Determinants of Degree Completion in Financial Engineering at Riga Technical University

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***Abstract*—This study analyses factors influencing the likelihood of a student successfully obtaining a degree in Financial Engineering bachelor's program at Riga Technical University (RTU). Statistical and econometric methods, including correlation analysis and logistic regression, are employed to estimate the significance of various factors such as first-year academic results, financial situation, secondary school performance, participation in extracurricular activities while studying at university, and geographical origin. Using data from 2009 to 2024, we identify the main determinants behind the likelihood of graduating from Financial Engineering. One of the significant findings is that students from outside the capital show a significantly higher completion rate than those from Riga, which points to the importance of such factors as motivation, adaptability, and financial constraints. Factors decreasing graduation likelihood include insufficient prior mathematical proficiency, poor performance during the first study year, and financial difficulties, which often lead to dropouts. Conversely, strong academic performance in the first year increases the probability of completing the program. Gender and student mobility programs are also evaluated for their potential impact. The results imply that increasing targeted financial help and offering more comprehensive academic support could improve graduation rates. The findings may be helpful for university administrators to reinforce student support mechanisms, particularly for at-risk groups. Performing the conducted analysis with data on other study programs can further contribute to understanding the factors that might help achieve higher academic success among university students and help RTU refine its educational strategies.**

Keywords—correlation analysis, graduation rate, logistic regression, odds ratio.

I. Introduction

A large number of active, motivated students is a key asset for any educational institution. Still, they are interested in high-quality, effective education and the possibility of acquiring modern knowledge and skills, which allow them to become highly sought-after experts in their field. It is generally in the best interest of both institutions and students that students graduate. Therefore, the graduation rate plays an important role in the evaluation of the work and reputation of the educational institution. This role is becoming more critical due to legal changes in the financing of higher education in Latvia. The current taximeter system in higher education financing ensures that a certain number of study places at universities are state-subsidised. To fill these places, the admission requirements are reduced, and as a result, there is an annual increase in student dropout statistics [1]. The OECD predicts a decrease in the tertiary graduation rate (represents the expected probability of graduating for the first time from tertiary education before the age threshold if current patterns are maintained) for Latvia to 35,95% [2]. These numbers underscore the necessity of addressing the issue of the increasing dropout rate without delay. With the new model of institutional financing of higher education institutions, a certain number of graduated specialists is the essential indicator of state funding. If too many students drop out, state financing is reduced, and this creates losses for the university. RTU was the first Latvian university to participate in the pilot project under this new system from the 2024/2025 academic year [3].

The importance of the graduation rate attracts many educational researchers to analyse it. Extensive literature with an examination of factors that affect graduation rates in different countries, colleges and universities, as well as bachelor's and master's educational programs separately, provide an understanding that dropout causes are numerous and complex. Various methods are employed in these investigations. Some papers use only descriptive statistics and correlation analysis (e.g., [4]). Most use more complicated mathematical techniques to prove their conclusions. For example, key factors affecting the completion of undergraduate studies in mathematics programs have been determined using Principal Component Analysis in [5]. Survival analysis is applied in [6] for evaluation of the probability of students graduating from universities in Austria. Various educational data mining techniques such as Naive Bayes, Decision Tree, KNN have been used in [7] to predict the probability of degree completion at JIIT University. Models with support vector machines and neural networks to predict students' graduation chances are used in [8]. However, according to the revision of the existing literature done by the authors of this paper, the primary method for obtaining results in papers devoted to the graduation rate is logistic regression (see, e.g., [7] - [12]). In fact, the authors of [8] especially note that their model with the logistic regression yields slightly higher classification accuracy scores compared with models with support vector machines and neural networks to predict students' graduation chances. In line with this, logistic regression has been chosen to analyse the graduation rate of RTU students in Financial Engineering for this paper.

There is a large volume of literature on graduation rates. Some of the other notable articles devoted to the prediction of graduation rates in dependence on different factors are [5], [7] - [9], [11], [12]. Some papers focus on the time students spend in the university system (e.g., [6], [10]). Most papers, as major factors which can affect dropouts, generally use demographic values such as gender and age and academic values such as high school grade point average (GPA) and Scholastic Assessment Test (SAT) scores (quantitative and verbal, if they are) by adding others depending on the aim of the study. Often, the performance in the first study year is considered

separately (see e., g. [9]). As mentioned in [13], citizenship, the demographic background of students (family income, parental education level, parental guidance), as well as financial aspects can influence dropping out. The social, psychological, economic, environmental, and personal factors can be used for analysis, as is shown in [5] or [14]. Such values are mainly obtained from questionnaires, as in [5] and [7].

It should be mentioned that existing research is not entirely consistent in its findings. Studies regarding the influence of standardised test scores and the previous education GPA have shown varying results. For example, it is proved in [11] that standardised test scores and early academic performance are significant factors in graduation, whereas Clayton and Cate in [15] did not find them significant. Zhang et al. [11] showed that ethnicity and citizenship are significant predictors of the likelihood of graduation in some universities but not in others. The authors also highlighted that gender and age are not significant in predicting the odds of graduation. As shown in [14] effects of GPA vary in different ethnic groups, and many psychological, economic, and environmental factors differ from person to person and country to country. The variation of these results is the reason to study the factors affecting graduation rate for separate study programs with the aim to examine the determinants of degree completion especially for them to be able to do corresponding activities for retention of these students.

This study is devoted to the examination of factors that affect the graduation rate of Financial Engineering students at RTU. The program of professional studies in Financial Engineering has been running at the Faculty of Computer Science, Information Technology and Energy of Riga Technical University since the 2009/2010 academic year. It is the first professional program in Financial Engineering in Latvia [16]. Over the last few years, applications to Financial Engineering, mathematical finance, and similar programs have grown steadily. A profession where mathematical, programming, and finance knowledge can be combined remains a popular career choice among many students with a quantitative background. However, it should be mentioned that the number of dropouts is increasing in this period, too. A gradual increase in the number of students not getting a degree in Financial Engineering (FE) can be seen in Fig. 1 starting

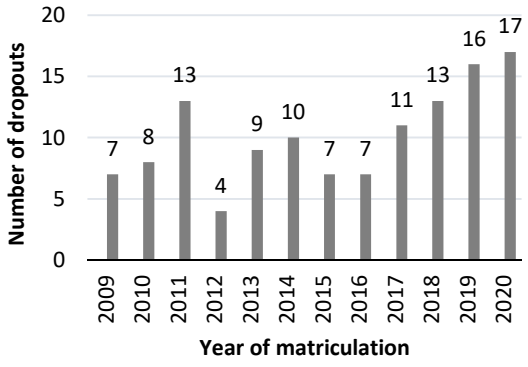

Fig. 1. The number of students not finishing FE in 4 study years from the shown year of matriculation.

from 2016. The aim of this study is to analyse and make conclusions about determinants affecting the graduation rate in this program with the goal of finding solutions to help and support students in the risk groups, which allows to reduce the dropout rate.

II. Materials and Methods

A. Data Background and Characteristics

Data were extracted from the administrative student database of RTU in December 2024. The sample for this study is the population of all students in the professional bachelor's program Financial Engineering between those who started studies in 2009 and those who graduated in 2024 with only two possible outcomes: "dropout" or "graduation". The following information about students is presented: gender, the Centralised School Exam grade in mathematics, secondary school performance in mathematics, first-year academic result (GPA), state-subsidised (budget) or paid by student place at the moment of matriculation, participation in the ERASMUS program, usage of academic leave, academic debts during study, and geographical origin of background. The data about 300 students who studied in FE are used in the analysis. Because of the changes in the Central school Exam grade system in 2012 (the transition from grades A, B, C and so on to the evaluation in percentage has been made, which doesn't allow these letters to be re-evaluated unambiguity to the percentages), only 236 observations can be used for the common model. Also, there are missing observations in the average grade in the first study year, which can be explained by the fact that those students had not got any grades before leaving. Only 283 students got the first course average grade. The remaining predictors do not have missing observations.

B. Methods

The correlation analysis is used for the preliminary investigation of the data and its relationships with a student's graduation. The correlation coefficient and its significance are calculated for each available factor from the dataset to assess the strength and direction of associations between variables.

Logistic regression is used for further analysis of the data. The choice of this technique is based on many reasons. Firstly, the variable of interest (whether a student will graduate) is binary (yes/no or 1/0). Secondly, as mentioned in the introduction, most researchers used it to analyse the graduation rate. The authors prefer logistic regression to the usual linear regression, which predicts continuous values. A logistic regression predicts the probability, in this study, the probability of getting a Bachelor's degree in FE. Finally, the efficiency of logistic regression is comparable with more complicated models like neural networks (see, e.g., [8]).

The coefficients of logistic regression show how each factor affects the probability of a positive outcome (probability of completing the studies).

The mathematical representation of the logistic regression model is given by formula [17]:

$$P(Y = 1|X_1, X_2, \dots, X_k) = \frac{1}{1+e^{\beta_0+\beta_1 X_1+\beta_2 X_2+\cdots+\beta_k X_k}}, \quad (1)$$

where $P(Y = 1|X_1, X_2, \dots, X_k)$ is the probability of getting a Bachelor's degree in FE in RTU for a student with the given values of $X_1, X_2, \dots, X_k$;
$X_1, X_2, \dots, X_k$ are the factors analysed in the study;
$\beta_0, \beta_1, \beta_2, \dots, \beta_k$ are estimated coefficients;

$\frac{P(Y=1)}{1-P(Y=1)}$ is the odds ratio (the ratio of the probability of getting 'yes' for the dependent variable to the probability of getting 'no') [17].

By taking the natural logarithm of the odds ratio, the equation (1) transforms into (2):

$$\ln\left(\frac{P(Y=1)}{1-P(Y=1)}\right) = \beta_0 + \beta_1 X_1 + \cdots + \beta_k X_k. \qquad (2)$$

The estimated coefficients correspond to log-odds values. Taking exponents of the coefficients e^{β_i}, their interpretation explains how the odds of the outcome increase/decrease. Exponentiated confidence intervals of the coefficients help to test the significance of the odds ratio.

Fisher Scoring is used to find the maximum likelihood estimates of the logistic regression coefficients. It is a variant of the Newton-Raphson procedure, and it has more stable convergence.

Because logistic regression doesn't have a coefficient of determination like linear regression, *McFadden's Pseudo* R^2 can be used to estimate how well the logistic model fits. *McFadden's Pseudo* R^2>0.4 means an excellent fit, *McFadden's Pseudo* R^2>0.2 is a good fit.

III. Results and Discussion

Analysis of the correlation between graduating and different factors to understand whether they have an influence has been done at the beginning of the study (see Table I).

The dependent variable of this study is graduation (*GetDegree*). It is valued as 1 if a student graduated in FE and 0 otherwise. The independent variables are the following:

- the grade of Centralised School Exam in mathematics (*CSchoolExam*);
- the school grade in mathematics (*X_school*);
- the average grade in the first study year (*X_course1*);
- having academic debts during study (*X_debts*);
- state-subsidised (budget) or paid by student place at the moment of matriculation (*X_budget*);

TABLE I. Correlation Values

GetDegree correl. with	Correl.	p-value	n	Conclusion
CSchoolExam	0.068	0.2993	236	Nonsignificant
X_school	0.318	1.49e-07	300	Strong significant!
X_course1	0.502	3.59e-18	283	Strong significant!
X_debts (0/1)	-0.557	4.12e-23	300	Strong significant!
X_budget (0/1)	-0.165	0.0078	300	Strong significant!
X_acadleave (0/1)	-0.297	9.95e-07	300	Strong significant!
X_riga (1/0)	-0.109	0.0805	300	At least 90% significant.
X_erasmus (0/1)	0.118	0.0576	300	At least 90% significant
X_gender (1F,0M)	0.300	7.7e-07	300	Strong significant!

- usage of academic leave (*X_acadleave*);
- geographical origin of background (*X_riga*);
- participation in the ERASMUS program (*X_erasmus*);
- gender *(X_gender*).

n in Table I is the number of available observations for each variable.

It appears (see Table I) that having academic debts, taking academic leave, getting a budget place or paid place starting studies, gender, as well as the school grade in mathematics and the average grade in the first study year are highly correlated with the likelihood of getting a degree in FE. The significance of these correlation coefficients is higher than 99%. Completely nonsignificant is the correlation with the Centralized School Exam (which is very surprising). Participating in Erasmus has at least a 94% significant positive correlation. Also, being from Riga or outside the capital has at least a 91% significant correlation in favour of being from regions. However, both last correlations are rather small (0.118 and -0.119 respectively).

Correlation with the average grade in the first study year is positive, as it should be, the higher the average grade is, the better are chances to graduate. The dependence is moderate (r=0.502). It appeared strongly significant (with *p-value*=3.591e-18).

The correlation with getting paid place entering higher school is negative. If a student starts studies paying for it, chances to graduate are slower than for people getting a budget place. The dependence is relatively weak (r=-0.165). However, it appeared significant (with *p-value*=0.0078).

Because the correlation between graduating and the Central School Exam grade appeared nonsignificant, the grade has been excluded from the list of possible predictors, which increases the number of possible observations.

For the model from Table II *McFadden's Pseudo* R^2=0.4906>0. The average grade in the first course and having academic debts appeared significant. Also, gender is rather significant. An excellent fit is observed, while only some coefficients are significant. It may be caused by multicollinearity. Therefore, some factors should be excluded from the model.

Table III contains the correlation matrix of all factors with the dependent variable for analysis of multicollinearity. It shows whether factors are correlated.

TABLE II. z Test of Coefficients of 8 Predictor Model

	Estimate	Standard Error	z value	Pr(>|z|)
Intercept	-5.14533	1.52301	-3.3784	0.000729 ***
X_school	0.14824	0.14563	1.0179	0.3087373
X_course1	0.76498	0.16915	4.5225	6.111e-06 ***
X_debts	-3.12948	0.56702	-5.5192	3.406e-08 ***
X_budget	-0.22364	0.44013	-0.5081	0.6113585
X_acadleave	-0.52818	0.71722	-0.7364	0.4614728
X_riga	-0.13154	0.40149	-0.3276	0.7431870
X_erasmus	0.64282	0.57224	1.1233	0.2612902
X_gender	0.97979	0.40280	2.4324	0.0149978 *
Signif. codes: 0 '***' 0.01 '*' 0.1 ' '				

The appeared correlations can be easily explained. Getting paid place entering high school is correlated with the school grade in math (r=-0.453) – lower grades reduce the chance of a budget place. Also, taking academic leave is correlated with having debts (r=0.4896). The average grade on the first course has a positive correlation (r=0.3544) with the school grade in math, which is not surprising.

The highly correlated variables cannot be included in a regression for an explanation of the dependent variables (completing studies in Financial Engineering). More correlated with the dependent variable and less correlated between themselves should be chosen.

For the model from Table IV, *McFadden's Pseudo* R^2=0.4774>0 shows an excellent fit. All coefficients of the model now are highly significant. Akaike Information Criterion of the short model is lower (186.99 < 192.45) preferring the model with three chosen predictors to the model with eight predictors.

$e^{\beta_1} = 2.4263$ means a one-unit increase in the average grade in the first study year increases the odds of getting FE bachelor's degree more than twice.

$e^{\beta_2} = 0.0363$ it means that the fact of having academic debts highly decreases the likelihood of completing the FE program.

$e^{\beta_3} = 2.6256$ means that the likelihood of getting the FE bachelor's degree for a female student is 2.63 as high as for a male student.

Moreover, constructing the 90% confidence intervals for e^{β_i}, the results show that by having a grade point average by one point higher, the program goes up by anywhere between 1.84 and 3.35 times.

With 90% confidence, it can be said that if a student has a debt at the end of the first academic year, the chance of obtaining a degree in Financial Engineering goes down by anywhere between 93% and 98%.

Then, for a female student, the chance of successfully graduating from this program goes up by anywhere between 1.38 and 5.08 times (with 90% confidence).

To make sure that the impact of the COVID-19 pandemic on dropout rates did not change the model dramatically, we estimated it without the data of those students who began studies in 2020 as being most influenced by the pandemic. As one can see from Table V, the coefficients are only slightly different. This shows that the results of our study are robust.

Therefore, the key determinants of graduation in FE at RTU are GAP in the first course, the debts during the study, and gender. It should be noted that it is critical not only to identify these factors but also to take them into account in planning educational strategies and in offering student support, particularly for at-risk groups.

Some activities have been done to improve the students' performance. For example, the reform of the RTU evaluation system was started in 2017 by reducing the weight of the exam in the final grade in favour of grades for semester work. It has been proved, for instance, in [18], that this reduction motivates students to study harder during the semester and improves their academic performance in the corresponding course. Some other changes have been offered in the last two years. The professors working with the students of FE continuously improve their academic experience and offer new and actual practices in the teaching process to enhance students' understanding of the study courses (see, e.g., [19], [20]). The work should be continued to offer targeted academic support to at-risk students. The students' services have been open in faculties of RTU since 2024, where students can get the help of mentors with homework assignments and study projects and get information on all issues of interest.

The study can be continued by adding other factors, for example, GPA of the second or third year, level of satisfaction with the University and the program, working during the study period, financial situation, and participation in extracurricular activities while studying at the university. This information could be obtained from the questionnaires. This may increase the level of accuracy of our model and support more information to the director of the program in FE and university administrators to enhance student support mechanisms.

TABLE III. CORRELATION MATRIX

	GetDegree (1/0)	**X_school**	**X_course1**	**X_debts (0/1)**	**X_budget (0/1)**	**X_acadleave (0/1)**	**X_riga (0/1)**	**X_erasmus (0/1)**	**X_gender (1F,0M)**
GetDegree (1/0)	1								
X_school	0.3301	1							
X_course1	0.5018	0.3544	1						
X_debts (0/1)	-0.625	-0.252	-0.256	1					
X_budget (0/1)	-0.187	-0.453	-0.224	0.1237	1				
X_acadleave (0/1)	-0.345	-0.142	-0.08	0.4896	0.078	1			
X_riga (0/1)	-0.118	-0.097	-0.038	0.1268	0.0794	0.0193	1		
X_erasmus (0/1)	0.0958	0.1004	0.1101	-0.001	-0.18	-0.116	0.0071	1	
X_gender (1F,0M)	0.2571	0.1854	0.1674	-0.159	-0.019	-0.082	-0.07	0.0278	1

TABLE IV. Z TEST OF COEFFICIENTS OF 3 PREDICTOR MODEL

	Estimate	Std. Error	z value	Pr(>|z|)
Intercept	-5.04015	1.29968	-3.8780	0.0001053 ***
X_course1	0.88639	0.18285	4.8477	1.249e-06 ***
X_debts	-3.31564	0.47797	-6.9369	4.007e-12 ***
X_gender	0.96533	0.39770	2.4273	0.0152116 *

TABLE V. MODEL COEFFICIENTS WITHOUT 2020 DATA

	Estimate	Std. Error	z value	Pr(>|z|)
Intercept	-4.4116	1.2775	-3.543	0.000554 ***
X_course1	0.8099	0.1784	4.540	5.63e-06 ***
X_debts	-3.1295	0.4716	-6.635	3.24e-11 ***
X_gender	1.0295	0.4095	2.514	0.011935 *

IV. CONCLUSIONS

To sum up, this study identifies the factors having more or less influence on degree completion in the Financial Engineering program at Riga Technical University. It appears that first-year academic performance has the largest positive impact on graduation rates. It was found that students with a higher first-year GPA are over twice as likely to graduate, with a 2.43-fold increase in the odds of completion for each point in GPA. On the other hand, students with academic debts are 93-98% less likely to graduate. Additionally, female students are 2.63 times more likely to graduate compared to male students. The findings suggest that providing additional academic assistance and financial support, particularly for at-risk groups, could help reduce dropout rates and raise graduation rates. Further studies on other study programs could broaden the research on trends in student retention and success.

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