A study of attendance rates in University College Dublin

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Abstract

The results of two lecture attendance surveys conducted in the colleges of Science in University College Dublin are presented. A questionnaire recording the attitudes of students towards attendance are also presented. Attendance rates are comparable to other studies in the literature. Living on/off campus, weather, the lecture schedule in the student's timetable and day of the week are among the factors influencing student's attendance. In addition student's engaged in part-time work differ in terms of satisfaction with their studies and lecture delivery than those who do not.

1 Introduction

In this paper we establish levels of attendance at lectures in the sciences at University College Dublin (UCD) and identify some of the determinants of attendance. Non-attendance of students at lectures is a significant issue in universities all around the world and has been the subject of a number of studies (eg. Longhurst, 1999; Gump, 2004, 2006). The study of attendance rates of students at lectures is of interest for a variety of reasons. The first is that lecture attendance may correlate highly with examination performance (Cohn and Johnson, 2006; Gatherer and Manning, 1998; Kirby and McElroy, 2003; Marburger, 2001; Rodgers, 2001). Secondly poor attendance can have an adverse effect on retention rates (Bennett, 2001). Thirdly, it is important in that attendance reflects the student's motivation and satisfaction with their course, and whether or not they are engaged with their subject or are merely passing exams in a perfunctionary way. It may also affect faculty morale (Friedman et al., 2001). Finally, there are other reasons for investigating attendance rates - issues such as commuting time to the university and part-time work may affect attendance rates as well as a myriad of other factors including timetabling, social life etc. Hence, a deeper understanding of lecture attendance can aid with the planning and scheduling of classes and student motivation so that attendance can be maximized. An overview of previous studies of attendance is given in Section 2.

The study outlined in this paper presents and analyses data from two sources. Firstly, the students of the Survey Sampling module at UCD conducted a survey of attendance rates as a class project under the direction of the first author, both in 2007 and 2008. In 2007, all modules taught in the first semester in the School of Mathematical Sciences were surveyed. In 2008, all modules at levels 0 and 1 taught in semester one in the two Science colleges were surveyed. It was decided to focus on modules at levels 0 and 1 based on the results of the 2007 survey and because retention rates are an issue primarily for students at this level. In addition, a questionnaire on attitudes and factors that might affect attendance rate was completed by

students of a level 0 module at the time of their mid-term in semester 1 of 2008; the survey was completed at this time so that habitual non-attenders would be present for sampling purposes. Further details on the surveys and their design are contained in Section 3.1. The methods for analysis of the questionnaire are described in 3.2.

The results of both surveys and questionnaire are presented and compared in Section 4. We conclude, in Section 5, with a discussion of the results of the analysis contained herein.

2 Background

A number of studies have explored the relationship between lecture attendance at university and examination performance. Cohn and Johnson (2006) in the University of South Carolina found a positive correlation between exam performance and attendance for students enrolled in undergraduate principles of economics courses. Gatherer and Manning (1998) in a UK university investigated the effect of attendance on examination performance in a first year biological science course and found a significant positive correlation between attendance and examination performance; the correlation was very strong amongst the group of students who came from ethnic minorities. Kirby and McElroy (2003) in University College Cork (UCC), Ireland studied the relationship between class attendance and final examination performance in first year economics and they found that attendance at lectures and tutorials has a positive effect on final examination performance. Marburger (2001) in a regional US university found mean examination score was significantly affected by absenteeism among students in a principles of micro-economics course. Rodgers (2001) completed a panel study of non-attendance in an introductory statistics model in an Australian university and found a significant relationship where high attenders performed better in exams than non-attenders. These studies show that a better understanding of student attendance will help with a deeper understanding and perhaps an improved student performance in examinations.

Retention rates at universities have been the subject of many studies in particular because of economic implications. A recent study of student retention in UCD in 2007 showed that 83.7% of students complete their studies (Blaney and Mulkeen, 2008). The majority of those who leave (69%) do so within the first twelve months following entry. Bennett (2001) report a Higher Education Funding Council (HEFC) estimate of the average drop out rate in UK universities of 16% at an annual cost to the UK exchequer of between £91M and £200M; the reported drop out rates vary hugely across universities and examples are cited with drop out rates as high as 41% and as low as 2%. Charlton et al. (2006) reports a drop out rate of 21.7% during the first year of studies for a sample of students from a range of disciplines within a single UK university. In addition, Harrison (2006) reports a drop out rate of 12% in the first year of studies in another UK university. So, the problem of student drop out at an early stage is a considerable one and it occurs widely. Drop out is highly associated with failure of students to engage with their studies at an early stage (Trotter and Roberts (2006)), so it is imperative that we understand the factors that influence attendance amongst early stage university students.

Studies on attendance of university students have found a number of reasons for missing class. Longhurst (1999) found that 52% of students reported themselves as missing at at least one class in a previous week. The reasons given included illness, medical conditions, weather, doing college work and social activities. He found that age was associated with absence whereas gender was not. He summarized his findings in saying that student commitment was a greater determinant of attendance than factors relating to the classes themselves. Kirby and McElroy (2003) also explore factors that influence attendance; they reported an attendance rate at lectures of approximately 46% in lectures and found that the number of hours worked and traveling more than 30 minutes to college were significant factors in determining attendance. Interestingly, traveling more than 30 minutes to college had a positive impact on attendance whereas hours worked had a negative effect. Marburger (2001) reported higher levels of absenteeism on Fridays, with an increase of an average of 9% on other days. Timmins and Kaliszer (2002) found absenteeism on Mondays and Fridays accounted for more than half of absenteeism episodes in a group of third year student nurses. Gump (2004) reported illness, weather and pre-occupation (working on material for other class or exam) as common reasons for failure to attend class. Gump (2006) studied factors that influence attendance and found a positive relationship between the importance that students attributes to class attendance to subsequent attendance in practice. In addition, Rocca (2004) studied the impact the instructor's communication style on attendance and found that instructor's immediacy to be positively related and their verbal aggressiveness to negatively related to attendance. Trotter and Roberts (2006) found that teaching and learning strategies that involve students actively in class are likely to be more successful in enhancing early student experience. A number of factors mentioned above that potentially impact attendance are under university control (eg. scheduling, increased availability of on-campus accommodation with associated zero travel time), so establishing whether these factors have an influence on attendance or not is an important part of any policy making within a university. In addition, exploration of different modes of lecture delivery may also have a positive impact on attendance levels.

3 Methods.

3.1 Survey & Questionnaire

The survey in 2007 was conducted in week 7 of semester one commencing on October 22. The sampling frame consisted of 203 module classes held in that week in the School of Mathematical Sciences. The classes were divided into non-overlapping strata as follows: stratum 1 modules, levels 0/1 from 9-11 am; stratum 2 modules, at level 2 from 9-11 am; stratum 3 modules, levels 3/4 from 9-11 am; stratum 4 modules, level 0/1, from 11-8 pm; stratum 5 modules, level 2, from 11-8 pm and stratum 6 modules, levels 3/4, from 11-8 pm. Each stratum thus consisted of clusters with a cluster being the students enrolled in a module. A simple random sample of clusters within each stratum was selected using proportional allocation. Three estimators of the overall attendance rate were considered representing three different models for the variation. Further details are in Appendix A.

The organization of the survey was done by the students in the Survey Sampling module with the help of the first author. All students took part in the collection of data and in the discussions about the survey. Students were assigned 3/4 classes of which they would have to count the attendance. These classes were assigned to students based on their own timetables. A letter was sent to each module coordinator in the sampling frame informing them that a survey would be taking place and offering them a choice to opt out. None chose to do so.

The survey in 2008 was also conducted in week 7 of semester one. The sampling frame consisted of 84 module classes at level 0/1 in the two science colleges. Engineering and Architecture were excluded. The frame was subdivided into the following strata: stratum 1 Monday from 9 - 11; stratum 2 Monday from 11 - 6; stratum 3 Tuesday, Wed. and Thursday from 9 - 11; stratum 4 Tuesday, Wed. and Thursday from 11 - 6; stratum 5 Friday from 9 - 11 and stratum 6 Friday from 11 - 6. A simple random sample was selected from each stratum again using proportional allocation. The organization of the survey was similar to 2007.

Finally in order to obtain further information on non-attendance a questionnaire was completed by all the students in a level 0 module at the time of their mid-term in semester 1,2008. A total of 224 students completed the questionnaire. Eight students were absent due to illness or family circumstances. The questionnaire is shown in Appendix B.

3.2 Analysis

Summary results regarding commuting time, number of hours in a part-time job, and number of lectures attended at that module up to the time of the mid-term are presented. Simple χ -squared tests were used to examine differences such as differences in the sexes.

Ordinal cumulative link models (McCullagh, 1980; McCullagh and Nelder, 1989; Agresti, 2002) are used to examine the relationship if any between level of attendance and having a job, living on campus, interest in the subject matter and other covariates detailed in the questionnaire. The ordinal response is attendance Y with categories 1-5 representing the number of lectures missed out of 14: none, ≤ 4 , 5-7, 8-10, > 10. The cumulative link model is given by

$$G^{-1}[P(Y \le j/x)] = \alpha_j + \beta^T x$$

and links the cumulative probabilities of the response categories of Y to the predictor variables x. The logit link function $G^{-1}(u) = \log[u/(1-u)]$ is the inverse of the standard logistic cumulative distribution function. This model assumes the same effects β for each logit. A score test is carried out of this proportional odds assumption of identical effect parameters for each cutpoint α_j .

4 Results

Table 1: Results from the survey of modules in the UCD School of Mathematical Sciences 2007

Stratum	Stratum size	Sample size	Module level	Time	Attendance rate	Standard error
1	21	5	$0,\!1$	9,10	42%	2.3%
2	13	3	2	9,10	51%	6.8%
3	32	8	3,4	9,10	52%	5.2%
4	25	7	$0,\!1$	11-8	28%	2.3%
5	27	7	2	11-8	44%	6.6%
6	85	22	3,4	11-8	78%	3.4%

Overall attendance rate $56\%(\pm 4.1\%)$.

The results of the attendance survey for 2007 are displayed in Table 1. A plot of the data is shown in Figure 1 (a). The plot indicates that the relationship between attendance and enrolment is approximately linear through the origin with increasing variance.



Figure 1: Attendance is plotted versus enrollment for modules in (a) the Survey in 2007 and (b) the Survey in 2008.

The increase in variance appears to be linear so we concluded that an estimator, commonly known as a ratio estimator, was optimal for estimating the attendance rate in each stratum. If we let y_j refers to the attendance of class j and x_j refers to its enrolment in a particular stratum then the estimator of the attendance rate for that stratum is given by $\frac{\sum_j y_j}{\sum_j x_j}$. The estimators for each stratum were then combined using standard formulae (Scheaffer et al., 2006) to give an overall estimate of attendance rate. Further details are in Appendix A.

At the end of the sampling week, there were a total of six missing values. Two of these missing values resulted from the lecturer being sick. There was a call-back for these two lectures the following week and they were both successful. Another missing value resulted from the lecture

being moved to a time earlier in the week. A call-back was not possible in this case. The remaining three missing values were as a result of not being able to locate the lecture, call-backs were attempted for these lectures but none were successful. Hence, the final data contained four missing values.

Stratum	Stratum size	Sample size	Day	Time	Attendance rate	Standard error
1	11	4	Monday	9,10	65%	2.5%
2	12	3	Monday	11-6	65%	8.4%
3	21	8	mid-week	9,10	45%	3.0%
4	26	13	mid-week	11-6	48%	5.0%
5	14	4	Friday	9-6	22%	5.0%

Table 2: Results from the survey of modules in the UCD science colleges 2008

Overall attendance rate $49\%(\pm 4.4\%)$.

The results of the attendance survey for 2008 are displayed in Table 2. The ratio estimator was again the optimal one (Figure 1 (b)).

The proposed sample size got reduced from 43 to to 32 due to missing values. Firstly, one of the surveyors was sick during the week of the sampling and this went unnoticed until the end of the week. This meant his four classes went uncounted. The results from two other modules couldn't be taken as the lecturer involved did not fully understand and was uncooperative. Lectures in a further two modules had finished earlier in the term. One class was on a field trip on the day of counting. Finally one surveyor sampled two incorrect modules that could not be used. Because all values but 1 were missing for Friday 9 - 11, instead of having Friday 9 - 11 and 11 - 6 strata, Friday 9 - 6 was taken as a single stratum.

Summary statistics on the questionnaire are displayed in Table 3. The results on attendance are slightly at variance from those of the surveys. If attendance rate is calculated from the questionnaire it is much higher than from the survey ($\approx 74\%$) even taking into account that lecture times for this module were Monday at 12 and Wednesday at 11.

There was no difference in attendance between the sexes and no difference between the sexes in relation to job questions. The average age and standard error of those with and without a job were 19.3(0.54) years and 18.7(0.26) years respectively. The difference was not statistically significant (p = 0.40, two-sample t-test). Those who commuted furthest regarded more campus housing becoming available as being very effective in improving attendance (p=0.06). However when commuting time for those off-campus was divided into quartiles and attendance compared

Female %	48.4
Male $\%$	51.6
Part-time job %	39.0
Females $\%$	41.0
Males $\%$	36.5
Average part-time hours per week for those with a job	12.9(5.4)
Females	11.8(5.2)
Males	13.9(5.4)
How work affects studies	
Job neither damaging or beneficial $\%$	56.0
Tired because of work – no effect $\%$	49.4
Not doing a part-time job – effective $\%$	19.5
– neither effective or uneffective $\%$	56.3
Travel	
Living on campus $\%$	14.4
Median commuting time	60 mins; range 5-280
Those living on campus	
Travel home on weekend – always affects $\%$	21.9
Lecture too early in the morning – affects or always affects $\%$	25.0
Only lecture that day – always affects $\%$	3.1
Bad weather – always affects $\%$	0.0
Those not living on campus	
More campus housing – very effective $\%$	31.4
Travel home on weekend – always affects $\%$	6.5
Lecture too early in the morning – affects or always affects $\%$	40.4

Table 3: Summary statistics (std. dev. in parentheses where appropriate)

Table 3 continued

Only lecture that day – always affects $\%$	16.9
Bad weather – always affects $\%$	20.2

Socializing

Tired because of socializing – always affects $\%$	4.9
Once off engagement – always affects $\%$	21.7
Planned holiday – always affects $\%$	16.7

 $\label{eq:attendance:number of lectures missed out of the 14 so far$

None %	20.1
1-4 %	46.0
5-7 %	23.2
8-10 %	7.1
> 10 %	3.6

Interest in lecture material

Not interested in material – no effect $\%$	
- always effects $%$	7.7
Lecturer not an effective communicator – always effects $\%$	14.0
More activity based learning – very effective $\%$	30.7
More interesting material – very effective $\%$	47.0

Time tabling

reschedule 9.00 – very effective $\%$	50.2
no Friday lectures – very effective $\%$	52.9
Marks for attendance very effective $\%$	55.2

across the quartiles there were no differences (p=0.32). Moreover there was no difference overall in attendance rates between those who lived on campus (no commute) and those who did not (p=0.78). We note 22% of those on campus reported socializing the night before had no effect versus 35% for those off-campus - however this difference was not significant (p=0.22). We note also there was no difference between the on/off campus groups in relation to part-time work.

However the variables tabulated above may be strongly associated and to investigate which were independent predictors all variables together with some interaction terms were entered into a cumulative link model with attendance as the outcome variable. The proportional odds assumption was satisfied in the case of the logit link so this model was assumed. Additional analyses were conducted separately for those with/without a job and those on/off campus. However because of the large number of predictors and with each predictor having 5 categories a more parsimonious and essentially equivalent model for representing the data was conducted where covariates were dichotomized in two ways i.e. 5/<5 no effect/some effect and 1/>1 always effects/otherwise, as well as no effect/some effect/always effects. The model that fitted best dichotomized the variables as 5/<5 no effect/some effect, but for the variable lecture too early, the best dichotomy was 1/>1 always effects/otherwise, and similarly for the variable more activity based learning the best dichotomy was 1/>1 very effective/otherwise and the ordinal logistic regression model was fitted with these variables. A series of forward and backward steps were used to find the best model. A score test of the proportional odds assumption was not statistically significant (p=0.0965) and thus the ordinal logistic model was valid. The significant predictors ($p \le 0.05$), their estimated coefficients, odds ratios and confidence intervals are reported in Table 4 and Table 5.

The effects can be interpreted as follows (the *p*-value for the effect are also reported):

- weather (p < 0.0001): Students who reported that bad weather makes travel to college unpleasant had a lower probability of attendance than those who reported that the weather had no effect. The weather effect did not have a significant interaction with other factors, including living on/off campus.
- living*early (p < 0.0001): The impact of classes being early in the day differs for students who live on/off campus. For students living on campus, those who responded an early lecture always effects had a higher probability of lecture attendance whereas for students living off campus the reverse was true.
- living*sex (p = 0.0041): Females who live on campus have a higher probability of lecture attendance than males who live on campus.
- **job*activity** (p = 0.0198): Those without a job who responded that more activity based

		Chi-	
Source	DF	Square	$\mathrm{Pr} > \mathrm{ChiSq}$
sex	1	7.01	0.0081
early	1	0.56	0.4527
living	1	3.76	0.0526
weather	1	18.28	< 0.0001
travel	1	1.94	0.1641
job	1	0.13	0.7222
only	1	3.44	0.0636
activity	1	1.17	0.2797
$living^*sex$	1	8.22	0.0041
living*travel	1	6.92	0.0085
living*early	1	17.67	< 0.0001
$living^*sex$	1	8.22	0.0041
job*activity	1	5.43	0.0198

Table 4: A list of significant predictors in the cumulative logit model. Overall p-values for a likelihood ratio test are reported.

Table 5: A list of significant predictors in the cumulative logit model. The estimated coefficients, odds ratios, confidence intervals and p-values are reported. Negative coefficients indicate that a variable decreases the probability of attending lectures and positive coefficients indicate that a variable increases the probability of attending lectures.

	Point	Odds	95% Wald	
Effect	Estimate	Ratio	Confidence Limits	$\mathrm{Pr}>\mathrm{ChiSq}$
weather < 5 vs 5	-1.3831	0.2508	0.1313 - 0.4792	< 0.0001
only < 5 vs 5	-0.5961	0.5510	0.2925 - 1.0379	0.0650
living=1 travel < 5 vs 5	-1.6064	0.2006	0.0494 - 0.8151	0.0247
living=1 early 1 vs > 1	2.6378	13.9831	2.0455 - 95.5873	0.0072
living=2 early 1 vs > 1	-1.8530	0.1568	0.0738 - 0.3329	< 0.0001
living=1 sex 1 vs 2	2.1812	8.8572	2.0493 - 38.2812	0.0035
job=2 activity 1 vs > 1	-0.9964	0.3692	0.1719 - 0.7930	0.0106

learning as very effective had a lower probability of attending lectures than those who responded otherwise.

- living*travel (p = 0.0085): Those who report traveling on weekends having an effect have a lower probability of attending classes for those students living on campus. For those living off campus there is no effect.
- only (p = 0.0636): Students reporting that having only one lecture in the day has some effect on attendance have a lower probability of attending classes than those students who report that this has no effect; this factor just misses the significance level of 0.05.

Analyses were conducted separately for those who had/did not have a job and those living on/off campus. The score test for proportional odds assumption was not statistically significant p = 0.4131 and again the ordinal logistic model was valid. The results were similar to the above except in the case of those who had a job where the variable interest was significant with the following result: lectures not interesting having some effect decreases the probability of attending lectures.

Table 6: The estimated coefficient, odds ratio, confidence interval and p-value for the variable interest for those with a job

	Point	Odds	95% Wald	
Effect	Estimate	Ratio	Confidence Limits	$\mathrm{Pr}>\mathrm{ChiSq}$
interest < 5 vs 5	-0.9504	0.3866	0.1502 - 0.9950	0.0488

5 Discussion

In this study, the attendance of students in Science courses in UCD was investigated using two surveys of class attendance and a questionnaire that was completed after a mid-term examination. The results estimate the overall attendance rate in modules in the UCD School of Mathematical Sciences in 2007 at 56% ($\pm 4.1\%$) and in the early stage modules in the two UCD science colleges at 49%($\pm 4.4\%$); these figures are very similar to the figures reported in Kirby and McElroy (2003) that also looked at attendance in an Irish context and Longhurst (1999) in a UK context. The figures on attendance in US universities tend to report higher attendance rates, for example, Marburger (2001) reports an attendance rate of 81.5% in a principles of microeconomics course.

In 2007 attendance rates varied amongst the strata from 28% to 78%. The stratum with the highest attendance rate was stratum 6 at 78%. This was the stratum of modules at levels 3 and 4 with lectures from 11:00 until the evening. The stratum with the lowest attendance rate of 28% was stratum 4 which was made up of modules at levels 0 and 1 with lectures from 11:00 until the evening. These results match our intuition; we would expect students in their final year to have a high attendance rate as all their modules are directly related to their degree programme. In addition class size is smaller for higher level modules. First years take many optional modules that they drop after their first year and that contribute little to their final degree GPA. Overall, the attendance rate for early morning lectures was 48% and for afternoon lectures was 50%.

The results of the 2008 survey proved to be quite interesting. It was very unexpected to see that classes on Monday between 9.00am to 11.00am had the highest attendance rate of all strata - 65% attendance rate. Overall, there was very little difference in the attendance of classes in the morning and the afternoon and, no noteworthy difference between attendance rates on Tuesday, Wednesday and Thursday with all three days having a similar attendance rate between 45 and 50%. The general pattern seen in 2007 - that there is negligible difference between attendance in morning and afternoon lectures - prevailed. Time of the day seems to

be of minor importance when scheduling lectures.

However, there was quite a substantial difference in attendance on Fridays compared to the rest of the week in the 2008 survey. There was a very poor attendance level in the Friday classes - 22% attendance. In light of these results Monday looks like the best day for scheduling lectures with Friday being by far the worst day for lecture attendance.

The 2008 survey showed a decrease in attendance rate as enrollment increased. However the trend was very slight : a linear regression of attendance on enrollment had a small slope (0.0005), p = 0.025 and the percentage of variation explained by the regression was only 15%. However it may be useful in future work to examine the effect of class size in similar type modules.

Finally, we note that some modules may have included students repeating the module exam but not attending the lectures. This could have led to a lowering of attendance rates. However, it was not possible to calculate the attendance of repeating students in each module.

The overall attendance rate determined from the survey of classes is lower than students' self reported attendance rate in the questionnaire ($\approx 74\%$). This suggests that the students overestimate the number of classes that they actually attend. This finding suggests that care needs to be taken when using self reported attendance rates as a proxy for actual attendance rates. Similar biases in self reporting have been noticed in many other contexts including for example self-reporting of weight (Koslowsky et al., 1994).

The percentage of students with a part time job (39%) is lower than the rates reported in Kirby and McElroy (2003) who found that 56% of Arts students and 60% of Commerce students did and Bennett (2001) who reported that the percentage increased from 30% in 2001 to 43% in 2002. The average number of hours worked was found to be 12.9 whereas Kirby and McElroy (2003) reported an average of 7.4 hours for Arts students and 8.5 for Commerce students. However, the average values reported by Kirby and McElroy (2003) include students who don't work and the comparable value for only those who work is approximately 12 hours which is comparable to the value that we found. Interestingly, we found that having a job did not have a significant effect on class attendance. This suggests that students with part time jobs may be very well motivated and attend class despite having a job. In contrast, Kirby and McElroy (2003) noticed a negative impact of hours worked. A large percentage of students reported that having a job is neither damaging or beneficial to their studies, a feeling that is supported by Bennett (2001) who found no significant effect of a job on college performance.

The results of the attendance surveys indicate that day of week is an important determinant of the rate of class attendance. In particular, attendance rates have a tendency to decrease during the week. Similar results were found by Timmins and Kaliszer (2002) who studied attendance amongst nursing students in an Irish university, however they noticed low attendance on Monday and Friday whereas the attendance survey presented here only showed high attendance on Monday. The questionnaire reveals that scheduling only one class in a day appears to have a marginally significant negative impact on class attendance (odds ratio=0.55). This suggests that timetabling should take this into account and schedule more than one lecture per day if possible.

Living on campus has a positive effect on attendance at early morning classes (odds ratio=14). The attendance model fitted by Kirby and McElroy (2003) included a positive effect for students who lived less than 11-20 minutes from college, but the effect was not statistically significant. In addition, those students who live on campus find that traveling on the weekend has a negative effect on attendance (odds ratio=0.20). Furthermore, there is a difference between females and males in terms of attendance for those students who live on campus, where females have a higher probability of class attendance (odds ratio=8.9). Kirby and McElroy (2003) found no gender effect on attendance, but their model did not contain an interaction with the distance that the students live from campus. The effect of living on campus and its interaction with other factors is of interest for universities who are planning on expanding their on campus accommodation facilities. Living on campus increases attendance in general, so the availability of on campus accommodation has the potential to improve student engagement with their studies.

Weather has a significant influence on class attendance, where students who reported that bad weather made travel unpleasant had a lower attendance rate than those who didn't report this (odds ratio=0.25). An interesting result is that this factor didn't have a significant interaction with other factors, for example, living on or off campus. Weather was also reported in Longhurst (1999) as one of the most common reasons for absence from class. Gump (2004) reported that 42% of students recorded good or bad weather as being a reason for not attending class; however, the percentage was lower (20%) amongst early stage students.

Those students who do not have a job and who reported more activity based learning as being very effective had a lower attendance rate than their counterparts (odds ratio=0.37). This suggests that these students may not be getting as much activity based learning as they would like, therefore reducing their attendance. Activity based learning has been shown to be an effective learning method in a wide variety of studies (see Crabtree and Silver, 2004) but it is expensive in terms of resources. For example, the student attendance survey presented here has been shown to be an effective class project for a Survey Sampling course over the years 2007 and 2008. The student's attendance at the course increased as a result of this activity based learning. Their engagement and satisfaction with the module was quite high. To quote the student's of 2007 in their report: "The survey we carried out was a huge success. Given the time constraints and the fact that this was the very first survey we had undertaken, we feel the exercise was an excellent achievement." The examination results also improved due to the introduction of the survey component in the module as can be seen in Table 7.

Table 7: Examination results for the Survey Sampling module from 2004–2009. Carrying out the attendance survey formed a component of the modules in 2007 and 2008.

Year	Homework $\%$	Exam $\%$	Survey $\%$	Average Score $\%$
2004/2005	41	51	n/a	50
2005/2006	48	56	n/a	55
2006/2007	47	54	n/a	54
2007/2008	67	75	97	76
2008/2009	57	64	77	68

In conclusion, we note the population under investigation in this study were Science students at an early stage in their studies. The results found in this study are of interest for this large cohort of students and can be used to further investigate student engagement which is an important aspect in drop out amongst early stage students. However, a much larger and more complex survey would need to be completed to extend the results to the UCD student population as a whole.

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Appendices

A Survey Methodology

A.1 Sample Size Selection

To be 95% sure that an estimate is in error by at most B, the sample size n is given by the formula

$$n = \frac{N\sigma^2}{(N-1)B^2/4 + \sigma^2}$$

where N is the population size and σ^2 is the variation in population.

For the 2007 survey, it was decided to use a sample size of 52 classes to give a 6% bound on the error of estimation. This was selected since it was desired to have the error of estimation as low as possible, but also because of the limitations of the survey sampling class size. As it was a small class of 15 people, it was impractical to consider sampling more than 3 or 4 classes per student. The sample size of 52 classes was then divided into 6 strata. It was decided to use the method of proportional allocation which assumes equal costs and variances for each stratum (Scheaffer et al., 2006).

The 2008 survey was conducted in a similar fashion. It was decided to sample 43 modules to give a bound on the error of estimation between 5% and 6%.

A.2 Attendance Rate Estimators

We let y_j refers to the attendance of class j and x_j refers to its enrolment. Then we consider $\operatorname{Var}(y_j/x_j) = \sigma^2/w_j$ where the weights are given by Method A: $w_j = 1/x_j$ Method B: $w_j = 1$ Method C: $w_j = 1/x_j^2$

The estimator for the mean proportion of attendance for stratum i for each method is given by

$$\bar{y}_i = \frac{\sum_{j=1}^{n_i} w_j x_j y_j}{\sum_{j=1}^{n_i} w_j x_j^2}$$

For all three methods the variance of the estimate \bar{y}_i can be estimated by

$$\hat{\text{Var}}(\bar{y}_i) = \frac{\sum_{j=1}^{n_i} w_j (y_j - \bar{y}_i x_j)^2}{\sum_{j=1}^{n_i} w_j x_j^2 (n_i - 1)}$$

In order to compute an average rate for the entire School of Mathematical Sciences the results of the six strata were combined. This was achieved using the following standard formulae:

$$\bar{y}_{st} = \frac{1}{N} \Sigma_{i=1}^L N_i \bar{y}_i$$

with estimated variance

$$\hat{\operatorname{Var}}(\bar{y}_{st}) = \frac{1}{N^2} \Sigma_{i=1}^L N_i^2 \hat{\operatorname{Var}}(\bar{y}_i)$$

where L = 6 is the number of strata.

B Questionnaire

Attendance Questionnaire

Please answer each question or tick one box throughout

Sex: Female

Age

General Information - Part time work

Do you have a part time job? yes no

If yes, how many hours do you work each week?

If yes, how do you feel your work affects your studies:

very damaging	1	2	3	4	5	very beneficial
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General Information - Residence and commuting

Are you living on campus?: yes no

If you are not living on campus, how many minutes do you typically spend commuting to and from the university each day?

Attendance at lectures

How many lectures of the 13 given so far have you missed for this module this semester? none $= 4 = 5.7 = 8.10 = 10$								
How do you feel the following affects your attendance?								
Bad weather making it unpleasant to travel -increased traffic-commuting time:								
Always affects $1 \ 2 \ 3 \ 4 \ 5 \ $ No affect								
Tired because of socialising the night before:								
Always affects $1 \ 2 \ 3 \ 4 \ 5 \ $ No affect								
Tired because of engaging in part-time work:								
Always affects $1 \ 2 \ 3 \ 4 \ 5 \ $ No affect								
Lecture on a Friday or Monday conflicting with travel home outside Dublin on weekends:								
Always affects $1 \ 2 \ 3 \ 4 \ 5 \ $ No effect								
Lecture on a Friday or Monday conflicting with planned social events:								
Always affects $1 \ 2 \ 3 \ 4 \ 5 \ $ No affect								
Lecture too early in the morning:								
Always affects $1 \ 2 \ 3 \ 4 \ 5 \ $ No affect								
The only lecture in your schedule that day making the commute not worthwhile:								
Always affects $1 \ 2 \ 3 \ 4 \ 5$ No affect								

Not interested in the lecture material:

Always affects 1 2 3 3 4 5 No affect
The lecturer not an effective communicator:
Always affects $1 \ 2 \ 3 \ 4 \ 5 \ $ No affect
Sickness:
Always affects $1 \ 2 \ 3 \ 4 \ 5 \ $ No affect
Once off other engagement e.g. wedding, funeral, doctor/dental appointment:
Always affects $1 \ 2 \ 3 \ 4 \ 5 \ $ No affect
A planned holiday:
Always affects $1 \ 2 \ 3 \ 4 \ 5 \ $ No affect
Other: please specify
How do you feel the following might improve your attendance ?
How do you feel the following might improve your attendance ? Rescheduling 9.00 am lectures:
How do you feel the following might improve your attendance ? Rescheduling 9.00 am lectures: Very effective $1 \ 2 \ 3 \ 4 \ 5 \$ No effect
How do you feel the following might improve your attendance ? Rescheduling 9.00 am lectures: Very effective $1 \ 2 \ 3 \ 4 \ 5 \ $ No effect No lectures on Fridays:
How do you feel the following might improve your attendance ? Rescheduling 9.00 am lectures: Very effective 1 2 3 4 5 No effect No lectures on Fridays: Very effective 1 2 3 4 5 No effect
How do you feel the following might improve your attendance ? Rescheduling 9.00 am lectures: Very effective 1 2 3 4 5 No effect No lectures on Fridays: Very effective 1 2 3 4 5 No effect More activity based learning i.e. students do tasks during lecture times:
How do you feel the following might improve your attendance ? Rescheduling 9.00 am lectures: Very effective 1 2 3 4 5 No effect No effect More activity based learning i.e. students do tasks during lecture times: Very effective 1 2 3 4 5 No effect
How do you feel the following might improve your attendance ? Rescheduling 9.00 am lectures: Very effective 1 2 3 4 5 No effect No effect More activity based learning i.e. students do tasks during lecture times: Very effective 1 2 3 4 5 No effect Lecture material made more interesting:

More campus housing becoming available:

Very effective	1	2	3	4	5	No effect
Not doing a Very effective	part-tin	me job: 2	3	4	5	No effect
Marks for a	ttendan	ce:				
Very effective	ve 1	2	3	4	5	No effect