

## STUDENT DROPOUT RATE IN ENGINEERING EDUCATION STUDY PROGRAM

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**Abstract.** The students' dropout is an important topic in many countries, because the country wastes the taxpayers' money and the proportion of graduated people. The purpose of this paper is to analyze the causes of the first study course students' dropout rates at the Latvia University of Agriculture using the data of the engineering science faculties from 2012 to 2014. Information about the students' study duration in months, age, gender, competition mark sum was included in the data analyses. The proportional hazard model or Cox model was used for evaluation of the students' dropout causes. The students' dropout rate is associated with the faculty or subject studied at the university (study program curriculum), gender and competition mark sum. There is significant difference between average competition mark sums of dropout students and continued study students. During the first academic year 26 % of the students on average leave the university, where the highest students' dropout rate between the engineering science faculties was 47.6 % in 2012-2014.

**Keywords:** hazard model, dropout rates, higher education.

### Introduction

There are many studies that investigated the students' dropout rate and the reason of it. According to the American Society for Engineering Education there are three key reasons why 40 to 50 percent of engineering science students' dropout: poor teaching and advising; difficulty of the engineering curriculum; and a lack of "belonging" within engineering [1]. The Italian university reform led to significant changes in the supply of university education, as the result it has the key role in reducing of the dropout rates [2]. The rates of dropout at the Spanish universities are 40 %, and, in the case of humanities and technical sciences like Software Engineering, the registered rates are higher and even exceed 60 % [3]. The difficulties of the engineering curricula is associated with the studied topics such as mathematics and physics [4] and as different studies show the students' dropout rate depends on the studied subject at the university as well as the pre-college academic qualification [5; 6].

The university dropout is an important topic in many countries, as well as in Latvia, because it is one of the criteria for evaluating higher education institutions and students' dropout can be flawed measures of institutional effectiveness. As Di Pietro and Cutillo study shows [7], higher education goes in the direction to reduction of the study standards and increasing the number of graduation students. Unfortunately, this kind of strategic policy of higher education institutions may increase the number of graduation students, but not necessarily the quality of the graduated students.

The purpose of this paper is to analyze the students' dropout rate during the first study year and students dropout causes using the three year data of engineering science faculties at the Latvia University of Agriculture (LUA).

### Materials and methods

The data set includes 953 full-time students from three faculties of engineering science enrolled in 2012, 2013 and 2014 at the Latvia University of Agriculture (LUA). Information about the students' study duration (month), gender, sum of secondary school marks (school marks) was included in the data set. Students' dropout has been defined in situations when a student who had registered for a study program leaves the university during the first academic year. Situations in which the students had left the university for a study break were not considered to be a dropout and therefore were eliminated from the analysis.

Information about the student distribution by model factors and the number of dropout students and students who started the 2<sup>nd</sup> study year is reported in Table 1, where 257 students dropout during the first study year. There is difference between the year and the students' dropout range from 7.0 % in 2013 and till 39.6 % in 2012. Male students have the highest rates of leaving the faculties; as well the students' dropout depends on the faculty.

Table 1

**Characteristics of the categorical variables for the sample based on the number of individuals**

Variables	<i>n</i>	Started the 2 <sup>nd</sup> study year	Dropout
Total	952	695 (73.0 %)	257 (27.0 %)
Year			
2012	341	206 (60.4 %)	135 (39.6 %)
2013	313	291 (93.0 %)	22 (7.0 %)
2014	298	198 (66.4 %)	100 (33.6 %)
Faculty of			
Rural Engineering	341	264 (73.1 %)	97 (26.9 %)
Engineering	313	245 (74.9 %)	82 (25.1 %)
Information Technologies	298	186 (70.5 %)	78 (29.5 %)
Gender			
1 – male	764	535 (70.0 %)	229 (30.0 %)
2 – female	188	160 (85.1 %)	28 (14.9 %)

For students dropout rate causes the following Survival analysis methods were used:

- Log-rank test was used to compare two and more groups survival curves and
- Proportional hazard model to determine whether the factors influence student dropout.

The proportional hazard model (Cox model) was used for evaluation of the students dropout causes:

$$h_i(t) = [h_0(t)] e^{(b_0 + b_1x_{i1} + b_2x_{i2} + b_3x_{i3} + b_4x_{i4})}, \quad (1)$$

where  $h_i(t)$  – hazard rate for the  $i^{\text{th}}$  case at time  $t$ ;

$h_0(t)$  – baseline hazard at time  $t$ ;

$b_j$  – value of the  $j^{\text{th}}$  regression coefficient;

$x_{i1}$  – gender (1-male, 2-female) ;

$x_{i2}$  – faculty (of Rural Engineering, Engineering, Information Technologies) ;

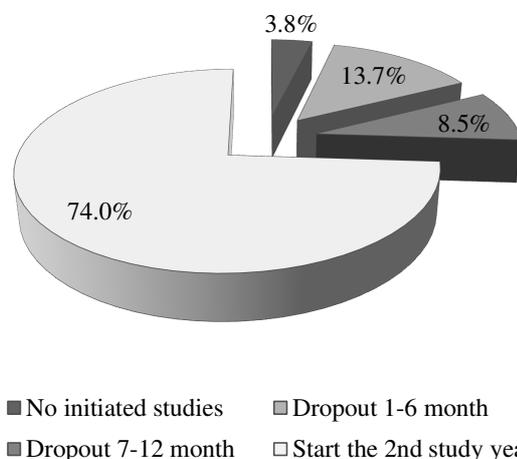
$x_{i3}$  – academic year (2012-2013; 2013-2014; 2014-2015) ;

$x_{i4}$  – secondary school marks.

Interaction effects of year\*faculty, year\*marks and marks\*faculty were included to the model. Statistical analyses were carried out with the program IBM SPSS Statistics 20, IBM, New York, USA.

**Results and discussion**

The number of students decreases over the study time and the censored students' proportion after the first study year in 2012-2014 is 74 % at the engineering faculties. During the first academic year 26 % of the students leave the university (Fig. 1).



**Fig. 1. Proportion of censored (start 2<sup>nd</sup> study year) and uncensored (dropout) students during the study year ( $n = 952$ )**

During the three years 3.8 % of the students did not initiate the studies. One of the reasons for that is that all potential students may choose several programs during the application process and they change their opinion before the study, as well as they may start to study at another faculty or study program. The students' dropout rate during the first six months is 13.7 % and it reaches their highest peak in the 5<sup>th</sup> and 6<sup>th</sup> months or after the first exam period, when the students did not pass some exams. At the same time 17.5 % of all first year students have not started the second semester. Relatively high percentage of students have decided not to continue their studies and left the university during the first academic year.

The students' dropout risk is associated with the faculty and subject studied at the university or the study program curriculum. Based on our data, the student dropout depends on the year and the faculty. The number of students enrolled to the university in different faculties has decreased over time – students leave the faculty every month, and at the end of the first academic year from 7.2 % to 47.6 % of the students left the faculties of the university.

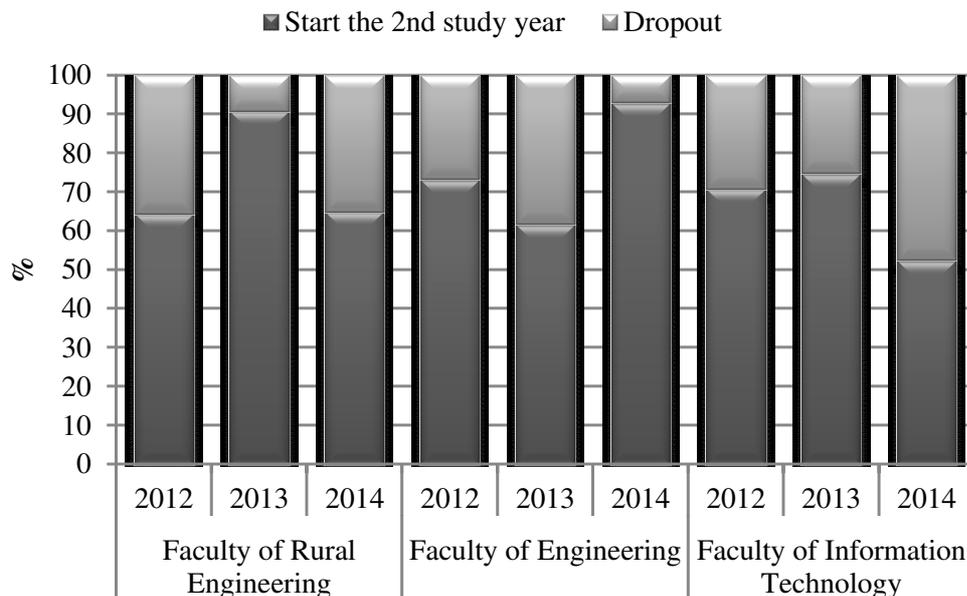


Fig. 2. Proportion of dropout students and students who started the 2<sup>nd</sup> study year in different faculties and years

Students leave the faculties every month, for example, the highest students' dropout rate 47.6 % and 38.4 % were accordingly in 2014 at the Faculty of Information Technologies and in 2013 at the Faculty of Engineering. Fig. 2 shows that the smallest dropout rate was in 2014 at the Faculty of Engineering (7.2 %) and in 2013 at the Faculty of Rural Engineering (9.3 %). At the LUA the engineering study program curriculum contains mathematics and physics and these subjects have important influence on the dropout among the students, because the level of the student knowledge in mathematics and physics is insufficient. As our previous study shows in 2011 the highest proportion of dropping out students was at the Faculty of Information technologies (51.6 %), whereas the students of the Faculty of Engineering and the Faculty of Rural Engineering have the smallest students' dropout rate, accordingly 24.3 % and 33.1 % [8].

The students' competition marks sums are on the range between 91 and 429 with average 225.9 for the students who continued the 2<sup>nd</sup> study year and 196.3 points for the dropout students. The competition marks sums include the points in Latvian and foreign languages as well as for engineering study programmes the points in mathematics. Students, who leave the faculties, on average, are with lower competition marks sums (Fig. 3). The average competition marks sums in different years and faculties are in the range from 164.7 till 209.3 points, for example, the highest average competition marks sum for the dropout students' was in 2014 at the Faculty of Information Technologies and the difference between average competition marks sums of the dropout students and continued study students is only 25 points. It means that not only the knowledge level but other factors as well

influence the students' dropout, sometimes the students did not have the motivation to study or the study process was not what they had expected.

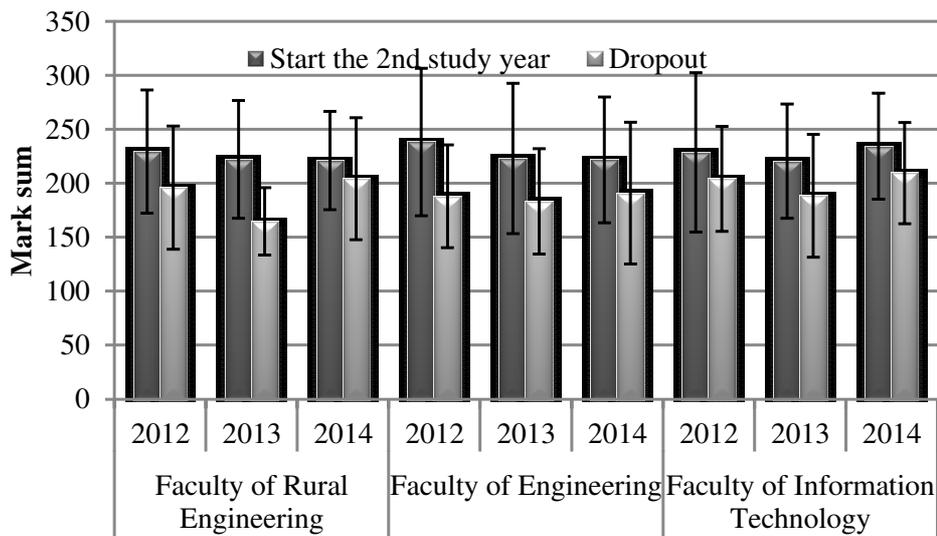


Fig. 3. Average secondary school marks of dropout students and students who started the 2<sup>nd</sup> study year in different faculties and years

The students' dropout rate can be affected by different factors. Each factor was analysed independently by the Long-rank tests. Summary results of the Log-rank test show that there are differences between survival curves for different study years and gender, and no differences between survival curves for the faculties (Table 2). However, the factors of the finance source and priority were not statistically significant in our previous investigation and these factors were not included in the analysis.

Table 2

Long-rank test statistics for equality of survival distributions for groups

Variables	Chi-Square	df	Significance
Year	99.483	2	0.000
Faculty	1.396	2	0.497
Gender	15.671	1	0.000

According to our investigation by the Survival analysis, one of the most important causes of students' dropout is the students' secondary school grades (Table 3). The students with higher marks have a lower dropout rate than the students with lower marks ( $p < 0.001$ ). A negative sign of the coefficient  $b$  means that the hazard rate (risk of dropout) is reduced. The students with higher school marks are associated with better survival than the students with low marks. The estimated coefficient  $b$  for school marks is equal  $-0.008$  with Hazard rate  $e^{-0.008} = 0.994$ . The regression coefficient of the school mark variable refers to decrease in the hazard rate for increase of 1 in the value of the school mark. The estimated hazard or risk of dropout decreases by  $100\% - (100\% * 0.994) = 1.16\%$  for a one mark unit or  $11.6\%$  for a ten mark unit.

In Chimka et al. [9] investigations students with greater English ACT (a standardized test for high school achievement) and Science ACT scores are more likely to graduate engineering science and in Chimka and Lowe [10] paper it has been reported that greater mathematics scores increase the probability of graduation among female students. The estimated hazard rate for males is  $e^{0.798} = 2.22$  of that of females; that is, the male dropout risk is 2.2 times higher than female ( $p < 0.001$ ). Dickson [11] reported that engineering is a historical male dominated field and in his investigation there were not significant differences between the graduate rates of female and male students, but he has concluded that the female students are succeeding in greater proportion. In Johnson [12] investigation females tended to leave the university more than males.

Johnes and McNabb [4] found differences in gender and they note that although married men are more likely to fail their degrees, this is not the case for married women, although for both groups being married increases the probability of dropping out.

Table 3

**Results of evaluation of the effects by the Proportional hazard model ( $n = 677$ )**

Factor	B	SE	Wald	df	Sig.	Exp(B) or HR
Year	-	-	78.9	2	0.000	-
2012	0.230	0.133	2.9	1	0.084	1.26
2013	-1.817	0.236	59.2	1	0.000	0.16
Faculty	-	-	5.3	2	0.068	
Rural Engineering	-0.134	0.157	.04	1	0.831	0.87
Engineering	-0.301	0.161	3.5	1	0.061	0.74
Gender	0.798	0.211	14.3	1	0.000	2.22
Marks	-0.008	0.001	41.1	1	0.000	0.994
Year x Faculty	-	-	3.3	4	0.494	-
Year x Marks	-	-	2.5	2	0.286	-
Faculty x Marks	-	-	1.6	2	0.450	-

The students' dropout risk is associated with the year ( $p < 0.001$ ), where the dropout rate was higher in 2012 (39.6 %) and lower in 2013 (7 %). The estimated hazard rate (HR) for 2012 is  $e^{0.230} = 1.26$  and for 2013 is  $e^{-1.817} = 0.16$  against 2014; that is, the dropout risk in 2012 was 1.26 times higher and in 2013 0.84 times reduced or lower in risk than in 2014 ( $p < 0.001$ ).

The students' dropout risk is associated with the faculty ( $p = 0.068$ ), where the dropout rate is higher among the students from the Faculty of Information Technologies. The average dropout rate during 2012-2014 at the Faculty of Information Technologies was 29.5 %. The students from the Faculties of Rural Engineering and Engineering are at lower risk to be dropout than the students from the Faculty of Information technologies (HR 0.87, HR 0.74). The factors year\*faculty, year\*marks and faculty\*marks interaction effects were not significant.

### Conclusions

1. The results of this study show that approximately 26.0 % of the students leave the Latvia University of Agriculture faculties of engineering sciences during the first study year and it depends on the faculty, gender and students' competition marks sums.
2. Students' dropout at the Latvia University of Agriculture in faculties of engineering sciences is influenced by the factors as the competition marks sums ( $p < 0.001$ ), gender ( $p < 0.001$ ), year ( $p < 0.001$ ) and faculty ( $p = 0.068$ ).
3. The students with higher competition marks sums have a lower dropout rate than the students with lower marks ( $p < 0.001$ ). The average competition marks sum for the dropout students was 196.3 points and for the students who continued the 2<sup>nd</sup> study year – 225.9 points.

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