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Analysis of academic desertion among ungraduated mathematics students

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ABSTRACT

University dropout is a phenomenon that has played an important role in the undergraduate program in mathematics at the University of Tolima (Colombia), because it has been a program that has high dropout rates semester by semester. To generate the results presented here, the population who was considered was students enrolled in the 2012A-2018B academic period. In this time frame, the information on the factors required to characterize student dynamics is consolidated and evaluated using the Kaplan-Meier statistical model, evaluation of associations, correlations and comparisons using non-parametric statistics. The aim is to determine the individual, academic, institutional, social and economic factors that cause students to drop out. As a result of the analysis in context, the factors that influence the problems of the phenomenon of dropout in this cohort were determined and characterized. This methodology presents causal factors for student retention on which actions should be taken to propose strategies associated with obtaining better percentages of retention and graduation within the Bachelor's Degree program in Mathematics.

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1. INTRODUCTION

Education at all levels from basic to higher education is a very valuable tool in the dynamics of growth and development with social, economic, cultural and academic equity in a country, which is why, as a policy, it is one of the expected goals in many countries, in relation to strategies for linking quality and coverage of young people in the university education system, and consequently, relevant factors are evaluated and determined on which guidelines are drawn up in order to guarantee their permanence in the system to achieve the goal of completing studies in the various programs with a high rate of graduates, allowing them to return as professionals, with greater indicators of personal empowerment and the development of a country. In addition, unemployment levels are lower when higher educational levels are achieved upon completion of university studies, which increases the likelihood of improving the standard of living of individuals and the achievement of sustainable development of communities to improve the economic and social prosperity of the country [1].

In the specific case of the official university system providing the public service of higher education in Colombia, its policy is to offer inclusive and quality education, which has served as support for many people of lower income in the first three of six social strata: stratum 1 (low-low), stratum 2 (low) and stratum 3 (medium-low). Strata classified according to the guidelines of the National Administrative Department of Statistics (DANE) in Colombia. The purpose of formal education is to ensure that people with lower incomes have an

opportunity in the search for better living conditions, in relation to individual and collective development, as one of the determining factors for the reduction of poverty and inequalities. However, in many cases, these dreams are truncated by different factors that cause students to drop out of university studies, which generates high personal and collective opportunity costs in the cultural and economic sphere in Colombia's productive social environment. The determination and characterization of this problem, generated by various complex factors, is one of the purposes of the Colombian Ministry of Education [2], for which it monitors graduation and dropout indicators for higher education students. Records indicate that students who manage to graduate from university are below 50% in all areas of study, with the lowest percentages of student retention in the Mathematics and Natural Sciences programs, with a low percentage of 27.28% of students graduating (data from 2016) [3].

For this reason, in recent decades there has been an increase in the number of studies that investigate educational desertion, trying to reflect on the situation and its causes to achieve a higher rate of retention and permanence of students in higher education. Within the research that has been developed to explore the phenomenon of dropout, this study was carried out with the aim of identifying the causes that motivate undergraduate mathematics students to abandon their undergraduate studies, as it is one of the degrees with the lowest graduation rate in Colombia. It is hoped that this research will generate a debate about the situation of university students, while at the same time decisions will be taken to reduce the current dropout rates presented in the Bachelor of Mathematics program, so that, in this way, positive changes could be generated at the economic, social, cultural, and academic level in the Tolima community and national.

In the process of research on dropout in different contexts, it is relevant to know what this term refers to and the factors associated with this phenomenon that affects school retention rates, in the European area it has been referred to as university dropout. In the literature, definitions of dropout are related to factors that have an impact on university dropout [4]–[6] defining this phenomenon as the fact that students do not follow the normal path of the degree course in which they are enrolled, because they withdraw or take longer than expected to finish it. Along the same lines, more recent definitions, such as the *Glosario del Sistema para la Prevención de la Deserción de la Educación Superior* (glossary of the system for the prevention of dropout in higher education) [7], define desertion as the state of a student who does not graduate because they have not graduated in any academic period of the program in which they enrolled; noting that this situation can be caused by different individual, academic, institutional or socioeconomic factors, and in a voluntary or forced way. In the review of dropout in European universities, desertion was described as the abandonment of studies before having completed the program, highlighting that they do not consider temporary abandonment (due to illness or pregnancy, for example) as dropout, and that it is a problem with many consequences for society, for the university and for the person who drops out. This term is linked to other concepts such as graduation, retention, persistence, or permanence [8], [9].

Graduation is often presented as the antithesis or the complementary concept to dropout. The glossary of the system for the prevention of dropout in higher education [10] defines a graduate as a student who acquires a higher education degree at the end of the academic period after passing all subjects. When exploring definitions of retention and persistence, some authors use these terms equally, while others use different definitions for each. Some literature [11] understand both retention and persistence as the act of remaining enrolled in a higher education institution, without withdrawing or dropping out. On the other hand, other research [12], [13] relate retention to the capacity of the institution to maintain the attendance of its students until they obtain their degree, while persistence is associated with the student, his ability or motivation to continue with their studies until they reach their academic goal. The latter way of understanding these concepts is the most common in the literature and, moreover, with the most current references. Finally, student permanence is defined as the condition that makes the student remain an active member of the higher education institution, without dropping out of the study program that will allow him to graduate [14].

A literature review of previous studies on dropout in higher education shows that it is a problem shared by different countries, including different continents. They all agree on a common research intention to determine factors associated with the dropout phenomenon affecting students, the family and the social environment, and some of these results were determined by implementing different assessment models to determine the relevant causal factors. Considering the high dropout rate in higher education, studies have shown the need to create mechanisms to detect it and for institutions to have an organization composed of representatives of students, teachers, administrators and parents, in order to achieve student retention [15]. Given this need, most of the studies found on the subject focus on the study of explanatory models on the retention and persistence of students in higher education [16]–[19], more specifically, on research on models of the variables that cause dropouts and, in this way, to be able to detect them and prevent dropouts, reducing current rates [1], [20]. It is necessary to highlight the previous work [21], [22] who conceptualize university student desertion, delving into what it is, what types of desertion exist, what are the associated variables and their levels of incidence, who are the actors of dropout, and what are the educational, social, and political problems associated with it.

Among the large number of researchers who focus their studies on the explanatory factors of desertion, highlighting the importance of studying in depth the causes that explain it [23], [24], many authors agree that it has a multi-causal structure, that is, a wide range of variables and types of variables that have a significant impact on the dropout of university students [1], [7], [20], [25]. Some of the variables that stand out as significant causes of student desertion in higher education are the following: personal circumstances of the students [23], their psychological nature [26]; academic, motivational, vocational and socioeconomic factors [25]; their own educational level and that of their parents, academic performance, funding and family configuration [27]; age under 30, low income, having to combine studies with a job, and the need for funding [25], [28]. Along the same lines, [29], [30], who studied the state of dropout and the causes that generate it, address the problem of dropout in computer science students, finding a correlation between dropout and the use of technological media, age and previous training; they also highlight, as the main reasons for dropping out, the difficulty in calculating the time needed to dedicate to university-level courses and the perceived difficulty in the curricular subjects of the Computer Science syllabus. For their part, study [31], [32] was conducted a with higher education students participating in cooperative study programs, which combine their studies with training in a work company, and they confirm the impact of cognitive skills and organizational awareness on dropout.

Finally, after studying the state of desertion and the causes that provoke it, some publications make proposals to alleviate this situation, such as Alban and Mauricio [23], who suggest increasing the links between universities and their students in order to improve their wellbeing and, in this way, prevent them from desertion. Other studies [33], [34] suggested measures that favor the adaptation of the students, emphasizing the work of the teachers that act as tutors; or previous research [35], [36], who recommend characterizing students at the beginning of their studies to find out their vulnerabilities, monitoring them with specialized software, facilitating their integration and providing them with guidance, as well as supporting them financially. As indicated, university desertion is considered a structural problem in higher education and, to a as indicated, university desertion is considered a structural problem in higher education and, to a greater extent, in Colombia. For this reason, this research has been carried out in a university in Colombia and it becomes fundamental to review the studies that clarify the situation of dropout in this country, in terms of higher education students. In this line, several research [10], [25] reviewed the existing theories on dropout and the retention programs that higher education institutions had to reduce it. Furthermore, this study analyzed the influence of individual, socioeconomic, academic, and institutional variables that affect desertion from higher education, highlighting the academic factor as the most significant. On the other hand, another studies [4], [10] investigated dropout through explanatory and factorial analysis, identifying the factors that influence dropout and non-graduation of the population, the results confirm the joint impact that socioeconomic, individual, academic and institutional factors have on dropout and graduation, which is a determinant for the design of truly comprehensive strategies for its prevention.

Other articles also investigate dropout in higher education in Colombia, highlighting the existing problem and the need to study it, but focusing on degrees or faculties other than mathematics, such in the Faculty of Psychology [28]; the Degree in Biology [37]; or the Degree in Nursing [24], [38]. To conclude, it is essential to point out the existence of other studies at the University of Tolima, since this is the institution where the present research is being carried out. Louten [12] conducted a study similar to the present one, but in different programs of the Science, Technology, Engineering, and Mathematics. On the other hand, Castro-Carvajal [25] focused on the Degree in Mathematics; they found the relationship between school dropout and economic conditions, the satisfaction of degree expectations and individual characteristics. Regarding the mathematical models used in similar studies, we have found different approaches, such Pellagatti [16] who propose the generalized mixed-effects random forest model (GMERF), which incorporates the use of ensemble methods based on trees within the structure of mixed-effects models;, an improved decision tree algorithm based on the id3 (iterative dichotomized 3) algorithm [39]; the open source Hadoop system [40]; and uplift model, which is a predictive analytics technique that estimates the effect of individual treatment [15].

In this study, an analysis of the different causes of dropout was carried out through a statistical model, based on the academic, individual, economic and institutional factors of the students of the Bachelor's Degree in Mathematics at the University of Tolima during the academic period 2012A-2018B, according to guidelines of the Ministry of Higher Education (MEN), in Colombia, with the purpose of identifying the social, economic and academic variables associated with student dropout in this program. The evaluation of relevant factors by categories was carried out by implementing the Kaplan-Meier statistical model [21]. Factor data according to data retention guidelines were consolidated using information provided by the University of Tolima. Non-parametric statistical models were implemented in the evaluation of these variables to determine individual, academic, institutional and economic patterns related to the causes of attrition of students of the Bachelor's Degree in Mathematics at the University of Tolima during the academic period 2012A-2018B.

2. METHOD

2.1. Research design

The approach used to develop this research is quantitative, because, recognizing some initial hypotheses related to the phenomenon of desertion and according to the information collected, some statistical analyses are carried out from which it is intended to extract patterns of behavior and conclusions about the results obtained [41]. Previous studies [42], [43] described three levels of non-experimental quantitative research design. These are exploratory, descriptive, and correlational. Considering that the research tries to characterize the most influential factors in the desertion of undergraduate students in mathematics at the University of Tolima, we resorted to an exploratory study because it allows us to increase the degree of familiarity with relatively unknown phenomena, obtaining information to carry out a more complete investigation on a particular context of real life, in this case the University of Tolima, in order to determine the causes and the different variables that cause these phenomena [25], [28].

In addition, this is a descriptive design because it aims to identify, expose, and describe the variables that influence a phenomenon [12], [15], [28], more specifically, the variables that cause desertion in the Degree in Mathematics at the University of Tolima. The third type of design developed in this research is correlational. Its purpose is to determine the relationship or degree of association that exists between different categories or variables in a particular sample or context [10], [25], that is, to examine the relationship between the variables that influence dropout in the Degree in Mathematics at the University of Tolima. The above is done considering what is proposed [1], [13], [15]. From the questions, hypotheses are established and variables are determined; a plan is devised to test them (design); variables are measured in a given context; the measurements obtained are analyzed using statistical methods; and a set of conclusions is drawn regarding the hypotheses.

The research technique used to develop this research is the multivariate analysis of the data. This analysis was carried out through non-parametric tests due to the variables that are the object of this study, and taking into account the characteristics [2], [25]. Most of these analyses do not require assumptions about the shape of the population distribution. They accept non-normal distributions ("free" distributions). The variables do not necessarily have to be measured at an interval or ratio level; they can analyze nominal or ordinal data. In fact, if non-parametric analyses are to be applied to interval or ratio data, they need to be summarized to discrete categories (to a few). The variables must be categorical.

To make the analysis of the information provided by the students of the degree in Mathematics, the personal information that each of them registered in the SPADIES platform was collected. SPADIES is a tool used to track number of students deserting in higher education [2], [6], [25]. The data collected with this platform were statistically analyzed with statistical software such as Excel [9] and Infostat [44]. This analysis has been carried out taking 21 study variables as a reference, among which correlations and associations were established, showing if there are variables that have a greater impact on the fact that a student drops out their undergraduate studies, updating the information we have on this academic program and, in this way, giving the possibility of generating solutions that generate an increase in the retention of students.

The results obtained have been interpreted based on the Kaplan-Meier statistical model, which is a non-parametric maximum likelihood count estimator of the survival function S(t) as in (1).

$$\hat{S}(t) = \prod_{t_i<t} \frac{n_i - d_i}{n_i} \quad (1)$$

Where, d_i corresponds to the number of students who drop out of the degree of mathematics at the time; t_i to the time determined by two consecutive semesters out of the degree, and n_i corresponds to the number of students enrolled in the program at potential risk until just the time t_i corresponding to the subjects passed by the students. If there is censure, n_i is the number of students remaining in the programme minus the number of censured cases. Only the variable corresponding to the subjects passed by students who remain in the program is observed [45].

2.2. Study variables

During the development of the research, Table 1 about variables generated by the GELIMO group in their research on desertion at the University of Tolima [25] was taken as a reference, due to the fact that the contexts evaluated are similar, as they are developed within the University of Tolima. The table of variables used in this research is presented in Table 1. The factors and time of observation are framed during the period 2012A-2018B, and these study variables are consolidated following the guidelines of the System for the Prevention on Evaluation and Monitoring of Dropout Phenomenon (SPADIES), to determine the observation of socio-economic, academic and cultural associated factors that can potentially influence dropout and that are baseline information referents in the methodological development of this research. Based on the results of the research, possible strategies for retention are projected in action plans aimed at mitigating the problems in achieving higher retention rates in higher education for students with a higher probability of potentially being dropouts [25], [45], [46], [47].

Table 1. Social, cultural, and academic variables in the conformation of the observation base for the characterization of academic desertion in the Degree of Mathematics at the University of Tolima [25]

Variable	Detail	Variable	Detail
Municipality of residence	Municipalities of Colombia	Municipality where the school is located	Municipalities in Colombia
Status	0: Enrolled 1: Deserter	Code	Valid per student, according to year of entry
Faculty	1: Education	Program	Degree in Mathematics
Program modality	0: On-site	Age	Age in years
Gender	0: Male 1: Female	Financial support	0: Yes 1: No
Civil status	1: Single 2: Married 3: Widower 4: Separate 5: Free union (FU) 6: Not defined (ND)	Socioeconomic stratum	1: Stratum-1 2: Stratum -2 3: Stratum -3 4: Stratum -4 5: Stratum -5 6: Stratum -6
Economic situation	1: Independent 2: Dependent 3: Employee 4: Not defined (ND)	Type of school	1: Public 2: Private 3: Not defined (ND)
Number of people in the family nucleus	Integer value	Number of people working in the household	Integer value
Subjects taken	Integer value	Subjects passed	Integer value
ICFES	Real value	Cumulative average	Real value
Semesters studied	Integer value	Tuition payment average	Real value
Year of observation	Year 2012-A Year 2018-B	Total observed variables	23 observed variables

2.3. Participants

During the development of the research, a sample of 501 students of the Degree in Mathematics was selected. For the selection of this sample, the main characteristic was students who enrolled in the Degree in Mathematics during the observation period 2012A-2018B. The letters A or B of the dates refer to the first and second term of the course, respectively.

It should be noted that, during the research, a percentage of students were still studying at undergraduate level, so some results may vary according to the length of time each student has been studying. In this time period, the study was conducted under the guidelines of the Ministry of National Education (MEN) evaluation of the dropout problem, within the legal framework of the principles of confidentiality, necessity, temporality, the data are used only for the purposes of evaluation of dropout for which they were collected, without being used for subsequent or different purposes. In this process, 23 factors were used to consolidate baseline as seen in Table 1, with the information captured by the office of planning and institutional development of the University of Tolima, in the framework of the law of transparency and the right of access to national public information, in accessible formats, protection of personal data.

3. RESULTS AND DISCUSSION

The results obtained from the analysis of the information collected on undergraduate students of the degree in mathematics at the University of Tolima are presented. According to the results presented in Figure 1, it can be observed that, during the period under evaluation, the average age of the students does not vary greatly from year to year (since the students are between 19 and 20 years old). Similar characteristic conditions in relation to the variables age (average 20 years), higher participation of male students and higher percentage of students coming from official schools are registered in the research [28], consequently this proportional relationship in percentages [6], [47], [48].

On the other hand, regarding the variable average grade, it is observed that students, year by year, present a neutral average performance, ranging between 3.1 (years 2017 and 2018) and 3.5 (year 2013). The average mark variable is taken from all the subjects taken by the students during their academic period. Therefore, the students observed from 2014 onwards have fewer subjects assessed. Evaluating the cohort in longitudinal analysis allows the dynamics of the factors over time to be determined [48], [49]. Regarding the third variable, which is the result of the 11 tests (ICFES), it can be concluded that the average score for admission to the Degree in Mathematics is within the central score managed by the University of Tolima (50 points), ranging from 47 (2014) to 55 (2018).

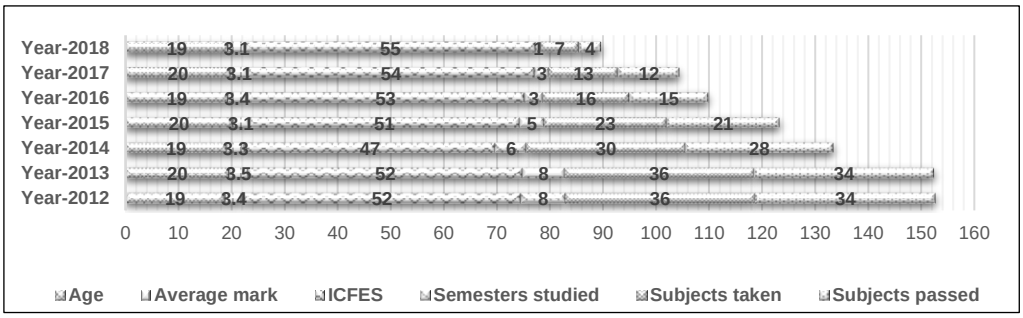


Figure 1. Quantitative variables of the Degree in Mathematics students in the period 2012A-2018B

For the variable semesters studied, it can be seen that the average for students in 2012 and 2013 (who at the time of the research had already completed the five years of the study plan, that is, 10 semesters) is 8 semesters, which is an indicator of the high level of premature completion by students of the Degree in Mathematics. In the other years, it is observed that the average result semester by semester decreases, and this is because year by year, the number of semesters seen is lower at the time of the information search. With reference to the subjects taken and subjects passed variables, it is observed that students who entered during 2012 and 2013 have similar averages in both variables (average of 36 in subjects taken and 34 in subjects passed) of 58 subjects that the Degree in Mathematics had when the plan III was offered. In subsequent years, it is observed that the average in both variables is lower, and this is because the study time of the students is less than in 2012 and 2013.

According to the information in Table 2, it is observed that there is a total of 501 students (309 males and 192 females), and the average mark obtained by the females (3.4) is higher than the average mark obtained by the males (3.2); so, it can be concluded that females, during their stay in the Degree in Mathematics, obtain better marks than males. Table 2 shows that there are significant differences in the academic performance of women with respect to the academic performance of men, because the p-value (0.0117) is less than 0.1. In studies which include professions where a percentage of mathematics-related subjects are required, the percentage of male participants is higher than that of females [25].

Table 2. Qualitative variables of the Degree in Mathematics students in the period 2012A-2018B

Variable		Size of the group (N)	Average marks	Standard deviation	Average rank	Letters
a. Gender	Female	192 (38%)	3.4	0.93	271.7	A
	Male	309 (62%)	3.2	1.1	238.2	B
b. Status	Non-dropout student	244 (49%)	3.8	0.44	340.8	A
(Deserter)	Dropout student	257(51%)	2.7	1.14	165.7	B
c. Type of school	Private school	44 (9%)	2.73	1.18	175.4	A
	Public school	457 (91%)	3.3	1.02	258.3	B
d. Financial	No	333 (67%)	3.0	1.07	199.3	A
support	Yes	168 (33%)	3.8	0.68	353.6	B
e. Year	Year-2012	78 (16%)	3.37	0.87	253.9	A
comparison	Year -2013	76 (15%)	3.43	0.77	268.7	A
	Year -2014	86 (17%)	3.27	0.9	242.7	A
	Year -2015	81 (16%)	3.1	1.28	245.2	A
	Year -2016	60 (12%)	3.25	1.07	259.6	A
	Year -2017	80 (16%)	3.13	1.17	237.8	A
	Year -2018	40 (8%)	3.13	1.23	254.9	A

(a) Averages with a common letter are not significantly different (p>0.10), Kruskal-Wallis (K-W) test by ranks, Alpha=0.10, p-value=0.0117 (***)
(b, c) Averages with a common letter are not significantly different (p>0.10), Kruskal-Wallis (K-W) test by ranks, Alpha=0.10, p-value=0.0001 (***)
(d) Averages with a common letter are not significantly different (p>0.10), Kruskal-Wallis (K-W) test by ranks, Alpha 0.10, p-value=0.0001 (***)
(e) Averages with a common letter are not significantly different (p>0.10), Kruskal-Wallis (K-W) test by ranks, Alpha=0.05, p-value=0.87

Regarding the academic status of the student (non-dropout student=244, dropout student=257), the average mark of the non-dropout students is 3.8, while the average mark of the dropout students is 2.7. About the significance level, it is observed that there is a highly significant difference (p=0.0001) between dropout and non-dropout students. The result of this category shows us that the academic issue has an impact on the

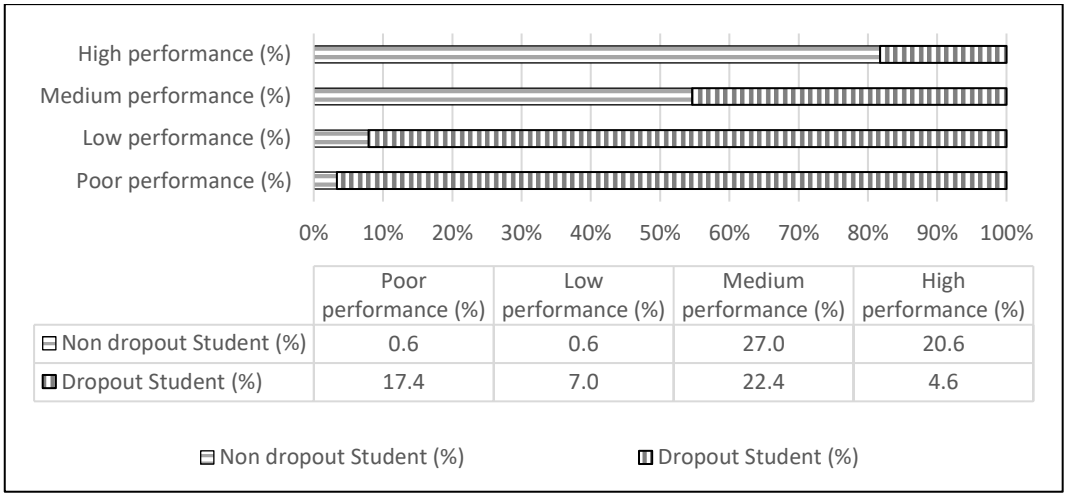
desertion of students of the Degree in Mathematics, because the total number of dropout students is higher than the number of non-dropouts, and the average of the students is lower than the minimum pass mark in the Degree in Mathematics (3.0), which indicates that low academic performance is an important factor for desertion of the program, so it is necessary to support the academic processes of the students.

Regarding the type of school, it is observed that a high percentage of students (91%) who enter the Degree in Mathematics belong to public schools, which demonstrates the importance of public education at the regional level, supporting low-income students. It is also observed that students from public schools obtain better average marks than students from private schools (3.3 public schools; 2.73 private schools), which indicates that students coming from the public sector have a greater affinity with the program, therefore they obtain more satisfactory results. About the level of statistical significance, it is observed that there is a highly significant difference (p=0.0001).

Figure 2 shows that there is a high association between the academic performance of the students and their motivation to continue or not to continue their studies. In other words, if the students obtain better marks, they are less likely to drop out of the Degree in Mathematics. This relationship is tested by the association of Spearman (p-value<0.001 (***)).

Table 3 shows that the students most likely to drop out are in the age range between 16 and 25 years, so the older the student, the lower the probability of dropping out of the Degree in Mathematics, with a significance p=0.0395 (**). Regarding the total number of students who do or do not receive financial support, it is observed that there is an association with respect to dropping out or not from the Degree in Mathematics, when receiving a financial incentive. According to the results, then, it can be indicated that, if the students receive some financial support, they are less likely to drop out of university studies. The socio-economic factor was observed as one of the main causes of dropout, coinciding with the results found in [3], [6], [25].

According to Table 4, it can be observed that there is a correlation between each pair of variables, except for ICFES with subjects passed, subjects taken, and semesters studied. Regarding the correlation between variables, the variables subjects passed, subjects taken, semesters studied and ICFES show a direct correlation, that is, when one of these variables grows positively, the correlated variable will also grow positively, but instead, the age variable shows an inverse correlation, so the younger the age, the higher the results of the correlated variables. This correlation indicates that attrition is lower for students with a higher level of academic education [1].



	Poor performance (%)	Low performance (%)	Medium performance (%)	High performance (%)
Non dropout Student (%)	0.6	0.6	27.0	20.6
Dropout Student (%)	17.4	7.0	22.4	4.6

Figure 2. Relationship between desertion and academic performance from 2012-A to 2018-B

Table 3. Relationship between desertion, age ranks and financial support from 2012-A to 2018-B

Variable		Dropout (%)	Non-dropout (%)	Total (%)
Age rank (%)	16-18 years old	20.6	25	45.6
	19-25 years old	28.4	21.6	50
	Older than 26 years	2.3	2.2	4.5
	Total (%)	51.3	48.7	100
	Pearson Chi-Square, alpha significance level=0.05, p-value=0.0395 (**)			
Financial support (%)	No financial support	43.3	23.2	66.5
	Yes, financial support	8.0	25.6	33.5
	Total (%)	51.3	48.7	100
	Pearson Chi-Square, alpha significance level=0.05, p-value=0.0001 (***)			

Table 4. Correlation between the variables of academic performance due to desertion, in the period from 2012-A to 2018-B

Numerical variables	Cumulative average	Subjects taken	Subjects passed	Semesters completed	Age	ICFES
Cumulative average	1	0.000	0.000	0.000	0.000	0.020
Subjects taken	0.53	1	0.000	0.000	0.000	0.080
Subjects passed	0.58	0.99	1	0.000	0.000	0.060
Semesters completed	0.46	0.95	0.95	1	0.010	0.120
Age	-0.15	-0.13	-0.14	-0.13	1	0.000
ICFES	0.11	0.08	0.09	0.07	0.18	1

Significance level, alpha=0.05, p-value=0.000

According to Figure 3, it can be concluded that there are no significant difference between genders in relation to the number of subjects passed (p=0.496), that is, male and female pass a similar number of subjects. Similar results in relation to gender are reported in previous study [21]. Figure 4 shows that financial support is related to the number of subjects passed (p=0,0000), so there is a very significant difference between students who receive financial support and those who do not. Therefore, it can be concluded that the economic variable is an aspect to be considered by students who drop out of their Degree in Mathematics. Therefore, it can be concluded that the economic variable is an aspect to be taken into account by students who drop out of the Bachelor's Degree in Mathematics [25], [28].

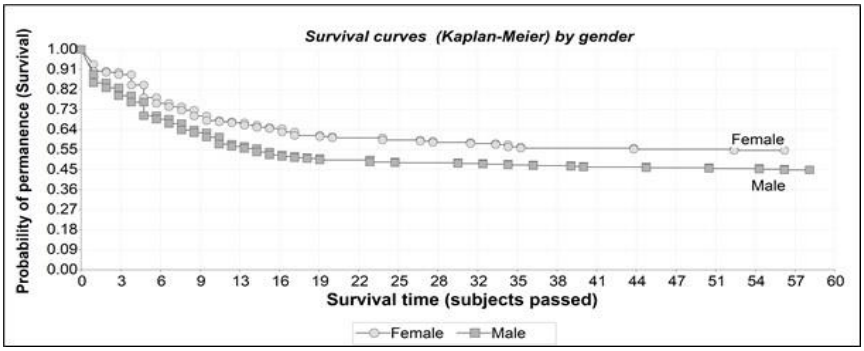


Figure 3. Survival curves by gender

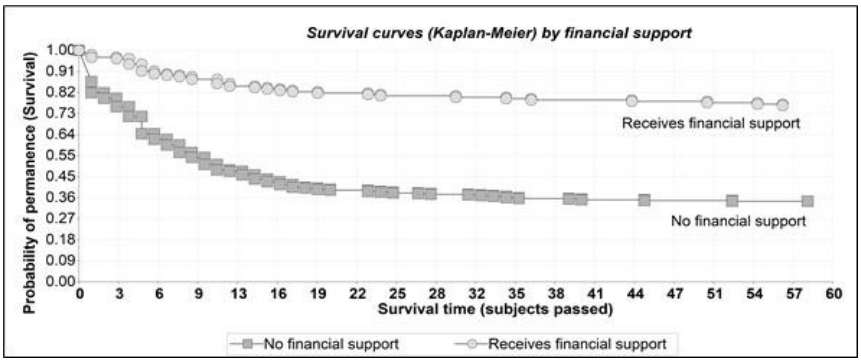
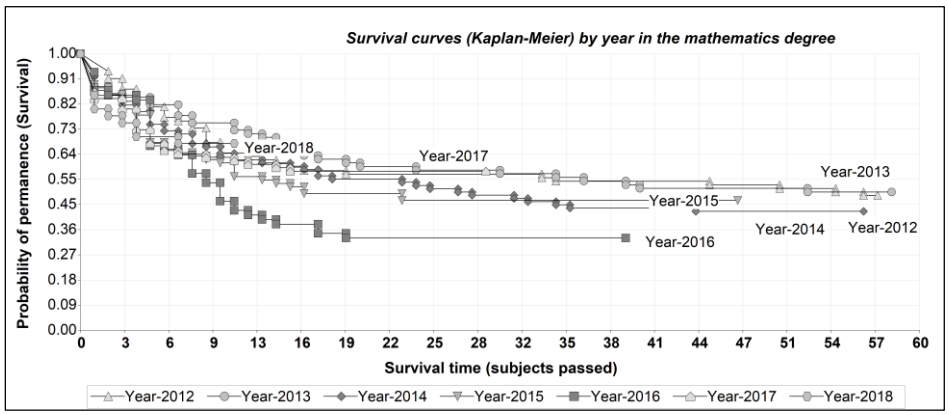


Figure 4. Survival curves by financial support

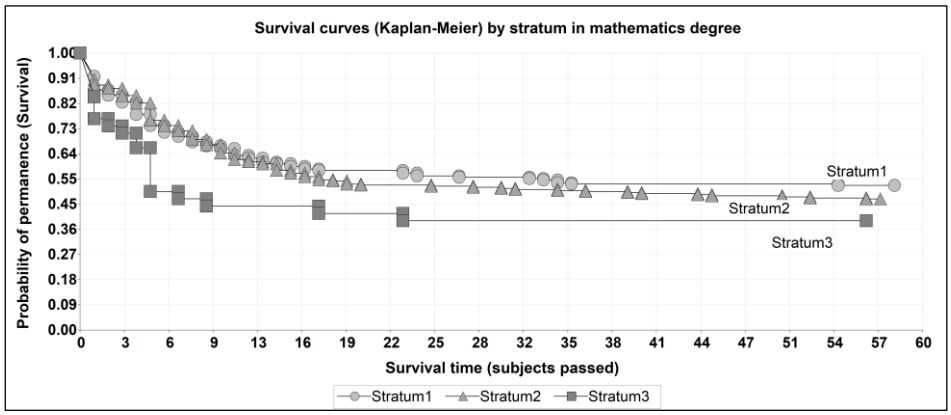
Figure 5 shows that there is no significant difference between students according to the period of entry to the program (p=0.3358), that is, the semester of entry has no direct influence on student dropout. Figure 6 shows the variables stratum and the number of subjects passed, where there is no difference between the different stratum in relation to the number of subjects passed (p=0.2104). According to Figure 7, there are no significant differences between the age ranges in relation to the subjects passed (p=0,411), so the passing results are close between all the age ranges analyzed. Figure 8 shows the significant difference between students from public schools and students from private schools with respect to the variable passed subjects (p-value=0.00019), that is, students from public schools obtain a better academic performance than students from private educational institutions. It is necessary to pay special attention to students from private schools, to motivate them to advance in their undergraduate studies [48], [49].

According to Figure 9, there are significant differences in the academic performance of the students with respect to the total number of subjects passed (p-value=0.0000), so students with low and poor performance do not complete their Degree in Mathematics. Therefore, it is important to pay attention to the academic performance in the Degree in Mathematics, and to support those students with low performance in order to improve the marks obtained during the first semesters, causality result that is reported in several studies [25], [28], [30], [48].



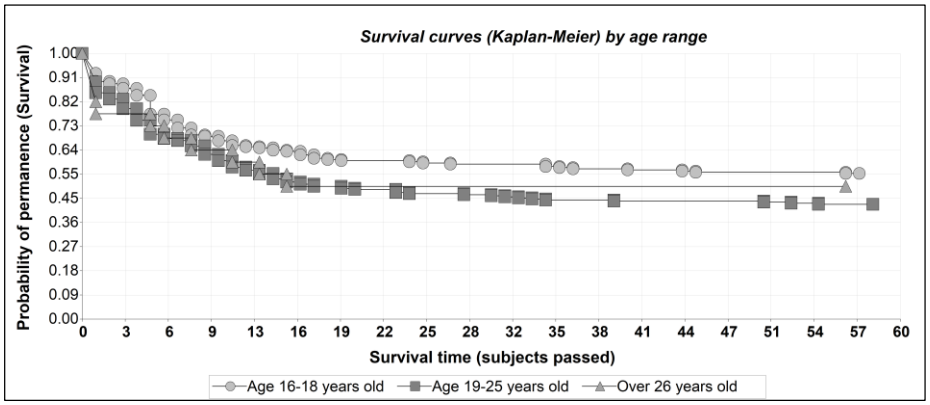
Significance level alpha=0.05, Test Log rang=6.841, p-value=0.3358

Figure 5. Survival curves by year in the Degree in Mathematics



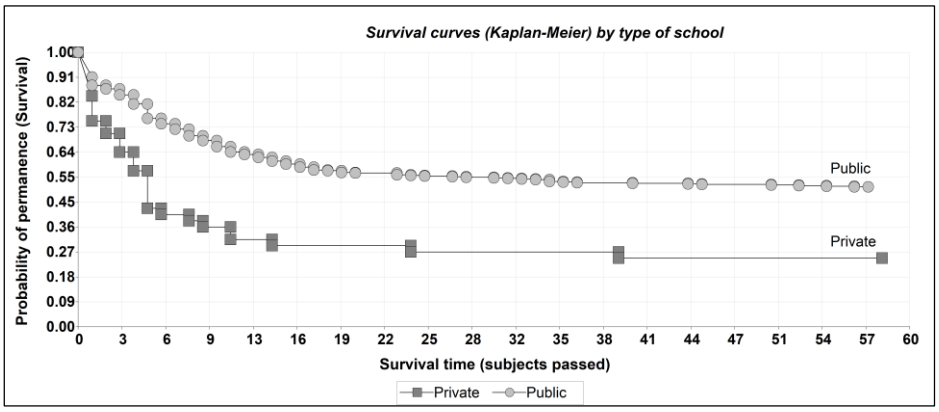
Significance level alpha=0.05, Test Log rang=6.841, p-value=0.2104

Figure 6. Survival curves by stratum in the Degree in Mathematics



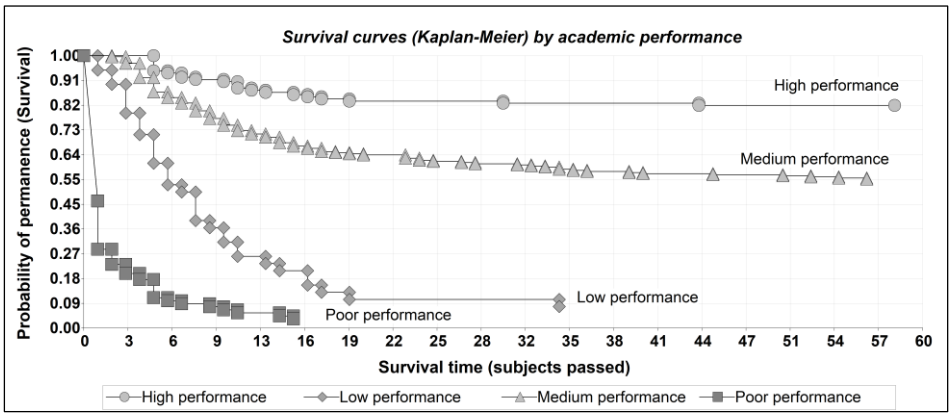
Significance level alpha=0.05, Test Log rang=6.382, p-value=0.411

Figure 7. Survival curves by age range



Significance level alpha=0.05, Test Log rang=18.337, p-value=0.00019 **(***)**

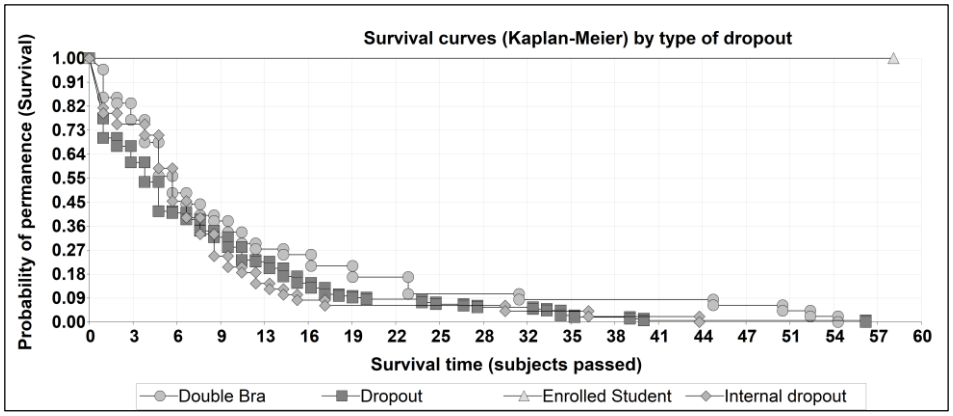
Figure 8. Survival curves by type of school



Significance level alpha=0.05, Test Log rang=405.45, p-value=0.0000 **(***)**

Figure 9. Survival curves by academic performance

Figure 10 shows a significant difference in the total number of subjects passed between dropout students and non-dropout students, so it is necessary to give importance to the students who dropout, and to generate possible solutions so that these students can re-enter and continue their studies in the Degree in Mathematics. Academic performance associated with passing grades is a significant factor in student retention at university level, results consistent with previous studies [1], [25], [28], [47].



Significance level alpha=0.05, Test Log rang=523.62, p-value=0.0000

Figure 10. Survival curves by type of dropout

According to the results, there is statistically significant evidence of the causality of factors associated with academic performance, which are causal to the risk of dropping out, a result that coincides with several research [1], [28], [47], who identified that students with higher academic performance obtained in the program remain and dropout less. This is an indicator for projecting strategies for accompanying students, and strategies for early identification of the subjects that are more difficult to pass, with the intention of preventing the risk of dropping out [25]. The socio-economic factor related to stratum did not show significant evidence of student dropout. These factors are relevant in previous studies [6], [49]. However, the financial factor in the present study was found to be significant in causal incentives for student retention ($p<0.001$), contrary to students who do not receive financial support, coinciding with results obtained in other studies [1], [28], [48].

4. CONCLUSION

It is essential to draw up data processing policies, identify and implement methodologies for consolidating and purging student information, within the guidelines for access to public data at national and international level. To outline processes to determine mechanisms for accessible formats, within the framework of protection and dynamization of personal data of baseline information on social, economic and academic variables, and the implementation of statistics. Determine and standardize methodological processes for validation and evaluation of baseline information required to determine causal factors in order to reorient teaching and administrative processes for student retention in real time. Information for decision-making on the implementation of student retention policies, according to the problems in the synergy between students, teachers and managers at universities, particularly at the University of Tolima. The results of the problem assessment are input for the projection of university retention strategies, which will allow a solution to this social problem, since when a student decides to abandon their university studies it directly affects the entire university and labor system, as the effects of this decision can transcend to the families, and the state in economic and social terms.

The results found in the different models show that receiving financial support is an important relief for students and is a motivation to continue their studies. Therefore, it is important that the University of Tolima generates more financial support (scholarships, subsidies, housing, food) which motivates students and gives them the basic tools to continue with their university studies. It is also important to continue strengthening the academic support programs for students with medium and low performance within the program, in order to encourage them to improve their marks so that they can continue with their studies without feeling frustrated with their performance. The implementation of student retention strategies should be evaluated by monitoring factors associated with academic performance, financial support, type of institution and type of academic dropout in each of the higher education programs.

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