1.53	1.37	1.02	-1.18	-1.65	-1.53	-1.37	-1.02
				Persons						
Research	3.70	4.56	5.08	4.32	3.25	-3.70	-4.56	-5.08	-4.32	-3.25
Master's by Coursework	2.09	2.18	1.90	1.64	0.96	-2.09	-2.18	-1.90	-1.64	-0.96
Other Postgraduate	1.03	1.17	0.53	0.18	0.17	-0.74	-0.79	-0.22	0.18	0.17
Total	1.79	2.09	1.90	1.49	1.04	-1.79	-2.09	-1.90	-1.49	-1.04

Finally, the prediction accuracy of postgraduate course completions is given in Table 4.25. The MAPE of 1-step-ahead predictions of the total completions for all postgraduate courses is 9.65 percent. However, this value may be unduly affected by the very high MAPE of 23.3 percent for Master's by Coursework completions. The MAPE for the other two course levels is less than 7 percent. It appears that the model cannot handle the structural change in Master's by Coursework courses that has resulted in a phenomenal increase in the number of their completions between 1989 and 1993. As shown in Table B6 in Appendix B, Master's by Coursework completions increased by an annual average of 29.6 percent during this period. In general, the models overestimate the number of completions.

Table 4.25 Prediction Accuracy for Postgraduate Course Completions, 1990 to 1994

	Mean Absolute Percentage Error					Mean Percentage Error				
	1-step	2-step	3-step	4-step	5-step	1-step	2-step	3-step	4-step	5-step
				Males						
Research	7.08	2.39	10.45	10.34	10.45	7.08	-1.11	-10.45	-10.34	-10.45
Master's by Coursework	21.63	7.20	4.56	4.91	6.90	21.63	5.39	-0.88	-4.91	-6.90
Other Postgraduate	9.37	4.59	1.04	0.07	0.07	9.37	4.59	1.04	0.03	0.07
Total	11.67	3.92	1.59	2.79	0.73	11.67	3.90	-1.10	-2.79	-3.19
				Females						
Research	6.43	2.31	10.07	13.10	15.92	6.43	-0.95	-10.07	-13.10	-15.92
Master's by Coursework	25.87	12.87	6.66	3.21	1.14	25.87	12.60	6.50	2.11	-1.14
Other Postgraduate	5.12	4.40	2.25	1.87	0.12	5.12	4.40	2.25	1.72	-0.12
Total	7.83	5.26	2.53	2.13	3.78	7.83	5.26	2.17	0.88	-1.25
				Persons						
Research	6.86	2.19	10.34	11.34	12.44	6.86	5.36	1.72	1.61	-12.44
Master's by Coursework	23.30	9.42	4.38	2.19	4.44	23.30	18.66	14.29	10.52	-4.44
Other Postgraduate	6.88	4.47	1.75	1.06	0.05	6.88	8.55	6.31	5.33	-0.05
Total	9.65	4.61	1.57	1.30	2.34	9.65	4.61	0.62	-0.87	-2.16

Concluding Remarks

The above analysis, although it does not prove statistically, indicates that the transition matrices, **Q**, are reasonably robust. In particular, models which were estimated with data with a high level of aggregation yielded **Q** matrices which appear remarkably stable. Results of the predictions of completion numbers suggests that the **R** matrices, too, are stable for higher aggregated data, although, in general, they generate less accurate predictions than the **Q** matrices do for total enrolment. The unconventional approach taken in setting up this experiment makes it difficult to interpret the results for other than that for 1-step-ahead predictions.

The models for some individual field of study and course level, such as Business, Health and Law for undergraduates and Research and Master's by Coursework for postgraduates, appear to be less stable, but this is largely due to the extreme volatility in the course commencement, enrolment and completion data for them. Structural changes in some of the courses may be a contributing factor for the large volatility.

5 Conclusion

Change in government policy, or of shifts in student demand, can have a significant impact on the size and shape of higher education. It is important to assess and estimate such an impact for a number of reasons, not least for budget purposes. Completion and dropout rates can be included in a measure of output and efficiency of the higher education sector. The projection of the former can also be used to manage and develop policy on national skill formation. Despite the existence of relatively very good data, little analysis of the sort just mentioned has been done in Australia. This project was undertaken to provide a model that could be used for these purposes.

An input-output model based on the theory of absorbing Markov chains was proposed to describe the student flows through the higher education system, and also to make projections of the number of students enrolled, the number completing and the number dropping out of courses. The model was outlined in chapter 2. Models of this sort have been considered before but have not been persisted with, probably because of the lack of sufficiently good data that is needed to estimate student flows through various stages of the system. As such flow data are not as yet available to us either. However, the currently available stock data on higher education in Australia from DEET, allows flow statistics necessary for this model to be closely estimated. Exploratory analysis of the data is presented in chapter 3.

Main Results

A range of summary statistics, such as the probability of completing a course, the average time in the system and the average time to complete a course are estimated for undergraduate students. It was found that these varied, and sometimes considerably, with the age at which the student commenced the course, gender and field of study. Projections of student numbers and course completions by gender and field of study are made. Similar analysis and projections for postgraduate students by level of course, but not by field of study, are also made.

Some general results for Australian undergraduate students are:

- the probability of completing a course for an Australian student varies from 58 percent for one who commences the course at an age between 25 and 34 years, to 74 percent for one who commences it at an age of 20 years;
- a female student has a higher chance of completing a course and takes a shorter time to complete it than a male student who commences the course at the same age;
- a 20-year-old Australian student has the highest chance of completing a course, with the chances for a female being 79 percent and that for a male 69 percent; and
- a student who commences a Business or Engineering course at an age of 24 years or more, or one who commences an Architecture or Science course at an age over 29 years has a 50 percent or less chance of completing it;
- a student who commences a course at an age of 21 years takes, on average, the shortest time (3.1 years) to complete it; and
- a female student takes less time, on average, to complete a course than a male student who commences at the same age, with the difference in the times as much as 0.7 years.

Some of the variation in the results may be related to the student's mode of study, that is, full-time, part-time or external. Another factor which may affect results is credit transfer from prior courses. These issues could be matters for further research.

The results for postgraduate students can be summarised as:

- the probability of completing a Research degree or an Other Postgraduate course vary quite a lot with the age at which the course is commenced, but that of completing a Master's by Coursework is almost invariant with the course commencement age;
- in general, male students have a better chance of completing a Research degree than female students who commence the degree at the same age;
- female students have a better chance of completing an Other Postgraduate course than male students who commence the course at the same age;
- the mean time to complete a Research degree varies from 4.4 to 6 years, that of completing a Master's by Coursework from 2.7 to 3.1 years and that of an Other Postgraduate course from 1.5 to 2.1 years; and
- in general, a male student takes, on average, a shorter time to complete a Research or Master's by Coursework degree than a female student commencing the course at the same age.

The same factors that may be contributing to the variation in the results for undergraduates may also be contributing to the variation in the case of postgraduates. There may also be variation due different fields of study. Since the category Research includes both doctorates and Master's by research, the results for time to completion are likely to be underestimates for doctorates and overestimates for Master's by research.

The undergraduate projections reflect:

- the 1993 to 1994 dynamics of students' progress through the system;
- the demographic changes projected to occur between 1995 and 2001;
- a constant school retention rate as calculated from the 1993 and 1994 school enrolment data;
- a constant proportion, based on the 1994 data, of Year 12 students continuing into higher education; and
- a constant proportion, based on the 1994 data, of non-school-leavers entering higher education.

Under this scenario the projections for Australian students up to the year 2001 can be summarised as follows:

- the total course commencements are projected to decline from 1995 to 1998 and then slowly rise until 2001;
- the increase in the total number of course commencements between 1995 and 2001 is projected to be 0.9 percent, with male and female numbers projected to increase by 0.4 and 1.2 percent, respectively;
- the total number of students enrolled is projected to increase by 4.8 percent between 1995 and 2001;
- the total number of students enrolled in Education (Initial training) are projected to decline by 1.2 percent, while those in Law are projected to increase by 13.4 percent between 1995 and 2001;
- the total number of course completions is projected to increase by 5.4 percent between 1995 and 2001, with females making up 60 percent of all completions in the year 2001; and
- course completions in Education (Initial training) are projected to decline by 7.3 percent, while in Law they are projected to increase by 20.1 percent.

The postgraduate projections reflect:

- the 1993 to 1994 dynamics of students' progress through the system;
- the demographic changes projected to occur between 1995 and 2001; and
- a constant proportion, based on the 1994 data, of a particular age group entering post graduate courses.

Under this scenario the projections for the period 1995 to 2001 can be summarised as follows:

- the total course commencements are projected to increase by 2.5 percent between 1995 and 2001, with male and female numbers increasing by 2.5 and 2.0 percent, respectively;
- the total number of students enrolled for Research, Master's by Coursework and Other Postgraduate courses is projected to increase by 18.4, 15.2 and 7.3 percent, respectively;
- male Research degree completions are projected to increase by 34.0 percent and that of females by 45.4 percent; and
- the total number of Master's by Coursework degree completions are projected to increase by 22.3 percent, with male and female completions increasing by 18.8 and 26.5 percent, respectively.

The model evaluation suggests that matrix **Q** and **R** are reasonably stable over at least a five year period. This is especially so when data are at a high degree of aggregation. In general, the prediction of total enrolment was more accurate than that for course completions. The mean absolute percentage error (MAPE) of predicting total enrolment of all undergraduate students was 0.81 percent and that of postgraduate students it was 1.79 percent. MAPE for predicting course completions by all undergraduate students was 3.54 percent and that for postgraduates it was 9.65 percent. The exercise on model evaluation showed a structural change that has possibly occurred for the Master's by Coursework courses over the last few years.

Limitations

The results in this report are based on the movement of students who were enrolled in 1993 either to enrolment in 1994 or out of the system (as a completion or a dropout), together with estimates of commencing students for the years 1995 to 2001.

The experience of students enrolled in 1993 may not be the same as students who were enrolled in earlier years, or who enrol in later years. However, earlier analysis on data from 1989 to 1992 seem to indicate little variation, at least at the aggregate level, in the rate of progression of students through and out of the system.

The projection of new intakes is a much more tentative matter. Government policy on student places can have a major impact on this, as can factors affecting the distribution of student demand for places. In this report, the estimates of commencements for the period 1996 to 2001 are largely a reflection of the demographic changes, a constant Year 12 retention rate and a constant participation rate for non-school-leavers. The model that we have used and the assumptions underlying it is but one of a range of plausible models for projecting student intake. Projections of student intake using alternative models or underlying assumptions can

easily be linked into the current input-output model to generate projections of student enrolment, completions and dropouts.

Further Work

The software used so far is based on a mixture of mainframe and desktop platforms. However, it is not inconceivable to design all procedures to run on a desktop or a mainframe platform.

With the existing data and the current model further analysis can be performed. For example, analysis can be done for each State, though some fields of study estimates for small states may not be all that reliable. Earlier work on this project (see Coleman and Burke (1993)) showed there are some differences in students' rate of progress through the system between States.

Some analysis by the student's enrolment status, that is, full-time, part-time or external, can also be carried out. However, existing data does not allow the estimation of course completions and dropouts as the course completions file does not indicate enrolment status.

The estimates that are reported can be converted to obtain approximate EFTSUs using the current ratios of students to EFTSUs in the various fields of study analysed. This could be refined when analysis by enrolment status is undertaken. The projections in EFTSUs can be used to project expenditure levels.

A great deal more work can be undertaken if full cohort data were available for at least a pair of years, say 1994 and 1995 and the student enrolment file was linked to the completions file. In particular, it may then be possible to model those students who transfer from one course to another within a university. In the current analysis these students are treated as dropouts from the first course and commencing in the other. The additional data would not much affect the capacity of the model to project total student numbers or completions. However, the picture of progression through courses and to completion could be substantially enhanced. A much clearer picture would emerge about the pathways of students and the proportion of a generation achieving a university qualification.

Projections made with the model outlined in this report will be linked with projections of immigration and of occupational demand in a joint study of *Medium term forecasts of supply and demand for the professions and some skilled occupations* between the Centre for the Economics of Education and Training, the Centre for Policy Studies and the Centre for Population and Urban Research, at Monash University. This project is funded by a large ARC grant.

Appendix A

Adjustment Process for Negative Dropout Quantities in Input-Output Matrix

The negative dropout numbers were forced to zero by redistributing the completion numbers among the states defined by the same age group. The adjustment was done with two principles in mind. First, only the completion numbers are adjusted. Secondly, any adjustments made must ensure that the total number of completions remain unchanged.

An example illustrating how the adjustment process for negative dropout numbers works is shown in Table A1. In this example, initial construction of the input-output matrix resulted in a negative number of students moving from the last two transient states to the dropout state. In the adjustment process these two values are forced to zero by reducing the number of students moving to the completion state. The number moving from the sixth year of enrolment to completion is reduced from 78 to 74, and the number moving from the fifth year of enrolment to completion is reduced from 43 to 40. The net effect is that the number moving from the fourth year of enrolment to completion is increased from 57 to 64.

Table A1 An Example to Illustrate the Adjustment Process for Negative Dropouts

Age:Year of Enrolment	Dropouts	Completions	Total for 1993
24:1	94 (94)	8 (8)	283
24:2	38 (38)	21 (21)	221
24:3	22 (22)	76 (76)	234
24:4	27 (12)	57 (64)	171
24:5	-3 (0)	43 (40)	78
24:6	-4 (0)	78 (74)	142

Note: Post adjustment numbers are in brackets

Appendix B

HIGHER EDUCATION ENROLMENTS AND COMPLETIONS, 1989 TO 1994

Undergraduates

The undergraduate commencements for 1989 to 1994 are given in Table B1. There has been, on average, 2.8 percent annual growth in the number of students commencing undergraduate courses during this period, with the growth in female numbers a 0.5 percentage points higher than that for males. However, the growth in numbers is not uniform across all years. There was a large increase of 10.1 percent from 1989 to 1990, but a drop of 7.4 percent between 1991 to 1992. In 1992 universities adjusted their intake to compensate for the unfunded enrolment in the previous couple of years.

The average annual growth in the number of Australians commencing undergraduate courses is 1.7 percent. There is considerable variation in the rate across fields of study and gender. On average, there has been an annual decline of 5.5 percent in the number of students commencing Education (I) while the number commencing courses in Law show an annual growth of 12.5 percent. The average growth in numbers commencing Business courses is a very small 0.2 percent per annum. The drop in numbers in 1992 over those in 1991 was for all fields of study except Architecture. The numbers in Education (I) and Health have dropped each year since 1992. Across all fields of study, except Architecture and Education (I), the average annual growth in female numbers has been higher than that for males. In Education (I) both males and females numbers have declined at almost the same average annual rate.

Table B1 Undergraduate Course Commencements, 1989 to 1994

	Year						Percentage Change From Previous Year					
	1989	1990	1991	1992	1993	1994	1990	1991	1992	1993	1994	Average
Males												
All	58680	63552	66975	61907	63418	66391	8.3	5.4	-7.6	2.4	4.7	2.5
Australian	56244	59335	62027	56622	57865	60032	5.5	4.5	-8.7	2.2	3.7	1.3
Architecture	1518	1671	1692	1649	1772	1845	10.1	1.3	-2.5	7.5	4.1	4.0
Arts	10012	10971	11828	10411	10824	11339	9.6	7.8	-12.0	4.0	4.8	2.5
Business	14955	15525	14864	13335	13584	14119	3.8	-4.3	-10.3	1.9	3.9	-1.1
Education (I)	3803	3903	3966	3408	3113	2874	2.6	1.6	-14.1	-8.7	-7.7	-5.4
Engineering	7751	7885	8633	8007	8557	8840	1.7	9.5	-7.3	6.9	3.3	2.7
Health	2396	2543	2875	2879	2965	2961	6.1	13.1	0.1	3.0	-0.1	4.3
Law	1284	1560	1790	1949	2054	2215	21.5	14.7	8.9	5.4	7.8	11.5
Science	11218	11981	13000	11780	11968	12482	6.8	8.5	-9.4	1.6	4.3	2.2
Females												
All	73223	81677	86895	80597	81867	84883	11.5	6.4	-7.2	1.6	3.7	3.0
Australian	71436	78340	82679	75794	76892	79210	9.7	5.5	-8.3	1.4	3.0	2.1
Architecture	922	1054	947	997	955	1051	14.3	-10.2	5.3	-4.2	10.1	2.7
Arts	21726	23827	25116	22867	23294	25475	9.7	5.4	-9.0	1.9	9.4	3.2
Business	11399	12863	12591	11267	11815	12447	12.8	-2.1	-10.5	4.9	5.3	1.8
Education (I)	10911	11181	11261	8946	8974	8217	2.5	0.7	-20.6	0.3	-8.4	-5.5
Engineering	908	1129	1249	1378	1393	1395	24.3	10.6	10.3	1.1	0.1	9.0
Health	11144	12605	14082	14023	13833	13328	13.1	11.7	-0.4	-1.4	-3.7	3.6
Law	1244	1538	1828	1661	2138	2350	23.6	18.9	-9.1	28.7	9.9	13.6
Science	7796	8503	9596	9143	9282	9856	9.1	12.9	-4.7	1.5	6.2	4.8
Persons												
All	131903	145229	153870	142504	145285	151274	10.1	5.9	-7.4	2.0	4.1	2.8
Australian	127680	137675	144706	132416	134757	139242	7.8	5.1	-8.5	1.8	3.3	1.7
Architecture	2440	2725	2639	2646	2727	2896	11.7	-3.2	0.3	3.1	6.2	3.5
Arts	31738	34798	36944	33278	34118	36814	9.6	6.2	-9.9	2.5	7.9	3.0
Business	26354	28388	27455	24602	25399	26566	7.7	-3.3	-10.4	3.2	4.6	0.2
Education (I)	14714	15084	15227	12354	12087	11091	2.5	0.9	-18.9	-2.2	-8.2	-5.5
Engineering	8659	9014	9882	9385	9950	10235	4.1	9.6	-5.0	6.0	2.9	3.4
Health	13540	15148	16957	16902	16798	16289	11.9	11.9	-0.3	-0.6	-3.0	3.8
Law	2528	3098	3618	3610	4192	4565	22.5	16.8	-0.2	16.1	8.9	12.5
Science	19014	20484	22596	20923	21250	22338	7.7	10.3	-7.4	1.6	5.1	3.3

Total enrolments of undergraduates between 1989 and 1994 are given in Table B2. There has been, on average, an annual growth of 4.9 percent in the total undergraduate enrolment, with the average annual growth in female numbers 1 percentage point higher than that for males. Although there has been a growth in total enrolment each year since 1989, the percentage change has declined from being 9.7 percent from 1989 to 1990 to only 0.9 percent from 1993 to 1994.

Changes in total enrolment of Australian students is not uniform across fields of study. Total enrolment in Education (I) show an average annual decline of 2.9 percent between 1989 and

1994, while in Law there has been an increase, on average, of 12.7 percent annually. A very high 22.4 percent increase in enrolments in Law was recorded in 1990. Part of this increase is probably due to the change in some field of study classification in 1987 which resulted in the transfer of some courses from Business to Law; see DEET (1995a). Total enrolment in Education (I) courses has been dropping since 1992. Female enrolments have increased at a higher average annual rate than male enrolments for each field of study, except Education (I). In the case of Education (I) male numbers declined at a higher average annual rate than female numbers. Since 1992 enrolments in Business courses have been dropping for males, but female numbers show a drop only in 1994.

Table B2 Undergraduate Total Enrolment, 1989 to 1994

	Year						Percentage Change From Previous Year					
	1989	1990	1991	1992	1993	1994	1990	1991	1992	1993	1994	Average
Males												
All	161469	174456	188942	193925	197385	199960	8.0	8.3	2.6	1.8	1.3	4.4
Australian	157503	167205	179020	181644	183426	184498	6.2	7.1	1.5	1.0	0.6	3.2
Architecture	5143	5391	5551	5683	5899	6020	4.8	3.0	2.4	3.8	2.1	3.2
Arts	26226	27973	30601	30946	31287	31801	6.7	9.4	1.1	1.1	1.6	3.9
Business	41914	44858	46560	45951	45272	44380	7.0	3.8	-1.3	-1.5	-2.0	1.1
Education (I)	10092	9962	10284	9844	9311	8561	-1.3	3.2	-4.3	-5.4	-8.1	-3.2
Engineering	23586	24937	27158	28171	29453	30344	5.7	8.9	3.7	4.5	3.0	5.2
Health	6178	6706	7293	7716	8143	8106	8.5	8.7	5.8	5.5	-0.5	5.6
Law	4608	5493	6207	6862	7401	7764	19.2	13.0	10.6	7.9	4.9	11.0
Science	28460	30677	33789	34928	35350	35885	7.8	10.1	3.4	1.2	1.5	4.7
Females												
All	185641	206333	228158	236845	240373	241649	11.1	10.6	3.8	1.5	0.5	5.4
Australian	182788	200655	219980	226119	228255	228348	9.8	9.6	2.8	0.9	0.0	4.6
Architecture	2638	2957	2993	3188	3263	3377	12.1	1.2	6.5	2.4	3.5	5.1
Arts	57225	61865	67578	68783	69059	71831	8.1	9.2	1.8	0.4	4.0	4.7
Business	28160	32593	35635	36531	37184	36832	15.7	9.3	2.5	1.8	-0.9	5.5
Education (I)	28828	29617	30578	28849	27255	24958	2.7	3.2	-5.7	-5.5	-8.4	-2.8
Engineering	2382	2911	3442	3993	4428	4696	22.2	18.2	16.0	10.9	6.1	14.5
Health	26255	30171	34467	37464	38293	36617	14.9	14.2	8.7	2.2	-4.4	6.9
Law	4031	5080	5969	6441	7343	7909	26.0	17.5	7.9	14.0	7.7	14.4
Science	18799	21061	23894	25287	26261	27327	12.0	13.5	5.8	3.9	4.1	7.8
Persons												
All	347110	380789	417099	430770	437758	441609	9.7	9.5	3.3	1.6	0.9	4.9
Australian	340291	367860	399000	407764	411681	412846	8.1	8.5	2.2	1.0	0.3	3.9
Architecture	7781	8348	8544	8871	9162	9397	7.3	2.3	3.8	3.3	2.6	3.8
Arts	83451	89838	98179	99729	100346	103632	7.7	9.3	1.6	0.6	3.3	4.4
Business	70074	77451	82195	82482	82456	81212	10.5	6.1	0.3	0.0	-1.5	3.0
Education (I)	38920	39579	40862	38693	36566	33519	1.7	3.2	-5.3	-5.5	-8.3	-2.9
Engineering	25967	27848	30600	32164	33881	35040	7.2	9.9	5.1	5.3	3.4	6.2
Health	32434	36878	41759	45180	46436	44723	13.7	13.2	8.2	2.8	-3.7	6.6
Law	8639	10574	12176	13302	14744	15673	22.4	15.2	9.3	10.8	6.3	12.7
Science	47259	51737	57683	60215	61611	63212	9.5	11.5	4.4	2.3	2.6	6.0

Course completion numbers for undergraduates between 1989 and 1993 are given in Table B3. It was found that the number for total completions (all courses) for 1991 obtained from the electronic file did not match with the published figure in DEET (1995a). The discrepancy of 109 was all in Arts completions. The completions increased at an annual average of 9.7 percent over this period, with the average for males being 8.0 percent and that for females 10.9 percent.

Australian course completions vary across field of study and gender. Course completions in Education (I) dropped, on average, by 1.6 percent per year between 1989 and 1993, while those in Health increased by 16.2 percent per year. Completions in Law are interesting. They show a drop of 12.5 percent from 1990 to 1991, but a massive increase of 40.9 percent from 1993 to 1994. Part of the variation is possibly due, as mentioned earlier, to the change in the field of study classification for some courses that was introduced in 1987. Female course completions show a higher average annual increase than male completions for each field of study, except Education (I). In the case of Education (I) male completions dropped at an annual average of 6.1 percent while those of females dropped at an annual average of only 0.1 percent. For some fields of study the difference in the male and female average annual growth in completions is quite large, for example, the difference in Engineering is 12 percentage points and that in Business 7.6 percentage points.

Postgraduates

The course commencements for postgraduates for 1989 to 1994 are given in Table B4. The total number of commencements grew by an average annual rate 11.1 percent over this period. The growth in Research degree commencements saw tremendous growth in the first three years, peaking at 34.1 percent in 1992, but then falling off dramatically with only a 1.1 percent growth in 1994. The growth in Master's by Coursework degree commencements reached a peak of 33.4 percent in 1989 and has been falling steadily ever since. Its growth of only 9.9 percent in 1994. Other Postgraduate course commencements have had less dramatic growth, in fact, there was no growth in their numbers in 1992. In general, female numbers have increased at a faster rate than those of males. Only female Other Postgraduate numbers in 1992 and male Research numbers in 1994 saw a reduction from the previous year.

Table B3 Undergraduate Course Completions, 1989 to 1994

	Year					Percentage Change From Previous Year				
	1989	1990	1991	1992	1993	1990	1991	1992	1993	Average
					Males					
All	27936	29378	31886	35242	37973	5.2	8.5	10.5	7.7	8.0
Australian	27705	28594	30378	33223	35243	3.2	6.2	9.4	6.1	6.2
Architecture	889	970	995	1038	1051	9.1	2.6	4.3	1.3	4.3
Arts	4604	4742	5193	5867	6247	3.0	9.5	13.0	6.5	7.9
Business	6224	6858	7447	8599	8907	10.2	8.6	15.5	3.6	9.4
Education (I)	2682	2399	2370	2116	2087	-10.6	-1.2	-10.7	-1.4	-6.1
Engineering	3412	3394	3340	3667	3980	-0.5	-1.6	9.8	8.5	3.9
Health	1226	1432	1564	1726	1895	16.8	9.2	10.4	9.8	11.5
Law	991	1041	889	1075	1470	5.0	-14.6	20.9	36.7	10.4
Science	5169	5409	6014	6607	6907	4.6	11.2	9.9	4.5	7.5
					Females					
All	36889	39589	44965	51235	55840	7.3	13.6	13.9	9.0	10.9
Australian	36616	38844	43567	48964	52780	6.1	12.2	12.4	7.8	9.6
Architecture	410	479	565	634	662	16.8	18.0	12.2	4.4	12.7
Arts	10146	10588	12067	13465	14286	4.4	14.0	11.6	6.1	8.9
Business	4110	4735	5599	6801	7736	15.2	18.2	21.5	13.7	17.1
Education (I)	7377	7423	7662	7137	7359	0.6	3.2	-6.9	3.1	-0.1
Engineering	315	364	366	478	568	15.6	0.5	30.6	18.8	15.9
Health	5749	6325	7513	9777	10815	10.0	18.8	30.1	10.6	17.1
Law	853	945	849	1005	1460	10.8	-10.2	18.4	45.3	14.4
Science	3573	3814	4463	4890	5452	6.7	17.0	9.6	11.5	11.1
					Persons					
All	64825	68967	76851	86477	93813	6.4	11.4	12.5	8.5	9.7
Australian	64321	67438	73945	82187	88023	4.8	9.6	11.1	7.1	8.2
Architecture	1299	1449	1560	1672	1713	11.5	7.7	7.2	2.5	7.2
Arts	14750	15330	17260	19332	20533	3.9	12.6	12.0	6.2	8.6
Business	10334	11593	13046	15400	16643	12.2	12.5	18.0	8.1	12.7
Education (I)	10059	9822	10032	9253	9446	-2.4	2.1	-7.8	2.1	-1.6
Engineering	3727	3758	3706	4145	4548	0.8	-1.4	11.8	9.7	5.1
Health	6975	7757	9077	11503	12710	11.2	17.0	26.7	10.5	16.2
Law	1844	1986	1738	2080	2930	7.7	-12.5	19.7	40.9	12.3
Science	8742	9223	10477	11497	12359	5.5	13.6	9.7	7.5	9.0

Table B4 Postgraduate Course Commencements, 1989 to 1994

	Year						Percentage Change From Previous Year					
	1989	1990	1991	1992	1993	1994	1990	1991	1992	1993	1994	Average
Males												
Research	2894	3324	4238	5549	6138	5975	14.9	27.5	30.9	10.6	-2.7	15.6
Master's by Coursework	4517	5706	7071	7912	8851	9497	26.3	23.9	11.9	11.9	7.3	16.0
Other Postgraduate	10441	11641	13097	13396	13663	13685	11.5	12.5	2.3	2.0	0.2	5.6
Total	17852	20671	24406	26857	28652	29157	15.8	18.1	10.0	6.7	1.8	10.3
Females												
Research	1774	2121	2727	3788	4095	4373	19.6	28.6	38.9	8.1	6.8	19.8
Master's by Coursework	3036	4373	5715	6505	7385	8353	44.0	30.7	13.8	13.5	13.1	22.4
Other Postgraduate	13471	14785	17107	16823	18420	19406	9.8	15.7	-1.7	9.5	5.4	7.6
Total	18281	21279	25549	27116	29900	32132	16.4	20.1	6.1	10.3	7.5	11.9
Persons												
Research	4668	5445	6965	9337	10233	10348	16.6	27.9	34.1	9.6	1.1	17.3
Master's by Coursework	7553	10079	12786	14417	16236	17850	33.4	26.9	12.8	12.6	9.9	18.8
Other Postgraduate	23912	26426	30204	30219	32083	33091	10.5	14.3	0.0	6.2	3.1	6.7
Total	36133	41950	49955	53973	58552	61289	16.1	19.1	8.0	8.5	4.7	11.1

Total enrolments of postgraduates are given in Table B5. Postgraduate numbers grew by an average annual rate of 11.7 percent between 1989 and 1994, with the female rate outstripping male rate by 2.4 percentage points. The pattern of changes are similar to that for course commencements. In 1989 females comprised 47.6 percent of all postgraduate enrolment, but by 1994 this proportion has increased to 50.3 percent. Over the same period female Research degree enrolment has increased from 35.8 to 40.8 percent.

Postgraduate course completions for 1989 to 1993 are given in Table B6. Overall course completions increased by an average of 12.4 percent per annum, with both male and female completions increasing at about the same average rate. However, completions of Master's by Coursework degrees increased by a staggering average of 29.6 percent per annum. Annual average increases in female completions of Research and Master's by Coursework degrees are substantially higher than that for males. Female completions of Research degrees make up 36.4 percent of all Research degree completions in 1994 compared to 30.9 percent in 1989. Female share of Master's by Coursework degree completions has increased from 38 percent to 42.8 percent over the same period.

Table B5 Postgraduate Total Enrolment, 1989 to 1994

	Year						Percentage Change From Previous Year					
	1989	1990	1991	1992	1993	1994	1990	1991	1992	1993	1994	Average
Males												
Research	9465	10445	11933	14667	16938	18344	10.4	14.2	22.9	15.5	8.3	14.1
Master's by Coursework	9564	11529	14096	16321	18515	19952	20.5	22.3	15.8	13.4	7.8	15.8
Other Postgraduate	17657	18964	21295	21991	22035	22336	7.4	12.3	3.3	0.2	1.4	4.8
Total	36686	40938	47324	52979	57488	60632	11.6	15.6	11.9	8.5	5.5	10.6
Females												
Research	5286	6094	7347	9620	11403	12640	15.3	20.6	30.9	18.5	10.8	19.0
Master's by Coursework	6417	8249	10889	12953	15046	17216	28.5	32.0	19.0	16.2	14.4	21.8
Other Postgraduate	21606	23481	27343	27903	29656	31471	8.7	16.4	2.0	6.3	6.1	7.8
Total	33309	37824	45579	50476	56105	61327	13.6	20.5	10.7	11.2	9.3	13.0
Persons												
Research	14751	16539	19280	24287	28341	30984	12.1	16.6	26.0	16.7	9.3	16.0
Master's by Coursework	15981	19778	24985	29274	33561	37168	23.8	26.3	17.2	14.6	10.7	18.4
Other Postgraduate	39263	42445	48638	49894	51691	53807	8.1	14.6	2.6	3.6	4.1	6.5
Total	69995	78762	92903	103455	113593	121959	12.5	18.0	11.4	9.8	7.4	11.7

Table B6 Postgraduate Course Completions, 1989 to 1993

	Year					Percentage Change From Previous Year				
	1989	1990	1991	1992	1993	1990	1991	1992	1993	Average
Males										
Research	1458	1460	1706	1775	2020	0.1	16.8	4.0	13.8	8.5
Master's by Coursework	1969	2503	3271	4278	5128	27.1	30.7	30.8	19.9	27.0
Other Postgraduate	6648	6564	7843	8547	8828	-1.3	19.5	9.0	3.3	7.3
Total	10075	10527	12820	14600	15976	26.0	4.5	21.8	13.9	12.2
Females										
Research	651	727	852	937	1156	11.7	17.2	10.0	23.4	15.4
Master's by Coursework	1207	1536	2190	3007	3843	27.3	42.6	37.3	27.8	33.6
Other Postgraduate	9380	9307	11258	12023	13094	-0.8	21.0	6.8	8.9	8.7
Total	11238	11570	14300	15967	18093	38.2	3.0	23.6	11.7	12.6
Persons										
Research	2109	2187	2558	2712	3176	3.7	17.0	6.0	17.1	10.8
Master's by Coursework	3176	4039	5461	7285	8971	27.2	35.2	33.4	23.1	29.6
Other Postgraduate	16028	15871	19101	20570	21922	-1.0	20.4	7.7	6.6	8.1
Total	21313	22097	27120	30567	34069	29.9	3.7	22.7	12.7	12.4

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