Lecture and Tutorial Attendance and Student Performance in the First Year Economics Course: A Quantile Regression Approach

by

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Abstract

Using Ordinary Least Square and Quantile regression, this study found a significant positive relationship between lecture and tutorial attendance and marks in a first year quantitative unit-Introduction to Economic Methods (IEM). The results reveal that students who had studied higher level HSC mathematics (with calculus) were better equipped to undertake IEM. In contrast, students who only studied general mathematics (without calculus) in the HSC were found to be heavily disadvantaged.

Keywords: Economics Education, General Mathematics, Two units Mathematics, Australia, OLS and quintile regression
JEL Classification*:* A20, A22

1. Introduction

In general, a student's University performance depends on personal characteristics (e.g. gender, age, country of origin) and their prior achievements [e.g. High School Certificate (*HSC*) scores, University Admission Index (*UAI*), Economics score, and the level of English and Mathematics completed in high school]. Class attendance and other variables such as the student's interest in the subject and commitment as depicted by the number of times the student logged on to *WebCT*. Most of the previous research has considered some of these variables to help explain the performance of students in Introductory Economics.

This study analysed the student's performance in a first year quantitative subject, as opposed to dealing with an economic subject as others have done. Teaching quantitative subjects to Economics and Finance students has become more challenging in Australian Universities across the sector, regardless of the entry qualification requirements of students. For UWS Business degrees, HSC students are admitted solely on the basis of their University Admission Index (UAI), and there are no prerequisites needed to enroll in any of the Economics and Finance units. In consequence, the current Economics and Finance programmes have a mixed intake of students, a large number of which lack proficiency in mathematics. Data collected from the final examination papers over the last three years suggests that; i) at least 35% of the students in IEM do not know the proper use of brackets, ii) at least 40% of the students do not know the proper use of a scientific calculator, iii) about 25% have never heard of some important functions in the calculator. Oftentimes, such students cannot finish the unit successfully, a reason which may partly explain the increased failure rates in the Economics and Finance programmes, and also that of the University. In recent years, the University has been primarily concerned with the number of students admitted, with little regard for the appropriateness of particular students in mathematics-based courses. This is due to the fact that Australian Universities are increasingly dependent on student intake to raise funds. However, despite admitting more students, shortcomings in the admission process has led to a falling retention rate, and a paradoxically reduced income.

Since teaching a unit called Introduction to Economic Methods (a combination of Mathematics and Statistics) in 2002, the author noticed that the failure rate in this unit is well above 25%. This failure rate is one of the highest in the School of Economics and Finance. Several remedial measures were put in-placed in the unit to help students. The co-ordinator had devoted a considerable amount of time for consultation, and remedial tutorials were run for each campus where the unit was being taught. In spite of these measures, the failure rate was only reduced marginally. Therefore, the primary purpose of this research is to ascertain the causes of the high failure rates in IEM, and therefore rectify them. To do this we have formulated the following two hypotheses:

Hypothesis 1: Does attendance and use of the internet site for IEM play any important roles in the success in a quantitative subject like IEM?

Does attendance affect performance in University subjects?

Hypothesis 2: Is there an association between the Mathematics scores in HSC and the performance in IEM?

As stated earlier, students enrolled in the Economics and Finance degree programmes have different levels of Mathematics background, including General Mathematics (GM), Mathematics, Extension One Mathematics, and Extension Two Mathematics, and thus the School is dealing with a group of students of heterogeneous mathematical ability. Experience reveals that it is not an easy task to teach this group of diverse students in one class. Therefore, this study hopes to identify the various determinants of the high failure rates in the quantitative subjects, specifically to verify whether previous mathematical background is a significant factor and in the process find out the cause of low the retention rates in the University. As indicated earlier, several studies regarding student performance indicators were undertaken in Australia. For instance, Birch and Miller (2006) considered the student's UAI as a determinant of student success in first year principles of economics unit at the University of Western Australia using quantile regression analysis. Likewise, Mallik and Varua (2008) examined the relationship between the UAI, HS maths scores and final marks in IEM at UWS, while Mallik and Basu (2009) did the same for First year Microeconomics and Macroeconomics units at Charles Sturt University. So far, no Australian studies have considered attendance in lectures and tutorials separately, nor investigated the use of materials for subjects from the internet as a predictor of university performance.

Attendance and Learning performance:

According to Romer (1993), attendance did contribute significantly to the academic success in a large intermediate macroeconomics course. Park and Kerr (1990) found that attendance was a determinant of student performance in a money and banking course, while Schmidt (1983) found a similar result in a macroeconomic principles course. Durden and Ellis (1995) confirmed previous findings and found that attendance has a positive and significant effect on a student's performance in Principles of Economics, having collected data by surveying students at the end of the semester. This study uses actual lecture and tutorial attendance data collected by the lecturer and the tutors, which is considered to be more accurate than that of survey data. Lectures and tutorials are not compulsory for IEM, however at the lowest level, active participation is an opportunity for students to reflect on and question material covered in the lectures. They also provide an opportunity to revise content already available on the website, with real, rather than virtual assistance. Previous studies have used tutorial attendance as an indicator of performance (Dancer and Fiebig, 2004; Ballard and Johnson, 2004 and Cohn and Johnson 2006). We assume that the attendance in the lecture and the tutorial[1] should positively associated with the score in IEM.

Mathematics and Learning performance:

A number of studies have shown that there is a strong link between mathematical background and performance in Economics and Finance units, and hence overall performance in the degree[2]. Eskew and Faley (1988) developed a model to explain student performance in an introductory college-level financial accounting course. Their model showed that previous accounting experience in high school and college explained some of the variance in academic performance. Similarly, Lagerlof and Seltzer (2007) concluded that the level of and performance in secondary school mathematics has strong predictive power on a student's performance at university level economics. However, Horvath et al (1992) found that quantitative aptitude did not provide additional useful information in predicting those students who were likely to persist and those who were not.

Butler et al. (1994) studied the effect of Calculus on learning intermediate microeconomics and macroeconomics and found a positive and significant association between intermediate microeconomics, but failed to establish the relationship with macroeconomics. Most studies used single measures of mathematical capacity such as the American Scholastic Aptitude Test (SAT) score, however there is no study that has been done in Australia prior to this, especially using two different levels of mathematics scores obtained by the students in their HSC. Using data from an Australian University, Mallik and Lodewijks (2010) found that higher level mathematics (with calculus) and economics in HSC can increase the marks in first year introductory economics subject significantly.

[1] A proxy for the students input in the subject.
[2] See Reid (1983), Anderson et al. (1994), Durden and Ellis (1995) and Lopus (1997).

Earlier research shows that standardised measures of aptitude such as the SAT explain a significant proportion of the variation in class performance[3]. On the other hand, Rothesein (2004) reasons that because of the acknowledged correlation between SAT scores and student socio-economic status, the significance of SAT scores in predicting success tends to be overstated. As such, some universities in the US such as the University of California (UC) have recently directed emphasis away from SAT scores in admission. In this study, the UAI is used instead of SAT to represent the student's ability. Initially, this study considered the four different levels of HSC mathematics scores[4], but finally considered only two levels of mathematics scores because of the limited number of students that did mathematics Extension 1 and 2.

Thus, our research differs from previous studies in the following ways:

1. Unlike survey data for attendance, this study used actual attendance data as collected by the lecture
2. Lecture and tutorial attendance was considered separately
3. Different levels of mathematics and economics scores from the HSC were used
4. We introduced new variables, including the number of times students logged into the course webpage, and the difference between the year of completion of high school and the year of entry into university

The outline for the remainder of the paper is as follows: Section 2 describes the data and outlines the model used in the study. The results are then discussed and presented in Section 3 while Section 4 presents the conclusion and recommendations of the study.

2. DATA AND METHODS

The data set for this study was constructed from the computerised student records of the UWS database and from the records on attendance collected by the IEM unit coordinator, as well as assessment results and total scores in IEM for 2009.

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[3] See Grabe and Latta (1981) and Camara and Echternacht (2000) for detail.

[4] General mathematics is relatively very easy compared to two unit Mathematics, Extension 1 Mathematics and Extension 2 Mathematics. Extension 2 Mathematics is the toughest one and very difficult to score higher marks in the HSC.

Although much of the literature dealing with economics education uses a production function model in their analysis with learning being treated as an output produced by such inputs as aptitude and courses taken (Anderson et al 1994), other studies in the US, where grades are awarded rather than marks, have used tobit and probit models (Jensen and Owen 2001; Dancer and Fiebig 2004). In addition, linear regression analysis using Ordinary Least Squares methods (OLS) is also used to quantify the marginal learning effects of certain inputs.

In this study, we used the OLS and quantile regression method to measure the importance of student characteristics at entry level as well as attendance in determining the results in Introduction to Economic Methods. We hypothesised that gender, UAI, and marks[5] in different levels of mathematics completed in high school would be significant variables in explaining overall performance in IEM.

The analysis developed for this study uses two procedures. The first procedure requires an OLS[6] specification of the form:

$$\begin{aligned} Total_i = \beta_1 + \beta_2 HSClag_i + \beta_3 Gender_i + \beta_4 Born_i + \beta_5 Webct_i + \beta_6 Tattn_i \\ + \beta_7 Lattn_i + \beta_8 UAI_i + \beta_9 Econ_i + \beta_{10} Engstd_i \\ + \beta_{11} GM_i + \beta_{12} Engone_i + \beta_{13} Math_i + \beta_{14} Phy_i + \varepsilon_i \quad \text{----------} \quad (1) \end{aligned}$$

The second procedure uses the quantile regression procedure. The majority of regression models specified to study student performance are concerned with analyzing the conditional mean of a dependent variable. Recently, there is increasing interest in the methods of modeling other aspects of the conditional distribution of the variables under study. One increasingly popular approach is the use of *quantile regression*. Quantile regression was originally proposed by Koenker and Bassett (1978). It provides estimates of the linear relationship between regressors x and a specified quantile of the dependent variable y. One important special case of quantile regression is the least absolute deviations (LAD) estimator, which corresponds to fitting the conditional median of the response variable. Moreover, this approach gives

5 Percentile scores obtained by the students in HSC.

6 Definitions of these variables are presented in Table 1.

a robust measure on the distribution scale and the estimated co-efficients of the explanatory variables are not sensitive to outlier observations in the sample data.

Further, quantile regression permits a more complete description of the conditional distribution than conditional mean analysis alone, allowing us, for example, to describe how the median, or perhaps the 10th or 95th percentile of the response variable, is affected by regressor variables. As the quantile regression approach does not require strong distributional assumptions, it offers a distributionally robust method of modeling these relationships. Additionally, when the error terms of the regression follows a non-normal distribution, the estimates obtained from the quantile regression are more valid than that of the OLS estimates.

Specifically, let $(x_i, y_i), i = 1, 2, ----n,$ be a sample of some population, where, x is a $k \times 1$ vector of regressors. The following assumptions have been made:

$$Pr(y_i \le \tau / x_i) = F_{\theta_0}(\tau - x_i' \beta_\theta / x_i), \quad \forall\ i = 1, 2, ---n.$$

This relation can be rewritten as:

$$y_i = x_i' \beta_\theta + u_{\theta_i}, \quad Quant_\theta(y_i / x_i) = x_i' \beta_\theta \tag{2}$$

where, $Quant_\theta(y_i / x_i)$ denotes the conditional quantile of y_i, conditional on the regressor vector x_i,[7] and $0 \langle \theta \langle 1$. It is also assumed that $Quant_\theta(y_i / x_i) = 0$.

The quantile regression estimates can be obtained by minimising the weighted sum of the absolute error and the θth conditional quantile regression estimator for β_θ. Mathematically, it can be expressed as:

$$\min_\beta \left[\sum_{\{i: y_i \ge x_i \beta\}} \theta |y_i - x_i \beta| + \sum_{\{i: y_i \langle x_i \beta\}} (1-\theta) |y_i - x_i \beta| \right] \tag{3}$$

7 We assume that both x_i and y_i are observed with no error and equation (1) is correctly specified. See Buchinsky (1998) for detail.

From (3), it follows that quantile regression allows for the impact of the explanatory variables on the dependent variable to be analysed along the total distribution of the sample data. Quantile regression has been used in the economics research extensively[8].

4. **Discussion of results**

Table 1 here

Table 1 presents the definitions and summary statistics of all variables included in the study. The results show that the average mark obtained in IEM is 51.88 percent and its corresponding standard deviation is 26.26. Similarly, the average number of attendance to tutorial sessions is 8.62 (out of 12 tutorials) and the average number of times students' logged on to WebCT is 23.67 per semester.

Table 2 here

It can be seen from Table 2 higher attendance levels for both lectures and tutorials correspond with higher the marks in IEM. It can also be seen from the table that students are more likely to go to tutorials than lectures. Approximately 186 students (56%) attended 81-100% tutorials, while only 132 students (40%) attended 81-100% of the lectures. Another important revelation was that the students who had done only GM in the HSC obtained an average of 32.13% in the IEM final exam, as compared to 65.05% for students who had done mathematics in the HSC. This trend persists even when accounting for attendance; that is, GM students had a lower average in spite of having attendance greater than 80%. Overall, it is unlikely for the students with a GM background in HSC to pass IEM even if they attend most of the lectures and tutorials. Therefore, the students having only a GM background should not do this subject. They should do another lower level mathematics subject before they undertake IEM.

[8] See Eide & Showalter (1998), Birch & Miller (2006), Bassett et al (2002) and Kremer & Levy (2003) for detail analysis.

Table 3 here

Table 3 reports the estimated coefficients obtained from equation (1) using the Ordinary Least Square (OLS) method. Overall, the estimated models are reasonably good with an R^2 ranging from 0.38 to 0.56. The result reveals no significant difference between the male and female students, contrary to most researches including that of Anderson, Benjamin and Fuss (1994), and Lumsden and Scott (1987) which concluded that females perform more poorly than males in Economics units. The research finding though is consistent with the study of Ellis et. al. in 1998. Attendance to lectures and tutorials however, proved to be a significant variable at least at 1 percent level. The result further implies that one additional day of attendance can increase the final mark by above 4.57 percent for lectures, and above 5.19 percent for tutorials. Likewise, WEBCT ends up being a significant and positive variable. The coefficient of the variables LATTN2, and TATTN2 are not significant, however, LATTN3, LATTN4, TATTN3 and TATTN4 are significant at one percent level for all cases. This implies that the attendance below sixty percent in lectures and tutorials does not contribute to the overall learning and better understanding in the unit, resulting in lower marks for the whole subject.

Variable ECON, ENGSTD, and ENGONE are not significant for all equations. The coeffcent of the variable GM is negative and significant, and MATH is positive and significant at one percent level. This suggests that lower level of mathematics (such as general mathematics without calculus) does not contribute to the higher level of learning in the university. However, a higher level of mathematics contributes to better understanding in university level quantitative subjects.

Figure 1 here

Figure 1 plots the coefficients of different independent variables obtained using quantile regression for different quantiles starting from 0.10 to 0.90. The X-axis represents the different quantile groups while the Y-axis denotes the estimated coefficients from respective quantile. The diamond shapes indicate that the coefficients are significant at 10 per cent level. It is clear from the graph that lecture attendance, tutorial attendance and Mathematics are significant for all quantile. This suggests that these three variables are very important and contribute to better marks. An interesting observation, however, is that the co-efficients of mathematics decrease slightly and lecture and tutorial attendance increase for higher quantiles. This suggests that though prior knowledge of mathematics is a very important determinant for obtaining good marks in IEM, regular attendance appears to have a more positive impact on marks in the higher quantiles.

4. CONCLUSIONS AND RECOMMENDATIONS

The significance of HSC mathematics as a predictor of success in higher education, especially in the Economics and Finance discipline, has important policy implications. It is clear from this research that one's UAI and background in general mathematics has no impact on the IEM score. On the other hand, attendance in lectures and tutorials are found to be a very important determinant of a students' success in the quantitative units at University. Our findings also suggest that the level of mathematics taken prior to university have a strong predictive power on students' performance. Interestingly, it was observed that attendance played a more important role in securing better marks compared to HSC mathematics scores, but only at the highest level. Students did not reap the benefits of improved attendance (>80%) if they only studied GM in high school, and had a lower average compared to students with Mathematics backgrounds. It is observed from past data that those who fail in quantitative units in university are more likely to drop out.

Therefore, to improve the retention rate, it is recommended that either the university offer bridging courses, remedial tutorials, and other learning opportunities to fill the gaps in student mathematical knowledge, or enrolling only those students who have completed HSC Mathematics (formerly Two Unit Mathematics) into economics and finance courses, thus providing a more homogenous teaching platform for lecturers. The importance of attendance has been clearly elicited in this study, and so enhancing student participation ought to be a crucial aspect of administration, in order to improve retention. Thus, a minimum of eighty percent attendance can be made mandatory, so that students view attendance as part of their assessment. At the same time, the lecturer should also create a good learning environment, to motivate students and engage their interest in the course, which enthusiasm in their field will serve them in good stead beyond university life.

REFERENCES

Anderson, G., D. Benjamin and M.A. Fuss (1994) 'The Determinants of Success in University Introductory Economics Courses', *Journal of Economic Education*, 25(2), pp. 99-119.

Ballard, C. L. and M. F. Johnson (2004), 'Basic Math Skills and Performance in An Introductory Economics Class', *Journal of Economic Education*, 35 (1), pp. 3-23.

Bassett, G., Tam, M. and Knight, K. (2002) 'Quantile Models and Estimators for Data Analysis', Metrika, 55(1), 17-26.

Birch, E.R. and Miller, P. W. (2006), "Student outcomes at university in Australia: A quantile regression approach", *Australian Economic Papers*, **45**(1), 1-17.

Buchinsky, M. (1998), 'Recent Advances in Quantile Regression Models: A Practile Guideline for Emperical Research', Journal of Human Resources, 33(1), 88-126.

Butler, J. S., T. Aldrich and J. J. Siegfried (1994), 'Does More Calculus Improve Student Learning in Intermediate Micro and Macro Economic Theory?' *American Economic Review*, 84(2), pp. 206-210.

Camara, W. J. and G. Echternacht (2000), 'The SAT I and High School Grades: Utility in Predicting in College', The College Board Research Notes. The College Board, Office of Research and Development, available at: http://www.collegeboard.com/research/abstract/3869.html, accessed November, 2007.

Cohn, E. and Johnson, E. (2006), 'Class attendance and performance in Principles of Economics', *Education Economics*, **14**(2), 211-33.

Dancer, D. and D. Fiebeg (2004), 'Modelling Students at Risk', *Australian Economic Papers*, 43, pp. 158-173.

Durden,G.C. and L.V. Ellis (1995) ‘The Effects of Attendance on Student Learning in Principles of Economics’ *American Economic Review (Papers and Proceedings)*, 85(2). pp. 343-346

Eide, E. and Showalter, M. (1998) ‘The effect of School Quality on Student Performance: A quantile Regression Approach’, *Economic Letters*, 58(3), 345-350.

Ellis, Larry V.,Dunden,Garey,C. and Gaynor,Paricia E. (1998) *Evidence of Factors that Influence Probability of Good Performance in the Principles of Economics Course*, http:/www.westgate.edu/~bquest/1998

Eskew, R. K. and R. H. Faley (1988), ‘Some Determinants of Student Performance in First College-Level financial Accounting Course’, *The Accounting Review*, LXIII(1), pp. 137-147.

Grade, M. and R. M. Latta (1981), ‘Cumulative Achievement in Mastery Instructional System: The impact of differences in resultant achievement motivation and persistence’, *American Educational Research Journal*, 18(1), pp. 7-13.

Horvath, J., B. Q. Beaudin and S. P. Wright (1992) ‘Persisting in the Introductory Economics Course: An exploration of Gender Differences’, *Journal of Economic Education*, 23 (2), pp. 101-108.

Jensen, E.J. and A.L. Owen (2001) ‘Pedagogy, Gender and Interest in Economics’ *Journal of Economic Education*, 32 (4), pp.223-243.

Koenker, R. and Bassett, G. (178), ‘Regression Quantiles’, *Econometrica*, 46(1), 33-50.

Kremer, M. and Levy, D. (2003), ‘Peer Effects and Alcohol Use Among College, Graduates’, National Bureau of Economic Research Working Paper no. 9837, National Bureau of Economic Research, Cambridge, United States.

Lagerlof, J. N. M. and A. J. Seltzer (2007), ‘The Effects of Remedial Mathematics on the Learning of Economics: A Natural Experiment’, available at http://ssrn.com/abstract=1004458, accessed November, 2007.

Lopus,J.S.(1997), ‘Effects of High School Economics Curriculum on the Learning in the College Principles Class’, *Journal of Economic Education*,28(2),pp.143-153.

Lumsden, K. G. and A. Scott (1987) ‘The Economic Students Re-examined: Male-female difference in comprehension’, *Journal of Economic Education*,19,pp365-375.

Mallik, G. and Basu, P. K. (2009), ‘Does High School Mathematics improve student learning in Economics in the University?’, *The International Journal of Learning*, **16(4)**, 15-20.

Mallik, G. and Lodewijks, J. (2010), ‘Student Performance in a Large First Year Economics Subject: Which Variables are Significant?’, *Economic Papers* (forthcoming)

Mallik, G. and Varua, M. (2008), ‘HSC Mathematics results and Tertiary success in Quantitative units: an Australian experience’, *Australasian Journal of Economic Education*, **5**(1 & 2), 1-10.

Nolan, E. and F. Z. Ahmadi-Esfahani (2007), ‘Predicting Performance in Undergraduate Agricultural Economics’, *The Australian Journal of Agricultural and Resource Economics*, 51, pp. 1-15.

Park, K. H. and Kerr, O. M. (1990), ‘Determinants of Academic Performance: A Multinomial Logit Approach’, Journal of Economic Education, 21(2), 101-11.

Reid, R. (1983). ‘A Note on the Environment as a Factor Affecting Student Performance in Principles of Economics’ *Journal of Economic Education*,14(4),pp. 18-22.

Romer, D. (1993), ‘Do Students Go to Class? Should They?’, Journal of Economic Perspectives, 7(2), 167-74.

Schmidt, R. M. (1983), ‘Who Maximizes What? A Study inStudent Time Allocation’, American Economic Review (Papers and Proceedings), 73(2), 23-28.

Table 1: Summary statistics of the variables under study			
	Description of variables	**Average**	**Standard deviation**
TOTAL	Total marks obtained in Introduction to Economic Methods (IEM) out of 100	51.88	26.26
HSClag	Difference between the year of admission and year of completion of HSC	0.46	0.90
GENDER	Dummy variable for gender[9]: 1 for male student, 0 for female student.	0.67	0.47
Born	Dummy: 1 if born in Australia, 0 otherwise	0.73	0.44
WEBCT	Numbers of times a student has logged on to the WEBCT (webpage for IEM) during the semester.	23.67	15.70
LATTN	Numbers of lectures attended by the student (out of 10)	7.20	1.56
LATTN1	Dummy: 1 if attended less than or equal to 40% of lectures, 0 otherwise	0.13	0.33
LATTN2	Dummy: 1 if attended more than 40% and less than or equal to 60% of lectures, 0 otherwise	0.11	0.31
LATTN3	Dummy: 1 if attended above 60% and less than or equal to 80% of lectures, 0 otherwise	0.24	0.49
LATTN4	Dummy: 1 if attended more than 80% of lectures, 0 otherwise	0.40	0.49
TATTN	Numbers of tutorials attended by the student (out of 10)	8.62	0.99
TATTN1	Dummy: 1 if attended less than 40% of tutorials, 0 otherwise	0.06	0.24
TATTN2	Dummy: 1 if attended more than 40% and less than or equal to 60% of tutorials, 0 otherwise	0.11	0.31
TATTN3	Dummy: 1 if attended more than 70% and less than or equal to 80% of tutorials, 0 otherwise	0.27	0.44
TATTN4	Dummy: 1 if attended more than 80% of tutorials, 0 otherwise	0.56	0.50
UAI	University Admission Index[10], constructed using the weighted average of all HSC units	71.71	10.06
ECON	Percentile score of two unit economics in HSC examination.	73.03	9.95
ENGSTD	Percentile score of Standard English in HSC examination.	71.65	5.39
ENGONE	Percentile score of two unit English in HSC examination.	73.47	7.07
GM	Percentile score of General Mathematics in HSC examination.	76.72	9.12
MATH	Percentile score of Mathematics in HSC examination.	69.08	11.53
PHY	Percentile score of Physics in HSC examination.	66.45	6.20
Sample size=331			

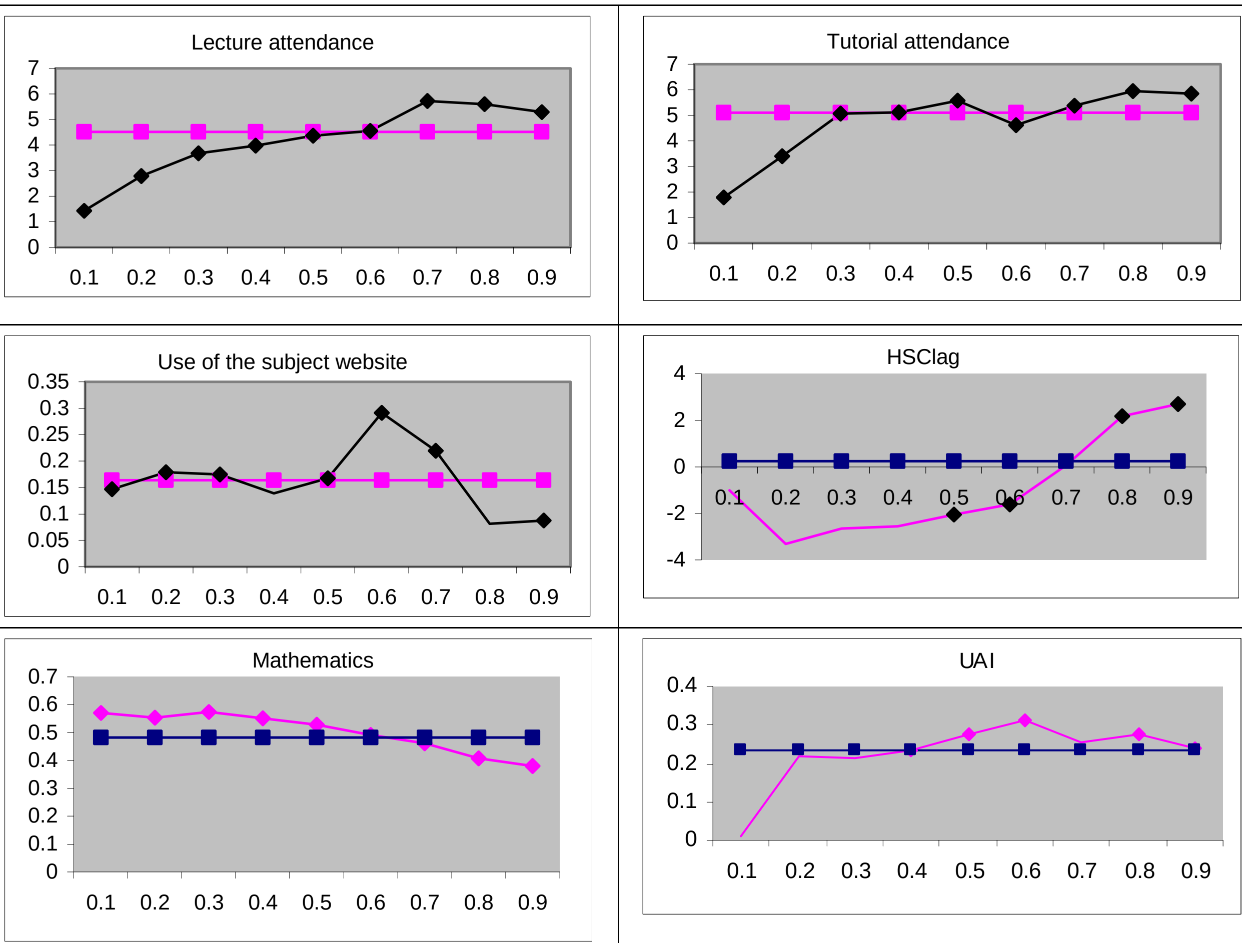
9 Lumsden and Scott (1987) concluded that female students tend to perform well in essay related assessments while males are performing better in quantitative related tasks. This was supported by the findings of Anderson et al (1994). Men perform better in calculus and functions, whereas women do better in English. In this study we intend to ascertain whether indeed there are difference between men and women when it comes to mathematical economics.

10 Several studies conducted in Australia such as the one recently completed by Nolan and Ahmad-Esfahani (2007) indicated that UAI is a good indicator of the student's performance in undergraduate agricultural economics at the University of Sydney.

Table 2: Bivariate summary table showing the relationships between attendance and marks obtained in IEM for different level of prior mathematics skill.						
Attendance (Percent)	Lecture			Tutorial		
	GM	Adv. Maths	Total	GM	Adv. Maths	Total
0 to 40	18.53 (41)	54.43 (37)	35.56 (77)	15.31 (8)	44.58 (12)	32.88 (20)
41to 60	20.81 (13)	57.25 (30)	47.44 (43)	27.08 (12)	55.42 (24)	45.97 (36)
61 to 80	42.63 (38)	64.50 (40)	53.85 (38)	32.51 (42)	64.41 (47)	49.36 (89)
81 to 100	39.41 (42)	72.26 (90)	61.81 (132)	34.62 (72)	69.48 (114)	55.99 (186)
Total	32.13 (134)	65.05 (197)	51.72 (331)	32.13 (134)	60.05 (197)	51.72 (331)

Table 3: Estimated co-efficient of the marks for Introduction to Economic Methods in the University using Ordinary Least Square methods.						
	(A)	**(B)**	**(C)**	**(D)**	**(E)**	**(F)**
Constant	-1.183 (-0.142)	-7.228 (-0.769)	15.948* (1.660)	11.534 (1.073)	7.770 (0.964)	-2.198 (-0.229)
HSClag	-0.258 (-0.214)	-0.738 (-0.595)	-1.565 (-1.136)	-2.182 (-1.533)	-0.405 (-0.340)	-0.770 (-0.617)
Gender	1.508 (0.689)	0.922 (0.407)	5.393** (2.183)	4.843* (1.890)	1.047 (0.486)	0.743 (0.324)
Born	-3.905* (-1.734)	-3.930* (-1.684)	-4.069 (-1.580)	-4.094 (-1.532)	-4.072* (-1.828)	-3.969* (-1.674)
Internet	0.147** (2.33)	0.164** (2.506)	0.154** (2.146)	0.175** (2.336)	0.151** (2.415)	0.164** (2.488)
Tattn		5.095*** (4.831)		5.624*** (4.674)		
Tattn2						8.183 (1.522)
Tattn3						16.880*** (3.504)
Tattn4						19.273*** (4.173)
Lattn	4.514*** (6.957)		5.108*** (6.938)			
Lattn2					-4.272 (-1.200)	
Lattn3					12.288*** (4.387)	
Lattn4					15.346*** (6.176)	
UAI	0.204* (1.898)	0.207* (1.856)	0.311** (2.585)	0.311** (2.487)	0.193* (1.808)	0.218* (1.937)
Econ	0.028 (0.990)	0.014 (0.484)	0.038 (1.191)	0.022 (0.668)	0.037 (1.341)	0.010 (0.335)
Endstd			-0.029 (-0.933)	-0.032 (-0.986)		
GM			-0.330*** (-10.633)	-0.350*** (-10.927)		
Engone	0.074 (1.130)	0.055 (0.805)			0.050 (0.777)	0.044 (0.648)
Math	0.460*** (15.622)	0.483*** (15.998)			0.456*** (15.359)	0.486*** (15.915)
Phy	0.051 (1.309)	0.046 (1.139)	0.085* (1.904)	0.080* (1.742)	0.049 (1.259)	0.051 (1.238)
Sample size	331	331	331	331	331	331
R^2	0.559	0.527	0.427	0.384	0.572	0.528
Adj-R^2	0.545	0.512	0.410	0.364	0.555	0.510
F-stat	40.574***	35.639***	23.903***	19.913***	35.365***	29.463***
Note: i) figures in the brackets are the t-statistics. ii) ***, ** and * implies significance at 1%, 5% and 10% level.						

Figure 1: Graph of the estimated coefficients for marks in the Introduction to economics methods subject for different quantile, obtained using quantile and OLS regression.



Note: i) Horizontal straight line represents the estimated co-efficient using OLS method.
ii) Square and diagonal shapes represents significant at least at 5% level.