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Predicting performance in undergraduate agricultural economics*

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Entry to the Bachelor of Agricultural Economics (BAgrEc) program at the University of Sydney is consistently less competitive than that for the Bachelor of Economics (BEc) and Bachelor of Commerce (BComm) programs. Given that students in the BAgrEc program undertake units in common with students in the BEc and BComm programs, it is of interest to examine the importance of school performance and first year university in the determination of success at university. This paper takes information for nine cohorts of BAgrEc students and tests their performance in first-year core subjects against the university entrance ranking, school English and mathematics marks, gender, and type of school. The paper then uses the same information to predict which student characteristics at entry level are likely to lead to students completing the degree program. The implications of the analysis are explored.

Key words: agricultural economics, education, school performance, university performance.

1. Introduction

This paper seeks to examine university admissions and demographic data for students enrolling in the Bachelor of Agricultural Economics (BAgrEc), a 4-year degree program at the University of Sydney, from 1993 to 2001. The paper uses data for students of the BAgrEc degree program in the Faculty of Agriculture, Food and Natural Resources (FAFNR) at the University of Sydney to identify factors which, at the time of entry to the program, contribute to their success in first year subjects, and in completing the degree program. Entry to the BAgrEc is less competitive than for the Bachelor of Economics (BEc) and Bachelor of Commerce (BComm) counterparts offered by the Faculty of Economics and Business (FEB). Therefore, the students in the FEB degrees are generally expected to be academically stronger on the basis of secondary school results. Approximately 50 per cent of the units taken by students in the BAgrEc degree program are taught in the FEB. The BAgrEc students must compete on an equal footing with students in the FEB.

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Section 2 will provide the background to the study. Sections 3 and 4 will present the empirical models, estimation procedures, and data, and the empirical results will be presented in Section 5. The implications of the analysis will be explored in Section 6, followed by concluding comments in Section 7.

2. Background

One of the central areas of interest in the economics education literature is the determination of the factors predicting student success in university economics, particularly success in first year economics. Published works in the USA suggest that results in the Scholastic Aptitude Test (SAT), and, more particularly, the mathematics component of the SAT, are significant predictors of success in tertiary economics (Anderson *et al*. 1994; Ballard and Johnson 2004). However, Rothstein (2004) argues that, because of the acknowledged correlation between SAT scores and student socioeconomic status, the significance of SAT scores in predicting success tends to be overstated.

There are a number of other factors that are highlighted in the literature as being likely to predict success in first year economics. There is consensus that a mathematics background that includes some calculus is significant (Anderson *et al*. 1994; Ballard and Johnson 2004). Ballard and Johnson (2004) also suggest that a tested ability to carry out some very simple mathematical operations is important. In the USA, it has been found that male students perform better in economics than do female students (Siegfried 1979; Jensen and Owen 2001; Ballard and Johnson 2004). Some of the conventional wisdom in this area of the published work seems to be outdated (e.g., Siegfried 1979), but gender does appear to be an issue. In Australia, it appears that female students perform better than male students across most areas of university education (Dobson *et al*. 1997; Pascoe *et al*. 1997). Female students also obtain higher Equivalent National Tertiary Entrance Ranking (ENTER) rankings than male students. The various categories of tertiary entrance rankings used in the different states of Australia are considered to be the best available predictors of success in the absence of previous university experience (Cooney 2001). However, ACER (2001) has found that nationally, on average, Catholic school students achieve an ENTER that is six marks higher than that for government school students. Independent school students are a further six points higher. Most previous studies deal with a period of only 1 or 2 years (e.g., Anderson *et al*. 1994; Jensen and Owen 2001; Ballard and Johnson 2004; Dancer and Fiebig 2004). The current paper will examine trends over a longer period.

Tertiary entrance in New South Wales is determined on the basis of the Universities Admission Index (UAI), which depends on the marks achieved by students in the New South Wales Higher School Certificate (HSC). This is an external examination set by the NSW Board of Studies. The HSC is taken by students in New South Wales at the end of their final year of secondary school. It is not an aptitude test, and subjects studied during the final year of

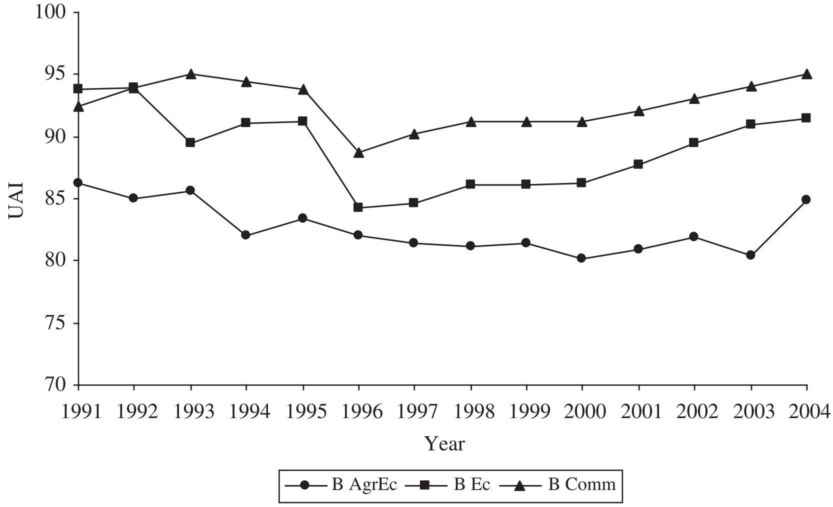

Figure 1 Universities Admission Index (UAI) cut-offs by degree.

school are examined. Most subjects consist of two units, but students can also elect to take more advanced units, such as 3 Unit and 4 Unit mathematics. Students complete between 10 and 14 units. The results from the best 10 units are selected, and scaled according to their perceived level of difficulty by the University Admissions Centre (UAC) to calculate the UAI. Students are admitted to their preferred degree program on the basis of supply and demand, and the UAI is the rationing device.

Demand for BEc and BComm degree programs is consistently higher than for the BAgrEc degree program, and the published UAI cut-off for the latter has been, since 1992, on average, 10 per cent lower than that for the BComm, and 7 per cent lower than that for the BEc (University of Sydney Statistics Unit 2005; University of Sydney Admissions Office, pers. comm. 2004). As can be seen in Figure 1, whereas the cut-off marks for the two FEB degree programs have been generally rising over that period, the cut-off mark for the BAgrEc degree program has been declining.

The admissions process also provides for limited numbers of Special Entry admissions. These admissions have been increasing, and Figure 2 shows that, whereas the mean UAI for the students in the sample declined only slightly from 1993 to 2001, the minimum UAI declined more dramatically. For example, in 1999, 13.7 per cent of students were admitted to the degree with a UAI below the published cut-off, and in 2001 this had risen to 29 per cent.

3. Empirical models and estimation procedures

Methodologically, much of the literature deals with economics education as a production function, with learning being treated as an output produced by

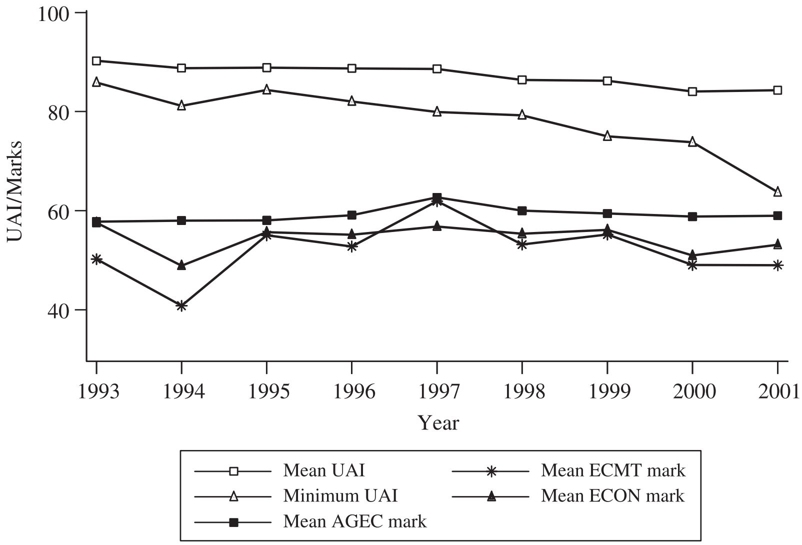

Figure 2 Trends in mean Universities Admission Index (UAI), minimum UAI and means of marks in core subjects.

such inputs as student aptitude and courses taken (Becker and Walstad 1987; Anderson *et al*. 1994). Linear regression analysis in the form of Ordinary Least Squares (OLS) is used to address questions related to the marginal learning effects of certain inputs (e.g., Anderson *et al*. 1994; Greene 1997; Ballard and Johnson 2004). Other studies, particularly in the USA, where grades are awarded rather than marks, have used tobit and probit models (e.g., Anderson *et al*. 1994; Jensen and Owen 2001; Dancer and Fiebig 2004).

In this study, we used OLS to measure the importance of student characteristics at entry in determining results in core first-year units of study. We hypothesised that gender, type of school, UAI, marks in school mathematics and English, and level of mathematics and English studied, would be significant in explaining performance in first year subjects. We then sought to identify the characteristics that increased the likelihood of students completing the degree program.

We developed two multinomial logit models to predict the likelihood of a student completing the degree program (the base case), dropping out despite obtaining good results, or dropping out after obtaining poor results. The Restricted Multinomial Logit Model was used to determine which entry factors were significant in predicting the likelihood of completion. In the Unrestricted Multinomial Logit Model, results in first-year core subjects were also included as explanatory variables in an attempt to discover whether or not the influence of school results was reduced as students progressed through the degree. EVIEWS was used for the OLS models and LIMDEP for the multinomial logit models.

The independent variables used in the analysis were UAI and HSC English and mathematics marks. Dummy variables were used for gender, type of school, and level of English and mathematics attempted for the HSC. Dummy variables for year of entry (with 1993 as the base year) were also used to determine whether or not there were any trends over the period.

The dependent variables for the first part of this study were the marks achieved in the three core first-year units in the degree. These were Agricultural Economics (AGEC1) in the FAFNR, and Economics 1 (ECON1) and Econometrics (ECMT) in the FEB. The marks would be based on a variety of assessment methods, including examinations, essays, and quantitative assignments set throughout the academic year. We developed a separate model for each of the three units. This allowed the identification of possible differing trends in the three units of study. For the logit model, the outcomes were whether the student completed the degree program, succeeded and dropped out, or failed and dropped out.

Other studies have used surveys to collect data for other characteristics such as attendance at tutorials, number of hours studied each week, and place of residence (e.g., Dancer and Fiebig 2004; Jensen and Owen 2001; Ballard and Johnson 2004). This was not possible for the current analysis, as the observations mainly related to past students. The longer time period also made it difficult to include a dummy variable for the lecturer, as has been performed, for example, in Anderson *et al*. (1994). We are aware, anecdotally, that there have been only minor changes in teaching staff for Agricultural Economics 1 and Econometrics, but that there have been constant changes in staff in Economics 1.

4. Data

Data were available for students entering the BAgrEc degree program from 1993 to 2001. The data were extracted from the university database, and departmental and faculty records. They included gender, type of school, UAI, English marks, mathematics marks, the levels of mathematics and English taken, and whether students completed the degree, succeeded and dropped out, or dropped out because of failure. Because the university does not upload HSC marks for students who defer for a year before starting university, there are gaps in the data. It has been possible to supplement most of the data from departmental records, but the department has not kept English and mathematics marks. The university records for English and mathematics for the 1997 cohort were particularly poor university-wide, and it has not been possible to obtain an explanation for this. The cohort entering in 2001 would normally have completed the degree in 2004. It was therefore possible to classify students into those who had completed (or would complete in 2004), dropped out after succeeding, or dropped out after failing, from first year onwards.

Decisions had to be made as to how to deal with the discrepancies in the data. In 1997, the admissions criterion was changed. Students were previously admitted to university in New South Wales on the basis of a Tertiary Entrance

Ranking (TER). From 1997, this was replaced by the UAI. TERs from the years prior to 1997 were converted to UAIs to make them comparable with UAIs for those for 1997 onwards. The scaling of Higher School Certificate (HSC) English was modified in 1996. A dummy variable for two-unit English up to 1995 was used to reflect the change. The University of Sydney semesterised all units of study in 1998, so an average of marks for first and second semester units was used for the dependent variables from 1998 onwards. The mark achieved at the first attempt at each unit by each student was chosen as the appropriate result.

Generally speaking, students who do not complete the degree program may drop out for two reasons. The first is that they are successful, and able to change to a preferred degree. The second is that they drop out because they are unable to cope with the requirements of the program. The students who have not completed the degree have been divided into those who have achieved good results and dropped out, and those who have failed and dropped out. This has been determined by examining detailed student transcripts for the first 3 years of their degree. It is not possible to determine, from the available information, the reason for a student's transferring.

Complete data were available for 502 observations. There were 104 missing observations for explanatory variables and 23 missing observations for dependent variables. Twelve students entered through alternative systems, and were therefore not included. Descriptive statistics for the dependent and independent variables for both the population and the usable sample are given in the Appendix. Although 20 per cent of the observations for the population are missing, they are random and there is no reason to believe that there is systematic bias. Most of the missing observations are incomplete because of missing English and mathematics marks. The data for gender, school and UAI are missing for only one or two observations. The mean, median and standard deviation are similar for the population and the usable sample. The main difference is in the increased number of failures in the population. This is because 22 of the 23 observations with missing dependent variables can be placed in the fail category.

Of the 502 students in the usable sample, 64 per cent were male, and 36 per cent female. Sixty-one per cent attended independent schools, 25 per cent government schools, and 14 per cent Catholic schools. Students can attempt more than one mathematics unit with 3 per cent taking 4 Unit mathematics (the most advanced level), 31 per cent 3 Unit mathematics, 90 per cent 2 Unit mathematics, and 7 per cent the less rigorous Mathematics in Society. Sixty-eight per cent of students took General English, 28 per cent took the more demanding 4 Unit related English, with the remainder taking lower levels. Fifty-six per cent of the students completed the degree. Twenty-two per cent dropped out after failing, and 22 per cent dropped out despite passing.

Although there are some problems with the data, the set of 502 observations is large enough to produce plausible results, despite the number of missing observations. The set provides valuable insights into the characteristics of students in the BAgrEc degree program over the period.

5. Results

The results of the OLS regressions for the three core subjects are given in Table 1. The three regressions were all statistically significant, with the *P*-values of the *F*-statistics being equal to approximately zero in all three. The R^2 values were 0.34 for Agricultural Economics 1 and Economics 1, and 0.38 for Econometrics 1. These are reasonable values for pooled data.

The results were not entirely consistent with those reported in previous studies. We found gender to be insignificant in predicting performance in first year in all three core units of study. Type of school showed mixed results. Attendance at a Catholic systemic school, rather than at a government school (the base case) was not significant. However, attendance at an independent school was highly significant, with a negative coefficient for all three regressions. Students who attended independent schools attained, on average, and *ceteris paribus*, marks that were approximately four below those achieved by students who had attended government schools. There is evidence of a positive correlation between attendance at an independent school and UAI (ACER 2001), but results reveal a negative correlation between attendance at an independent school and results in first-year university units of study. It appears that students from independent schools may achieve a higher UAI because they are given more support at school, but that once this extra support is removed, they may struggle to achieve outcomes at the same level. Thus, when admitting students on the basis of criteria other than UAI, it should be borne in mind that students from independent schools may not perform as well as their school results may indicate. It appears probable that, *ceteris paribus*, students from government schools may, on average, outperform those from independent schools.

UAI was the most strongly significant predictor of performance, with *P*-values of approximately zero, and a *t*-statistic greater than 10 for Agricultural Economics and for Economics 1, and six for Econometrics. A student's mathematics mark was significant for all three core units, as was the dummy variable for 2 Unit mathematics. The standardised coefficients for UAI were, respectively, 0.48 for Agricultural Economics and for Economics 1, and 0.33 for Econometrics, whereas those for mathematics ranged from 0.13 for Economics to 0.28 for Econometrics. Those for independent schools ranged from 0.13 to 0.16. UAI was confirmed as the most important predictor of success. A somewhat surprising result was that the fact that a student had taken the more advanced 3 Unit or 4 Unit mathematics was not significant in predicting performance in any of the core subjects.

The other counter-intuitive result was that English marks, and the level of English, were not significant indicators of performance. The lack of significance may be explained by the fact that the UAI is a much stronger predictor of performance, and that it captures a number of the same attributes as the English marks. Although it is clear that the UAI must be included in any satisfactory model, it can be seen from the information reported in Table 2 that if UAI were not included as an explanatory variable, the English mark

Table 1 Output of Ordinary Least Squares (OLS) regressions for core first-year subjects

Explanatory variable	AGEC1					ECON1					ECMT				
	Slope coefficient	*t*-statistic	*P*-value	R^2	*F*-statistic (*P*-value)	Slope coefficient	*t*-statistic	*P*-value	R^2	*F*-statistic (*P*-value)	Slope coefficient	*t*-statistic	*P*-value	R^2	*F*-statistic (*P*-value)
				0.33	13.81 (0.00)				0.34	14.91 (0.00)				0.39	18.06 (0.00)
C	–69.53	–7.38	0.00			55.08	–6.33	0.00			–72.68	–6.51	0.00		
MALE	0.31	0.28	0.77			0.85	0.85	0.39			–2.07	–1.63	0.10		
IND	–3.36	–2.82	0.01			–4.23	–3.84	0.00			–4.39	–3.11	0.00		
CATH	–1.56	–0.97	0.33			–0.44	–0.29	0.77			2.86	1.50	0.13		
UAI	1.21	10.02	0.00			1.16	10.39	0.00			0.99	6.88	0.00		
ENGMARK	–0.002	–0.04	0.97			– 0.06	–0.96	0.34			–0.03	–0.32	0.75		
ENG2U	2.24	1.20	0.23			2.66	1.54	0.12			1.38	0.62	0.53		
MATHMARK	0.14	3.12	0.00			0.09	2.15	0.03			0.35	6.44	0.00		
MATH2U	8.47	4.42	0.00			5.76	3.25	0.00			9.78	4.30	0.00		
MATH3OR4U	–1.85	–1.49	0.14			–0.11	–0.10	0.92			–0.35	–0.25	0.81		
YR1994	2.67	1.12	0.26			–6.32	–2.87	0.00			–6.91	–2.45	0.01		
YR1995	3.16	1.22	0.22			–0.003	–0.001	0.99			7.73	2.52	0.01		
YR1996	4.19	1.77	0.08			0.33	0.15	0.88			7.29	2.60	0.01		
YR1997	8.06	3.03	0.00			3.58	1.46	0.14			14.45	4.59	0.00		
YR1998	9.13	3.78	0.00			4.19	1.88	0.06			11.27	3.94	0.00		
YR1999	8.82	3.69	0.00			5.22	2.37	0.02			13.28	4.69	0.00		
YR2000	12.05	4.63	0.00			3.72	1.55	0.12			11.47	3.72	0.00		
YR2001	10.75	4.37	0.00			5.35	2.36	0.02			11.54	3.96	0.00		

became significant at all levels of significance in all three subjects, and the level of English (2U as opposed to lower levels of English) also became significant. Although the UAI was excluded, this model was statistically significant, with a *P*-value for the *F*-statistic of approximately zero for all three subjects.

As can be seen from Table 1, the dummy variables for the years of entry were significant for all years from 1997 for Agricultural Economics, from 1994 for Econometrics, and for 1994, 1998, 1999, and 2001 for Economics 1. The main trend was the general improvement of marks in all three units, but notably in Econometrics, compared with the 1993 base year. This was particularly marked from 1997 onwards. This implies that students in the BAgrEc degree program were performing better than would have been expected on the basis of their entry characteristics.

A correlation matrix of the residuals for the three models showed a coefficient of Agricultural Economics residuals with Econometrics residuals of 0.60 and with Economics residuals, of 0.66. The coefficient for Economics residuals with Econometrics residuals was 0.57. This implies that there was some, but not perfect, correlation between performance in the three units of study.

The results for the multinomial logit models are given in Table 3. Both of the models were statistically significant, with LR statistics of 90.60 and 269.37 for the restricted and unrestricted model, respectively, and *P*-values of the LR statistic of approximately zero for both. The unrestricted model was more powerful, with a much higher LR statistic, a higher Pseudo R^2, and a higher percentage of correct predictions. The influence of entry factors appears to fall as students progress in the degree program.

It was clear from the restricted model that the factors predicting performance in first-year subjects are not necessarily useful in predicting the likelihood of completing the degree. In determining the probability that a student would fail and drop out rather than completing the degree, UAI and the dummy variable for 2 Unit mathematics were significant. Both had the expected negative coefficient, so that an increase in UAI, or the taking of a higher level of mathematics, would be likely to decrease the likelihood that a student would fail. The type of school attended, although strongly significant in predicting performance in first-year units, was not significant in predicting whether or not a student would complete the degree.

Once the results for the three first-year core units of study were included as explanatory variables, none of the entry factors was significant in predicting the likelihood that a student would fail compared with the likelihood of a student passing. The marks for Agricultural Economics and for Econometrics were significant at all levels of significance and that for Economics at the 5 per cent level of significance. All had the expected negative coefficients.

The most important information arising from this study arguably relates to the likelihood of a student completing the degree. In this case, the logit models appear to be the most useful. However, it should be recognised that in the unrestricted model, the entry factors still had an indirect effect, as they were

Table 2 Full Ordinary Least Squares (OLS) output for core subjects excluding Universities Admission Index (UAI)

	AGEC1					ECON1					ECMT				
Explanatory variable	Slope coefficient	*t*-statistic	*P*-value	R^2	*F*-statistic (*P*-value)	Slope coefficient	*t*-statistic	*P*-value	R^2	*F*-statistic (*P*-value)	Slope coefficient	*t*-statistic	*P*-value	R^2	*F*-statistic (*P*-value)
				0.19	6.98 (0.00)				0.20	7.44 (0.00)				0.33	14.81 (0.00)
C	1.28	–0.12	0.50			12.69	2.00	0.28			–15.04	–1.95	0.05		
MALE	0.42	0.35	0.63			0.95	0.87	0.29			–1.99	–1.49	0.14		
IND	–3.29	–2.52	0.01			–4.16	–3.42	0.00			–4.33	–2.93	0.00		
CATH	–2.80	–1.59	0.23			–1.63	–0.99	0.60			1.85	0.93	0.35		
ENGMARK	0.32	5.12	0.00			0.25	4.31	0.00			0.24	3.36	0.00		
ENG2U	7.07	3.57	0.00			7.28	3.96	0.00			5.31	2.37	0.02		
MATHMARK	0.30	6.31	0.00			0.24	5.45	0.00			0.48	8.91	0.00		
MATH2U	9.36	4.45	0.00			6.61	3.39	0.00			10.50	4.42	0.00		
MATH3OR4U	–1.70	–1.24	0.07			0.04	0.03	0.54			–0.23	–0.15	0.88		
YR1994	1.77	0.67	0.58			–7.18	–2.96	0.01			–7.65	–2.59	0.01		
YR1995	2.99	1.05	0.58			–0.16	–0.06	0.82			7.59	2.37	0.02		
YR1996	4.05	1.56	0.16			0.20	0.08	0.70			7.18	2.44	0.01		
YR1997	6.77	2.32	0.09			2.35	0.87	0.52			13.40	4.08	0.00		
YR1998	6.97	2.64	0.01			2.13	0.87	0.17			9.52	3.19	0.00		
YR1999	6.28	2.41	0.02			2.79	1.15	0.11			11.21	3.81	0.00		
YR2000	7.69	2.73	0.01			–0.45	–0.17	0.90			7.92	2.50	0.01		
YR2001	7.35	2.75	0.01			2.10	0.85	0.40			8.77	2.91	0.02		

Table 3 Output for multinomial logit models

Explanatory variable	Unrestricted Multinomial Logit Model: Fail and drop out vs Complete: Slope coefficient	z-statistic	*P*-value	Succeed and drop out vs Complete: Slope coefficient	z-statistic	*P*-value	Pseudo R^2	Percentage of correct predictions	LR statistic (*P*-value)	Restricted Multinomial Logit Model: Fail and drop out vs Complete: Slope coefficient	z-statistic	*P*-value	Succeed and drop out vs Complete: Slope coefficient	z-statistic	*P*-value	Pseudo R^2	Percentage of correct predictions	LR statistic (*P*-value)
CONSTANT	6.80	1.78	0.07	3.32	–1.42	0.16	0.27	66.7	269.37 (0.00)	12.14	4.23	0.00	–2.21	–1.00	0.32	0.09	57.96	90.60 (0.00)
MALE	0.37	1.35	0.18	0.17	0.65	0.52				0.39	1.41	0.16	0.11	0.42	0.68			
IND	0.04	0.09	0.93	–0.38	–1.31	0.19				0.41	1.30	0.19	–0.38	–1.40	0.16			
CATH	–0.11	–0.19	0.85	–0.07	0.18	0.86				–0.05	–0.12	0.91	0.15	0.42	0.68			
UAI	0.03	0.67	0.50	0.03	0.88	0.38				–0.13	–3.82	0.00	0.01	0.29	0.77			
ENGMARK	–0.03	–1.47	0.14	–0.01	–0.77	0.44				–0.02	–1.10	0.27	–0.01	–0.84	0.40			
ENG2U	–0.14	–0.05	0.96	–0.63	–1.35	0.18				–0.42	–0.87	0.38	–0.67	–1.47	0.14			
MATHMARK	0.01	0.73	0.46	0.02	1.91	0.06				–0.01	–1.16	0.25	0.02	2.04	0.04			
MATH2U	0.37	0.68	0.50	–0.44	–0.89	0.37				–0.87	1.96	0.05	–0.46	–0.99	0.32			
MATH3OR4	–0.41	–0.08	0.93	–0.01	–0.39	0.70				0.00	0.01	0.99	0.01	–0.42	0.68			
AGEC	–0.10	–4.46	0.00	–0.06	–3.73	0.00												
ECON1	–0.05	–2.34	0.02	0.03	1.83	0.07												
ECMT	–0.07	–4.41	0.00	0.02	1.44	0.15												
YR1994	1.27	1.33	0.18	1.09	1.84	0.07				1.30	1.85	0.06	0.63	1.11	0.27			
YR1995	0.93	0.89	0.37	–0.03	–0.06	0.96				0.35	0.46	0.64	0.02	0.03	0.98			
YR1996	1.26	1.26	0.21	0.77	1.37	0.17				0.59	0.82	0.41	0.65	1.21	0.22			
YR1997	1.87	1.60	0.11	0.27	0.42	0.68				–0.01	0.01	0.99	0.08	0.12	0.90			
YR1998	2.63	2.65	0.01	0.51	0.85	0.40				0.63	0.87	0.38	0.27	0.48	0.63			
YR1999	2.47	2.45	0.01	0.51	0.88	0.38				0.46	0.64	0.52	0.32	0.59	0.56			
YR2000	1.58	1.52	0.13	–0.20	–0.28	0.78				–0.38	–0.49	0.62	–0.67	–0.99	0.32			
YR2001	–0.19	–0.17	0.86	0.56	0.96	0.34				–1.25	–1.53	0.12	0.28	0.51	0.61			

significant in predicting performance in the first-year units of study. Their influence was captured by first-year marks in the unrestricted logit model. The results from the OLS regressions are therefore still important, and they are all the more illuminating for policy purposes. In particular, the positive trend in the coefficients of the dummy variables for each year of entry suggested that students in the BAgrEc degree program might perform better than would be expected for a given set of entry characteristics for each year. This finding tended to imply that weaker students could succeed in university economics. The negative correlation between attendance at an independent school and marks in first year is also important, particularly as independent school students made up a large part of the intake.

6. Implications

A number of implications emerge from this analysis. First, UAI, pre-university mathematics and attendance at an independent school can be used to identify students at risk of failing in first-year university courses. Second, because results from the logit models show that marks in introductory subjects were significant in predicting whether students were likely to complete the degree, these three factors that affected marks in first year subjects can also be used to identify students at risk of failing and dropping out of the degree. Third, the BAgrEc degree program has special value in achieving better marks from weaker students than could be expected, given their entry characteristics. Students in recent years have demonstrated enhanced performance in the sense that the mean first year marks achieved by students in this degree program have not declined, despite a relative decline in entry standards. Fourth, while UAI is clearly the most important factor in predicting performance, other factors could also be taken into account. The reported positive correlation between an independent school education and UAI (ACER 2001), and the negative correlation between an independent school education and results in first year, provides one example. Because of their significance in predicting student performance, mathematics scores and school type should be taken into account when considering applications for special entry. As English marks became significant when UAI was omitted from the regressions, attention should also be given to English marks when assessing eligibility for special entry. The special entry program could be used to allow for non-UAI factors.

The first two observations should probably be noncontroversial, and could have been expected given the importance of SAT scores and mathematics background in the student at risk published work cited previously. The third and fourth findings call for further discussion. The apparent superior performance noted in the third observation may in fact be the outcome of grade inflation in first year economics subjects, as suggested by Abelson (2005). This could only be confirmed (or otherwise) by including BEc and BComm students in the study. However, nearly 10 000 students in total have been enrolled in

Economics 1 over the 9-year period under consideration, and 7500 in Econometrics 1. A study dealing with such a large group in the detail attempted in the current study is beyond the scope of the current analysis, but does provide an area for further research. As far as the fourth observation is concerned, while factors other than the UAI appear significant in predicting results, UAI remains the most important predictor of performance, and there is clearly a limit to the extent that other factors can be taken into consideration.

The BAgrEc degree program appears to differ from its FEB counterparts in that the smaller numbers allow for increased student/staff contact in the units taught in the FAFNR. Although questions could be posed about the cost effectiveness of the degree program, it should be noted that nearly 50 per cent of the units in the program are taught in classes with large numbers in the FEB, whereas the core units in the program, and its administration, are the responsibility of the FAFNR. This means that, although overall teaching costs are not high, students have the benefit of administrative support, and small group teaching in some units. This may allow the students to feel part of a cohesive group. They also seem to have greater access to support from staff on an individual basis, and this is not possible in a much larger faculty. Although these considerations are not quantifiable, they tend to have a positive effect on performance and retention, effectively placing the degree program in a special category. It is clearly not possible to transfer these conditions to larger faculties. However, we argue that there is a role for the degree program, as it provides an opportunity for students who do not perform strongly at school to find a place in an economics-based degree at the University of Sydney. The evidence presented here suggests that it is possible for them to succeed in first year, and to complete the degree program.

7. Concluding comments

The factors that predict a student's success in economics-based subjects have been analysed. The findings presented are significant, and the results suggest that the Agricultural Economics degree program at the University of Sydney has a value, and that the admissions policy for the degree appears reasonable. The study also identifies factors that should be taken into account in making special entry decisions. Although the students in the degree program appear to perform better than would be expected of them based on entry characteristics, it would be of interest to test the robustness of the findings in further research by comparing the overall performance of BAgrEc students with their BEc and BComm counterparts.

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Appendix

Descriptive statistics for population

	AGEC1	ECMT	ECON1	MALE	CATH	IND	FAIL DROP OUT	SUCCEED DROP OUT	UAI	ENGMARK	ENG2U	MATHMARK	MATH2U	MATH3OR4U
Mean	58.33	51.41	53.30	0.65	0.14	0.61	0.26	0.21	86.90	71.73	0.12	74.35	0.92	0.31
Median	58.50	53.75	53.50	1.00	0.00	1.00	0.00	0.00	86.50	72.00	0.00	76.00	1.00	0.00
Maximum	96.00	90.00	94.00	1.00	1.00	1.00	1.00	1.00	99.90	97.00	1.00	98.00	1.00	1.00
Minimum	0.00	3.00	12.00	0.00	0.00	0.00	0.00	0.00	63.70	27.00	0.00	0.00	0.00	0.00
Std. Dev.	13.58	16.48	12.52	0.48	0.34	0.49	0.44	0.41	5.37	9.16	0.33	13.44	0.27	0.46
Skewness	–0.54	–0.51	–0.18	–0.62	2.11	–0.46	1.10	1.45	0.09	–0.42	2.29	–1.60	–3.08	0.81
Kurtosis	4.66	3.07	3.80	1.39	5.46	1.21	2.21	3.10	3.18	4.57	6.25	8.86	10.48	1.66
Jarque–Bera	101.63	25.64	20.03	108.78	625.40	105.81	143.12	220.30	1.72	69.23	692.69	990.32	2086.01	93.22
Probability	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.42	0.00	0.00	0.00	0.00	0.00
Sum	36225.50	30843.00	32994.50	408.00	86.00	384.00	163.00	130.00	54485.28	37658.00	65.00	39628.00	490.00	157.00
Sum Sq. Dev.	114368.90	162688.10	96900.95	143.35	74.22	149.20	120.76	103.13	18033.16	43921.59	56.98	96029.09	39.53	108.09
Observations	621.00	600.00	619.00	629.00	628.00	628.00	629.00	629.00	627.00	525.00	525.00	533.00	533.00	504.00

Descriptive statistics for usable sample

	AGEC1	ECMT	ECON1	MALE	CATH	IND	FAIL DROP OUT	SUCCEED DROP OUT	UAI	ENGMARK	ENG2U	MATHMARK	MATH2U	MATH3OR4U
Mean	59.04	51.46	54.08	0.64	0.14	0.61	0.22	0.22	86.91	71.74	0.12	74.63	0.93	0.31
Median	59.00	53.00	54.50	1.00	0.00	1.00	0.00	0.00	86.43	72.00	0.00	77.00	1.00	0.00
Maximum	96.00	90.00	94.00	1.00	1.00	1.00	1.00	1.00	99.90	97.00	1.00	98.00	1.00	1.00
Minimum	0.00	5.00	12.00	0.00	0.00	0.00	0.00	0.00	63.70	27.00	0.00	0.00	0.00	0.00
Std. dev.	12.88	16.00	12.04	0.48	0.35	0.49	0.41	0.42	5.36	9.10	0.33	12.93	0.26	0.46
Skewness	–0.26	–0.44	–0.03	–0.58	2.03	–0.45	1.37	1.34	0.09	–0.30	2.29	–1.53	–3.26	0.84
Kurtosis	4.31	3.09	3.79	1.34	5.14	1.20	2.88	2.81	3.30	4.13	6.24	8.63	11.65	1.70
Jarque–Bera	41.26	16.19	13.26	86.05	442.11	84.52	157.82	151.92	2.48	34.47	657.48	857.70	2454.81	93.98
Probability	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.29	0.00	0.00	0.00	0.00	0.00
Sum	29639.00	25832.50	27147.00	321.00	72.00	306.00	109.00	111.00	43627.08	36012.00	62.00	37465.00	465.00	154.00
Sum Sq. Dev.	83173.62	128330.90	72591.97	115.74	61.67	119.47	85.33	86.46	14414.25	41473.29	54.34	83730.82	34.27	106.76
Observations	502.00	502.00	502.00	502.00	502.00	502.00	502.00	502.00	502.00	502.00	502.00	502.00	502.00	502.00