Encouraging Tutorial Attendance and its Impact on Grades: A Randomised Controlled Trial

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Abstract

Tutorial programs offer academic support to students at the tertiary level. In a randomised trial, the effect of encouragement provision on tutorial uptake was explored on second-year economics students at the University of Cape Town. The experiment used a tutorial group-clustered randomisation design to send informative emails regarding the impact that tutorials can have on grades. This led to a substantial increase in tutorial attendance amongst treated students, particularly for males and previous high academic achievers. The increase in attendance however did not translate into an improvement in final grades. This was partially attributed to the fact that the treatment did not appeal to low academic achievers, for whom tutorials would have proved most beneficial.

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1 Introduction

South Africa has a history of unequal access to high quality education. In order to improve university graduation rates, the University of Cape Town (UCT) has had to provide additional higher learning support to its students through structures such as its tutorial program.

Tutorials allow for learning in a close, comfortable environment with the same tutor over time. In a study by Finn and Achilles (1990) it was found that smaller class sizes at school significantly raised final grades. This idea has been extended to the tutorial system at the tertiary level. Small tutorial groups are successful in providing a safe space to ask the questions that one is unable to ask during crowded lectures. Tutorials also offer the personal attention one may require for learning to take place.

Given that resources are scarce, it is essential to ensure that these support programmes achieve the desired impact. The UCT School of Economics (SOE) in particular, spent approximately R144 300 on tutor salaries alone for its second-year microeconomics course. Given that the school offers 19 undergraduate courses per year, undergraduate tutorials are costing the school almost R3 000 000 per annum.

The study examined whether the provision of attendance encouragement could lead to higher tutorial uptake amongst university students. The study also focused on whether the SOE's tutorial system added sufficient value and improved course grades. A randomised controlled trial (RCT) was conducted on an economics undergraduate course to investigate these issues. The outcome of the study can potentially be generalised to all SOE undergraduate courses. Taking this further, other departments at UCT and even other universities may benefit from these results.

This paper is structured as follows: Section 2 provides a brief history of past education interventions. Section 3 describes the experimental setting in which the trial takes place. Section 4 delves into the intricacies of the experimental design. Section 5 describes the data used and section 6 explores the results. Section 7 provides a detailed discussion and conclusion.

2 Literature Review

There have been many interventions aimed at improving the quality of education at the primary and secondary level. Lavy (2002) used monetary incentives for both schools and teachers, and showed that both types of incentives produce large improvements in student performance, and that it is more cost effective to incentivise teachers than schools. Duflo (2011) examined the impact of tracking in a sample of schools in Kenya, using a randomised controlled trial. Results showed that students at all levels of academic ability benefited from being streamed according to their grades, obtaining an average score of 0.14 standard deviations higher than students in non-tracking schools. Finn and Achilles (1990) used an RCT to assess the effect of class size on reading and mathematics for kindergarten students, and found a significant benefit to students in smaller classes, particularly for minority students.

Tutorials are another means of improving the quality of education at school and university. Banerjee (2007) launched a remedial program in treatment schools for students lacking basic literacy and numeracy skills. It was found that average test scores of all students in treatment schools increased by 0.28 standard deviations. Horn and Jansen

(2009) investigated the impact of the tutorial system at Stellenbosch University on the performance of economics students. They found that lecture and tutorial attendance contributed positively to the performance of economics students. Another interesting finding was that females attended more tutorials than males, with females comprising 67% of the total number of students attending more than 70% of the tutorial classes. Colvin (2007) studied the structure and dynamics of the peer tutoring program at the University of Utah. He uncovered much confusion regarding the role of the tutor from the students, tutors and lecturers. He concluded that although tutorial systems were becoming more prominent at universities, it was essential that students and tutors found a common ground for the purpose served by the tutorial system. A number of international studies on the effectiveness of tutorials (Taylor, 1969; Etters, 1967) showed that the tutorial system was beneficial for students who extensively utilized the program, while tutorials were most helpful for low academic achievers.

Since tutorials are so effective, it is desirable to increase students' tutorial uptake. Previous methods for increasing uptake in the education system have included mandatory policies. There have been some positive results for compulsory schooling. Angrist (1991) concluded that students who began school at an earlier age due to mandatory schooling earned a higher income as a result of the extra schooling than those who started later. Monetary rewards have also been used to incentivise uptake. Explicit economic incentives have often been ineffective in encouraging uptake and have even produced counter-productive results. Angrist and Lavy (2009) offered cash rewards to students who passed their exams in treated schools. This had no impact on boys, little effect on academically weak girls, and a significant impact on girls who were already likely to matriculate. Freyer (2011) offered incentives to students in schools across Dallas, New York and Chicago. The impact of incentive offerings on grades was statistically zero. Although mandatory policies and provision of incentives are both viable options to increase tutorial uptake, there is concern for the unintended crowding out of students' intrinsic motivation to learn (see Cardenas, 2000; Gneezy and Rustichini, 2000).

Perhaps rather than enforcement, attitudes toward learning and education uptake should be improved. Dweck and Kamins (1999) explored the effect of praise on students' confidence and their educational achievements. They claimed that attempting to boost a child's self-esteem often produced unintended feelings of pressure and a sense of helplessness toward learning. There is a whole school of RCT literature based on encouragement design. Sewell and Shah (1968) randomly selected high school students in America to study the impact of parental encouragement on student's intention to go to college. Parental encouragement was reported to have the strongest effect on the college plans of students with relatively high intelligence and students with high-standing socioeconomic backgrounds. Jensen (2010) gave students at randomly selected schools in the Dominican Republic information on returns to education. He hypothesized that the return perceived by students and parents determined a student's length of study. The students given the encouraging information completed on average 0.3 more years of schooling over the next four years than those who were not exposed to the information.

The literature shows that tutorials can be a powerful mechanism through which to improve student grades. In order for tutorials to be most effective, it is not necessarily the quality of tutorials that needs to change. The focus of this paper is on increasing tutorial uptake amongst students. The SOE's current policy of mandatory tutorial attendance may not be producing the desired results due to crowding-out of the intrinsic motivation to learn. Therefore the impact of encouragement on non-compulsory tutorial uptake is examined. This RCT provides a strong argument as to whether encouragement can be

used as a successful education intervention in a university context in South Africa.

3 Experimental Setting

The experiment was targeted at the 732 UCT students registered for the ECO2003F 2012 second-year microeconomics course. The course was a semester long: the first term ran for 6 weeks and the second term ran for 6 weeks. Assessments in the first term included test one and weekly submissions. Assessments in the second term included test two, an essay and weekly submissions. A prerequisite for registering for the course was completion of the first-year microeconomics course, ECO1010F. Students who failed ECO1010F were able to redo the course in second semester, ECO1010S.

Four lectures were provided per week. There were three lecturers, each of whom taught a third of the subject material. All students had the same lecturer at any given time and lecture venues held approximately 300 students per lecture.

One hour tutorials took place once a week, predominantly on a Wednesday, with some overflow on a Tuesday and Thursday. Students self-selected into a tutorial slot which suited their timetable and tutors were then randomly allocated to tutorial groups. Tutorial groups were comprised of an average of 15 students. There were a total of twelve weeks of tutorials. Tutorial attendance was compulsory for the first four weeks, and was then subsequently changed to be non-compulsory for the rest of the course. Five weekly submissions were required for hand-in which the tutors marked, returned and worked through in the tutorial session. There were an available eight submissions from which to choose. At the end of the first term a tutor evaluation was performed. Students could choose to rate their tutor's performance in the previous term. However, tutor evaluations were not compulsory for the students to submit. Lecturers and tutors communicated daily with the students in the form of announcements through a UCT website called 'Vula', as well as through emails to students' UCT email accounts.

The final grade was comprised of: two tests, an essay, five tutorial submission marks and the final exam. Students were given a 'term mark' before the exam, which was a cumulative mark encompassing grades from the two class tests, the essay, and the five tutorial submission marks. Students had to meet certain requirements by the end of the term in order to be qualify to write the final exam. This requirement is known as 'Duly Performed' (DP). To obtain DP, students must have written two class tests and an essay, submitted five tutorial hand-ins and obtained a term mark of at least 35%. Finally, at the end of the course, a record of all marks achieved throughout the ECO2003F course were compiled in the ECO2003F 'Gradebook'. Students passed the course by obtaining a final mark of 50% or above, and were permitted to write a supplementary exam with a final mark between 45% and 50%.

The sample population used in the analysis consisted of all students registered for ECO2003F who followed through with the course from start to finish and had a final year mark recorded in gradebook. This included students who wrote the exam but failed the course. This excluded students who registered late for the course, students who did not write the exam or students with missing final grades. Students in the tutorial groups of the head tutor and author of this paper were also excluded. This left a total of 682 individual students, 49 tutorial groups and 19 tutors in the analysis of the trial.

Table 1 displays background summary statistics for student, tutorial and tutor covariates. Final grade for the sample in ECO1010F was on average 65.28%. Proportion

of tutorials attended for ECO1010F (where seven out of nine were compulsory) was a high 95%, as expected. The sample size of students in ECO1010F in 2011 who continued with ECO2003F in 2012 was 529. The 153 other students in the ECO2003F course were missing a final mark for ECO1010F, either because they wrote a supplementary exam for ECO1010F, or took the ECO1010F course before 2011, or because they passed the ECO1010S course in second semester. There were also 25 students with a final grade for ECO1010F of less than 45%, which means they were required to have taken ECO1010S and succeeded in passing.

Due to the fact that a number of students had data that was unavailable from the UCT Institutional Planning Department, sample sizes vary throughout the rest of Table 1. Less than half of the sample was female. Only 11% of the sample consisted of students on a four year undergraduate track instead of three years. These students elected to spread their degree over a longer period than was required. While all 11 national South African languages were recorded, only English is reported, where almost 80% of the sample spoke English as their home language. Since the experiment took place in South Africa, it was necessary to collect data on race and socio-economic status. Almost half of the full sample was white, just under a third was black, 13.7% was Indian/Asian and 9.3% was coloured. Almost all of the students were South African citizens. Of the full sample, 9% had applied for financial assistance in paying their university fees.

One third of tutorial groups were predominantly female and exactly half of the tutorial groups were predominantly white. Tutorial times of day were defined as follows: 'early' tutorials began between 8 am and 10 am, 'midday' tutorials began between 11 am and 1 pm and 'late' tutorials began between 2 pm and 4 pm. Almost half of the students were members of a midday tutorial, which was unsurprising due to the fact that students were more likely to sign up for a tutorial time which fitted between lectures throughout the day.

The number of years of a tutor's education was defined as 12 years of high school, plus an additional three years for undergraduates, four years for honours students, five years for masters students and six years for a PhD (as are the standard lengths of degrees at UCT). Therefore the number of years of tutor's education variable ranges in value from 15 to 18. The average tutor had 15.8 years of education, which was expected since more educated tutors were allocated to more advanced courses. Finally, a tutor quality rating was created from tutor feedback surveys. Each student had to rate their tutor from 4 options: 'Excellent', 'Above Average', 'Average' and 'Below Average'. Excellent was given a rank of 4 and Below Average was given a rank of 1. It was not compulsory for students to provide tutor feedback. Therefore a rating for each tutor was calculated as an average of the tutor's students who did submit feedback, and this number was then stretched to the individual level for all those students under the supervision of this tutor. It was also unclear whether students who were more satisfied or less satisfied with their tutor were inclined to participate in tutor feedback. Since each tutor had a different number of ratings and ratings were entirely subjective, this variable may be subject to measurement error[1]. With this in mind, the average tutor had a ranking of 3.1.

[1]Regressions examining the treatment effect were run with and without the tutor rating variable. Although coefficients did change slightly between specifications, all variables maintained their significance. Therefore there was less concern for the effect that measurement error in tutor rating had on the estimates.

Table 1: Background Descriptive Statistics

	Observations in Full Sample	Full Sample (1)
Student Covariates		
Final Grade ECO1010F 2011	529	65.284
		(12.822)
Proportion Total Tuts Attended ECO1010F 2011	535	0.959
		(0.067)
Female	680	0.440
		(0.497)
Student on Four Year Track	680	0.113
		(0.317)
English as Home Language	675	0.748
		(0.434)
Black	621	0.291
		(0.455)
White	621	0.478
		(0.500)
Coloured	621	0.093
		(0.291)
Indian/Asian	621	0.137
		(0.344)
SA Citizen	680	0.850
		(0.357)
Financial Aid Applicant	681	0.091
		(0.288)
Tutorial Group Covariates		
Predominantly Female Tut Group	49	0.347
		(0.481)
Predominantly White Tut Group	49	0.490
		(0.505)
Early Tut Group	49	0.306
		(0.466)
Midday Tut Group	49	0.449
		(0.503)
Late Tut Group	49	0.245
		(0.434)
Tutor Covariates		
Years of Tutor's Education	19	15.789
		(0.918)
Black Tutor	19	0.474
		(0.513)
Male Tutor	19	0.579
		(0.507)
Average Tutor Rating	19	3.099
		(0.438)

Notes: Standard deviations are shown in parentheses.

4 Experimental Design

4.1 Methodological Approach

The experiment took the form of a randomised controlled trial (RCT). Randomisation is a preferred tool for analysis for a number of reasons: it safeguards against selection bias and is the most thorough way of determining whether a cause and effect relationship exists (Gore, 1981: 1958). Randomisation ameliorates selection bias since every individual in the sample has an equal likelihood of being selected into the treatment group. The result can never be deliberate because there is no predictable pattern of selection. Randomisation also attempts to safeguard against selective compliance and attrition. Finally, while other studies can hypothesize causality, they cannot eliminate the possibility that an identified relationship is influenced by some unobserved factor. Randomisation ensures that no differences in factors facing the treatment and control groups can account for the outcome. A comparison of these two groups allows one to discern whether the results may have occurred even without the program. The difference between the average treatment and control outcomes is observed as follows (Deaton, 2010: 539):

$$E(Y_i|Treat_i = 1) - E(Y_i|Treat_i = 0) \tag{1}$$

A cluster randomised controlled trial is a type of RCT in which groups of subjects (as opposed to individual subjects) are randomised. In these experiments, the intervention is made at the group level, while analysis is made at the individual level. In this study, a cluster randomised controlled trial was performed. The randomisation was performed at the tutorial level and analysis was done at the student level. Cluster randomised trials (CRTs) are common practise in medical and economic literature (Angrist and Lavy, 2009; DiIorio *et al*, 2007; Patton *et al*, 2006; Campbell *et al*, 2000). Angrist and Lavy (2009) in particular, allocated 40 high schools into treatment and control groups, and performed their analysis on 3821 student observations distributed across treatment and control schools.

The CRT design was beneficial for this experiment due to the fact that spill-over and cross-over within tutorial groups was eliminated. There was also a logistical advantage to grouping by whole tutorial groups when sending emails and examining tutorial attendance. A limitation of CRTs is that one's ability to make statistical inferences is diminished due to small sample size. This is why it was ensured that post-trial analysis was performed at the individual student level. Another limitation includes intraclass correlation, which reflects how strongly units in the same group resemble one another. Strong group homogeneity can produce higher variance in group statistics than truly exists for individual group members (Murray *et al*, 2004: 425). Robust standard errors were used in all regressions to correct for the impact of clustering by tutorial group on the variance.

4.2 The Randomisation Process

Stratification is the process by which individual agents are divided into homogeneous, mutually exclusive subgroups before sampling. Stratification is said to be preferable to many of the alternative randomisation processes due to its ability to ensure balance in a number of important covariates across the treatment and control groups. This is done by ensuring observations are selected according to specified characteristics (Murray *et al*, 2004: 425). The main disadvantage of stratification is that only a small number of variables can be used to create the strata and that stratification is not always able to remove all imbalance between treatment and control (Bruhn and McKenzie, 2008: 10).

In the experiment, stratification was performed on three different categories: whether the tutorial group was predominantly female (over 50%), whether the tutorial group was predominantly white (over 50%) and whether the tutorial group had a male tutor. These covariates were thought to be important due to the fact that students self-selected into tutorial groups. It was likely students self-selected to be with their friends which made it important to stratify by gender and race composition of tutorial groups. As shown in Table 1, two thirds of tutorial groups were dominated by males, and white was by far the largest racial group in the sample. It was important for students to be able to associate with their tutors, and since students were able to request a change of tutorial group upon meeting their tutors, it became necessary to stratify by tutor gender. However, these three categories were used for stratification mainly due to the fact that they provided the most well-balanced treatment and control groups on a number of covariates [2]. This stratification process produced eight strata comprised of different combinations of the three categories [3]. All 49 tutorial groups fell into one of these eight strata depending on their own tutorial characteristics. Within each of these strata, every tutorial group was assigned a random number. By one strata at a time, the tutorial groups were placed in ascending order of their number and every second tutorial group was selected into the treatment group leaving the remainder for the control. This ensured an almost equal number of similarly characterised groups in the treatment and control.

Balancing checks were done to ensure no single factor acted as a determinant of placement into the treatment and control groups. Special attention was paid to the balancing of the variables 'Proportion Total Tuts Attended ECO1010F 2011' and 'Final Grade ECO1010F 2011' since these variables indicated students' propensity to attend tutorials and propensity to academically achieve. All other covariates used in the balancing-stage were believed to be important determinants of tutorial attendance. Covariates were inspected to ensure, on average, their means were equal between both groups. Balancing tests were performed as follows:

$$X_i = \beta_0 + \beta_1 Treat_i + u_i \tag{2}$$

where X_i refers to any pre-treatment student, tutor or tutorial covariate and $Treat_i$ is a dummy variable for members of the treatment group. β_0 is the mean value of the covariate for the control group, while β_1 is the difference between the mean of treatment and control. If the mean of the covariate is similar across treatment and control, the coefficient β_1 should display as insignificant. Balancing test results are displayed in Table 2, with all covariates having insignificant treatment-control differences [4].

[2] Randomisation through stratification was performed a number of times using a variety of categories for strata formation until the best balancing results were achieved.

[3] Examples of strata included tutorial groups that were predominantly female and predominantly white with a male tutor, or tutorial groups that were predominantly male with predominantly non-white students and a female tutor.

[4] Balancing took place using the whole sample of 732 ECO2003F students, prior to the implementation of the trial. Upon trial completion it was desired to use a sub-sample of students who had completed the ECO2003F course. Balancing was rechecked for this sub-sample and all variables remained insignificant at the 5% and 1% level. A dummy for selection into the new sample also balanced across treatment and control. Therefore Table 2 displays covariate balance for the updated sample detailed under Section 3.

Table 2: Covariate Balance

	Observations	Mean Control	Mean Treat	Difference
		(1)	(2)	(3)
Final Grade ECO1010F 2011	529	65.392	65.172	-0.219
				(1.291)
Proportion Total Tuts Attended ECO1010F 2011	535	0.961	0.957	-0.004
				(0.006)
Female	680	0.429	0.450	0.021
				(0.040)
Student on Four Year Track	680	0.127	0.099	-0.028
				(0.027)
English as Home Language	675	0.736	0.761	0.024
				(0.042)
Black	621	0.303	0.280	-0.022
				(0.047)
White	621	0.494	0.463	-0.031
				(0.056)
Coloured	621	0.073	0.114	0.041
				(0.028)
Indian/Asian	621	0.131	0.143	0.013
				(0.035)
SA Citizen	680	0.844	0.856	0.011
				(0.037)
Financial Aid Applicant	681	0.092	0.090	-0.002
				(0.021)
Predominantly Female Tut Group	682	0.341	0.417	0.076
				(0.145)
Predominantly White Tut Group	682	0.530	0.556	0.025
				(0.147)
Early Tut Group	682	0.298	0.390	0.092
				(0.143)
Midday Tut Group	682	0.415	0.390	-0.025
				(0.145)
Late Tut Group	682	0.287	0.219	-0.067
				(0.128)
Years of Tutor's Education	682	15.928	15.832	-0.097
				(0.275)
Black Tutor	682	0.484	0.471	-0.013
				(0.149)
Male Tutor	682	0.587	0.613	0.025
				(0.146)
Average Tutor Rating	682	3.200	3.025	-0.174
				(0.115)

Notes: Table reports treatment and control group means and treatment-control differences for full sample with all covariates at individual level. Robust standard errors control for clustering at the tutorial group level. Standard deviations shown in parentheses.
*** p<0.01, ** p<0.05, * p<0.1

4.3 Treatment Implementation

Each individual in the treatment group was contacted once a week via email. This email provided the students with motivation as to why they should be utilizing the tutorial system. Each week the motivation provided an alternative explanation as to why their attendance at tutorials would prove beneficial (see Appendices D - I). Emails were sent via software called 'Mailchimp' which was designed to send bulk emails and included a useful data analysis package. 'Mailchimp' recorded the student numbers of students who received and opened each email. Thereafter, tutorial attendance registers were taken by tutors every week. It was therefore possible to ascertain if tutorial uptake increased for those students who received the email. In order to reduce suspicion, students were notified that they may receive additional emails from tutors of the ECO2003F course.

It was imperative that both students and tutors did not discover the nature of the experiment. If students had learnt that they were in the control group, they may have worked harder to compensate. Were the tutors to have found that they were tutoring in the control group, they may have improved their tutoring quality in order to encourage more students to attend tutorials. In line with this, tutorial groups belonging to the head tutor and the paper's author were excluded from this experiment due to the fact that both were fully informed on the workings of the trial [5].

4.4 Caveats

The project was specifically designed to ensure that no group of students gained an advantage over another group. Since the tutorial system was already in place at UCT, everybody had the opportunity to attend tutorials. This experiment simply encouraged half the students to attend the tutorials, despite the fact that they may already have been doing so. If any student chose not to attend tutorials, this decision was their own and could not be attributed to the trial since the university has always maintained that going to tutorials is beneficial to one's studies. The data was kept entirely anonymous and only student numbers were used to identify students. Students' background data only included the variables in Table 1, thereby disabling the opportunity for identifying any individual by these characteristics.

There was a possible threat of tutors taking inaccurate register in tutorials or forgetting to take register and inventing their attendance records. To ensure that this did not occur, two actions were taken. Firstly, it was emphasized to the tutors that taking adequate attendance register was vital to the success of the course. Secondly, for the first two weeks of the trial, extra tutorial registration was taken by the author in four randomly selected tutorials from the treatment group and four from the control, which was then compared to the tutors' own attendance records. If the two did not match, then possible measurement error had taken place[6].

Breakages in the communication chain could have placed limitations on the findings. Therefore a number of precautions were taken to monitor for breakages. If students didn't receive the email, a full delivery report was provided by 'Mailchimp' and therefore any email that went undelivered was detected [7]. If students didn't open the email, this was monitored by 'Mailchimp'. If students opened the email but didn't read it, this was more

[5] In order to reduce suspicion, students and tutors were informed that a study was being done on tutorial attendance but details regarding the intricacies of the trial were kept private

[6] The results of this endeavour showed almost perfect attendance registration and it was safely assumed that registration was thoroughly conducted for the rest of the term.

[7] All emails were successfully delivered throughout the treatment process

challenging to monitor. This was solved by placing a link at the bottom of the email which, when clicked, provided a measure of the number of people who had in fact read to the end of the email. It may even have been satisfactory for students to see the email subject in their inbox, be reminded of their tutorial, and not to read the email at all.

There was a slight threat that only certain subgroups of the full sample read their emails. For example, white students may have checked their emails more frequently than other students due to easier access to internet. However, in response to this, it was most unlikely that all students were not regularly reading their emails since this was the prime source of daily communication between the department and the students. In an informal survey done in lectures, roughly 70 - 80% of students were found to have received emails on their cellphones.

4.5 Unforeseen Complications

In practise, a number of unpredictable complications occurred during the implementation of the trial. Unforeseen obstacles are not uncommon during any RCT, as shown by Victor and Lavy (2009).

A multivariate regression of treatment on all baseline controls was done to check for covariates that may have determined whether a student was placed into a treatment or control group. This regression acted as a reduced form regression, testing whether the treatment contained any endogeneity when included as an explanatory variable for tutorial attendance. The results are displayed in Appendix B. Appendix B shows that student on a four year track and average tutor rating were significant determinants of placement into the treatment group. In order to remove this endogeneity, these significant variables were controlled for throughout the analysis. Therefore, the main regression in question took the form

$$PropTutAttDuringTreat2012_i = \beta_0 + \beta_1 Treat_i + \beta_2 FourYearTrack_i + \beta_3 TutorQuality_i + u_i \quad (3)$$

where $PropTutAttDuringTreat2012_i$ refers to the proportion of treatment-phase tutorials attended, $Treat_i$ is a dummy variable for members of the treatment group, $FourYearTrack_i$ is a dummy variable for students extending the length of their degree and $TutorQuality_i$ is a ranking of the tutors' performance levels.

Two public holidays happened to fall on scheduled tutorial days. Although it was possible to encourage make-up tutorials the following day, the administration involved in collecting and collating tutorial attendance for those weeks was too great a task. Therefore it was decided to exclude those two weeks from the analysis. In the scenario of tutor absenteeism from tutorials, students were allowed to attend make-up tutorials. However, again the administration involved in determining whether students did in fact attend a make-up tutorial was too large and as a result, tutorial attendance for that tutorial group was indicated as missing.

In practise it was discovered that tracking whether emails were being opened in 'Mailchimp' was more difficult than expected. Students had to actively click a link in the email that would then record the email as opened. Due to this late discovery, the first treatment did not have any record of the number of emails that were opened, although all the subsequent treatments did. Due to the extra effort required from the students to click the email link, only 95 students in total were recorded as having read any of the emails. Although this was believed not to be an accurate representation of how many emails were read, the impact of this small sample is explored further in the results.

5 Data and Summary Statistics

5.1 Data Collection

The tutorial attendance data, tutor quality data and course grades for ECO2003F 2012 and ECO1010F 2011 came from the UCT economics department's records. Student background characteristics were obtained from the UCT Institutional Planning Department. Pre-trial data was collected in March 2012. This included all student background data, tutorial and tutor data, and data from the ECO1010F 2011 course. Post-trial data was collected in June 2012 which included ECO2003F course specific data contained in gradebook. Tutorial attendance data was collected weekly throughout the trial.

Tutorial attendance is a very important variable for the study. Tutorial attendance is recorded as[8]:

$$ProportionOfTutorialsAttended = \frac{NumberOfTutorialsAttended}{NumberOfAvailableTutorials} \tag{4}$$

There were 12 tutorials in total for the ECO2003F course. The first five tutorials took place before the implementation of the trial and were compulsory for students to attend. After the fifth tutorial, it was announced to the students that tutorial attendance would no longer be compulsory. The treatment began just after the sixth tutorial and lasted until the end of the semester. Finally, tutorial 5 and tutorial 10 fell on public holidays so data from those weeks has been excluded. Therefore the trial spanned over five weeks and five tutorials. This is summarised clearly in the following table.

Breakdown of ECO2003F Tutorials

Tutorial	Compulsory	Treated	Excluded
1	X		
2	X		
3	X		
4	X		
5			X
6			
7		X	
8		X	
9		X	
10		X	X
11		X	
12		X	

5.2 Data Summary Statistics

There were a total of 682 individual students in the sample. Of these, 333 students were in the treatment group and 349 students were in the control. Table 3 displays the summary statistics from the ECO2003F course at the student level for the full sample, treatment group and control group. Mann-Whitney tests on differences across treatment and control means are displayed.

[8]When tutors were absent from a tutorial, this tutorial was reported as missing. Therefore since the number of available tutorials changes per tutorial group, tutorial attendance was reported as a proportion.

On average, 63.7% of all the tutorials were attended by the sample. Compulsory tutorial attendance was at a very high 92.6%, as expected. Less than half of the non-compulsory tutorials were attended. Of the pre-trial tutorials, 85.0% were attended since all but one of these tutorials were compulsory. Only 40.7% of tutorials that took place in the duration of the treatment (hereinafter referred to as treatment-phase tutorials) were attended by the full sample. The treatment and control difference in compulsory tutorial attendance and pre-treatment tutorial attendance was insignificant. The remaining tutorial-specific variables showed significant differences between treatment and control, which was attributed to the intervention [9].

As shown in Figure 1, attendance remained high and fairly equal between treatment and control while tutorials were compulsory. Attendance dropped suddenly for all students after tutorials became non-compulsory from tutorial 6 onward. The treatment seemed to have an effect on the treatment group from the moment it was implemented, just after tutorial 6. Attendance rates remained consistently higher for treated students thereafter. It is interesting to note how attendance jumped for both treatment and control groups at tutorial 11 which took place the week after the second ECO2003F test. Attendance for tutorials 7, 8, 9 and 12 was significantly different for treatment and control[10].

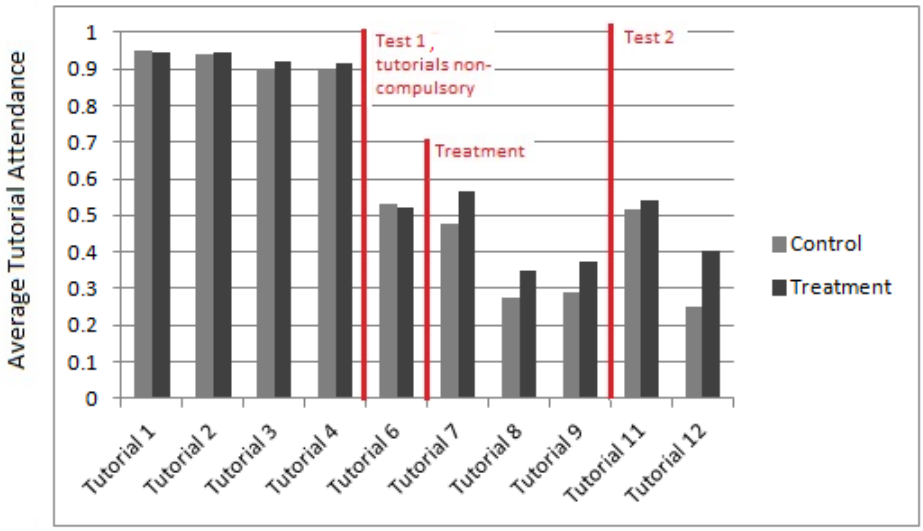

Figure 1: Proportion of Students in Treatment and Control Attending Tutorials

[9]Mann-Whitney tests by treatment produced: Proportion Total Tuts Attended with z-statistic = -3.018 and p-value = 0.0025; Proportion Non-Compulsory Tuts Attended with z-statistic = -2.857 and p-value = 0.0043; Proportion Tuts Attended During Treatment with z-statistic = -3.615 and p-value = 0.0003.

[10]Mann-Whitney tests by treatment produced: Tutorial 7 with z-statistic = -2.400 and p-value = 0.0164; Tutorial 8 with z-statistic = -2.052 and p-value = 0.0401; Tutorial 9 with z-statistic = -2.383 and p-value = 0.0172; Tutorial 12 with z-statistic = -3.756 and p-value = 0.0002.

A total of eight hand-ins were available for submission over the semester while only five submissions were required for a student to be eligible to write the ECO2003F exam. The full sample of students handed in on average 5.9 submissions. There were five submission dates prior to the treatment and the remaining three submission dates took place during treatment. The number of submissions prior to treatment was on average 4.1, while the number of treatment-phase submissions dropped to 1.6 for the full sample. There was very little difference between treatment and control group submissions.

There is no significant difference in grade outcomes between treatment and control groups. Test 1 mark was on average 65% for the full sample, while test 2 mark dropped to 46.3%. Test 1 mark was similar for all achievement levels across treatment and control. A high achiever was defined as having obtained a grade between 100% and 65%. A low achiever had a grade below 65%. Test 1 high achievers obtained marginally higher marks in the treatment than the control at the 10% level [11]. The essay mark was on average 58.34% for the full sample. Term mark, exam mark and final mark for the full sample, treatment and control was on average 59%.

It is likely that those students who were high achievers in ECO1010F continued to be successful in ECO2003F. In fact, the correlation between final grade 2011 and final grade 2012 was 71% and significant at the 1% level (see table of correlations in Appendix C). Final grade for ECO1010F was on average 5% higher than the final grade for ECO2003F.

[11] Mann-Whitney tests by treatment produced: High Achievers with z-statistic = -1.675 and p-value = 0.0939.

Table 3: Descriptive Statistics for ECO2003F Specific Individual Covariates

	Observations in Full Sample	Full Sample (1)	Treatment (2)	Control (3)	Significant Difference
Proportion Total Tuts Attended 2012	682	0.637	0.661	0.614	***
		(0.217)	(0.225)	(0.206)	
Proportion Compulsory Tuts Attended 2012	682	0.926	0.929	0.922	
		(0.161)	(0.160)	(0.162)	
Proportion Non-Compulsory Tuts Attended 2012	682	0.429	0.467	0.393	***
		(0.327)	(0.335)	(0.315)	
Proportion Tuts Attended Pre-Treatment 2012	682	0.850	0.852	0.849	
		(0.180)	(0.184)	(0.177)	
Proportion Tuts Attended During Treatment 2012	682	0.407	0.454	0.362	***
		(0.334)	(0.342)	(0.321)	
Total Number of Submissions 2012	682	5.941	5.997	5.888	
		(1.063)	(1.043)	(1.081)	
Number of Submissions Pre-Treatment 2012	682	4.109	4.129	4.089	
		(0.843)	(0.839)	(0.848)	
Number of Submissions During Treatment 2012	682	1.604	1.646	1.564	
		(0.875)	(0.885)	(0.864)	
Test 1 Mark 2012	676	65.010	65.145	64.882	
		(16.644)	(17.043)	(16.279)	
Test 1 Mark High Achievers 2012	354	77.890	78.663	77.159	*
		(8.829)	(8.877)	(8.744)	
Test 1 Mark Low Achievers 2012	322	50.851	50.430	51.256	
		(10.620)	(10.236)	(10.994)	
Test 2 Mark 2012	642	46.285	45.634	46.932	
		(15.304)	(14.794)	(15.791)	
Essay Mark 2012	682	58.336	58.829	57.865	
		(11.415)	(10.803)	(11.967)	
Term Mark 2012	682	59.264	59.291	59.238	
		(10.164)	(10.294)	(10.054)	
Exam Mark 2012	682	59.497	59.508	59.487	
		(14.287)	(14.407)	(14.193)	
Final Grade 2012	682	59.305	59.333	59.278	
		(11.013)	(11.198)	(10.849)	

Notes: Standard deviations are shown in parentheses. Significant differences in treatment and control groups are displayed from a Mann-Whitney test: *** p<0.01, ** p<0.05, * p<0.1. Proportion of Non-Compulsory Tuts Attended and Proportion of Tuts Attended During Treatment differ only by one tutorial.

6 Results

6.1 *The Treatment had a Significant, Positive Effect on Tutorial Attendance*

Table 4 provides evidence that the experiment was successfully executed and produced significant results. Specification 1, the short regression, is the basic regression of treatment-phase tutorial attendance on treatment controlling for multivariate imbalance of the treatment. The coefficient on treatment is 0.111 and significant at the 5% level[12]. This indicates that the proportion of tutorials attended by the treatment group was 11.1% higher than members of the control group. This accords with the summary statistics in Table 3.

It is standard RCT practice to run the treatment effect regression with baseline data as additional controls (Deaton, 2010: 443). Since all individual covariates are balanced across treatment and control groups, their inclusion in the regression should not affect the estimate of the treatment coefficient (Angrist and Pischke, 2008: 18). However, inclusion of the controls act to increase the precision of the treatment estimate by absorbing variance (Deaton, 2010: 443). In other words, controlling for background covariates $\mathbf{X}_i$ should not significantly change the estimates of β_1 in the long regression

$$PropTutAttDuringTreat2012_i = \beta_0 + \beta_1 Treat_i + \boldsymbol{\beta}_2 \mathbf{X}_i + u_i \tag{5}$$

as compared to the estimates of β_1 in the short regression

$$PropTutAttDuringTreat2012_i = \beta_0 + \beta_1 Treat_i + u_i. \tag{6}$$

Specification 2, the long regression, includes all baseline controls other than the ECO1010F 2011 covariates, while Specification 3 includes ECO1010F controls. Since the coefficient on treatment in specification 1 is similar to its counterparts in specification 2 and 3, this confirms that the treatment effect was significant with or without the additional baseline controls. Thus a successful RCT was conducted. The inclusion of 2011 data changed the sample size from 621 students to 477. In comparing specifications 2 and 3, the results of specification 3 appear to be robust despite the smaller sample size and the 2011 covariates are used as legitimate controls henceforth [13].

Specification 4, a placebo regression, displays the regression results of pre-treatment tutorial attendance on treatment. Since the coefficient on treatment is now sufficiently small and insignificant, it confirms that the treatment had neither a practically nor statistically significant impact on tutorial attendance prior to its implementation. Finally, specifications 5 and 6 are the same placebo regressions as specification 4 with additional baseline controls. Specification 5 excludes 2011 covariates and specification 6 includes 2011 covariates. As shown in all three specifications, the treatment had a statistically insignificant impact on tutorial attendance prior to its implementation, as desired.

[12] Specification 1 was rerun without controlling for the multivariate imbalance of treatment and the treatment still displayed significance at the 5% level.

[13] Specification 3 provides an indication of the important determinants of tutorial attendance. Females, students who attended tutorials in ECO1010F and financial aid applicants attended significantly more tutorials in ECO2003F. Black and Indian/Asian students, and South African citizens attended significantly fewer tutorials in ECO2003F.

Table 4: Treatment Effects

	Proportion Tuts Attended During Treatment (1)	Proportion Tuts Attended During Treatment (2)	Proportion Tuts Attended During Treatment (3)	Proportion Tuts Attended Pre-Treatment (4)	Proportion Tuts Attended Pre-Treatment (5)	Proportion Tuts Attended Pre-Treatment (6)
Treat	0.111**	0.123***	0.121***	0.008	0.010	0.004
	(0.043)	(0.045)	(0.042)	(0.021)	(0.021)	(0.020)
Final Grade ECO1010F 2011			0.002			0.002***
			(0.001)			(0.000)
Prop Tuts Attended ECO1010F 2011			0.834***			0.433***
			(0.235)			(0.142)
Female		0.071**	0.091***		0.029*	0.030**
		(0.030)	(0.032)		(0.016)	(0.015)
Student on Four Year Track	-0.010	-0.010	0.050	-0.007	-0.008	-0.045
	(0.043)	(0.044)	(0.095)	(0.026)	(0.028)	(0.045)
English as Home Language		-0.096	-0.043		0.004	0.025
		(0.064)	(0.063)		(0.027)	(0.024)
Black		-0.083	-0.109*		0.013	0.018
		(0.056)	(0.061)		(0.025)	(0.025)
Indian/Asian		-0.112**	-0.134***		-0.023	-0.044*
		(0.042)	(0.044)		(0.023)	(0.022)
Coloured		-0.031	0.070		-0.009	0.064**
		(0.066)	(0.071)		(0.030)	(0.030)
SA Citizen		-0.100*	-0.129**		-0.033	-0.054
		(0.055)	(0.057)		(0.034)	(0.033)
Financial Aid Applicant		0.026	0.132*		0.012	0.003
		(0.052)	(0.066)		(0.027)	(0.040)
Predominantly Female Tut Group		-0.000	-0.009		-0.024	-0.031*
		(0.040)	(0.043)		(0.019)	(0.018)
Predominantly White Tut Group		0.003	-0.004		0.040*	0.046**
		(0.046)	(0.039)		(0.023)	(0.021)
Early Tut Group		-0.008	-0.008		-0.016	-0.039*
		(0.046)	(0.050)		(0.022)	(0.022)
Late Tut Group		0.042	0.040		0.001	-0.004
		(0.054)	(0.055)		(0.025)	(0.027)
Constant	0.065	0.672	-0.186	0.714***	0.556**	0.005
	(0.216)	(0.463)	(0.611)	(0.087)	(0.220)	(0.261)
Observations	680	621	477	680	621	477
R-squared	0.032	0.072	0.141	0.009	0.031	0.114

Notes: Specifications 1, 2 & 3 are regressions of treatment-phase tutorial attendance on treat. Specifications 4, 5 & 6 are placebo regressions of pre-treatment tutorial attendance on treat. Specifications 2 & 5 control for baseline covariates excluding 2011 covariates. Specifications 3 & 6 control for all baseline covariates. Robust standard errors control for clustering at the tutorial group level. Tutor covariates not reported. Standard deviations shown in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

6.2 *Low Academic Achievers were Non-Responsive to the Treatment*

Subgroups of the sample were isolated to identify which were significantly affected by the treatment. Table 5.1 displays the coefficients and standard errors from the basic regression of treatment-phase tutorial attendance on treatment for particular subgroups, controlling for multivariate imbalance of the treatment. Also shown in specification 1 of Table 4, the full sample of students in the treatment group attended a significant 11.1% more tutorials than the full sample in the control.

The treatment effect was examined on the sub-sample of students who were recorded as not having read any of the emails. Since only 95 students were reported as having read an email, there was concern that it was only these few students who were pushing the significant treatment results. When these students were excluded from the full sample regression, the treatment effect was still significant with students in the treatment group attending 9.1% more tutorials than students in the control group. This confirms that certainly more than the 95 students reported were reading the emails.

The treatment effect was examined for students of different academic achievement levels for final grade ECO1010F 2011 and test 1 of ECO2003F 2012. High achievers in ECO1010F were significantly impacted by the treatment and attended on average 16.6% more tutorials than high achievers in the control. Treated low achievers in ECO1010F were insignificantly affected by the treatment, despite the fact that they were the most likely to benefit from the tutorials. High achievers in test 1 ECO2003F attended a significant 12.8% more tutorials than their counterpart in the control. Low achievers in test 1 ECO2003F increased their attendance at the 10% significance level in response to the treatment.

While females were insignificantly impacted by the treatment, males in the treatment group attended 15.2% more tutorials than males in the control.

Table 5.2 displays the results of Mann-Whitney tests conducted across treated students from academic subgroups. Of the treated students, high achievers from 2011 and 2012 attended significantly more tutorials than low achievers from 2011 and 2012. Together with the results from Table 5.1, this provides good evidence that low academic achievers were non-responsive to the treatment.

Table 5.1: Treatment Effect Estimates in Covariate Subgroups

DEPENDENT VARIABLE: Proportion Tuts Attended During Treatment		
	Observations	Coefficient Treat
Full Sample	680	0.111**
		(0.043)
Not Recorded as Having Read Any Email	591	0.091*
		(0.047)
High Achiever ECO1010F 2011	265	0.166***
		(0.059)
Low Achiever ECO1010F 2011	262	0.060
		(0.046)
High Achiever Test 1 2012	354	0.128**
		(0.053)
Low Achiever Test 1 2012	320	0.095*
		(0.051)
Female	299	0.061
		(0.057)
Male	381	0.152***
		(0.049)

Notes : Regressions of treatment-phase tutorial attendance on treat, including controls for multivariate treatment imbalance. Estimates from full subgroup samples. Robust standard errors control for clustering at the tutorial group level. Standard deviations are shown in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

Table 5.2: Tutorial Attendance Comparisons Between Treatment Groups of Covariate Subgroups

	Observations in Treatment Subgroups	Mann-Whitney Test: Ho: High Achievers from Treat = Low Achievers from Treat
High Achiever ECO1010F 2011	125	z = -2.157
Low Achiever ECO1010F 2011	136	Prob > |z| = 0.0310 **
High Achiever Test 1 2012	172	z = -2.246
Low Achiever Test 1 2012	158	Prob > |z| = 0.0247 **

Notes: Mann-Whitney test statistics from comparisons of treatment-phase tutorial attendance between treated high academic achievers and treated low academic achievers. *** p<0.01, ** p<0.05, * p<0.1.

6.3 *Increased Tutorial Attendance Had no Impact On Final Grade*

It was desired to estimate the impact of the increased tutorial attendance as a result of the treatment on ECO2003F course grade. Final grade for ECO2003F was regressed on treatment-phase tutorial attendance, treatment and an interaction term of treatment and attendance[14]. This is shown below as

$$\begin{aligned} FinalGrade2012_i = \beta_0 + \beta_1 PropTutAttDuringTreat2012_i \\ +\beta_2 Treat_i + \beta_3 Treat_i * PropTutAttDuringTreat2012_i + u_i \end{aligned} \tag{7}$$

Table 6 reports the estimates from a number of different specification checks. Specifications 1, 2 and 3 report OLS estimates of variations of equation 7. Specifications 4 and 5 report IV estimates where proportion of tutorials attended for ECO2003F is instrumented by the treatment.

Specification 1 is an OLS regression of equation 7, additionally controlling for treatment multivariate imbalance. It shows that an increase in tutorial attendance led to a significant increase in final grade. Belonging to the treatment group had no impact on final grade and there was no significant difference in the impact of attendance on final grade between treatment and control group members.

Specification 2 is this same regression, controlling for important determinants of final grade. Tutorial attendance still had a significant, positive impact on final grade, while the treatment effect on final grade remained insignificant. Students on four year tracks and females appear to have had significantly lower final grades for ECO2003F. White students had significantly higher final grades for ECO2003F.

Tutorial attendance in specification 2 was suspected of endogeneity, since unobservable individual characteristics such as motivation and ability were held in the error term u. It was attempted to control for this endogeneity by using proxy variables. A proxy variable x for unobservable x^* should satisfy: $x^* = \delta_0 + \delta_1 x + v$, where v must be uncorrelated with x and as well as with all independent variables from the full equation (Wooldridge, 2009: 307). In satisfying these requirements, motivation was proxied by number of non-compulsory tutorials attended for ECO1010F 2011[15], ability was proxied by final grade for ECO1010F 2011 and socio-economic status was proxied by financial aid applicant status[16].

Specification 3 is the same OLS regression of equation 7 with all controls including proxies for motivation, ability and socio-economic status. Under this specification, tutorial attendance remained a significant determinant of final grade. The coefficient on female is now positive and significant at the 5% level. Females achieved a higher grade than males. Being an English speaking student and having high academic ability significantly increased final grade.

[14] Final grade for ECO2003F was (as explained in Section 3) comprised of a number of assessments. The test 1 assessment occurred before the treatment took place. Since the study was only interested in the impact on grade as a result of the treatment, test 1 outcomes were checked for balance across treatment and control groups (see Table 3). Upon finding balance, it was concluded that any significant difference in final grade between the treatment and control groups could be accounted for by treatment-phase assessments only.

[15] Since seven of nine tutorials were compulsory in 2011, motivation was shown by attending more than seven tutorials. Therefore $NumberOfNonCompulsoryTutsAttended2011 = NumberOfTutsAttended2011 - 7$. The variable ranges from 0 (low motivation) to 2 (high motivation), and the larger the coefficient, the greater the motivation.

[16] All proxy variables were balanced across treatment and control groups.

Table 6: Final Grade Specification Checks

	Final Grade 2012				
	OLS (1)	OLS (2)	OLS (3)	IV (4)	IV (5)
Proportion Tuts Attended During Treatment 2012	5.533***	6.137***	5.846***	2.167	-1.204
	(1.761)	(1.957)	(1.528)	(8.378)	(5.608)
Treat	-1.236	-0.947	0.119		
	(1.331)	(1.349)	(1.076)		
Proportion Tuts Attended During Treatment 2012*Treat	1.651	0.954	-2.108		
	(2.471)	(2.385)	(1.893)		
Number of Submissions During Treatment 2012		0.269	-0.244	0.683	0.297
		(0.442)	(0.401)	(0.828)	(0.535)
Student on Four Year Track	-8.751***	-5.469***	5.036	-5.491***	5.031*
	(1.267)	(1.298)	(3.420)	(1.306)	(3.055)
Female		-1.757*	1.581**	-1.517	2.062***
		(0.893)	(0.688)	(1.007)	(0.749)
English as Home Language		0.965	2.305*	0.596	2.248*
		(1.479)	(1.264)	(1.587)	(1.194)
Black		-1.695	-1.740	-1.568	-1.497
		(1.342)	(1.660)	(1.365)	(1.586)
White		4.300***	-0.392	4.821**	0.408
		(1.521)	(1.374)	(1.873)	(1.536)
Coloured		-0.449	-1.537	-0.184	-0.655
		(2.118)	(2.023)	(2.251)	(2.627)
SA Citizen		0.956	2.397	0.633	1.708
		(1.484)	(1.436)	(1.676)	(1.606)
Final Grade ECO1010F 2011			0.593***		0.598***
			(0.029)		(0.027)
Number of Non-Compulsory Tuts Attended ECO1010F 2011			0.228		0.773
			(0.628)		(0.870)
Financial Aid Applicant			-1.033		-0.202
			(1.776)		(1.775)
Predominantly Female Tut Group		1.774	0.166	1.790	0.113
		(1.128)	(0.597)	(1.104)	(0.604)
Predominantly White Tut Group		0.990	0.552	0.953	0.467
		(0.972)	(0.695)	(0.994)	(0.773)
Early Tut Group		0.828	1.008	0.702	0.788
		(1.290)	(0.644)	(1.285)	(0.709)
Late Tut Group		1.337	1.000	1.547	1.321*
		(0.981)	(0.680)	(1.030)	(0.777)
Constant	54.153***	54.129***	21.260***	54.928***	22.695***
	(3.558)	(10.450)	(7.110)	(10.620)	(8.003)
Observations	680	621	476	621	476
R-squared	0.107	0.211	0.560	0.195	0.532

Notes : Specifications 1, 2 & 3 report coefficients from OLS regressions. Specifications 4 & 5 report coefficients from IV regressions. Specifications 3 & 5 include proxy variables. Robust standard errors control for clustering at the tutorial group level. Tutor covariates not reported. Standard deviations shown in parentheses. *** p<0.01, ** p<0.05, * p<0.1

It was difficult to reconcile the fact that tutorials were shown as highly significant determinants of final grade in specifications 1, 2 and 3, yet treated students (who attended more tutorials) showed no significant change in their grade. It was possible that tutorials truly were important for grades, or alternatively that the people who were attending these tutorials exhibited characteristics that were important for good grades. Therefore tutorial attendance was still suspected of endogeneity. One or more of the proxies may have been poor or there may have been remaining correlation between tutorial attendance and unobservables in the error. In the quest for the most accurate estimate of tutorial attendance, the instrumental variable technique was used. An instrumental variable z must satisfy the requirements that z is uncorrelated with the error u, and that z is correlated with the endogenous independent variable x (Wooldridge, 2009: 526). Using the treatment as an instrument ensured these requirements were met: treatment was certainly significantly correlated with tutorial attendance as shown in Table 4, with a coefficient of 0.111 at the 5% significance level. Due to the treatment's randomly assigned nature (while controlling for its multivariate imbalance), it was uncorrelated with u. Specifications 4 and 5 reflect IV estimates of final grade on treatment-phase tutorial attendance, with tutorial attendance instrumented by the treatment.

Specification 4 is an IV regression controlling for other determinants of final grade. The coefficient on treatment-phase tutorial attendance is no longer significant. This implies that students with increased tutorial attendance attributed to the treatment showed insignificant change in their final grade as compared to students in the control. Students on four year tracks achieved a lower final grade at the 1% significance level, while white students and students with high quality tutors achieved higher final grades at the 5% significance level.

Specification 5 is the same IV regression as in specification 4, with the inclusion of the additional proxies. Tutorial attendance remained insignificant under this specification. This shows that it was not the extra attendance that improved grades, but rather the types of students that were doing the extra attending.

6.4 *Increased Tutorial Attendance had No Impact on Final Grade for Any Subgroup*

Table 7 displays estimates of the IV regression of final grade on treatment-phase tutorial attendance instrumented by treatment for the same subgroups examined in Table 5.1. The intention was to discover whether increased tutorial attendance as a result of the treatment led to improved final grades for any sub-sample of the population. All controls, including proxy variables were added to the regressions. Table 7 makes it immediately evident that tutorial attendance had an insignificant impact on final grade for all subgroups.

Table 7: Attendance Estimates in Covariate Subgroups

DEPENDENT VARIABLE: Final Grade ECO2003F 2012	Observations	Coefficient Treatment-Phase Tutorial Attendance
Full Sample	476	-1.204 (5.608)
Not Recorded as Having Read Any Email	414	-5.495 (7.575)
High Achiever ECO1010F 2011	243	-2.798 (5.860)
Low Achiever ECO1010F 2011	233	5.332 (9.992)
High Achiever Test 1 2012	279	-0.199 (4.480)
Low Achiever Test 1 2012	195	-5.516 (8.964)
Female	214	-8.590 (12.475)
Male	262	0.047 (5.938)

Notes: IV regression estimates of final grade on treatment-phase tutorial attendance with attendance instrumented by treatment. Controls for all covariates. Robust standard errors control for clustering at the tutorial group level. Standard deviations are shown in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

7 Discussion and Conclusion

A randomly assigned weekly email to second-year microeconomics UCT students generated significantly improved tutorial attendance amongst the treated students. Whole tutorial groups were assigned to treatment and control groups, and correction for the impact of clustering by tutorial group on the variance was used. A causal interpretation of the results was supported by estimates from models that controlled for baseline covariates. High academic achievers and males responded to treatment. The treatment appeared to have no effect on final grades for the microeconomics course, despite the increase in tutorial attendance that it caused in the treatment groups. This translated into the very surprising result that increased tutorial attendance had no impact on final grade. The discussion to follow delves deeper to find possible competing explanations for this result.

At first it was thought that the treatment had an effect on some ECO2003F assessment other than final grade. Figure 2 below displays seven different outcome variables by treatment and control. This is in order to shed some light on the possible causal mechanisms through which tutorial attendance may affect grades, despite not significantly impacting on overall final grade. It is clear that the treatment had an insignificant effect on all course outcomes other than tutorial attendance[17].

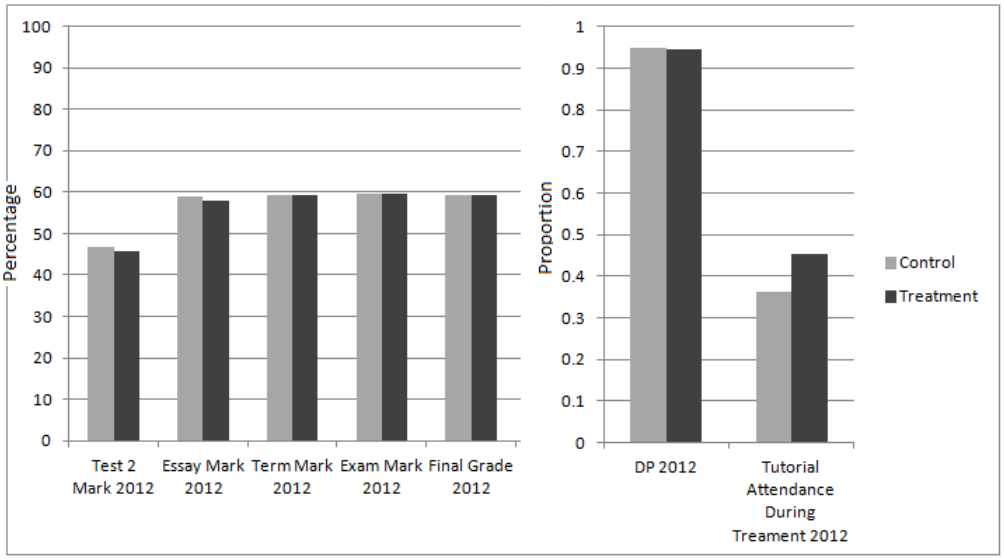

Figure 2: ECO2003F Outcomes by Students in Treatment and Control

It was then hypothesized that there were opposing movements occurring in the sample distribution. Perhaps the increased attendance had positive effects on grades for certain subgroups, and negative effects for others, and was reflecting as a negligible average result. Therefore, in section 6.4 the instrumental variable estimates were checked for various subgroups, yet all sub-samples reflected insignificantly affected final grades.

[17]DP as graphed in figure 2 was measured by the full 732 students registered for the ECO2003F course. This is larger than the sample used throughout the analysis, since all students used in the analysis obtained DP. The graph displays the proportion of students that obtained DP.

Return now to the interesting result from section 6.2. The treatment had a positive impact on tutorial attendance of high academic achievers from 2011 and test 1 2012. However, the treatment had a negligible impact on low achievers, meaning that this treated subgroup did not increase their tutorial attendance. As the literature in Section 2 shows, it is precisely these low achievers who would have benefited most from the extra support given by the tutorial system. Even though the smart students did attend more tutorials, it is likely that these students would have excelled in their final grade irrespective of their increased attendance. Therefore, it is possible that while tutorials had no impact on final grade for good students, they were far more likely to have had positive results on the grades of weaker students, had these students responded to the treatment in the same way. A suggestion can be made to the SOE to redirect tutorials toward catering for the weaker students if they are intent on maximising gains from tutorials. The SOE's biggest challenge lies in making tutorials appealing to these weaker students who are not receptive to casual encouragement.

It is important to be cautious of the results obtained via this sub-group analysis. The sub-group analysis used in this study has received criticism from the likes of Deaton (2010: 440). Deaton explains that there is no guarantee that a new RCT, directed only at a particular subgroup will produce the same results. The SOE is encouraged to target a new RCT at low performing students to verify this study's results.

The size of the tutorial classes may have had opposing forces on final grade. Larger number of students in tutorial groups may have created a "learning effect" by which students learnt from the contributions of their peers (causing a positive effect on grades). However, larger tutorial groups may have also resulted in increased congestion and less attention from the tutor (causing a negative effect on grades). Therefore, it is possible that the higher attendance rates in the treatment groups had conflicting effects on the students' learning and resulted in an insignificant impact on their final grades.

The matters of cross-over and spill-over are yet to be addressed. Cross-over occurs when students in the control group gain access to the treatment. This contamination can heavily influence the results and cause the experiment to be ineffective. It was safely assumed that cross-over did not occur during the trial for two reasons. Firstly, the implementation of treatment occurred at the tutorial level, thereby ensuring full tutorial groups were classified as either treatment or control. Secondly, the 'Mailchimp' software monitored all forwarding of emails, and it accurately reported that no emails were forwarded directly to students outside of the treatment group. Monitoring spill-over posed more of a challenge [18]. Spill-over effects are externalities of the treatment. There were four interesting effects at play. (1) As a member of the treatment group, there may have been a reinforcement effect on one's tutorial attendance by one's peers in the treatment group. This is explained by the fact that as more people attended one's tutorials, diverse opinions made the tutorials more interesting. (2) As a member of the control group, one may have been influenced to attend tutorials by peers in the treatment group. (3) As a member of the treatment group, one may have been influenced not to attend tutorials by peers in the control group, despite the positive influence derived from the treatment one received. (4) As a member of the control group, there may have been a reinforcement effect on one's not attending tutorials by one's peers in the control group. This is explained by the notion that the fewer people in one's tutorial group, the more intimidating and unappealing the tutorial environment became. These four influences and their effect on the treatment coefficient are displayed in the following table.

[18] Data was collected to monitor spill-over, but this was not the focus of this paper.

Reciprocal Influences of Treatment and Control Groups

	Member of Treatment Group	Member of Control Group
Influence of Treatment Group	(1) Reinforces Treatment	(2) Undermines Treatment
Influence of Control Group	(3) Undermines Treatment	(4) Reinforces Treatment

Since the impact of the treatment on tutorial attendance was so significant, the greatest concern about the treatment group influencing the control was eased. It is true that perhaps the coefficient on treatment may in fact have been a lot larger without the spill-over. It is also true that the coefficient on treatment may have been larger in the case that the control group negatively influenced the treatment group. However, since significant impact was still achieved, as was the purpose of the experiment, forces (2) and (3) were no longer of grave concern. It is important to be aware that forces (1) and (4) could have been a driving factor of the large significant difference in tutorial attendance between the treatment and control groups. This would have resulted in some of the significance in treatment in Table 4 being accorded to students' preference for larger tutorial groups, as opposed to the direct impact of the treatment. More attention should be paid to spill-overs in future trial designs.

Finally, it is possible that tutorials are highly ineffective, and should be scrapped entirely. Before any changes are made to the tutorial system by the SOE, these results should be verified next year. A limitation posed by the RCT is one of narrowness of scope. While the treatment obtained significant results in this study, it is difficult to know whether the effect measured in this experiment would hold in alternative contexts. Banerjee and Duflo (2011: 14) acknowledge that RCTs should not be performed as a once off and rather require a number of different interventions and locations to make the results more robust.

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Appendix A: Variable Descriptions

Final Grade 2012	Course mark for ECO2003F
Total Tuts Attended 2012	Proportion of total tutorials attended for ECO2003F: Possible tutorial numbers include 1,2,3,4,6,7,8,9,11,12
Proportion Compulsory Tuts Attended 2012	Proportion of compulsory tutorials attended for ECO2003F: Possible tutorial numbers include 1,2,3,4
Proportion Non-Compulsory Tuts Attended 2012	Proportion of non-compulsory tutorials attended for ECO2003F: Possible tutorial numbers include 6,7,8,9,11,12
Proprtion Tuts Attended Pre-Treatment 2012	Proportion of tutorials attended prior to treatment for ECO2003F: Possible tutorial numbers include 1,2,3,4,6
Proportion Tuts Attended During Treatment 2012	Proportion of tutorials attended during treatment for ECO2003F: Possible tutorial numbers include 7,8,9,11,12
Total Number of Submissions 2012	Number of submitted assignments for ECO2003F
Number of Submissions Pre-Treatment 2012	Number of assignments submitted prior to treatment for ECO2003F: Possible assignment numbers include 1,2,3,4,5
Number of Submissions During Treatment 2012	Number of assignments submitted during treatment for ECO2003F: Possible assignment numbers include 6,7,8
Not Recorded as Having Read Any Email	Dummy: Student is not recorded as having read one or more treatment email=1
Treat	Dummy: Student is a member of the treatment group=1
High Achiever	Mark between 100% and 70%
Average Achiever	Mark between 70% and 60%
Low Achiever	Mark lower than 60%
Final Grade ECO1010F 2011	Course mark for ECO1010F
Proportion Total Tuts Attended ECO1010F 2011	Proportion of total tutorials attended for ECO1010F: Possible tutorial numbers include 1,2,3,4,5,6,7,8,9
Number of Non-Compulsory Tuts Attended ECO1010F 2011	Number of non-compulsory tutorials attended for ECO1010F ranging from 0 to 2
Female	Dummy: Female=1
Student on Four Year Track	Dummy: Student extends degree over four years=1
English as Home Language	Dummy: Home language is English=1
Black	Dummy: Racial classification is black=1
White	Dummy: Racial classification is white=1
Coloured	Dummy: Racial classification is coloured=1
Indian/Asian	Dummy: Racial classification is Indian/Asian=1
SA Citizen	Dummy: Citizen of South Africa=1
Financial Aid Applicant	Dummy: Applied for financial aid=1
Predominantly Female Tut Group	Over 50% of group comprised of female students
Predominantly White Tut Group	Over 50% of group comprised of white students
Early Tut Group	Tutorial begins between 8am and 10am
Midday Tut Group	Tutorial begins between 11am and 1pm
Late Tut Group	Tutorial begins between 2pm and 4pm
Years of Tutor's Education	Highest number of years of education received
Black Tutor	Dummy: Tutor racial group is classified as black=1
Male Tutor	Dummy: Tutor is male=1
Average Tutor Rating	Average student-given ranking of tutor ranging from 1 to 4

Appendix B: Testing Covariate Balance in a Multivariate Framework

	Treat
	(1)
Final Grade ECO1010F 2011	0.000
	(0.002)
Proportion Total Tuts Attended ECO1010F 2011	0.021
	(0.281)
Female	-0.037
	(0.031)
Student on Four Year Track	0.718***
	(0.171)
English as Home Language	-0.006
	(0.080)
Black	-0.048
	(0.084)
White	-0.059
	(0.068)
Coloured	0.132
	(0.090)
SA Citizen	-0.064
	(0.076)
Financial Aid Applicant	0.003
	(0.091)
Predominantly Female Tut Group	0.008
	(0.207)
Predominantly White Tut Group	-0.005
	(0.176)
Early Tut Group	0.093
	(0.235)
Late Tut Group	-0.121
	(0.219)
Years of Tutor's Education	-0.027
	(0.096)
Black Tutor	-0.106
	(0.163)
Male Tutor	-0.009
	(0.183)
Average Tutor Rating	-0.401**
	(0.174)
Constant	2.318***
	(1.379)
Observations	477
R-squared	0.098

Notes: Robust standard errors control for clustering at the tutorial group level. Standard deviations shown in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Appendix C: Correlation Coefficients

ECO2003F-Specific Correlation Coefficients

	Test 1 Mark	Test 2 Mark	Exam Mark	Final Mark	Prop Total Tut Attend	Prop Tut Attend Pre Treat	Prop Tut Attend During Treat	Total Num Submissions	Num Submissions Pre Treat	Num Submissions During Treat
Test 1 Mark	1.000									
Test 2 Mark	0.413	1.000								
Exam Mark	0.588	0.609	1.000							
Final Mark	0.748	0.727	0.929	1.000						
Prop Total Tut Attend	0.150	0.208	0.195	0.240	1.000					
Prop Tut Attend Pre Treat	0.180	0.190	0.244	0.250	0.742	1.000				
Prop Tut Attend During Treat	0.082	0.179	0.155	0.183	0.915	0.427	1.000			
Total Num Submissions	0.118	0.224	0.208	0.226	0.450	0.374	0.388	1.000		
Num Submissions Pre Treat	0.263	0.278	0.280	0.333	0.442	0.445	0.329	0.690	1.000	
Num Submissions During Treat	-0.080	0.073	0.042	0.020	0.207	0.080	0.235	0.746	0.132	1.000

Other Interesting Correlation Coefficients

	Grade 2011	Grade 2012	Female	English	Black	White	Coloured	SA Citizen	Financial Aid	Four Year Track
Grade 2011	1.000									
Grade 2012	0.711	1.000								
Female	-0.238	-0.073	1.000							
English	0.082	0.176	-0.015	1.000						
Black	-0.130	-0.221	0.018	-0.742	1.000					
White	0.248	0.278	-0.042	0.467	-0.628	1.000				
Coloured	-0.033	-0.033	0.010	0.106	-0.144	-0.313	1.000			
SA Citizen	0.054	0.095	-0.015	-0.066	-0.236	0.277	0.051	1.000		
Financial Aid	-0.052	-0.067	-0.003	-0.164	0.216	-0.231	0.116	0.074	1.000	
Four Year Track	-0.133	-0.081	0.035	-0.167	0.148	-0.093	-0.021	0.024	0.095	1.000

Appendix D - Motivation Week 1

Dear ECO2003F student

My name is Callie Shenker. I am one of the tutors for ECO2003F. I did three years of economics in my undergraduate degree and am now studying economics honours. Although I did get permission from Katherine Eyal (the ECO2003F course convenor) to email you, I am sending you this of my own accord as I wish my tutors had done for me.

I am writing to you to try and explain the benefits that can be gained from attending tutorials. Please don't close this email just yet. If you read on, you may learn something you didn't know and may even want to change the way you approach your tutorials. I thought it would be most fitting as economics students to weigh up the opportunity cost against the benefit of tutorial attendance.

Opportunity Cost of Attending Tutorials

An extra free hour at university can drastically improve your day. Sometimes you would prefer to take the hour off to spend time with friends, or to catch up on some work in the library. You may even be able to gain an extra hour of sleep. I am still a student and I have also had thoughts like these. But in reality it is clear that skipping tutorials for more free time is short term thinking. What you should be thinking about is your long term goal to get good grades on your transcript which can eventually lead you to getting the degree or career you've always wanted.

Benefit from Attending Tutorials

Attending tutorials can make a large impact on your final grade for ECO2003F. The economics tutorial system is designed for tutorials to be combined with lectures. In lectures you gain an overall understanding of the work. Tutorials spend time focusing on applications of what you learn in class and are a reflection of what you can expect in an exam. It is unlikely you are attending every lecture. In this case, you should at least be attending your tutorials. Tutorials provide a recap for the most important concepts from that week's lectures which can be really helpful when you are overwhelmingly behind in your work. If you can follow the work covered in each tutorial, you are guaranteed to be ready for your exam when the time comes.

So, next time you feel tempted to skip your non-compulsory economics tutorial, think again about the hour sacrifice you should make for your future gain. The University of Cape Town is an excellent university and you should take full advantage of the tutorial system that it has on offer. Tutorials are there for many reasons which I will explore over the next few weeks. I'm sure, no matter who you are or what your reason for attending university, that you can find at least one reason why the tutorial system is good for you.

I really want you to do well in ECO2003F. This goal is certainly within your reach.
See you in tuts,
Callie

Appendix E - Motivation Week 2

Hi All

I trust you have been attending your ECO2003F tutorials this term.

I thought I'd share with you some information around how and why the tutorial system works. The beauty of tutorials is that they allow for learning in a close environment with the tutor. Each tutorial contains a maximum of 16 students, compared to lectures of 300 people. In a study by Finn and Achilles (1990) it is shown that smaller class sizes can significantly raise final grades. This happens for two reasons:

Firstly, your tutorial is a safe space for you to ask all the questions that you have been too shy to ask in lectures. Everyone has been in the scenario when they don't understand something that has been said in lectures but don't want to draw attention to themselves in front of 300 other people so they prefer not to ask. That is why in tutorials, if you are not asking a question every time you do not understand, you are not fully reaping the benefits of studying at UCT.

Secondly, the tutorial allows you to get the personal attention from your tutor that you need. All your tutors are up to date with your progress in tutorial submissions and tests and are aware of your areas of strength and weakness.

So, next time you feel tempted to skip your non-compulsory economics tutorial, think again about the hour that could be spent enhancing your understanding and addressing your misconceptions from class.

See you all in tuts, Callie

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I promise this will not result in any spam being sent your way.

References: Finn, J and Achilles C. 1990. Answers and Questions about Class Size: A Statewide Experiment. American Educational Research Journal. 27(3): 557- 577.

Appendix F - Motivation Week 3

Hello again everybody

This week I thought you might be interested to find out how your tutor gets selected for his/her position. Perhaps in understanding this rigorous process, you will realize that UCT really does want your tutorials to be as beneficial and of high a quality as possible.

Students can first begin to apply for a tutoring position at the end of their second year of study. They may only tutor a course that they themselves have done and in which they achieved a grade of 65% or above. This goes to show that your tutors really do know and understand the material which they teach. After getting through the academic round, every applicant is then interviewed in person. They are required to work through a multiple choice question on the board. They are examined for their ability to explain concepts clearly, their enthusiasm, and their general understanding.

This semester, over 200 students applied to be economics tutors, where only approximately 115 of them were selected. Therefore it is clear that your tutors are qualified in their jobs.

So, next time you feel tempted to skip your non-compulsory economics tutorial, think again about all the knowledge that your economics tutor has to give. After all, all of your tutors have passed ECO2003F themselves and all of them have passed well.

See you all in tuts,
Callie

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Appendix G - Motivation Week 4

Good Morning

I trust you have all been attending your tutorials regularly.

By now, the novelty of having non-compulsory tutorials is probably wearing off, and you are starting to realize that the ECO2003F test is next week. It will be a very good idea to attend your tutorial next week for the following reasons:

Reason 1: Tutors generally devote most of the tutorial in the week of the test for revision, practise MCQ and last minute quick tips. It can be very useful to watch your tutor's approach to solving MCQs. They have ideas you may not have thought of and some useful tricks. Some tutors even give advice as to how to optimize your time during the test, when to avoid guessing, and which formulae are the most useful to jot down at the start of the test.

Reason 2: You need all the practise you can get. Firstly, practising will help you to confirm for yourselves that you are comfortable with all sections of the material, or expose areas of weakness that need work. Secondly, practise is useful because many MCQs are often recycled from year to year or are only slightly adapted.

Reason 3: This is application of your knowledge at its best. The really great thing about this tutorial is that for the first time you are entirely familiar with all the work and can fully apply yourselves to the examples that are being done on the board.

So, next time you feel tempted to skip your non-compulsory economics tutorial, think again about just how beneficial this week's tutorial has the ability to be for you. All you need to do is arrive. I really want you to do well in your ECO2003F test 2.

See you in tuts,
Callie

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Appendix H - Motivation Week 5

Hello again!

I hope that your ECO2003F test was a success and that you are feeling confident for your exam. The final two weeks of the ECO2003F course has arrived. Generally, every year around this time, there are very few people attending lectures and tutorial attendance is low. However, this is definitely a bad idea.

It is common knowledge that during the last few weeks of the semester, the hardest material is covered. This makes sense, since all the foundation work has been laid and the course can finally end on some challenging concepts. This is why it is unwise to start slacking now. If your motivation to attend lectures is low, you should especially be attending your tutorials as an attempt to substitute your learning.

Many of you may rejoice at the idea of having no more ECO2003F tests to write. However, this means that you will have no measure of your understanding of the work covered at the end of the term. The only practise you will get with this material is through your tutorial submissions and during your tutorial slots. I highly advise you to go to your tutorials, engage with your tutors and ensure that they help you to fully understand the rest of the syllabus.

So, next time you feel tempted to skip your non-compulsory economics tutorial, think again about how close you are to the end of the semester. All you have to do is push through and attend these last two tutorials to ensure you are fully prepared for the exam.

See you in tuts,
Callie

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Appendix I - Motivation Week 6[19]

Hello, for the last time!

Finally, the last week of tutorials is upon us. I'm sure you agree that the semester has flown by and you are eagerly awaiting June holidays. However, holidays are certainly not upon us yet and it is not advisable to assume the semester is over.

I highly encourage you to attend your last ECO2003F tutorial as there is much to be gained in the final hour. Usually in the last tutorial of the semester:

Information is given about what to expect in your ECO2003F exam. Clarification on your exam structure, material to focus on and the weighting of each of the three sections may be given.

An overall recap of the course material is given. Your tutor may choose to focus on particular areas of weakness from test 2, or on the newest material from class. They may also provide you with new examples that you have not seen and run through some more practise MCQ.

All misconceptions are addressed. You should come prepared to your final tutorial with questions about material that you don't understand and take full advantage of your tutor's help for the last time. This tutorial will be most useful to you if you have already started revising your work and have begun your studying for exams.

So, next time you feel tempted to skip your non-compulsory economics tutorial, think again about the fact that this is your very last one, that you should make the effort to attend and that you should take everything from it that you can.

See you in tuts,
Callie

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[19]There were six weeks of treatment sent but only five weeks are used for the analysis due to a public holiday falling over one tutorial week.