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Challenges of the Formation of the Military Professional at the University of Defence

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Abstract

Higher education for military professionals is provided by the University of Defence, the only military university in the Czech Republic. Like other universities, it has to deal with students who drop out of their studies. Retrospectively collected data on the withdrawals from the study were statistically analyzed using survival analysis methods to assess student dropout rates. With the five-year records, we quantified the effects of two faculties and five classes, which showed that the risk of dropping out is higher for students in technical fields (approximately by 18%). On the other hand, the creation of support groups led to a more gradual dropout rate compared to the previous years without these groups (approximately by 25%). We believe that these results will help the academics and commanders guide students as they become military professionals.

KEY WORDS: *military professional, student, University of Defence, dropout rate, comparison, survival analysis, hazard rate.*

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1. Introduction

The military-economic-political situation in the world in recent years has not been as stable as most people would have imagined. This is reflected in the increase of military conflicts, which affect the lives of more and more people in one way or another. In this situation, the armies of the respective countries play a key role. It is important to have educated people in command positions who serve the democratic principles of their country. In the Czech Republic, the University of Defence is responsible for the education and training of military officers. Three faculties, two institutions and three centers are involved in the bachelor's, master's and doctoral studies in military leadership, technical and medical fields [1].

During the existence of the University of Defence, the study programs have undergone minor and major changes in order to meet the requirements of a modern army and to respond to the military-political situation in the world. As a result, the duration and content of the studies have naturally changed. One of the logical consequences was the transition to a five-year master's program with an emphasis on the formation of the military professional's personality, physical fitness and language skills.

Military students – future commanders – have been enrolled in newly accredited five-year study programs. During their studies, the students have to fulfill not only their academic obligations, but also a demanding military training. For this reason, greater emphasis is placed on physical fitness and mental resilience, as well as language skills and basic theoretical knowledge in selected subjects. Not every student is able to cope with this successfully. In this paper, we will focus on the last mentioned point – the theoretical subjects, which are one of the first challenges students face in their studies. In particular, we compare the dropout rate from the five-year study program at the Faculty of Military Leadership and the Faculty of Military Technology, as well as the dropout rate for each year of study.

The academic performance is the topic which universities are concerned with and not only in the face-to-face education, but also in online education [2]. The dropout and retention is a critical problem in all type of universities and colleges. The spread of higher education has led to a growing demand for graduates, which pose a challenge to universities to guaranteed the very same level of knowledge [3].

In larger groups, there is a possibility of an individual to be hidden in the group and various procedures and processes can be conducted to help students with their study and, as a result, to lowering the dropout rate [4].

Improving the retention of the students, namely the students in the technical fields, is an obvious approach to fulfill the demand of the "civilian" labor market as well as the military subjects [5]. Moreover, with the concept of emerging adulthood [6], the universities have to change their approach to the students and their physical, social and mental needs [7,8]. Several studies have been conducted to describe and model student dropout and retention from a qualitative perspective [9–13].

2. Data and Methods

In this retrospective study, we collected the data in the period from September 2014 to July 2023, which covers the full five year of study for all students enrolled in the new five-year study program. The dataset now includes complete information to assess the dropout rate over the course of the five-year study program.

We examine the dates up to which withdrawing student's studies officially ended. Usually the reasons for dropping out are not known (or in some cases they are confidential); however, some of the reasons can be guessed, such as the discrepancy between the idea of studying and the actual process of studying – in the simple words of one of the students, "more sitting in the classrooms than running in the woods".

We use the same notation as in the first article of the series [14], since this article is a continuation of a long-term study. The students are then divided into five groups with the labels "Class 2014", ..., "Class 2018" standing for the groups of students who started their studies in 2014, ..., 2018, respectively. Newly, we distinguish two groups concerning the affiliation to the Faculty of Military Leadership (FML) and the Faculty of Military Technology (FMT).

The collected data for survival analysis were denoted as follows

(1) the dropout occurred (event),
(2) the student completed the study and graduated (censored)
(3) the student was allowed to repeat the year (censored).

For the survival analysis, we use R program with its libraries (survival, survminer and pch) and apply the Kaplan-Meier estimate of survival functions. Having several survival curves, we utilize the Gehan-Breslow-Wilcoxon test and its modifications – log-rank test and Peto-Peto-Wilcoxon test, which place more weight on later or earlier survival times, respectively. To assess the occurrence of student dropouts during the single years of their study, we apply the piecewise exponential model with constant hazard rate within the given period [15,16]. To quantify an effect given by faculties and classes, we use Cox proportional hazard model [17,18] and calculate conditional survival probabilities [19].

3. Results and Discussion

Given survival data, the first estimate is the Kaplan-Meier nonparametric estimate of the survival function, which is shown in Figure 1. On the left panel of the figure, we can see that the overall survival is slightly better for the Faculty of Military Leadership (in green color). However, the dropout rate during the first year is very similar for students of both faculties and it takes value around 65%. On the right panel of the figure, we can identify a similar pattern of the dropout rate when students are distinguished by the classes. The Class 2018 (in green color) seems to have the best survival rate.

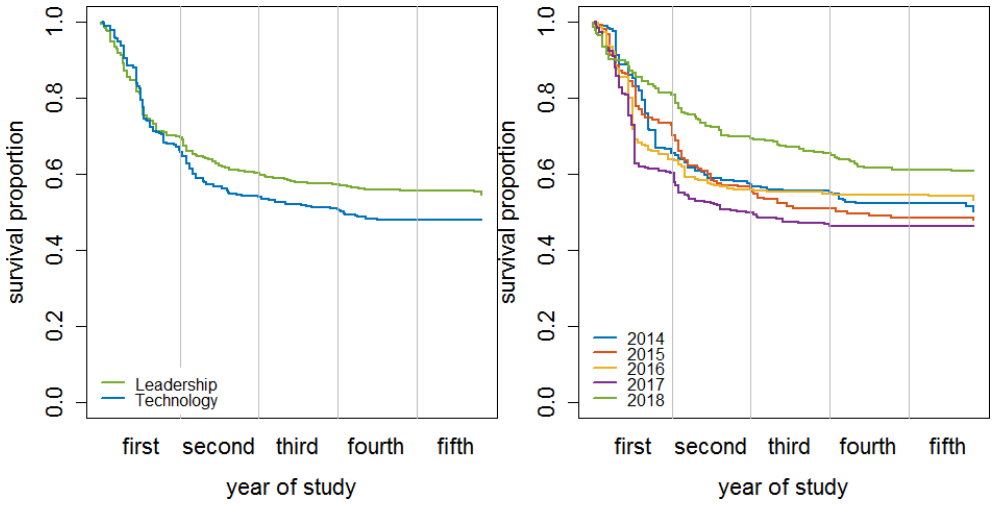

Fig. 1. Kaplan-Meier estimates of the dropout rate stratified by the faculty (left panel) and by the class (right panel)

We supported the visual comparison from Figure 1 by testing for the statistical difference between these curves. Using both the log-rank test (LR) and the Peto-Peto modification of the Wilcoxon test (PPW), we concluded that the survival curves are different. The p-values of the tests (LR: $p = 0.0429$, PPW: $p = 0.1392$) show that the difference between the

faculties is very small. On the other hand, the p-values associated with the classes (LR: p = 0.0005, PPW: p = 0.00005) indicate the statistically significant difference between the classes.

The survival rates of the stratified data are presented in Tables 1 and 2 for the stratification by the faculty and by the class, respectively. The first two semesters exhibit similar behavior in both faculties, which can be related to the students' uncertainty about the right choice of university program [14]. Then, the survival rate is slightly better for the Faculty of Military Leadership.

Table 1.

Survival rates stratified by the faculty in the respective semesters

	F. M. Leadership		F. M. Technology	
semester	survival	confidence interval	survival	confidence interval
1	0.794	(0.767; 0.822)	0.794	(0.761; 0.828)
2	0.695	(0.664; 0.727)	0.656	(0.618; 0.697)
3	0.620	(0.588; 0.654)	0.566	(0.526; 0.608)
4	0.601	(0.569; 0.635)	0.540	(0.500; 0.583)
5	0.578	(0.546; 0.613)	0.519	(0.479; 0.562)
6	0.573	(0.541; 0.608)	0.506	(0.466; 0.549)
7	0.559	(0.526; 0.593)	0.482	(0.442; 0.526)
8	0.556	(0.524; 0.591)	0.480	(0.440; 0.524)
9	0.556	(0.524; 0.591)	0.478	(0.438; 0.522)
10	0.553	(0.520; 0.587)	0.478	(0.438; 0.522)

The survival rate of each class follows a different pattern. We can distinguish few patterns – in the first semester, the Classes 2014, 2015 and 2018 have a higher survival rate than the Classes 2016 and 2017. In the second year of the study, the Classes 2017 and 2018 show different behavior than other classes. At the end of the study, the Class 2018 has the highest survival rate. Their overall survival rate is higher than in other classes, we suspect that this is strongly influenced by the small group tutoring that was introduced that academic year.

Table 2.

Survival rates (with confidence intervals) stratified by the year in the respective semesters

semester	Class 2014	Class 2015	Class 2016	Class 2017	Class 2018
1	0.851 (0.808; 0.896)	0.829 (0.781; 0.881)	0.716 (0.667; 0.769)	0.729 (0.683; 0.779)	0.866 (0.829; 0.905)
2	0.653 (0.597; 0.715)	0.700 (0.642; 0.764)	0.639 (0.586; 0.696)	0.602 (0.551; 0.657)	0.808 (0.765; 0.853)
3	0.588 (0.530; 0.653)	0.584 (0.522; 0.654)	0.573 (0.519; 0.632)	0.523 (0.471; 0.580)	0.723 (0.675; 0.775)
4	0.572 (0.514; 0.637)	0.561 (0.499; 0.631)	0.559 (0.505; 0.619)	0.497 (0.446; 0.555)	0.694 (0.644; 0.747)
5	0.555 (0.497; 0.621)	0.514 (0.452; 0.585)	0.552 (0.498; 0.612)	0.475 (0.423; 0.532)	0.671 (0.620; 0.726)
6	0.555 (0.497; 0.621)	0.509 (0.447; 0.581)	0.549 (0.495; 0.609)	0.462 (0.410; 0.519)	0.654 (0.603; 0.710)
7	0.522 (0.464; 0.589)	0.495 (0.432; 0.567)	0.545 (0.491; 0.605)	0.462 (0.410; 0.519)	0.615 (0.563; 0.672)
8	0.522 (0.464; 0.589)	0.485 (0.423; 0.557)	0.545 (0.491; 0.605)	0.462 (0.410; 0.519)	0.612 (0.559; 0.669)
9	0.522 (0.464; 0.589)	0.485 (0.423; 0.557)	0.541 (0.487; 0.601)	0.462 (0.410; 0.519)	0.612 (0.559; 0.669)
10	0.514 (0.455; 0.580)	0.485 (0.423; 0.557)	0.541 (0.487; 0.601)	0.462 (0.410; 0.519)	0.608 (0.556; 0.666)

Applying the parametric model, the piecewise exponential model, to the data, we can see in Figure 2 that the slope of the survival curve is decreasing, which is true for both faculties and classes. This behavior was more or less expected [14]. However, the model reveals an interesting feature of student survival – the overall dropout rate is decreasing with respect to the classes. This may be due to students getting used to the new program and having older students (from the same program) to help them with any study problems they may encounter.

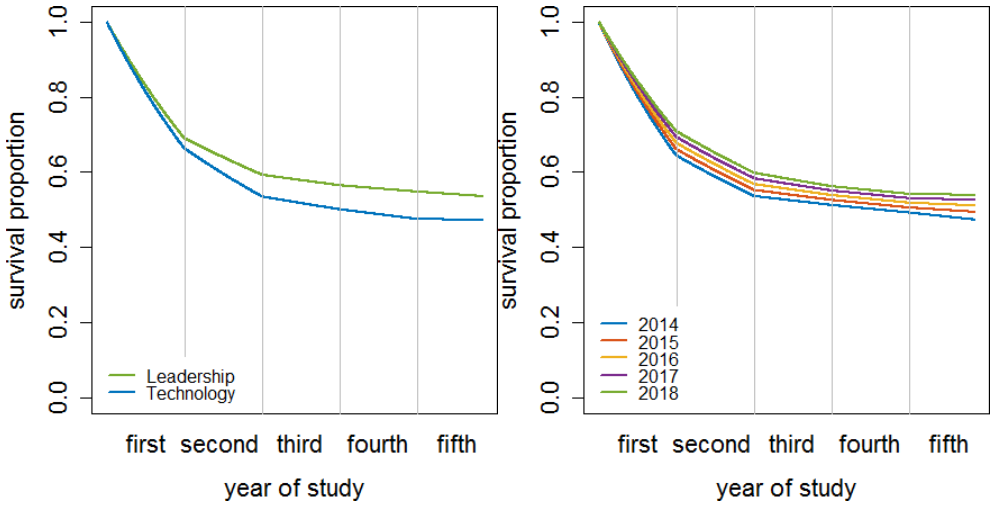

Fig. 2 Piecewise exponential model of the dropout rate stratified by the faculty (left panel) and by the class (right panel)

The hazard rates associated with the piecewise exponential model are summarized in Table 3, which shows another noteworthy feature. The fifth year of study brings a final state examination and defense of the thesis, which is the last and difficult step in the study, and some of the students cannot fulfill the requirements.

Table 3.
Piecewise constant hazard rates (×105) within the years of study for the respective faculties and classes

Faculty	first	second	third	fourth	fifth
Leadership	101.71	46.62	13.12	8.35	7.25
Technology	112.59	58.82	17.95	14.39	1.35
Class	first	second	third	fourth	fifth
2014	120.61	50.09	12.47	10.95	1.26
2015	113.46	49.14	13.46	10.73	7.44
2016	106.74	48.20	14.53	10.50	4.41
2017	100.42	47.29	15.68	10.29	2.61
2018	94.47	46.39	16.93	10.07	1.55

When quantifying an effect that is provided by faculties and classes, we use the Cox proportional model. Although the result of the log-rank test shows that the assumption of constant proportional hazard is not met, we can apply the model (pretest test statistic Q is negative [18]). The resulting model is displayed in Figure 3 along with the corresponding hazard function, which is aggregated by semester to easily see its behavior.

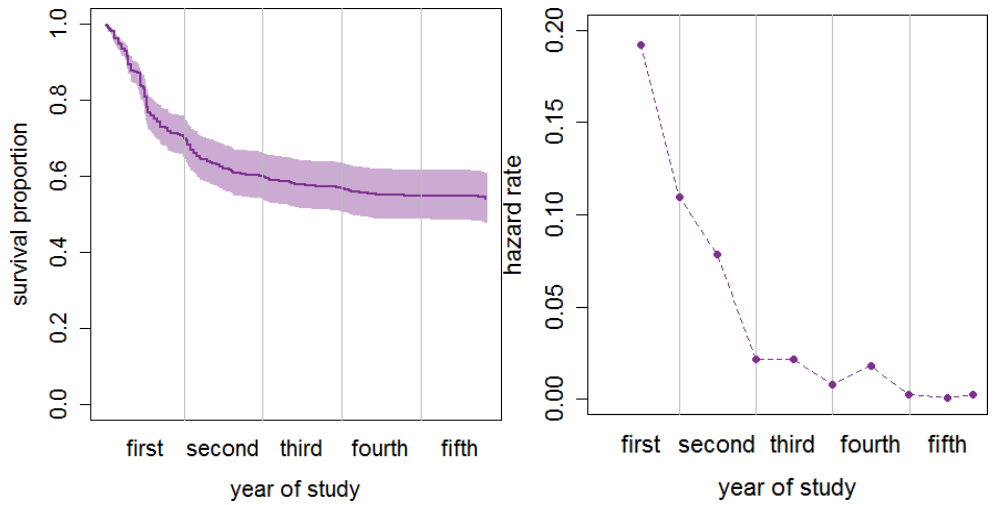

Fig. 3. Cox proportional model with 95% confidence interval (left panel) and the corresponding hazard function aggregated by semester (right panel)

The analysis shows that both factors influence the survival rate (p-value less than 0.0002). The statistically significant difference is found between faculties ($p = 0.0365$) and between the Class 2018 and Class 2014 ($p = 0.0175$), which is taken as a reference. The hazard ratio of FMT to FML is 1.18, i.e., a student from FMT is 1.18 times more likely to drop out from the study than a student from FML. It suggests that studying at FMT is more demanding. This is a more general

topic, most students in all schools are leaving technical fields [7]. Similarly, the hazard ratio of the Class 2014 to the Class 2018 is 1.35, which means that a student from the Class 2014 had a 1.35 times higher rate of possible dropout than a student from the Class 2018.

Results of the overall survival rates are summarized in Table 4. We can see that the initial one-year survival rate is 0.7. However, when we take into account that the students get accustomed to the university type of study (as opposed to the high school system [20], we see that for the students who have already "survive" the first year the rate of non-dropping out increased to 0.85.

Table 4.

Survival rates from the Cox model compared with conditional survival rates

year of study	survival rate	conditional survival rate
1	0.70	-
2	0.60	0.85
3	0.57	0.95
4	0.55	0.96
5	0.54	0.98

It is obvious that most of the students drop out from the study after the first semester, which is similar to other universities [21]. The first semester is, in a sense, the time when students practically check their choice of the major [22]. The risk of dropping out is still high in the second and third semesters (see Figure 3). There is a small local maximum in the seventh semester (half of the fourth year). We assume that this is caused by the semifinal exam at the end of the third year, with unsuccessful students withdrawing during the seventh semester (the administrative process takes a while).

Overall, we have addressed the issue of dropout rates among military students on the basis of the available data. Although we do not have information on the reasons for their leaving, we could speculate and trace some "critical periods" of increased dropout rates. One could be called "the second choice", students were not accepted to their first choice university and enrolled in their second choice university and did not identify with the specific type of military study. Another reason could be that a student was accepted to his or her "first" university and left after the first year to enroll in the priority school in the following year. Failure to fulfill study obligations due to the difficulty of some subjects also plays a significant role in dropping out.

We cannot influence the first two factors, however, the third one can be improved. The teachers of these subjects should focus more on at-risk students and offer them a helping hand. For example, in the mathematics, the subject "Practice in Mathematics" was included in the study plan in order to eliminate the shortcomings of the students' different secondary school background [23].

4. Conclusions

The paper evaluates and compares the dropout rate of the five-year study program at the Faculty of Military Leadership and the Faculty of Military Technology, as well as the dropout rates of individual classes. We used statistical methods to illustrate this issue with corresponding graphs and tables, including accompanying commentary. As for the reasons for the dropout rate, we only know the official date of withdrawal for each student, but not the factors that led to this decision. Therefore, some of the possible causes of dropout are only conjectures of the authors of the publication.

The outcomes of this study show that the first year is critical for the students of both faculties. Although the reasons for dropping out are not known, we can conjecture that the high dropout rate after the first semester is influenced by the discrepancy between the students' perceptions and the reality of the university studies [14,20]. Unlike other universities, the military university has its own specifics. In addition to academic duties, the future military professional has to complete demanding military training. The factor of psychological resilience also plays a significant role. Therefore, we believe that the high dropout rate after the initial semester is related to the failure of some students to adapt to the military regime.

After the first year, the dropout rate decreases substantially. This may be related to the military adaptation already mastered. Targeting at-risk students seems to be of considerable benefit, as it has positively influenced the number of students leaving the study. This fact can be observed in the Class 2018, which has already been affected by the creation of math support groups, which has led to a more gradual dropout rate in the first three years compared to other classes. From a pedagogical point of view, it is important to pay more attention to the students during this critical period and to motivate them more to study.

In addition, moving the division into professional military specializations from the third to the second year seems to be the right step. This will give students a clearer idea of their future military profession in advance. In our opinion, the logical consequence is increased motivation for successful completion of studies. Subsequently, by successfully completing the five-year university program, the student becomes a full military professional.

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