# WHEN PROCRASTINATION LEADS TO DROPPING OUT: ANALYSING STUDENTS AT RISK

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## ABSTRACT:

Higher education is a very expensive process which creates highly qualified citizens, a key asset in our information society. Nevertheless, in some cases, the educational system fails to provide the appropriate support to all learners. Dropout rates are very high, resulting in frustration for both the learner and for institutional managers. This problem is even worse at distance/online universities, as students can take breaks for one or more semesters, procrastinating in what it is supposed to be their main goal for ensuring success: maintaining an adequate enrolment pace, which puts them in a risk situation. In this paper we analyse the relationship between taking a break and dropping out for several undergraduate degrees at an online university. Results show that the risk of extending a break too long and finally dropping out is very high during the first few semesters, where most dropouts occur. By using the appropriate policies and strategies, higher education institutions can detect students at risk and try to improve retention through a better understanding of the dropping out drama.

## KEYWORDS:

procrastination, dropping out, breaks, enrolment, retention, time management, e-learning, higher education

## INTRODUCTION

From an institutional perspective, dropping out of university is very important, as it needs to be seen as a failure of the university system to generate an outcome (graduates) with the considerable quantity of public resources invested. However, financial costs of dropping out[1] are only part of the total costs: non-pecuniary (or affective) costs – which can only be guessed – are also important for non-graduates (Johnes, 1990).

After a first approach, it can be noticed that university dropout is a multidimensional phenomenon that needs to be correctly defined before a deep analysis and correction of its causes is tackled. One of the authors who puts most emphasis on the creation of a doctrine of university dropout is Vincent Tinto (Tinto, 1975). Tinto mentions the importance of reaching a good definition of university dropout, placing the importance of such a definition on a level with the importance of detecting the causes of dropping out:

> *"Despite the very extensive literature on dropout from higher education, much remains unknown about the nature of the dropout process. In large measure, the failure of past research to delineate more clearly the multiple characteristics of dropout can be traced to two major shortcomings; namely, inadequate attention given to questions of definition and to the development of theoretical models that seek to explain, not simply to describe, the processes that bring individuals to leave institutions of higher education."*

Nowadays, high levels of university dropout are a concern for the majority of governments with developed higher education systems. For example, in Spain, the Conference of Spanish University Rectors (CRUE)[2] has defined the dropout rate in an arbitrary way as the percentage of students, with respect to the total of students enrolled for these degrees in their first semester, who have not enrolled for the academic year when they should theoretically have finished the degrees or the following year. This definition applies indistinctly to "brick-and-mortar" and online universities. This definition assumes that students advance smoothly each semester, taking all predetermined subjects, which, is, by no means, the reality at distance universities.

Although the definition of the CRUE may be valid for "brick-and-mortar" universities, where the main priority of most students, above other professional or family duties, is studying, it does not seem that it can be valid in the same way for online and/or distance universities, where the majority of students have more work and family commitments, and where the existence of breaks (semesters without enrolment) therefore seems much more likely[3]. The main difficulty lies in the fact that, faced with several successive semesters of non-enrolment by a given student, it cannot be said with certainty that the student has definitively dropped out of the degree, as it may be that a longer or shorter break is being taken. It should therefore be concluded that the official definition of dropping out in Spain does not reflect the particular features of online higher education.

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1. We use the term "dropout" and "dropping out" interchangeably.
2. Conferencia de Rectores de las Universidades Españolas (CRUE). (2010). Universidad Española en Cifras. Madrid.http://www.crue.org/export/sites/Crue/Publicaciones/UEC2010VOLI.pdf
3. In the case of the UOC, a 100% virtual university, in the majority of cases the real duration of the degrees is double the theoretical duration. The academic requirements for remaining on the degree do not stand in the way of this (contrary to the situation at some brick-and-mortar universities), nor do they prevent students taking a break between two academic semesters.

In addition, it is interesting to note that some definitions of dropout in e-learning appear in the bibliography (for example Castles (2004) defined dropout students "as those who had formally withdrawn, had left without notifying the university, or did not complete a course during a semester", or Levy (2007), as the students who "voluntarily withdraw from e-learning while acquiring financial penalties", but neither of them takes into account the actual enrolment behaviour of students.

Academic procrastination is defined "as intentionally deferring or delaying work that must be completed" (Schraw, Wadkins, & Olafson, 2007). Understanding procrastination in the sense of taking a break of one or more semesters, it can be observed that this is not uncommon at distance universities (due to their relaxed enrolment requirements), as students have more opportunities to decide how many subjects they take each semester and their pace. In Grau-Valldosera and Minguillón, (2011), a new definition of dropping out is introduced for online higher education (using UOC as a case study), taking into account the aforementioned issues; that is, the particular features of students and also the possibility of taking breaks procrastinating at semester level. This definition falls into the category "Time personalization (rhythms, adaptive time, acceleration, etc.)" defined by Gros et al. (2010), where time factor in e-learning is analysed. Using this definition we can clearly establish a line between those students just taking a break and those starting a long break that leads them into dropping out. According to Michinov et al. (2011), it is interesting to pair the concept of "taking a break" with that of procrastination, translating the temporal dimension from the subjects to that of the degree.

As time (of inactivity) is the leitmotiv behind the ad-hoc definition for dropout that has been arrived at, some of the variables that can

eventually be related to dropout as descriptors or even as causes would also be related to the time-factor "macro-variable". For example, time management skills were detected as predictors of persistence studies in a questionnaire of 60 items (Holder, 2007), while the tendency towards procrastination/disengagement "is often associated with deficiencies in the processes of self-regulation", and would also be a factor that can affect the learning and performance and that can potentially cause dropout (Michinov,Brunot, Le Bohec, Juhel & Delaval, 2011). Other variables like time availability or time constraints (Romero, 2011) would be more external, that is, more imposed by the environment (Lee & Choi, 2011).

This paper is structured as follows: Section 2 describes the methodology we have followed for analysing the relationship between taking a break and dropping out. In Section 3 we describe the data sets used in the experiments, as well as the discussion of the analysis performed on such data sets. Finally, in Section 4, we summarize the conclusions that may be drawn from the results obtained in the analysis and the current and future research lines related to this topic are outlined.

## METHODOLOGY

### EMPIRICAL DEFINITION OF DROPPING OUT

To analyse dropping out, we only need to know whether or not a student is enrolled on a specific degree during a specific semester. Therefore, only the "IDP" (student ID), "semester of enrolment" and "degree" fields are needed to generate an "enrolment record" for each student. Once arranged, these records have the following coding (as an example, a random record is selected):

IDP;1;1;1;0;1;0;0;0;0;0;0;0;0

Where the first field is the student's IDP and then a binary string for the semester record ("1" = student enrolled at least in one subject during that semester, "0" = student not enrolled in any subject). In this case, this student was enrolled during her three first semesters, then she took a break for one semester, she enrolled again for one semester and then never enrolled again during the next 8 semesters. The trail of zeros shows that this student has been inactive for several semesters, but she is still a potential student if she decides to enrol again.

The specific nature of this string is that, for analysis purposes, all enrolment sequences have been aligned in the "same starting position", that is, the first semester when each IDP is enrolled for each degree is considered to be the same for all students for this degree. In other words, we analyse student data as if all students were a single cohort. Obviously, the first element after IDP is always "1" (the first enrolment of each student). Notice that the sequences "IDP;1;0;0;0;0;0;0" and "IDP;1;0;0" are different in the sense of the quantity of information they contain, as more enrolment history about the first student is available for analysis (specifically, 7 semesters as opposed to 3). Our goal is precisely to determine the minimum length of the trailing zeros that best captures dropping out.

Once the enrolment sequences file of each degree is generated, the frequency of break sequences (that is, of sequences of one or more "0") can then be analysed. This is performed using a pattern information analysis process that detects the longest break sequence (with "1;0;...;0;1" format) within each enrolment sequence of each individual, with the particular feature that if, for example, a student has taken a break once for 5 semesters and for another 2 a semester later, she will only be calculated as having taken a break over 5 semesters (that is, the longest break). Notice that this process does not take graduates into consideration,

as they could be considered as taking a break or abandoning their studies, when they have in fact obtained their degree. Similarly, as has been stated before, from a degree performance perspective, students are considered to have dropped out of a particular degree even if they move to another one.

In order to define dropping out, we are interested in establishing a threshold for what we consider a reasonable break period, which may be shorter or longer from degree to degree, depending on the enrolment-break behaviour of its students. This threshold is established based on the accumulated proportion (i.e. estimated probability) of students returning to their degree after taking a break of "N" consecutive semesters. We establish an upper boundary for this value of 5% which can be seen as a maximum error rate in classifying students as dropouts once they have taken a break of N or more semesters in a specific degree. Then, we compute N according to this boundary as the smallest number of consecutive breaks we have to wait until we can say that a student will drop out with an error of less than 5%. The details of this procedure can be found in (Grau-Valldosera and Minguillón, 2011).

### TAKING A BREAK VS DROPPING OUT

Procrastination is defined as "intentionally deferring or delaying work that must be completed" (Schraw, Wadkins & Olafson, 2007). Additionally, they note the fact that "although research in this domain has yielded mixed results, most studies report negative correlations between procrastination, grades, learning, and completion of course work" (Howell et al., 2006). In this paper, the temporal dimension of the semester, which is the usual time frame in which procrastination is analysed, is widened to that of the degree. That is, we analyse "inter-semester" procrastination

rather than "intra-semester" one, although both timeframe levels are probably related. Then, for a given N and a specific semester (namely S), we can analyse the sequence of semester enrolments for each student, starting from such semester S, as follows:

| IDP | 1st sem | … | (S-1)th sem | Sth sem |
|-----|---------|---|-------------|---------|
| idp | 1 | … | 1 | X |

| … | (S+N-1)th sem | … | Last sem |
|---|---------------|---|----------|
| … | Y | … | Z |

In the Sth semester, students may be enrolled (X=1) or taking a break (X=0). If X=1 we deduce that students are not dropping out in the semester S (maybe they will drop out later but not in that semester). If X=0 we analyze the sequence of N consecutive semesters starting (and including) semester S. As previously defined, if we find N consecutive breaks (that is, Y=0 for all the N semesters starting in semester S), we can conclude that the student drops out.

Nevertheless, we will use all available information, in order to not count students taking a break of length N or greater but continuing later as dropouts (there is at least one Z=1 from the S+N semester until the last semester we have information from such student).

Suppose N=5 and S=2 (the simplest case: dropping out after the first semester or, equivalently, in the second semester). Table 1 describes the different situations we can find when analysing data according to the enrolment pattern. Then, for a given semester S we can classify students according to Table 1 and generate a 2x2 contingency table, as follows:

| Break vs dropping out | Does not drop out in Sth semester | Drops out in Sth semester |
|-----------------------|-----------------------------------|---------------------------|
| Does not take a break during the Sth semester | $N_{00}$ | $0^1$ |
| Takes a break during the Sth semester | $N_{10}$ | $N_{11}$ |

Finally, we can estimate the following probabilities:

$$P_{11} = P(\text{dropping out}) = N_{11} / (N_{00} + N_{10} + N_{11})$$
$$P_{10} = P(\text{taking a true break}) = N_{10} / (N_{10} + N_{11})$$
$$P_{1|1} = P(\text{dropping out}|\text{taking a break}) = N_{11} / (N_{10} + N_{11})$$

Here, $P_{11}$ is the estimated probability of dropping out in a given semester. According to preliminary dropping out analysis, we expect this figure to decrease across the number of semesters and achieving a "basal" level. On the other hand, $P_{10}$ is the probability of taking a true break (that is, not dropping out after such break). We want to analyse whether this probability varies with time. Finally, $P_{1|1}$ is the conditional probability of dropping out as the

**Table 1.** Possible situations according to enrolment data.

| IDP | Sequence | Situation |
|-----|----------|-----------|
| IDP2 | 1;1;X;…;X | This student does not take a break during the 2nd semester. She therefore does not drop out in the 2nd semester. |
| IDP2 | 1;0;0;0;0;0;…;0 | This student has 5 consecutive zeros starting from the 2nd semester and she never enrols again. We therefore determine that she drops out in the 2nd semester. |
| IDP3 | 1;0;0;0;0;0;X;…;1;…;X | This student has 5 consecutive zeros starting from the 2nd semester but she later enrols again. We do not know whether she will be dropping out or not, but we determine that she does not drop out in the 2nd semester. |

result of taking a break. Once again, we assume this probability to be very high in the first semesters and to decrease with $P_{11}$.

In the following Section we will compute these probabilities for different degrees, varying the semester S from 2 to the maximum available data (that is, until one of the $N_{xx}$ is zero and we cannot compute the conditional probabilities). We will also analyse whether there are statistically significant differences between degrees.

# EXPERIMENTS

## DATA SETS

We have used all the available data from the five most popular degrees at the Universitat Oberta de Catalunya, namely Business Science, Humanities, Law, Psychology and Technical Engineering (both branches, Computer Management and Computer Science, altogether). This data has been gathered since 1996 up to 2010, prior to the radical change in higher education introduced by the Bologna Process. Table 2 shows, for each degree, its

duration in semesters, the number of students enrolled on the degree and the computed N as described in (Grau-Valldosera and Minguillón, 2011). Taking all this data into consideration, we can extend our analysis, varying S from semester 2 to semester 15. However, as the number of students with available enrolment data decreases with the number of semesters, probabilities computed for large Ss (12 or more) need to be considered as indecisive for analysis purposes.

Table 3 shows the number of students advancing through the second and third semester. Notice that we do not use data for all students, but only for those with enough enrolment data (i.e. with at least N+1 semesters) in order to determine whether they drop out or not according to the definition in (Grau-Valldosera and Minguillón, 2011). This means students with partial records are not included in the analysis.

Notice that after the first semester, there are 13,601 students who drop out (27.3%), which is a respectable figure. Furthermore, after the second semester, accumulated dropping out rises to 18,413 students (37.0%), which means that one out of three students does not continue after the first year[5]. This figure is

**Table 2.** Duration, number of students and number of consecutive breaks in order to determine a dropout for each degree.

| Degree | Duration (semesters) | Number of students | N |
|---|---|---|---|
| Business Science | 6 | 18,608 | 5 |
| Humanities | 8 | 6,582 | 5 |
| Law | 8 | 5,535 | 5 |
| Psychology | 8 | 8,407 | 3 |
| Technical Eng. CM/CS | 6 | 12,604 | 5 |
| Total | --- | 51,736 | --- |

4. Students not taking a break are, by definition, not dropping out.

5. A 2010 report from the UNESCO Chair in Higher Education Management and Policy at the Universitat Politécnica de Madrid shows that dropping out (according to the official definition) states that the dropout rate for Catalan universities ranges from 21% up to 33% approximately. Available at http://catedraunesco.es/escuela/Inicio_files/dossier.pdf

**Table 3.** Number of students (and percentages) taking a break or dropping out for the second and third semesters..

| Degree | $N_s$ 2nd sem | True breaks | Drop-outs | $P_{1|1}$ | $N_s$ 3rd sem | True breaks | Drop-outs | $P_{1|1}$ |
|---|---|---|---|---|---|---|---|---|
| Business Science | 18,240 | 1,188 (6.5%) | 4,713 (25.8%) | 79.9% | 11,261 | 899 (8.0%) | 1,560 (13.9%) | 63.4% |
| Humanities | 5,396 | 330 (6.1%) | 1,529 (28.3%) | 82.2% | 3,321 | 278 (8.4%) | 488 (14.7%) | 63.7% |
| Law | 5,301 | 372 (7.0%) | 1,324 (25.0%) | 78.1% | 3,444 | 227 (6.6%) | 445 (12.9%) | 66.2% |
| Psychology | 8,401 | 494 (5.9%) | 2,407 (28.7%) | 83.0% | 5,496 | 354 (6.4%) | 947 (17.2%) | 72.8% |
| Technical Eng. CM/CS | 12,459 | 1088 (8.7%) | 3,628 (29.1%) | 76.9% | 7,649 | 705 (9.2%) | 1,372 (17.9%) | 66.1% |
| Total | 49,797 | 3,472 (7.0%) | 13,601 (27.3%) | 79.8% | 31,171 | 2,463 (7.9%) | 4,812 (15.4%) | 66.1% |

**Figure 1.** Probability of dropping out.
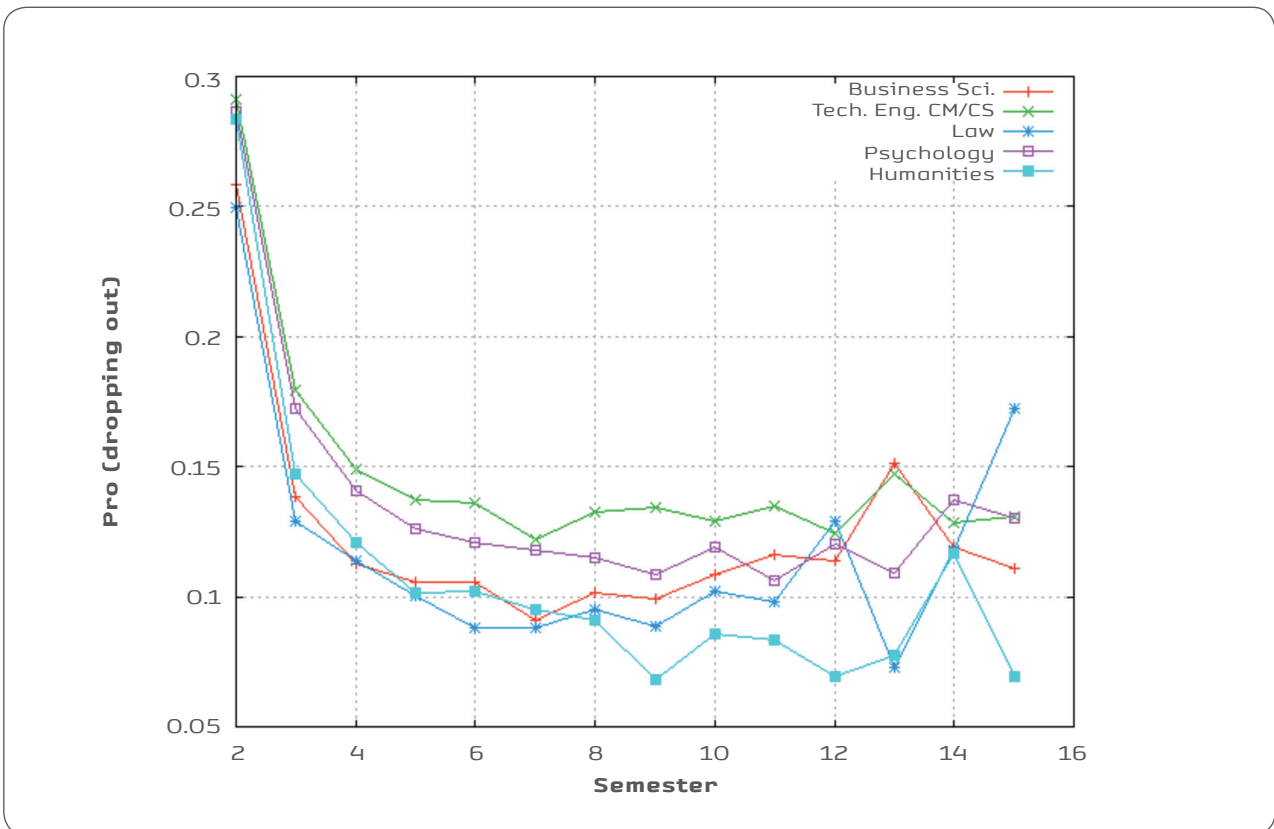
comparable to those for other distance learning providers. For instance, the UK Open University reported a dropout of 45% approximately after the first semester (Ashby, 2004). However, it must be taken into account that, as stated in Lee & Choi (2011), "although online learning has gained immense popularity and attention, recent studies indicate online courses have

significantly higher student dropout rates than conventional courses (Levy, 2007)".

Figure 1 shows the probability of dropping out for a given semester. Notice that we compute this probability assuming that the student was enrolled during the previous semester, so we start with S=2 (i.e. the 2nd semester). In other words, S means "student was enrolled in

semester S-1 but decided not to take semester S and dropped out". These are "true" dropouts, that is, the student has no further enrolments.

Notice that all degrees, even though they have particular features and differences, show similar behaviour. The probability of dropping out is very high the 2nd semester, then rapidly decreases until it reaches a relative plateau in approximately the 6th semester. It is not surprising that figures stabilize after the 6th semester, as this number coincides with the expected duration of the degree. In fact, preliminary experiments show students at UOC usually enrol in half the number of subjects each semester, so, on average, they double the expected degree duration. It is reasonable to think that students reaching the 6th semester with half the degree "in the bag" have a different mindset to students in their first few semesters. This fact may be used to explain

dropping out using two different approaches: during the first four or five semesters, dropping out may be caused by the clash between the student (becoming a student again for adult learners with different expectations and personal situation) and the institution (methodology, support, etc.); on the other hand, after the 6th semester, dropping out may be caused by attrition: that is, students that foresee that they will take too long to finish their degree and become disappointed.

On the other hand, Figure 2 shows the probability of taking a true break, that is, a student taking one or more subjects during semester S-1, not taking any during semester S but then enrolling again in semester S+1 or later.

In this case, it can be seen that the probability of taking a true break increases with time, but

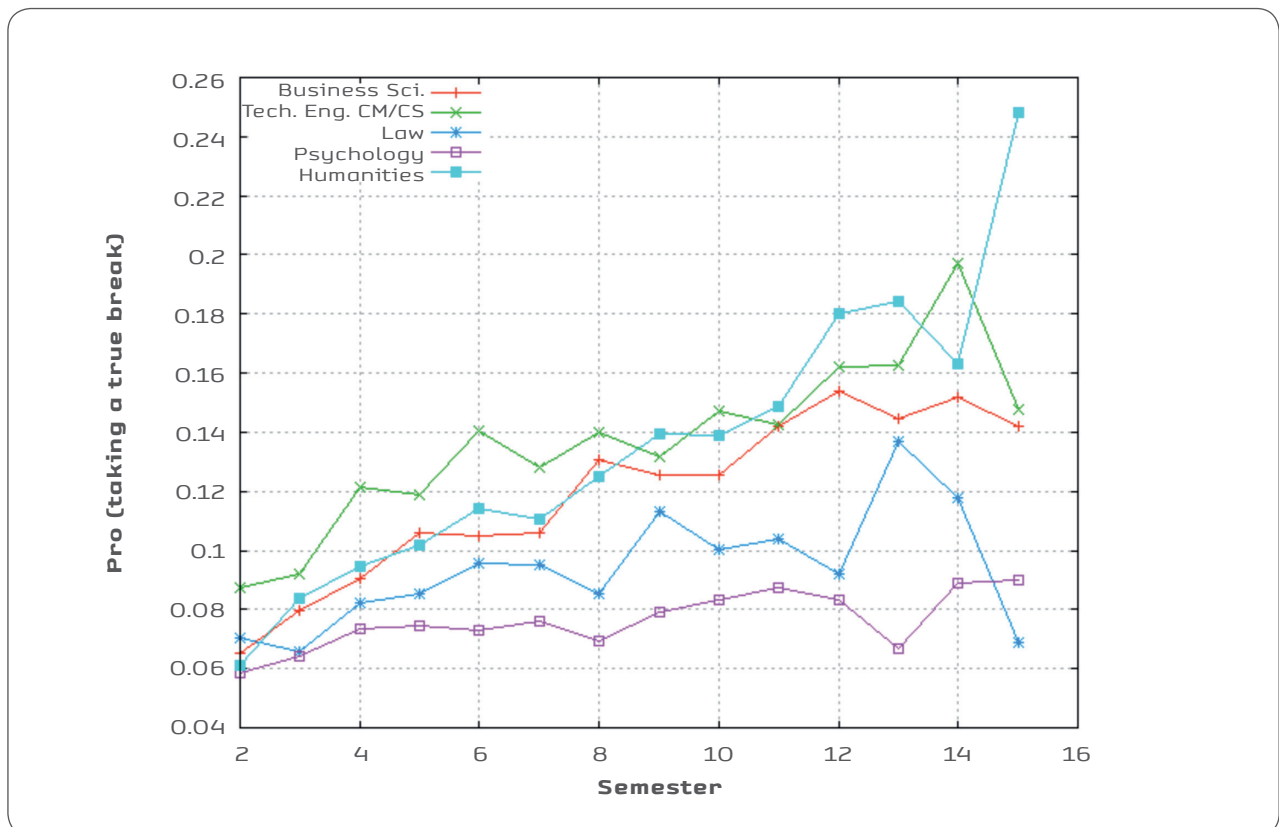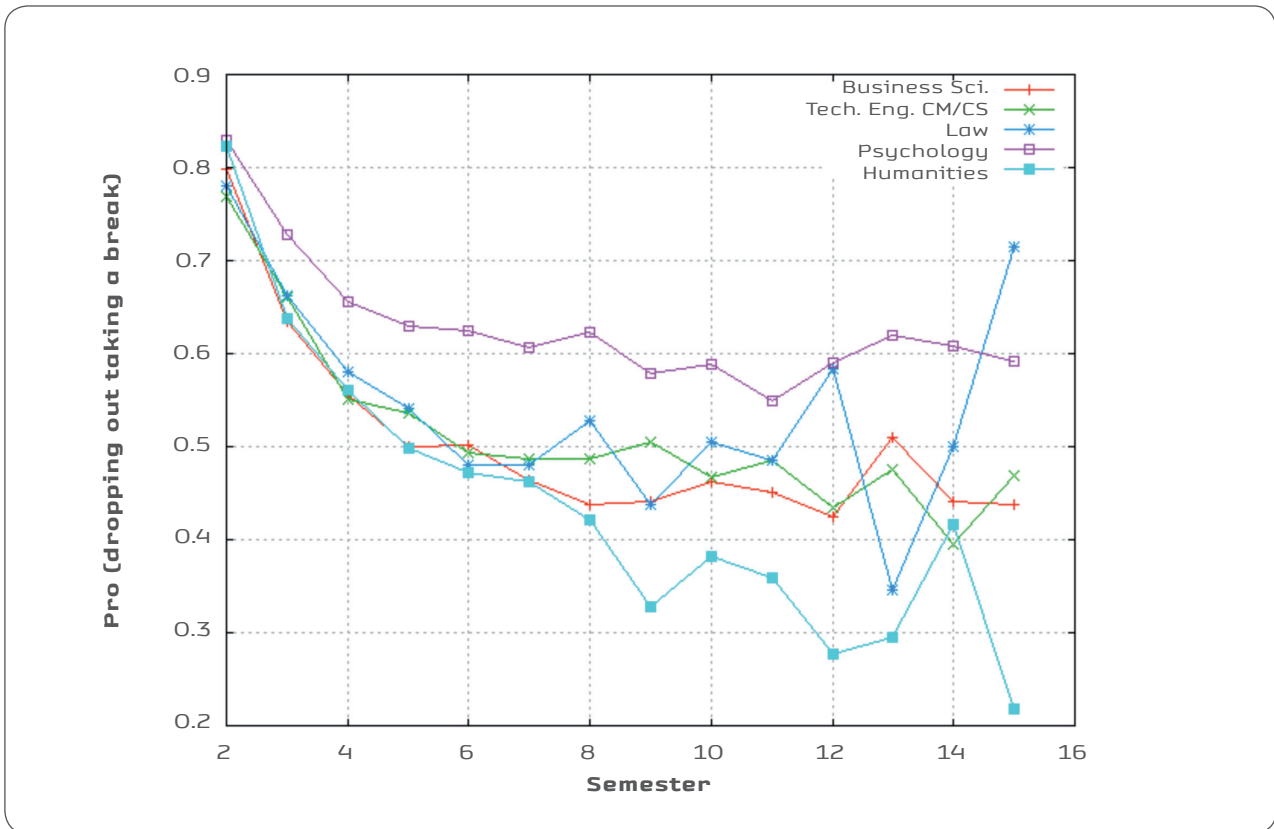**Figure 2.** Probability of taking a true break (i.e. not dropping out).

**Figure 3.** Probability of turning a break into a dropout situation.



at a different pace for each degree. However, from a wider perspective, Figure 2 shows that dropout behaviour seems to have a similar pattern among the various degrees.

Finally, Figure 3 shows the conditional probability of dropping out in semester S provided there is a break in that semester (in other words, this would be the probability that this break it is not a "true" break, triggering a dropout situation).

Notice that, once again, that all degrees seem to follow a common pattern for dropping out when starting a break, which is very high in the first six semesters and then stabilizes. It is also remarkable that for the Psychology degree, the probability of dropping out when starting a break is higher that the probability of it being a true break (as it is always higher than 0.5). On the other hand, the other degrees

follow almost exactly the same behaviour, except the Humanities degree, where the probability of dropping out continues to reduce with time.

**DIFFERENCES BETWEEN DEGREES**

In order to explain differences between degrees, we build a Generalized Linear Model using the following approach. We generate a dummy variable for each one of the available degrees, which will be 1 for students taking such degrees and 0 for the rest; that is, we convert a categorical variable (degree) with 5 different values into 5 different binary variables. In fact we only need 4 dummy variables as what we do is compare the differences between one degre and the others. We code these dummy variables as BS, HU, LA, PS and TA, following the same order than in Table 2.

According to Table 3, the Law degree is the one with the lowest dropout rate during the 2nd semester. If we build a generalized linear model using dropout as the dependant variable and BS, TE, PS and HU as the independent variables (that is, removing LA), we obtain the following results:

```
Deviance Residuals:
 Min 1Q Median 3Q Max
-0.8297 -0.8217 -0.7732 1.5708 1.6657

Coefficients:
 Estimate Std. Error z value Pr(>|z|)
(Intercept) -1.09987 0.03173 -34.664 < 2e-16
***
BS 0.04551 0.03596 1.266 0.206
HU 0.17201 0.04381 3.926 8.63e-05 ***
PS 0.18749 0.03986 4.703 2.56e-06 ***
CS 0.21028 0.03736 5.629 1.81e-08 ***
---
Signif. codes: 0 '***' 0.001 '**' 0.01 '*'
0.05 '.' 0.1 ' ' 1

(Dispersion parameter for binomial family
taken to be 1)

 Null deviance: 58397 on 49796 degrees of
freedom
Residual deviance: 58331 on 49792 degrees of
freedom
AIC: 58341

Number of Fisher Scoring iterations: 4
```

Notice that HU, PS and CS show strong differences with respect to LA, while BS does not (at a 0.05 significance level). We can repeat this analysis taking one of the degrees at a time, and the results obtained are equivalent: LA and BS degrees have a dropping out behaviour during the 2nd semester which is different to HU, PS and CS degrees.

If we repeat the same procedure for the probability of taking a true break during the 2nd semester, using PS as the baseline for building the model, we obtain the following results:

```
Deviance Residuals:
 Min 1Q Median 3Q Max
-0.4275 -0.3815 -0.3670 -0.3553 2.3806

Coefficients:
 Estimate Std. Error z value Pr(>|z|)
(Intercept) -2.77297 0.04638 -59.794 < 2e-16
***
BS 0.10897 0.05524 1.973 0.04852 *
HU 0.04175 0.07334 0.569 0.56912
LA 0.18897 0.07101 2.661 0.00778 **
CS 0.42624 0.05619 7.585 3.32e-14 ***
---
Signif. codes: 0 '***' 0.001 '**' 0.01 '*'
0.05 '.' 0.1 ' ' 1

(Dispersion parameter for binomial family
taken to be 1)

 Null deviance: 25,190 on 49,796 degrees of
freedom
Residual deviance: 25,105 on 49,792 degrees
of freedom
AIC: 25,115

Number of Fisher Scoring iterations: 5
```

In this case it can be seen that the BS, LA and CS degrees show differences (at a 0.05 level), while HU does not (with respect to PS). Therefore, taking into account both behaviours at the same time (dropping out or taking a true break), we obtain three different groups: 1) LA and BS; 2) HU and PS; 3) CS. Notice that this analysis does not say anything about the degrees or the causes that may lead to dropout, it is merely an indication that there is strong evidence that degrees should be analysed separately.

## CONCLUSIONS

Dropping out is a serious problem that higher education institutions need to understand better so they can combat it. In a distance learning scenario, dropout figures are even worse, as students do not have the pressure to enrol every semester because the enrolment requirements are usually more relaxed. *A priori*, this "inter-semester" procrastination could be seen as something positive to help students self-regulate their learning pace

within a degree. In this paper we have analysed the relationship between taking a break in a given semester and the probability of never enrolling again; that is, dropping out the same semester.

In the light of the results from Section 3, we can state that there is a strong relationship between taking a break and dropping out, especially for the first four semesters, where the probability of dropping out knowing that the student is taking a break is bigger than the probability of not doing so. Therefore, even though taking a break is a natural and reasonable decision at a distance university, it is a very strong warning sign about the possibility of such a break being "extended", finally leading to dropping out. Higher education institutions such as UOC should establish policies for promoting the retention of students taking a break in the second semester, as four out of five students (see Table 3) not enrolling after the first semester are true dropouts. Had the institution been able to "rescue" just one out of these four drop-outs over all these years, it wouldthave saved more than 3,000 studentsdfrom dropping out after the first semestes.

On the other hand, we have also shown that there are significant differences betweensdegrees. Educational institutions need to tackle dropping out as an overall concern, but "one-size-fits-all" solutions cannot be applied, astdro-out rates differ from one degree to another, probably because of different underlying causes.

Current and future research in this topic should include the characterization of students according to the situations described by Table in order to see whether there is a "typical" profile for dro-outs or not. The evolution of such profile with respect to semester is also an interesting topic, as the reasons for dropping out will probably be different (clash vs attrition plus other unexpected causes). Obviously, building a complex model for dropping out, including information about the student and her academic performance during the previous semester, is also a very interesting topic. Among the reasons that can explain thetdro-out phenomenon, time-factor related variables like time-management abilities, time flexibility or time availability will presumably have an important role. Finally, further analysing the differences between degrees is also necessarydto achieve a better understanding of the true nature of dropping out.

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74