Journal of Further and Higher Education

ISSN: 0309-877X (Print) 1469-9486 (Online) Journal homepage: http://www.tandfonline.com/loi/cjfh20

Lecture attendance rates at university and related factors

Gabrielle E. Kelly

To cite this article: Gabrielle E. Kelly (2012) Lecture attendance rates at university and related factors, Journal of Further and Higher Education, 36:1, 17-40, DOI: 10.1080/0309877X.2011.596196

To link to this article: http://dx.doi.org/10.1080/0309877X.2011.596196

Published online: 16 Aug 2011.

Journal of Further and Higher Education
Vol. 36, No. 1, February 2012, 17–40

Routledge
Taylor & Francis Group

Lecture attendance rates at university and related factors

Gabrielle E. Kelly*

School of Mathematical Sciences, University College Dublin, Belfield, Dublin 4, Ireland

(*Received 16 February 2010; final version received 14 September 2010*)

There is a perception that university students have changed dramatically in their modes of learning in recent years, mainly due to their widespread use of the Internet as an information source, the change in student body due to the greater accessibility of third level education and changes in experience in second level education. Lectures, however, remain the central mode of traditional teaching and learning at most universities and thus attendance at lectures continues to be a subject of considerable importance. However, few studies report actual attendance levels in any comprehensive way. Herein, levels of lecture attendance in the colleges of Science in University College Dublin are documented from two probability-based surveys. The results of a questionnaire recording the attitudes of students towards a range of factors that potentially affect attendance are also presented. Factors that continue to influence attendance, that are in the control of the university, such as living on/off campus, the lecture schedule in the students' timetable, day of the week and transport problems are revealed. Factors in students' personal lives, such as engagement in part-time work, irrespective of purpose, are seen to be related to satisfaction with studies and lecture delivery. Suggestions for active measures to increase the level of lecture attendance, appropriate to the present day, are made.

Keywords: attendance rates; ordinal logistic regression; living on campus; university logistics; personal determinants of attendance

1. Introduction

The lecture is the traditional and continues to be the central mode of teaching and learning in most universities. Lecture attendance is a significant issue in universities all around the world and the drivers of this have been the subject of a number of studies (e.g. Gump 2004; Dolnicar et al. 2009). Attendance rates of students at lectures has been studied 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;

*Email: Gabrielle.Kelly@ucd.ie

ISSN 0309-877X print/ISSN 1469-9486 online

http://dx.doi.org/10.1080/0309877X.2011.596196
http://www.tandfonline.com

Kirby and McElroy 2003; Marburger 2001; Rodgers 2001). For example, 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. Secondly, poor attendance can have an adverse effect on retention rates. Retention rates at universities have been the subject of many studies in particular because of economic implications. Ireland has experienced substantial increases in participation in higher education since the 1960s. In 2004 the national admission rate to higher education was 0.55, high by European standards (O' Connell et al. 2006). Ireland also has relatively high retention rates: 83% in 2004 (van Stolk et al. 2007), but in absolute numbers, drop-out involves 2000–3000 students annually with subsequent loss to the exchequer. The Irish higher education system is almost entirely funded by the state and since 1995 full-time undergraduate students have been exempt from tuition fees. A recent study of student retention in University College Dublin (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 12 months following entry. There have been similar studies and findings in the UK (Bennett 2003; Charlton et al. 2006; Harrison 2006) showing 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.

Thirdly, it is important because attendance reflects the students' motivation and satisfaction with their course, and whether or not they are engaged with their subject or are merely passing exams in a perfunctory way. It has also been shown that attendance may affect faculty morale (Friedman et al. 2001).

Studies on attendance of university students have found a number of reasons for missing class. These can be separated, as in Dolnicar et al. (2009), into university-related and student-related (including socio-economic and pedagogical) factors.

The accessibility of the university and transport problems were found by Kottasz (2005) to negatively affect attendance, while Kirby and McElroy (2003) found travelling more than 30 minutes to college had a positive impact on attendance. There are few reports on the effect of availability of on-campus accommodation, with its associated negligible travel time, on attendance and this is a factor that we study here. Timetabling of classes is an issue often quoted by students to explain absence, but optimal scheduling is still difficult to attain because of varying reports and different student requirements. Devadoss and Foltz (1996) found 10 am to 3 pm to be the optimum lecture times among agriculture students. Marburger (2001) reported higher levels of absenteeism on Fridays, with an increase of an average of 9% over the 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.

Among student-related factors, lecture quality is one of the most frequently cited reasons for non-attendance. Dolnicar et al. (2009) found the quality of the lectures as perceived by the student to be a factor in attendance in a group of marketing students. 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. Rocca (2004) studied the impact of the instructor's communication style on attendance and found instructor's immediacy to be positively related and their verbal aggressiveness to be negatively related to attendance. The intrinsic motivation of students to attend lectures has been explored in a number of studies. Moore et al. (2008) found that 60% of students gave reasons for non-attendance such as too tired, bad weather, engagement in social activities, which were classified as indicative of low motivation; 23% of students gave reasons that indicated moderate motivation (including putting higher priority on completing other assignments); and 17% indicated high motivation levels (illness or family bereavement). Gump (2004) reported all of these motivational factors in their study.

Another factor commonly reported by researchers to be related to non-attendance is students' engagement in part-time work. Friedman et al. (2001) and Kirby and McElroy (2003) found that the number of hours worked had a negative effect on attendance. Both university and student factors listed above are potentially changeable, so establishing whether these factors have an influence on attendance or not is an important part of any policymaking within a university. In addition, an exploration of students' motivational levels may indicate how they may be improved and changed.

Because the twenty-first century has seen many changes, in particular the advent of new technologies and changes in student life, there is a perception that lectures may no longer be relevant (Dolnicar et al. 2005) and that attendance is declining. However, reported estimates vary widely, perhaps because they relate to single subject groups of students and/or are taken at a single time-point (Marburger 2001; Kirby and McElroy 2003; Massingham and Herrington 2006). More comprehensive estimates are needed. It is also necessary to examine what the present major drivers of attendance are and if they have changed. Many studies have focussed on single factors influencing attendance and even when they are studied in combination, as in Dolnicar et al. (2009), it is unclear if there are synergetic effects (i.e. interaction terms are not modelled). Other studies, as described above, are limited in that they survey single subject groups of students only and/or have poor response rates.

In this study, we have two specific objectives. Lecture attendance rates are established using two objective surveys of students in the sciences at UCD for every year of their programme, whilst controlling for the factors:

time of day, day of week and class size. Because the attendance is monitored in a number of groups, the possibility of the confounding with year of programme, time in the semester and social conditions that arise in single group studies is avoided. In addition, the problems of bias and non-response with studies that rely on students' self-reported data is overcome by the objective attendance survey component of this study. Secondly, an overview of the determinants of attendance, as identified in the literature, are studied simultaneously for a cohort of first year students. With a response rate of almost 100%, this establishes for 'good' attenders and 'bad' attenders alike, the current major determinants of their attendance patterns. In studies with high non-response rates, perhaps it is the non-attenders who mostly do not respond, thus potentially biasing the results.

The objectives are studied by the analysis of data from UCD students. A demographic profile of UCD students at entry in 2006 can be found in Blaney and Mulkeen (2008). Briefly, approximately half of all students are female; the median age at entry is 18.75 years; 63.5% live at home; 50% come from Dublin and a further 15% from counties adjacent to Dublin, i.e. commuting distance; 27% are from the higher professional socio-economic group; 19% are in receipt of state funding which is on a means-tested basis and 53% took up their first preference course.

We obtain data from two sources. Firstly, the students of the survey sampling module at UCD conducted a survey of attendance rates (using a simple head count) 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, as described above, was completed by students of a level 0 module at the time of their mid-term examination 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 2.1. The methods for analysis of the questionnaire are described in Section 2.2. The results of both surveys and the questionnaire are presented and compared in Section 3. We conclude, in Section 4, with a discussion of the results of the analysis contained herein.

2. Methods

2.1. Survey and Questionnaire

The survey in 2007 was conducted in week 7 of semester one, commencing on 22 October. 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: levels 0/1modules from 9–11 am (stratum 1); level 2 modules from 9–11 am (stratum 2); levels 3/4 modules from 9–11 am (stratum 3); level 0/1 modules, from 11–8 pm (stratum 4); level 2 modules, from 11–8 pm (stratum 5) and levels 3/4 modules, from 11–8 pm (stratum 6). Each stratum thus consisted of clusters with a cluster being the students enrolled in a module. As is common in stratified random sampling, the strata were chosen so as to be as homogenous as possible within and heterogenous between, using factors found to be relevant in published reports on timetabling listed in Section 1 and the students' own experiences (Scheaffer et al. 2006). The number of strata/factors were limited due to logistical problems in conducting the survey – in particular time constraints and sample size. Note, also, that students in level 0 and 1 modules are all first year students – modules at level 0 are taught at a more introductory level than those at level 1. Modules at level 3 and 4 are similar in that they are compulsory for most students in attendance as part of their degree programmes and have very few students taking them as electives; this is also cited in Gump (2006). 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 1.

The organisation 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 (each student was assigned a number of modules with associated date and time and did a head count of attendance) and in the discussions about the survey. 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 modules were excluded. The frame was subdivided into the following strata: Monday from 9–11 (stratum 1); Monday from 11–6 (stratum 2); Tuesday, Wednesday and Thursday from 9–11 (stratum 3); Tuesday, Wednesday and Thursday from 11–6 (stratum 4); Friday from 9–11 (stratum 5) and Friday from 11–6 (stratum 6). The rational for the choice of strata was as above and also drew on the results of the 2007 survey. A simple random sample was selected from each stratum again using proportional allocation and the organisation 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 2 and it is organised into three sections. The first has questions regarding age, sex, part-time work, commuting time, living on/off campus and a question on attendance at lectures (self-reported). Secondly, there are a number of more specific questions regarding what affects attendance (on a scale of 1–5, always affects to no affect), including timetabling and weather. Finally, there are questions regarding what would improve attendance, including teaching strategies (on a scale of 1–5, very effective to no effect).

2.2. 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 (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.

A cumulative logistic model is given by:

$$\begin{aligned} \text{logit } [P(Y \leq j/x)] &= \log\,(P(Y \leq j/x)/(1 - P(Y \leq j/x))) \\ &= \alpha_j + \beta^T x,\ j = 1, \ldots, 4 \end{aligned}$$

and links the cumulative probabilities of the response categories of Y (cumulative logits) to the covariates x. Note $P(Y \leq j/x)$ is the probability attendance falls into categories j or below, for covariate values x. A model for $\text{logit}[P(Y \leq j/x)]$ alone is an ordinary logistic model for a binary response, in which categories 1 to j form one outcome and categories j+1 to 5 form the second. The model above uses all 4 cumulative logits in a single parsimonious model. Each cumulative logit has its own intercept α_j. The α_j are increasing in j, since $P(Y \leq j/x)$ increases in j for fixed x.

This model assumes the same effects parameter (β) for each logit and a score test is carried out on this proportional odds assumption. The coefficients $\beta^T = (\beta_1, \beta_2, \ldots, \beta_p)$ quantify the effect of each covariate on the cumulative categories. A positive coefficient indicates the probability of attendance in categories j or below increases as the covariate increases, a negative coefficient indicates it decreases and a zero value indicates no effect. The coefficients can be interpreted in terms of odds: if two students 1 and 2 have covariates x_1 and x_2 respectively, the odds of student 1 making a response $\leq$ j are $\exp[\beta^T (x_1 - x_2)]$ times the odds of student 2.

3. Results

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.

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 refer to the attendance of class j and x_j refer to its enrolment in a particular stratum then the estimator

Table 1. Results from the survey of modules 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	15	3,4	11–8	78	5.4

Note: Overall attendance rate 56% (±4.1%).

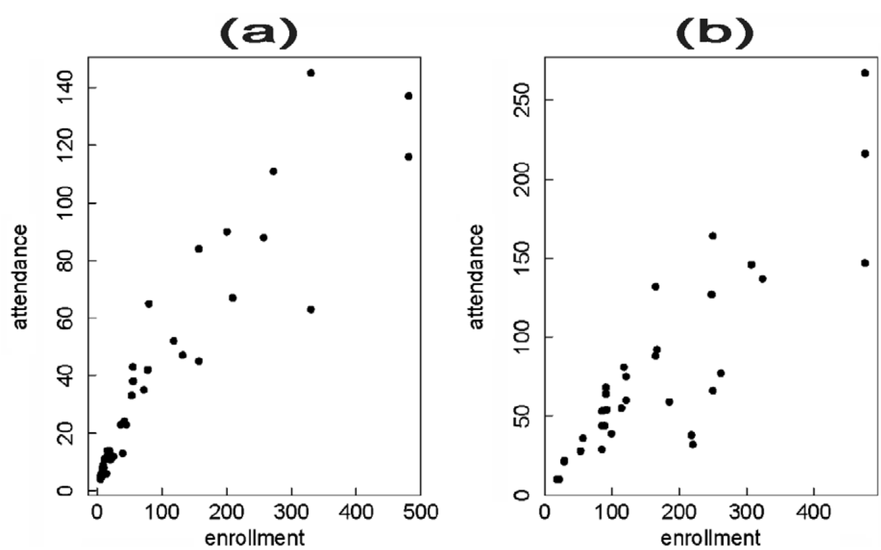

Figure 1. Attendance is plotted versus enrolment for modules in (a) the Survey in 2007 and (b) the Survey in 2008.

of the attendance rate for that stratum is given by $(\Sigma_j\ y_j)/(\Sigma_j\ x_j)$. 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 1.

At the end of the sampling week, there were a total of six missing values. Two of these 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. However, the desired bound on the error of estimation of the overall estimate was achieved (Table 1).

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 was 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. We note, however, that the desired bound on the error of estimation of the overall estimate was achieved (Table 2), as the sample size chosen initially was based on conservative calculations.

Summary statistics on the questionnaire are displayed in Table 3. The results on attendance can be compared to the 2008 survey for levels 0/1 and are slightly at variance with it. Attendance rate calculated from the

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

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

Note: Overall attendance rate 56% (±4.1%).

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

Female %	48.4
Male %	51.6
Part-time job %	39.0
Males	41.0
Females	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 effects %	21.9
Lecture too early in 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 effects %	6.5
Lecture too early in morning – affects or always affects %	40.4
Only lecture that day – always affects %	16.9
Bad weather – always affects %	20.2
Socialising	
Tired because of socialising – always effects %	4.9
Once off engagement – always effects %	21.7
Planned holiday – always effects %	16.7
Attendance: No. 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 lecture material – no effect %	37.8
– always effects %	7.7

(*Continued*)

Table 3 (*Continued*)

Lecturer not an effective communicator – always effects %	14.0
More activity based learning – very effective %	30.7
More interesting material – very effective %	47.0
Timetabling	
reschedule 9.00am – very effective %	50.2
no Friday lectures – very effective %	52.9
Marks for attendance – very effective %	55.2

questionnaire is much higher than from the survey (≈ 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 on 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 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 socialising 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.

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

Source	DF	Chi-Square	Pr > Chi-Square
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
Job*activity	1	5.43	0.0198

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.

Effect	Point estimate	Odds ratio	95% Wald confidence limits	Pr > Chi-Square
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

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. Additional analyses were conducted separately for those with/without a job and those on/off campus. Because of the large number of covariates and with each covariate having 5 categories a more parsimonious and essentially equivalent model for representing the data was conducted where covariates were dichotomised 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 dichotomised 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 cumulative 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 model was valid. The significant predictors ($p \leq 0.05$), their estimated coefficients, odds ratios and confidence intervals are reported in Table 4 and Table 5.

For example in Table 5, the student's response to the question on weather was dichotomised into no effect: 5, or some effect: < 5. Those in the < 5 group had an odds of a lower response of 0.25 that of the 5 group i.e. a greater odds of higher response i.e. missing more lectures. The significant effects can be interpreted as follows (the *p*-values for the effects are also reported):

University related factors:

- The impact of classes being early in the day differs for students who live on/off campus $p < 0.0001$. For students living on campus, those who responded 'an early lecture always affects' had a higher probability of lecture attendance whereas for students living off campus the reverse was true.
- Females who live on campus have a higher probability of lecture attendance than males who live on campus $p = 0.0041$.

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

Effect	Point estimate	Odds ratio	95% Wald confidence limits	Pr > Chi-Square
Interest < 5 vs 5	−0.9504	0.3866	0.1502 − 0.9950	0.0488

- For students living on campus, those who report travelling on weekends having an effect have a lower probability of attending classes $p = 0.0085$. For those living off campus there is no difference.
- 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 $p = 0.0636$; this factor just misses the significance level of 0.05.

Student related factors:

- 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 $p < 0.0001$. The weather effect did not have a significant interaction with other factors, including living on/off campus.
- Students without a job who responded that more activity based learning as very effective had a lower probability of attending lectures than those who responded otherwise $p = 0.0198$.
- 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).

4. 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% (±4.1%) and in the early stage modules in the two UCD science colleges at 49% (±4.4%).

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 year students take many optional modules that they drop after their first year and that contribute little to their final degree GPA. Blaney and Mulkeen (2008) cite 'wrong course choice' as the most influential factor in student drop-out at UCD, indicating as here, academic interest is a serious consideration for these students. 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 and 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. Thus, 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. It is interesting to note that in the study of retention of UCD students (Blaney and Mulkeen 2008), the second noteworthy factor students cited for non-completion was negative experiences of social and environmental aspects of college life. Our results are in agreement with this, as we found students give a high priority to socialising at weekends. In contrast, Yorke and Longden (2004) show that students at British universities are more concerned with factors such as failing exams and financial concerns.

The 2008 survey showed a decrease in attendance rate as enrolment increased. However, the trend was very slight: a linear regression of attendance on enrolment 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 contexts.

We note that in the 2008 survey, despite missing values, low standard errors for estimates were achieved, as the strata were quite homogenous within.

The overall attendance rate determined from the survey of classes is lower than students' self-reported attendance rate in the questionnaire ($\approx$74%). 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).

There are few reports on attendance rates and they tend to be for individual groups of students: Kirby and McElroy (2003) reported an attendance rate at lectures of approximately 46% for first year economics students; Massingham and Herrington (2006) reported levels varying from 7% to 70% for commerce students; Marburger (2001) in the US reported an attendance rate of 81.5% in a principles of microeconomics course. Many reports are also mainly based on a single time point in a week. However, our results show wide variation can be expected with year of programme, day-of-week and time of day.

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 may be related to the findings of Kottasz (2005) who found students may be absent in order to fulfil other university assignments. Timetabling should take this into account and schedule more than one lecture per day per student, if possible. In particular, for higher level students, where class sizes are small and groups are more homogenous in terms of their timetable, this is not difficult to achieve.

The other primary university factor that influenced attendance to emerge from this study, apart from scheduling, was living on/off campus. Campus accommodation is only available to those not in commuting distance (~35%) of Dublin. In this study 14% of students lived on campus. Living on campus has a positive effect on attendance at early morning classes (odds ratio = 14). Similarly, 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 travelling on the weekend has a negative effect on attendance (odds ratio = 0.20). Blaney and Mulkeen (2008) report the highest retention rates are for students living on campus. 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.

Delaney et al. (2007) surveyed Irish students in higher education institutes in 2006/2007, measuring the living conditions and demographic and social background characteristics of the students (as part of a larger European survey). They found Irish men experience higher levels of adjustment difficulties than women when it comes to college. It is possible that this effect is greater for men not living at home. In UCD 63.5% of incoming students lived at home in 2006, in comparison to a national average of 36% living with their parents or relatives in Delaney et al. (2007). This study found students living on-campus, go home regularly on weekends, and for all students transport is important in terms of being able to commute from home or visit at weekends. The effect of living on campus and its interaction with other factors (financial and social) is of interest for universities who are planning on expanding their on campus accommodation facilities. Delaney et al. (2007) found students not living in the parental home scored lower on a number of health, mental well-being and life satisfaction issues than students who did live at home, as well as having lower levels of satisfaction with accommodation and finances. However, living on campus increases attendance in general, so the availability of on campus accommodation has the potential to improve student engagement with their studies.

The student factors related to attendance in this study were part-time work and weather. 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. The Delaney et al. (2007) survey reported 45% of full-time Irish students worked during term time with an average of 12 hours worked per week. The average number of hours worked in this study was similar, 12.9, and was also similar to Kirby and McElroy (2003) who reported a figure of approximately 12 hours. Delaney et al. (2007) found the majority of Irish students come from professional and senior manager/official backgrounds (63%) and 14% from the semi-skilled or unskilled manual group with 30% in receipt of state funding. The proportion from the latter socio-economic class is probably smaller in this study as evidenced by only 19% of UCD students in receipt of state funding (which is means tested) in 2006. The reliance on part-time employment as a financing source is one of the key features of the Irish education system (Hochschul-Informations-System 2005). Students spend most of their money on accommodation, followed by food and alcohol. However, Delaney et al. (2007) found levels of employment to be similar among the different social classes. In the survey of early leavers by Blaney and Mulkeen (2008), which asked students to rate 21 different factors on their decision to leave, financial difficulties ranked only 13 for the 2005 and 9 for the 2006 cohorts. This survey did report a link between lower socio-economic class and early withdrawal, perhaps arising from poor academic coping skills (Yorke and Longden 2004).

Overall, a large percentage of students reported that having a job is neither damaging nor beneficial to their studies, a finding supported by Devadoss and Foltz (1996), Bennett (2003) and Dolnicar (2005), who found no significant effect of a job on college performance. In contrast, Friedman et al. (2001), Kirby and McElroy (2003), Kottasz (2005) and Massingham and Herrington (2006) reported a negative impact of students work commitments. The Delaney et al. (2007) found the effects of working up to 20 hours a week do not seem to be important but that there were substantial negative effects beyond that. However, interestingly, we found that having a job, in combination with other factors, was associated with class attendance. We found 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. The traditional lecture format has begun to be increasingly criticised and there has been a paradigm shift away from teaching to an emphasis on learning in the field of education (O'Neill and

McMahon 2005). Activity-based learning has been shown to be an effective learning method in a wide variety of studies (see Hall and Saunders 1997; Crabtree and Silver 2004; Kelly, 2010) but it is expensive in terms of resources.

We also found students who had a job were affected by whether or not the lecture was interesting and perhaps these students have a wider range of life experiences that needs to be acknowledged in the learning situation. In addition, Devadoss and Foltz (1996) and Dolnicar (2005) proposed these students were self-funding and more likely to attend classes to get 'value for money'. This has implications for the issue of university fees, a subject of current media attention, which is usually only seen in a narrow context of immediate cost to the exchequer, while its effect on student motivation is largely ignored. Other studies (Friedman et al. 2001; Kottasz 2005; Massingham and Herrington 2006; Dolnicar et al. 2009) have found that students are more likely to attend lectures that they perceive as high quality. These studies, however, did not distinguish between students with and without part-time work or parents' educational background (i.e. did not include this interaction term in their statistical analyses), factors of great relevance in any proposed changes in lecture formats that will be inclusive of the needs of all students.

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). 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. An interesting result here is that weather did not have a significant interaction with other factors, including living on or off campus. Thus, it seems it is not related to difficulty in travel, and Moore et al.'s (2008) understanding that weather as a reason for missing class as indicative of low motivation may be correct. No other student factors indicative of low motivation e.g. too tired, social activities, were found to be related to attendance in this study, unlike Moore et al. (2008).

We note that quality of the lecturer was not a factor in explaining attendance in this study. This is not surprising, because similar to the results of Dolnicar et al. (2009), the factor 'lecturer not an effective communicator' and the factor 'lecture quality needs to be made more interesting', were highly correlated. The factors differed in that quality of the lecturer had a slightly lesser effect on attendance. One explanation for this is that a student may find the same lecture delivered by two different lecturers interesting, although one of the lecturers may be poorer in terms of delivery.

Although many of the issues discussed here have also been considered by many other authors, our study has two important features. Firstly, the attendance data is based on objective surveys and not on self-reports by students, which our questionnaire showed to over-estimate attendance rates.

Secondly, our questionnaire has almost a 100% response rate because all students (other than a few due to personal reasons such as illness) were present at their mid-term examination. Thus, it incorporates data from non-attenders, who perhaps are more likely not to respond to a general questionnaire, for reasons of lack of motivation and being more likely to drop-out. Many studies, in a wide range of contexts, have found differences between respondents and non-respondents. For example, in the Iowa Women's Health Study, 41,836 women responded to a mailed questionnaire in 1986. Bisgard et al. (1996) compared those respondents to the 55,323 non-respondents and found that the age-adjusted mortality rate and the cancer rate were significantly higher for the non-respondents than for the respondents. The study on lecture attendance by Dolnicar et al. (2009) based on an email questionnaire to undergraduate students at an Australian university had a 29% response rate. Thus, even though it based its results on a large sample size of 2175 students, results may have an inherent systematic bias as non-responders may respond quite differently. Moreover, the responses on attendance at lectures are self-reported. Similarly, Delaney et al. (2007) had approximately 3000 respondents but only an 8% response rate.

Our study has certain limitations. We note in the survey data, that for some modules (mostly level 0 and 1), enrolment numbers 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 questionnaire component of this study is based on self-reported data and, as noted above, this may lead to biases when reporting attendance. There is however, a certain consistency in the responses to other questions. For example, students who travel on weekends report Friday lectures affect attendance, consistent with Table 3. Similarly, responses on questions related to illness and engagement in social activities do not seem inherently biased, when looked at in conjunction. Also, in retrospect, the effect of the student's ability on attendance was not considered (as measured perhaps by the grades achieved when entering the university) nor the student's interest in a subject (perhaps measured by whether the student is studying a course for which they expressed high preference on their university application). However, the latter may only be of relevance for Level 0/1 students as we found attendance rates to be very high among students at a higher level, where they have committed to a certain degree programme. Pedagogical issues were not explored in-depth in our survey but the finding of an interaction with part-time work is an interesting one requiring further exploration. Income from part-time work and its uses could also be explored further. The positive effect of living on campus on lecture attendance found here needs to be disentangled somewhat from the well-being effect of living at home found in Delaney et al. (2007).

In conclusion, the results of our study have identified a few key areas where changes may be implemented in order to enhance attendance. At the university level logistically these are, provision of on-campus housing, timetabling and an investigation into student fees. At the educational level, lecture quality needs to be made interesting and perhaps other modes of teaching and learning appropriate in the twenty-first century such as activity-based learning conducted on a larger scale. We note the population under investigation in this study were science students and the results are of interest for this large cohort of students and can be used to further investigate student engagement which is an important aspect in college 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 body as a whole with its differing faculties and professional degrees.

Acknowledgements

I am indebted to my colleague Professor Brendan Murphy for helpful suggestions and references in relation to this work. I would also like to thank two referees for insightful comments that greatly improved this manuscript.

Notes on contributor

Gabrielle E. Kelly is a senior lecturer in statistics in the School of Mathematical Sciences at University College Dublin. In addition to a PhD in statistics she has a Higher Diploma in education.

References

Agresti, A. 2002. *Categorical data analysis*. 2nd ed. Hoboken, NJ: Wiley.

Bennett, R. 2003. Determinants of undergraduate student drop out rates in a university business studies department. *Journal of Further and Higher Education* 27: 123–41.

Bisgard, K., A. Folsam, C. Hong, and T. Sellers. 1996. Mortality and cancer rates in nonrespondents to a prospective study of older women: 5-year follow-up. *American Journal of Epidemiology* 139: 990–1000.

Blaney, C., and S. Mulkeen. 2008. *Student retention in a modular world*. Dublin: UCD Registry, University College Dublin.

Charlton, J.P., C. Barrow, and P. Hornby-Atkinson. 2006. Attempting to predict withdrawal from higher education using demographic, psychological and educational measures. *Research in Post-Compulsory Education* 11: 31–47.

Cohn, E., and E. Johnson. 2006. Class attendance and performance in principles of economics. *Education Economics* 14: 211–33.

Crabtree, H., and J.A.K. Silver. 2004. Can student retention and progression be improved by active participation in learning? *Innovative Learning in Action* 2: 11–6.

Delaney, L., A. Bernard, C. Harmon, and M. Ryan. 2007. *Eurostudent survey III: Report on the social and living conditions of higher education students in Ireland 2006/2007*. Dublin: Higher Education Authority.

Devadoss, S., and J. Foltz. 1996. Evaluation of factors influencing student class attendance and performance. *American Journal of Agriculture Economics* 78: 499–507.

Dolnicar, S. 2005. Should we still lecture or just post examination questions on the web? The nature of the shift towards pragmatism in undergraduate lecture attendance. *Quality in Higher Education* 11: 103–15.

Dolnicar, S., S. Kaiser, K. Matus, and W. Vialle. 2009. Can Australian universities take measures to increase the lecture attendance of marketing students? *Journal of Marketing Education* 31: 203–11.

Friedman, P., F. Rodriguez, and J. McComb. 2001. Why students do and do not attend classes. Myths and realities. *College Teaching* 49: 124–33.
Gatherer, D., and F.C.R. Manning. 1998. Correlation of examination performance with lecture attendance: A comparative study of first-year biological science undergraduates. *Biochemical Education* 26: 121–3.
Gump, S.E. 2004. The truth behind truancy: Student rationales for cutting class. *Educational Research Quarterly* 28: 50–8.
Gump, S.E. 2006. Guess who's (not) coming to class: Student attitudes as indicators of attendance. *Educational Studies* 32: 39–46.
Hall, J., and P. Saunders. 1997. Adopting a student-centred approach to management of learning, In *Implementing flexible learning*, ed. C. Bell, M. Bowden, and A. Trott, 85–94. London: Kogan Page.
Harrison, N. 2006. The impact of negative experiences, dissatisfaction and attachment on first year undergraduste withdrawal. *Journal of Further and Higher Education* 30: 377–91.
Hochschul-Informations-System. 2005. *Euro student: Social and economic conditions of student life in Europe 2005.* Hanover, Germany: Hochschul-Informations-System.
Kelly, G.E. 2010. An activity-based learning third-level course on survey sampling. *Educational Studies* 36: 461–4.
Kirby, A., and B. McElroy. 2003. The effect of attendance on grade for first year economics students in University College Cork. *Economic and Social Review* 34: 311–26.
Koslowsky, M., Z. Scheinberg, A. Bleich, M. Mark, A. Apter, Y. Danon, and Z. Solomon. 1994. Predicting actual weight from self-report data. *Educational and Psychological Measurement* 54: 168–73.
Kottasz, R. 2005. Reasons for students' non-attendance at lectures and tutorials: An analysis. *Investigations in University Teaching and Learning* 2: 5–21.
Marburger, D.R. 2001. Absenteeism and undergraduate exam performance. *Journal of Economic Education* 32: 99–109.
Massingham, P., and T. Herrington. 2006. Does attendance matter? An examination of student attitudes, participation, performance and attendance. *Journal of University Teaching and Learning Practice* 3: 82–103.
Moore, S., C. Armstrong, and J. Pearson. 2008. Lecture absenteeism among students in higher education: A valuable route to understanding student motivation. *Journal of Higher Education Policy and Management* 30: 15–24.
O'Connell, P.J., S. McCoy, and D. Clancy. 2006. Who went to college? Socio-economic inequality in entry to higher education in the Republic of Ireland in 2004. *Higher Education Quarterly* 60: 312–32.
O'Neill, G., and T. McMahon. 2005. Student centred learning: What does it mean for students and lecturers? In *Emerging issues in the practice of university learning and teaching*, ed. G. O'Neill, S. Moore, and B. McMullin, 28–36. Dublin: AISHE.
Rocca, K.A. 2004. College student attendance: Impact of instructor immediacy and verbal aggression. *Communication Education* 53: 185–95.
Rodgers, J.R. 2001. A panel-data study of the effect of student attendance on university performance. *Australian Journal of Education* 45: 284–95.
Scheaffer, R.L., W. Mendenhall III, and R.L. Ott. 2006. *Elementary survey sampling*. 6th ed. Kent, Boston: Duxbury.
Timmins, F., and M. Kaliszer. 2002. Absenteeism among nursing students – fact or fiction? *Journal of Nursing Management* 10: 251–64.
Trotter, E., and C.A. Roberts. 2006. Enhancing the early student experience. *Higher Education Research & Development* 25: 371–86.
van Stolk, C., J. Tiessen, J. Clift, and R. Levitt. 2007. *Student retention in higher education courses: International comparison*. Technical Report. Cambridge: Rand Corporation.
Yorke, M., and B. Longden, eds. 2004. *Retention and student success in higher education.* Buckingham, UK: Society for Research into Higher Education and Open University Press.

Appendix 1. Survey methodology

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:

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

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 (conservative estimate). 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.

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% (conservative estimate).

Attendance rate estimators

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

$$\text{Method A}: w_j = 1/x_j$$
$$\text{Method B}: w_j = 1$$
$$\text{Method C}: w_j = 1/x_j^2$$

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:

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

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:

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

with estimated variance:

$$\mathrm{Var}(\bar{y}_{st}) = \sum_{i=1}^{L} N_i^2 var(\bar{y}_i)$$

where L = 6 is the number of strata.

Appendix 2. Questionnaire

Please answer each question or tick one box throughout.

Sex:
Female ☐ Male ☐

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

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 effect

Lecture too early in the morning:
Always affects 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐ No effect

The only lecture in your schedule that day making the commute not worthwhile:
Always affects 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐ No effect

Not interested in the lecture material:
Always affects 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐ No effect

The lecturer not an effective communicator:
Always affects 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐ No effect

Sickness:
Always affects 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐ No effect

Once off other engagement e.g. wedding, funeral, doctor/dental appointment:
Always affects 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐ No effect

A planned holiday:
Always affects 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐ No effect

Other: please specify

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:
Very effective 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐ No effect

Lecture material made more interesting:
Very effective 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐ No effect

More campus housing becoming available:
Very effective 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐ No effect

Not doing a part-time job:
Very effective 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐ No effect

Marks for attendance:
Very effective 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐ No effect