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Relationship between Entrance Exam Scores, Academic Performance, and Student Dropout Rates: A Longitudinal Case Study

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Abstract. This study investigates the relationship between entrance exam scores and academic performance, as well as their implications for student retention, at the Jorge Basadre Grohmann National University (UNJBG). Using data from 1,526 students admitted in 2017 and tracked through 2024, the analysis explores entrance scores by subject area, average academic performance, and dropout rates across four study tracks. Results reveal that Verbal Reasoning (VR) and Language (LA) consistently exhibit moderate positive correlations with academic performance, while discipline-specific subjects such as Biology (BI) and Mathematical Reasoning (MR) show varying levels of influence depending on the study track. A strong negative relationship between entrance scores and dropout rates was identified, supported by Spearman correlations of -0.8 (average scores) and -0.77 (minimum scores). Based on these findings, a data-driven admission policy is proposed, introducing track-specific minimum score thresholds designed to reduce dropout rates while maintaining accessibility. The proposed threshold for Health and Biomedical Sciences would result in eliminate 24.29% of dropouts by reducing admissions by only 16.56%. The study underscores the value of aligning admission criteria with program-specific academic demands and highlights the potential of advanced data science techniques to refine predictive models and identify more nuanced patterns. These insights contribute to the development of evidence-based admission policies that optimize retention and support long-term academic success in the Peruvian higher education context.

Keywords: entrance exams; student dropout; academic performance

1. Introduction

Entrance exams are a fundamental component of higher education systems worldwide, serving as a critical tool for evaluating prospective students and

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ensuring the selection of the most capable candidates. These standardized assessments aim to measure cognitive abilities, subject-specific knowledge, and readiness for the academic rigor of university programs. Their importance lies not only in facilitating access to education but also in predicting academic success during higher education (Sawyer, 2007). Understanding the relationship between entrance exam performance and subsequent academic achievement is vital for refining admission policies and fostering student success.

Numerous studies have explored the predictive validity of entrance exams across diverse contexts and disciplines. For instance, Yang (2020) examined the correlation between subject-specific entrance tests and undergraduate academic performance in China, revealing significant variability in their predictive power depending on the academic discipline and admission track. These findings underscore the nuanced relationship between different components of entrance exams and university success, suggesting the need for a tailored approach to admissions that accounts for discipline-specific requirements.

Critics of entrance exams often argue that these tests may reflect socioeconomic disparities rather than true academic potential. Sackett et al. (2009) addressed this concern by analyzing large datasets and demonstrating that while socioeconomic status (SES) influences exam scores, the predictive validity of these scores for academic performance remains largely independent of SES. This highlights the robustness of entrance exams as a tool for assessing academic potential, though it also calls attention to the broader context of equity in education.

In the healthcare education domain, studies have shown that integrated admission criteria—including cognitive and non-cognitive measures—are more effective in predicting academic performance than relying solely on standardized tests. Iftikhar et al. (2020) found that medical college admission criteria combining academic exam scores with assessments of communication, empathy, and ethics provided a more comprehensive prediction of success in clinical years. Similarly, Diarsvitri et al. (2020) emphasized the importance of considering psychological and demographic factors alongside academic tests to estimate students' academic success in preclinical medical education.

The relationship between prior academic performance, as reflected in high school grades, and university success has also been a focus of research. High school GPA often emerges as a stronger predictor of first-year college GPA than standardized exam scores in less selective institutions, while the opposite is true for highly selective universities (Sawyer, 2007). Poláčková and Svatošová (2012) further illustrated this point in their study of economics students, where entrance exam results were found to correlate significantly with average progress in bachelor's programs.

In Latin America, there is limited research on the predictive validity of entrance exams, despite their widespread use. Baccaro and Shinyashiki (2017) investigated this relationship at a public university in São Paulo, Brazil, and found that entrance exam performance was positively associated with academic success across various disciplines, regardless of career field. Their findings emphasize the

influence of entrance modalities and personal factors on student performance, underscoring the importance of further localized studies in the region. These findings align with international research but also highlight the need for more localized studies to address region-specific educational challenges.

In Peru, each university has the autonomy to determine its admission procedures. All national universities in Peru, where competition for admission is fierce, conduct an entrance test. For example, San Marcos Major National University conducts entrance tests with a total of 17 subject areas where the number of questions per subject area depends on 4 study tracks.

At Jorge Basadre Grohmann National University (UNJBG) in Tacna, Peru, entrance exams play a pivotal role in the selection process for undergraduate programs. The entrance test consists of exams per study track (that group the study programs), each with different 8 subject areas and variable number of questions. In 2024, 14,683 applicants took the entrance exam to gain entry into one of the 34 study programs, but only 1,794 were admitted (12.21%), whereas for the Medicine study program the acceptance rate was just 1.67% (30 students). However, the extent to which these tests are related to academic performance remains unexplored.

Despite extensive research exploring the relationship between entrance exam scores, academic performance, and student retention, a significant gap remains in understanding this dynamic within the specific context of Peruvian higher education. Specifically, little is known about how entrance exam scores influence student outcomes at UNJBG, particularly regarding their predictive validity for academic success and retention across different programs and subject areas. Addressing this gap is crucial to inform evidence-based admission policies tailored to local contexts and academic demands.

This study aims to address this gap by conducting an in-depth analysis of the relationship between entrance exam scores and academic performance throughout students' university careers at UNJBG, focusing on 1,526 students admitted in 2017 whose records have been tracked until 2024, making it a long-term longitudinal study. From this cohort, 500 students dropped out, representing a significant dropout rate of 32.76%. This highlights the pressing need to investigate factors contributing to dropout, such as entrance exam scores and scores per subject area, to develop strategies that improve retention and support academic success. Using a data-driven approach and visualization tools, this research examines entrance exam scores by subject area, providing comprehensive insights into their impact on academic performance and student retention within the Peruvian higher education context. Three main research objectives are addressed: (i) To describe the exam scores and academic performance of students. (ii) To analyze the relationship between exam scores and student dropout. (iii) To analyze the relationship between exam scores by subject area and academic performance.

The findings of this study have significant implications for policymakers, educators, and university administrators. The insights gained from

understanding the entrance exam performance and academic performance, as well as analyzing the relationships between exam scores by subject area, students' dropout, and academic performance, can guide the development of more effective admission criteria's, ensuring a selection process that is focused on academic success and retention.

2. Literature Review

The relationship between entrance exam scores and subsequent academic performance remains a central focus in higher education research. Many studies report a positive correlation between entrance examination results and university achievements. However, some researches reveal no significant association, and others emphasize that additional factors (e.g., socioeconomic status, admission modality, personal competencies) mediate this relationship. The following systematization groups relevant recent studies into three main clusters—those positing a positive correlation, those finding no significant correlation, and those highlighting other influential factors—followed by a summary table.

2.1. Studies Indicating a Positive Correlation

Several studies across diverse contexts highlight a statistically significant positive relationship between entrance exam scores and academic performance. For example, Baccaro and Shinyashiki (2017) found that entrance exam performance was positively associated with student success in a Brazilian public university, suggesting that the exam remained predictive regardless of career field. In Nigeria, Oluwatayo and Fajobi (2012) reported that Post-UTME scores correlated positively with Mathematics/Computer Science undergraduates' CGPAs, particularly during their first year, indicating substantial predictive validity at early stages of university.

A similar trend was observed by Ilave et al. (2020) at the San Marcos Major National University, where students' entrance exam scores were positively related to their academic performance coefficient, although the strength of this correlation was moderate. Likewise, Sackett et al. (2009) demonstrated that, despite the influence of socioeconomic status (SES) on exam scores, the predictive validity of entrances tests remained largely intact after controlling for SES, thus reinforcing the robustness of such exams. In a medical education context, Iftikhar et al. (2020) showed that standardized exam scores (MDCAT) predicted academic performance in preclinical years and worked in tandem with assessments of non-cognitive skills to forecast clinical performance.

Additionally, recent studies have expanded on these findings by incorporating predictive models to assess dropout risks in higher education institutions. Pérez et al. (2018) developed a multivariate model that accurately predicted first-year dropout rates in Chile, identifying key categorical variables that influence student retention. Similarly, Gutiérrez et al. (2024) employed regression and decision tree techniques to optimize resource allocation in a private Chilean university, demonstrating that machine learning models can enhance dropout predictions.

Ferrão and Almeida (2018) reported that the university entrance score was the strongest predictor of first-year GPA in Portugal, although its effect varied across

courses. Similarly, Diarsvitri et al. (2020) found that cognitive entrance exam scores, along with a psychological test, significantly correlated with academic success in the preclinical stage of a medical program in Indonesia.

Taken together, these studies suggest that entrance tests can serve as valid indicators of future academic performance, particularly in the early semesters or preclinical stages of professional programs. Nonetheless, many highlight the attenuating effect of time—predictive power often diminishes after the first or second academic year—and the role of complementary factors (e.g., non-cognitive skills, motivation, socioeconomic background).

2.2. Studies Reporting No Significant Correlation

A group of investigations has found no statistically significant correlation between admission criteria and subsequent performance, questioning the extent to which exam scores alone can predict academic success. For instance, Rudhumbu and Mudau (2020) concluded that undergraduate degree classifications in Zimbabwe did not significantly influence postgraduate performance, implying that prior academic achievements, as screening tools, had limited predictive power at the advanced level.

In Turkey, Metli and Özcan (2020) showed that International Baccalaureate Diploma Program scores did not have a significant correlation with students' rank order in a university entrance exam, suggesting that IBDP results might not be a strong predictor of entrance exam outcomes. Similarly, Nugraha (2021) found no positive relationship between high university entrance scores and the academic achievement of first-year students, reinforcing the notion that entrance exam success may not always translate into favorable performance once enrolled.

Opazo et al. (2021) further contribute to this discussion by demonstrating that different universities exhibit distinct dropout predictors, emphasizing that applying a universal predictive model across institutions may not always yield accurate results. Their study found that machine learning models perform best when tailored to individual universities rather than generalized across multiple institutions.

2.3. Studies Highlighting Other Influential Factors

A third cluster of research indicates that while entrance exam scores may or may not be relevant, a host of additional factors—such as policy interventions, admission modality, socio-demographic variables, and personal competencies—play crucial roles in academic outcomes.

Recent studies have highlighted the impact of economic, institutional, and psychological factors on university dropout rates. Núñez-Naranjo (2024) analyzed dropout determinants in Ecuador, revealing that socioeconomic conditions, academic background, and institutional support significantly influence student retention. Similarly, Wild and Heuling (2020) applied event history analysis to cooperative education students in Germany, identifying workplace commitment and personality traits as significant factors in dropout risk.

Deng et al. (2020) focused on Yunnan's Preferential Admission Policies (PAPs) for ethnic minorities. Their findings highlight how geographical remoteness, linguistic barriers, and socioeconomic constraints necessitate policy-driven support, overshadowing the sole predictive power of cognitive exam scores. Aguilar-Ruiz et al. (2021) found that the modality of entrance (e.g., specialized track, direct entry) constituted a key variable explaining first-semester performance for Engineering students in Peru, alongside personal interests and habits such as media consumption. Ponce-Sanchez and Quinteros (2022) similarly documented that at the National University of Engineering (UNI) in Lima, students' academic performance significantly depended on the route used for admission (ordinary, direct, or school-based), underscoring that exam scores alone did not fully explain variations in subsequent performance.

Kalaycıoğlu (2019) demonstrated that student-centered activities were negatively associated with both Turkish-social and mathematics-science exam results, whereas teacher-centered activities had a positive relationship with Turkish-social science scores. Moreover, student interest and self-perception of success in each subject area emerged as critical factors. Furthermore, Wild et al. (2024) explored how motivation and lecturer support influence dropout rates in cooperative education programs, identifying that perceived support from instructors can mitigate dropout risk. Their findings emphasize the importance of integrating student support services into higher education retention strategies.

These studies emphasize that contextual variables—ranging from regional policies to instructional approaches—can be just as decisive as (or even more decisive than) entrance exam scores in influencing university success.

2.4. Concluding Remarks on Related Works

Overall, a majority of the reviewed studies find positive though often variable correlations between entrance exam performance and subsequent university achievement. However, an important subset of research concludes that entrance exam scores do not significantly predict success for all students, especially when broader institutional, socioeconomic, and personal variables enter the equation. Still other investigations highlight additional factors, such as admission modalities, non-cognitive skills, teaching methods, and equity policies, which can reshape or moderate the effect of entrance exam scores.

These mixed findings highlight the need for further research on the relationship between entrance exam results and academic performance in specific institutional contexts. In particular, exploring this relationship at the Jorge Basadre Grohmann National University (UNJBG) in Peru, where there is a high dropout rate, promises to yield valuable insights. Indeed, focusing on entrance tests as the primary criterion for university selection and examining their predictive power for both persistence (dropout) and success stands as an essential step toward improving admission policies and student outcomes in Peruvian higher education.

3. Research Methodology

In this section, the research design, research paradigm, data collection and processing procedures, and ethical considerations.

3.1 Research Design

This study employed a quantitative research approach grounded in the postpositivist paradigm, utilizing a longitudinal cohort analysis to investigate the relationship between entrance exam scores, academic performance, and student dropout. The longitudinal design allowed for the tracking of a cohort of 1,526 students admitted to the Jorge Basadre Grohmann National University (UNJBG) in 2017 over a seven-year period, from admission through to 2024.

A retrospective data analysis strategy was used, leveraging existing institutional records, including entrance exam scores per subject area (e.g., verbal reasoning, mathematical reasoning, biology, etc.), and university student performance. The retrospective nature of the analysis ensures the use of real-world, pre-existing data collected for administrative purposes, repurposed here to gain insights into academic outcomes and student retention.

Unlike experimental or quasi-experimental designs, this study examines naturally occurring patterns and relationships in the data. By adopting this approach, the study aims to describe trends in academic performance, analyze the influence of entrance exam scores by subject area on both academic success and student dropout, and explore whether a minimum entrance score threshold can be established to predict outcomes effectively.

The analysis employed statistical methods, including descriptive statistics, correlation analysis (Spearman's rank correlation), and visualization techniques to explore the relationship between entrance exam scores, academic performance, and student dropout. Data processing, statistical analyses, and visualizations were performed using Python programming language with libraries such as Pandas for data manipulation and Matplotlib for graphical visualization. Utilizing these powerful data analysis tools facilitated efficient processing, exploration, and interpretation of large datasets, thereby enabling robust, insightful, and reproducible findings.

This design provides a robust framework for analyzing the complex interplay between admission criteria and academic success in the context of Jorge Basadre Grohmann National University and Peruvian higher education, with findings that can inform evidence-based policymaking and institutional strategies for student support and retention.

3.2. Data Collection

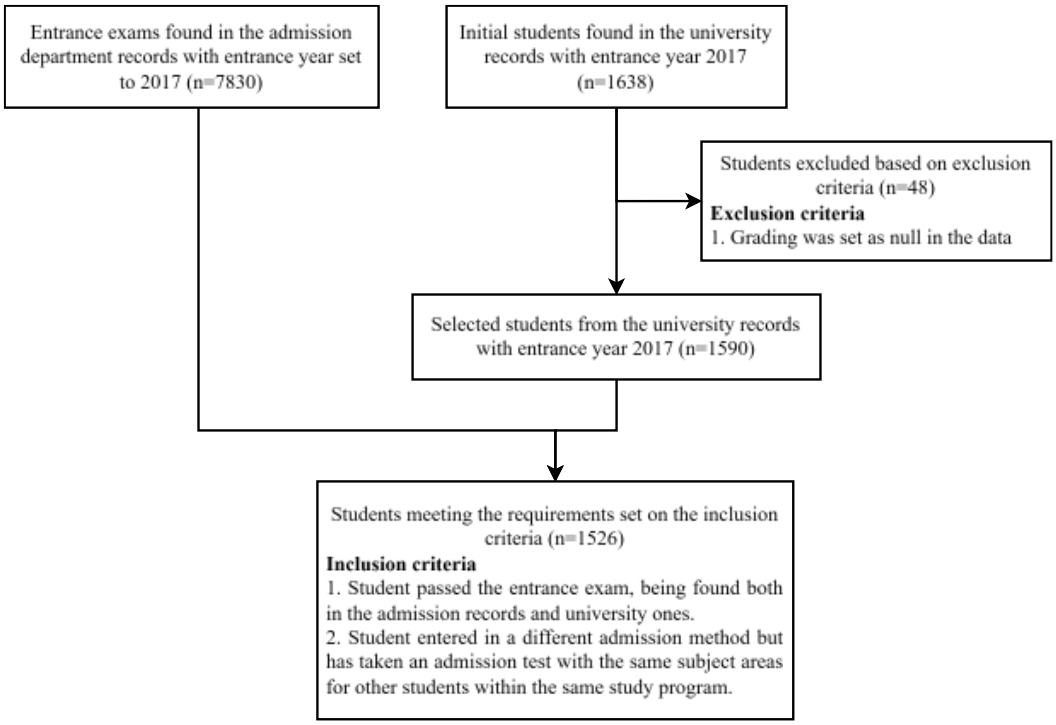

Figure 1: Data Selection Process for the Study Cohort, Including Exclusion and Inclusion Criteria for Students Admitted to the Jorge Basadre Grohmann National University in 2017

This study utilized institutional records from the Jorge Basadre Grohmann National University (UNJBG) to construct a comprehensive dataset of students admitted in 2017. The data collection process followed a systematic approach to ensure the inclusion of relevant and accurate records, as described below and illustrated in Figure 1.

Table 1: Study Tracks and Corresponding Study Programs and Number of Semesters at the Jorge Basadre Grohmann National University

Admission Type	CEPU			Fase		Total
	I	II	III	I	II	
Applicants	818	1399	1169	2002	2441	7829

The initial dataset comprised 7,330 records of entrance exams from the admission department for the year 2017, including both admitted and non-admitted students. The types of admission include the Centro de Estudios Preuniversitarios (CEPU) exam, where students attend preparatory classes and are then tested on what they have learned, and the Fase exam, which is divided into two categories: Fase I and Fase II. The Fase I exam is specifically oriented for students who have just completed secondary school, while the Fase II exam is oriented to all applicants. The number of applicants for each exam type is presented in Table 1. All exams are graded on a scale from 0 to 600.

Simultaneously, 1,638 student records were identified in the university database for students who enrolled in 2017, with their academic records spanning the period from 2017 to 2024. To enhance data quality, exclusion criteria were applied. Specifically, 48 students were excluded due to incomplete or null grading data in the university records. This refinement resulted in a dataset of 1,590 students who met the minimum data quality standards.

Records form the admission department and university records were cross-referenced to create a unified dataset, ensuring consistency between sources.

Following this step, inclusion criteria were implemented to finalize the dataset. Students were included if they satisfied the following conditions:

1. They passed the entrance exam and had corresponding records in both the admission and university datasets.
2. They were admitted through alternative pathways but had taken an entrance exam with the same subject areas required for their respective study programs.

Applying these criteria, the final dataset comprised 1,526 students, forming the cohort analyzed in this study. This dataset provided the foundation for a longitudinal analysis of entrance exam scores, academic performance, and student retention over a seven-year period, from 2017 to 2024. By adhering to these rigorous selection processes, the study ensured the validity and reliability of its findings, aligning with its objectives to examine the interplay between admission criteria and academic outcomes.

3.3. Data Processing

The processing of entrance exam data involved utilizing records obtained from the admissions department of the (UNJBG). These records included the applicants' responses and the corresponding correct answers for the admission exam.

Table 2: Study Tracks and Corresponding Study Programs and Number of Semesters at the Jorge Basadre Grohmann National University

Study Track	Study Programs (#semesters)
1: Health and Biomedical Sciences	EMVZ: Veterinary Medicine and Zootechnics (10); ESBM: Biology – Microbiology (10); ESFB: Pharmacy and Biochemistry (**12**); ESEN: Nursing (**12**); ESOB: Obstetrics (**12**); ESOD: Dentistry (**12**); ESMH: Human Medicine (**12**)
2: Exact Sciences, Engineering, and Architecture	ESME: Metallurgical Engineering (10); ESMI: Mining Engineering (10); ESAM: Environmental Engineering (10); ESMA: Mathematics (10); ESFI: Applied Physics (10); ESIQ: Chemical Engineering (10); ESGE: Geological Engineering – Geotechnics (10); ESMC: Mechanical Engineering (10); ESAG: Agronomy (10); ESIP: Fisheries Engineering (10); ESIA: Food Industries Engineering (10); ESIS: Computer Science and Systems Engineering (10); ESIC: Civil Engineering (10); ESAQ: Architecture (10)

3: Social Sciences and Humanities	ESHI: History (10); MACI: Education: Mathematics, Computing, and Informatics (10); SPRO: Education: Social Sciences and Socio-Cultural Promotion (10); LELI: Education: Language and Literature (10); IDEX: Education: Foreign Language (10); NATA: Education: Natural Sciences and Environmental Education Promotion (10); ESAR: Arts (10); ESCC: Communication Sciences (10); ESDE: Law and Political Science (**12**)
4: Actuarial and Business Sciences	ESAD: Administrative Sciences (10); ESCF: Accounting and Financial Sciences (10); ESCO: Commercial Engineering (10); ESEA: Agricultural Economics (10)

The entrance exams varied depending on the study track, as detailed in Table 2, which outlines the study tracks and their associated study programs.

Table 3: Subject Areas Included in the Entrance Exam by Study Track

Subject Area	Study Track			
	1	**2**	**3**	**4**
Verbal Reasoning (VR)	X	X	X	X
Mathematical Reasoning (MR)	X	X	X	X
Arithmetic and Algebra (AA)	X	X	X	X
Language (LA)	X	X	X	X
Geometry and Trigonometry (GT)	X	X		X
Physics (PH)	X	X		
Chemistry (CH)	X	X		
Biology (BI)	X			
Logic (LO)		X		
History (HI)			X	X
Literature (LI)			X	
Economy (EC)			X	X
Geography (GE)			X	X

Each study track corresponds to a unique combination of subject areas evaluated in the entrance exam, as shown in Table 3.

Using the study track assigned to each applicant and the order of questions in their respective entrance exams, the data were processed to calculate the percentage of correctly answered questions for each subject area. This step allowed for a detailed analysis of applicants' performance by subject area within their respective study tracks. This processing ensured that the data accurately reflected applicants' proficiency across the different components of the entrance exam.

For the data corresponding to academic performance obtained from the university database, several metrics were calculated to facilitate analysis. For each student, the following measures were derived:

1. Average GPA: The mean grade obtained across all enrolled courses each semester and in total.
2. Enrolled Courses: The number of courses in which the student was officially registered each semester and in total.

3. Failed Courses: The number of courses the student failed each semester and in total.

Additionally, the dataset included temporal information about each student's academic trajectory, such as:

1. Start Year: The year the student began their studies.
2. Last Year of Study: The most recent year in which the student was enrolled in courses.

To identify student retention, a labeling process was conducted to categorize students as dropouts. Applicants were labeled as dropout if they met the following criteria:

1. They were not enrolled in any courses during the penultimate or last semester of the analysis period.
2. They were not registered for any courses in 2024.

This systematic approach ensured a comprehensive understanding of students' academic performance and their enrollment status over the study period, enabling a detailed examination of retention patterns and academic outcomes.

3.4. Ethical Considerations

This study adhered to ethical standards. Approval was obtained from the ethics committee of the Jorge Basadre Grohmann National University on October 14th, 2024, ensuring that the use of institutional data adhered to established ethical guidelines. The authorization granted allowed for the analysis of academic records while safeguarding the privacy and confidentiality of the students involved.

To protect individual identities, all data were anonymized in the final dataset. Identifiable information was removed, ensuring that it is not possible to trace the records back to any specific student. These measures were taken to uphold the principles of data protection and privacy throughout the research process.

4. Results and Analysis

4.1. Entrance Exam Scores and Academic Performance Overview

4.1.1 Overview of Entrance Exam Scores

This section provides a detailed analysis of entrance exam scores for 2017, focusing on their distribution across study tracks, admission types, and study program types. Using visual representations, such as box plots, the data highlights key differences in test performance among applicants and their alignment with the requirements of specific tracks and programs.

The analysis begins by examining the relationship between study tracks and admission types, showcasing variations in exam scores across preparatory and direct exam modalities. Subsequently, the focus shifts to a deeper exploration of exam scores within each study track, categorized by program types, to uncover patterns of applicant preparedness and performance. These visualizations and

insights set the foundation for understanding the broader implications of entrance exam results and their connection to academic success.

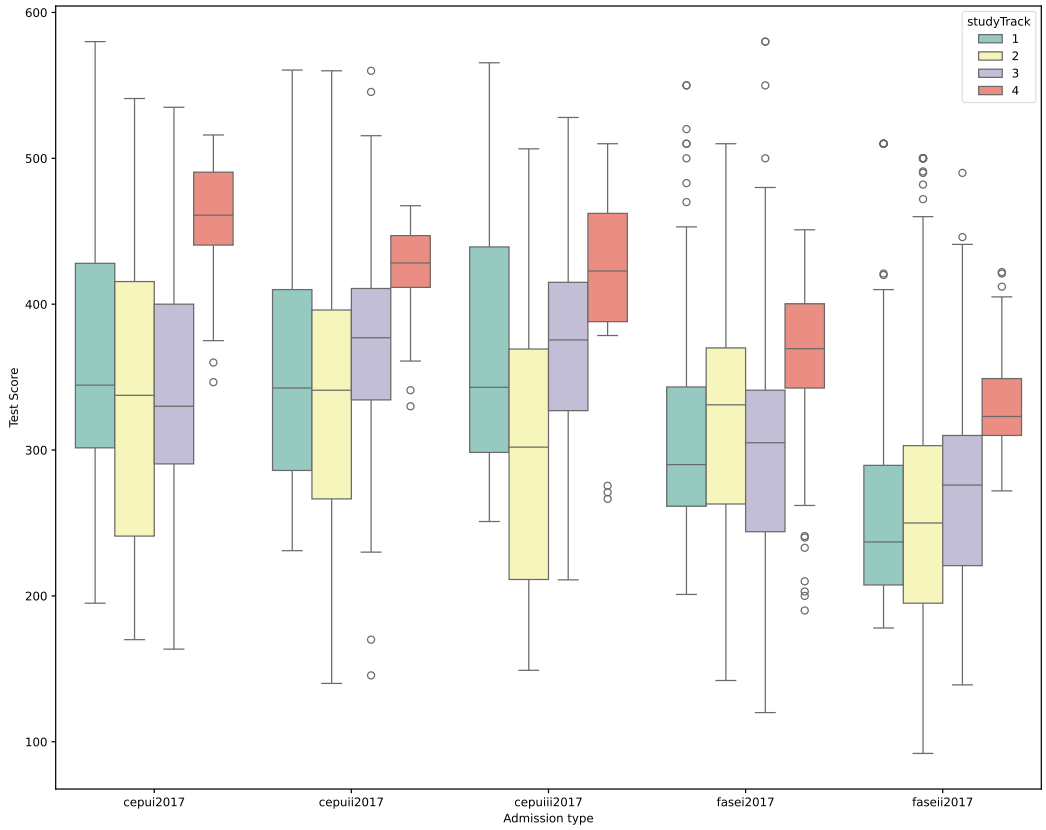

Figure 2: Exam Scores Boxplot per Study Track Grouped by Admission Type

Figure 2 presents the distribution of exam scores for 2017 admission, per study track and grouped by admission type (CEPU I, CEPU II, Fase I, and Fase II). The study tracks are color-coded, with Study Track 4 (Actuarial and Business Sciences) consistently showing the highest median exam scores across most admission types. In contrast, Study Track 3 (Social Sciences, and Humanities) generally exhibits lower median scores.

Test score variability is more pronounced in the CEPU I and CEPU II admission types, indicating a wider range of preparedness among students. In comparison, Fase I and Fase II display tighter distributions, indicating more consistent performance, particularly for Fase I, which is specifically designed for recent high school graduates.

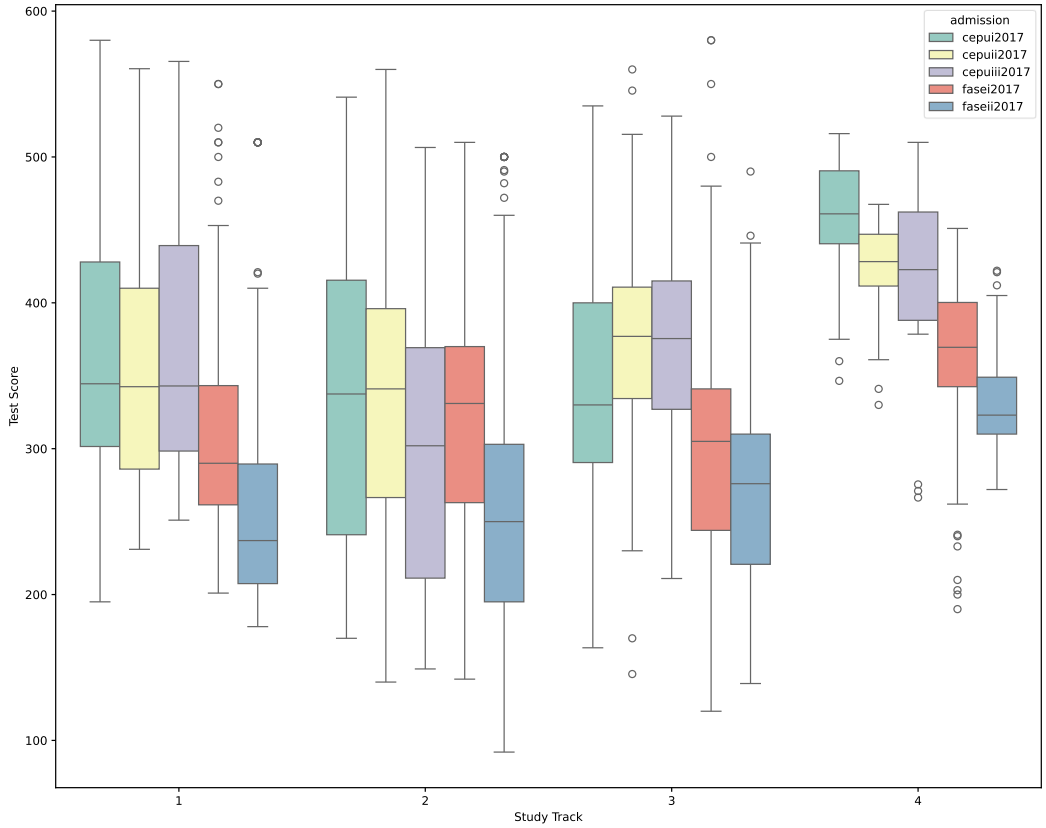

Figure 3: Distribution of Entrance Exam Scores Boxplot per Admission Type Grouped by Study Track

Figure 3 presents the distribution of exam scores for 2017 admission per admission type grouped by study track (CEPU I, CEPU II, Fase I, and Fase II). The box plots depict the median, interquartile range (IQR), and variability of exam scores, with outliers represented as individual points.

Across all study tracks, CEPU I and CEPU II admission types exhibit broader score distributions compared to Fase I and Fase II, indicating greater variability in applicant test performance. This pattern suggests that the preparatory nature of CEPU exams may lead to a wider range of outcomes. In contrast, Fase I scores, tailored for recent high school graduates, show more consistent performance with tighter IQRs.

Study Track 4 (Actuarial and Business Sciences) consistently demonstrates higher median scores across most admission types compared to other study tracks, reflecting stronger performance among its applicants. Conversely, Study Track 3 (Social Sciences and Humanities) generally has lower median scores, particularly for CEPU II and Fase II applicants.

This chart emphasizes key differences in test performance across study tracks and admission modalities, providing insights into the diversity of applicant preparedness.

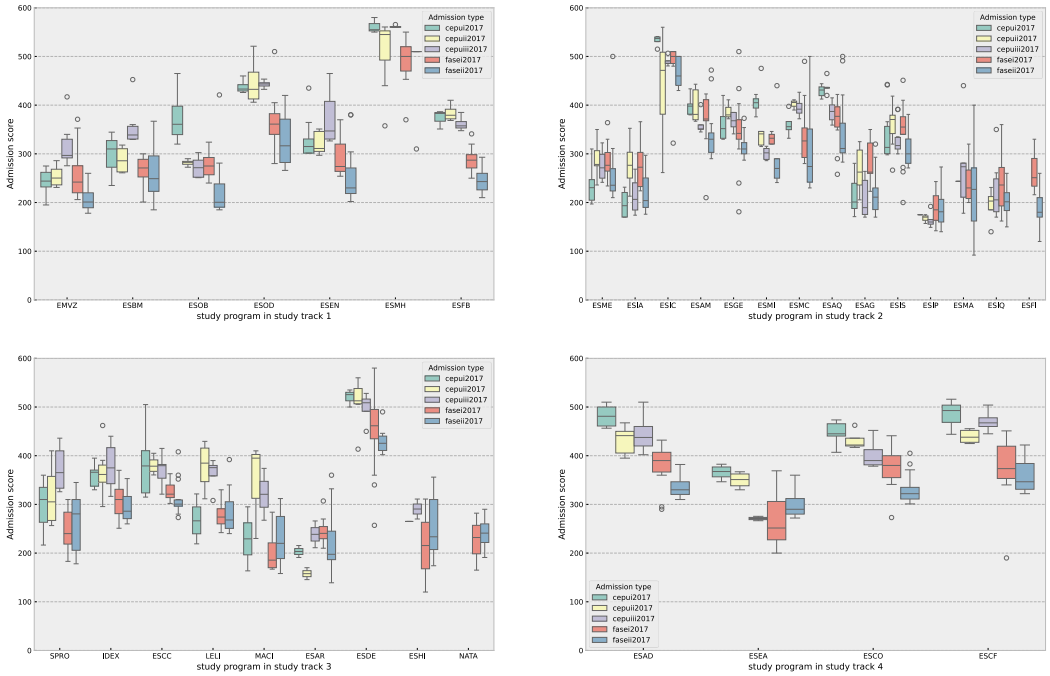

Figure 4: Exam Scores Boxplot per Study Program types Grouped by Study Track

Figure 4 presents the distribution of exam scores grouped by study program within each study track. The chart highlights variations in test performance across different program types and tracks, providing insights into applicant preparedness and the academic demands of specific fields.

Across the study tracks, programs in Health and Biomedical Sciences (Study Track 1) demonstrate moderate variability in exam scores, with medians clustering closer to the upper quartile, indicating relatively strong performance among applicants. Conversely, programs in Social Sciences and Humanities (Study Track 3) show broader score distributions, with lower medians compared to other tracks, reflecting greater variability in applicant preparedness.

Exact Sciences, Engineering, and Architecture (Study Track 2) presents consistent medians with narrower interquartile ranges, particularly in high-demand programs such as Civil Engineering and Mining Engineering, suggesting more homogeneous applicant performance. Actuarial and Business Sciences (Study Track 4) consistently shows higher median scores across program types, reinforcing the trend of stronger performance observed in this track.

Outliers are evident across all study tracks, particularly in preparatory program types, suggesting that while most applicants cluster within expected ranges, a subset of students exhibits significantly different performance levels.

4.1.2 Overview of Academic Performance

This section provides an analysis of academic performance among students in the 2017 admission cohort, focusing on variations across study programs and tracks. Using visualizations, it examines average academic performance and course

failure rates, offering a comprehensive understanding of student outcomes within each track.

The analysis begins by exploring average academic performance, highlighting differences in outcomes across study programs grouped by study track. It then delves into course failure rates, providing insights into the academic challenges faced by students in various fields.

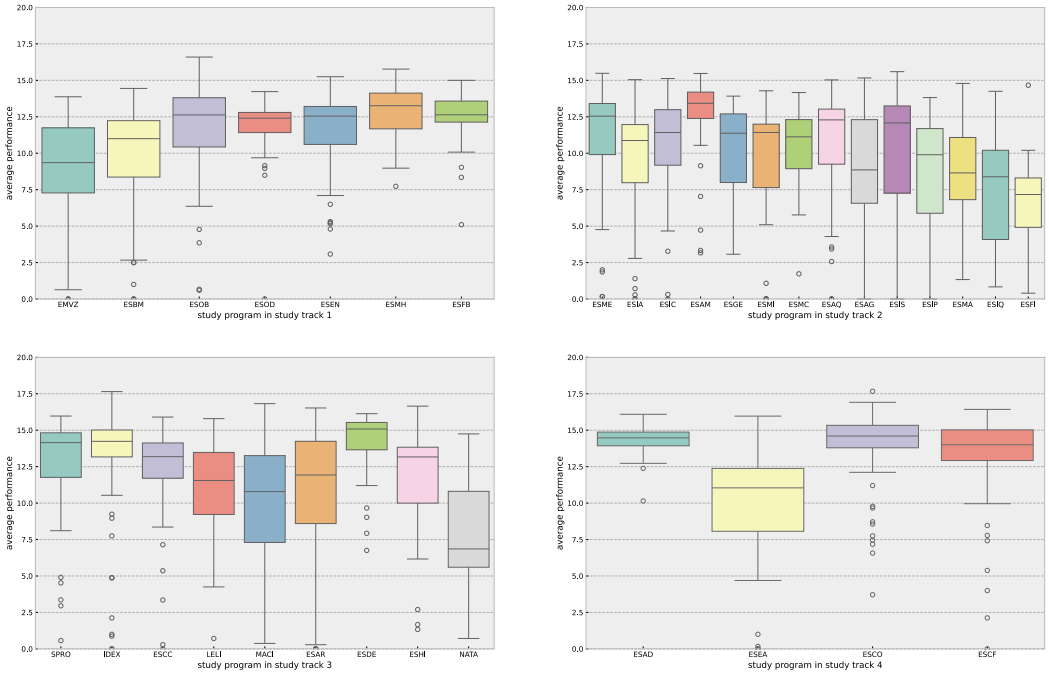

Figure 5: Average Performance per Study Program Grouped by Study Track

Figure 5 shows the average performance per study program, grouped by study track, for the 2017 admission cohort. The chart highlights variations in academic performance across programs within each study track, providing insights into the diversity of outcomes among students.

Study Track 4 (Actuarial and Business Sciences) consistently demonstrates higher average performance across its programs, indicating strong academic outcomes in this track. In contrast, Study Track 3 (Social Sciences and Humanities) exhibits more variability, with some programs showing notably lower average performance compared to others.

Programs within Study Track 1 (Health and Biomedical Sciences) display moderate performance with less variability, suggesting consistent academic outcomes across its programs. Similarly, Study Track 2 (Exact Sciences, Engineering, and Architecture) shows stable performance.

These patterns underscore significant differences in academic performance across study programs and tracks, reflecting the varying academic demands and preparedness of students.

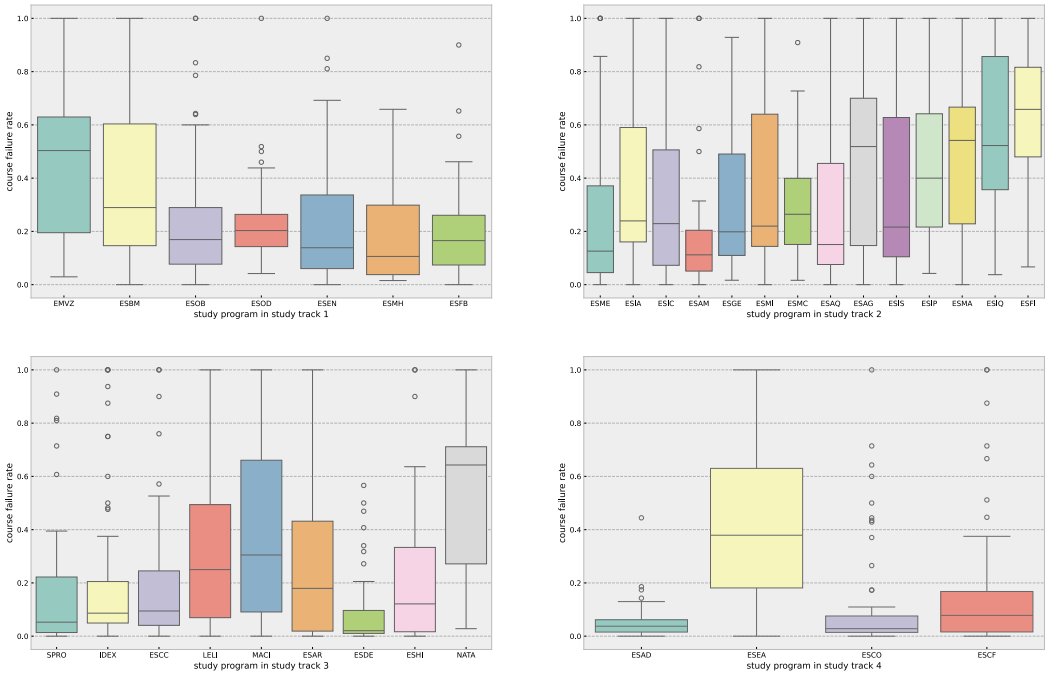

Figure 6: Course Failure Rates per Study Program Grouped by Study Track

Figure 6 illustrates the course failure rates per study program, grouped by study track, for the 2017 admission cohort. The chart highlights differences in failure rates across programs, providing insights into academic challenges faced by students in various fields.

Study Track 4 (Actuarial and Business Sciences) exhibits relatively low failure rates across its programs, indicating stronger academic outcomes and fewer difficulties for students in these disciplines. In contrast, Study Track 3 (Social Sciences and Humanities) shows higher variability in failure rates, with some programs displaying significantly elevated rates, suggesting greater challenges for students in certain areas.

Programs within Study Track 1 (Health and Biomedical Sciences) have moderate failure rates, reflecting consistent academic performance among students. Meanwhile, Study Track 2 (Exact Sciences, Engineering, and Architecture) shows higher failure rates in some demanding programs, such as Engineering fields, which align with the rigorous nature of these disciplines.

This chart emphasizes the disparities in academic performance across study programs and tracks, highlighting the need for targeted academic support in programs with elevated failure rates.

4.2. Relationship Between Exam Scores and Student Dropout

The relationship between entrance exam scores and student dropout rates, focusing on how academic preparedness impacts retention outcomes was explored. Using regression analyses and visualizations, the data reveals strong

negative correlations between exam scores (both average and minimum) and dropout rates, highlighting the predictive value of entrance exam performance.

The analysis begins by examining dropout rates in relation to average and minimum entrance exam scores, showcasing the trends and correlations that underline the importance of exam thresholds in reducing dropout rates. It then investigates the trade-offs associated with setting minimum score thresholds, specifically their effects on both dropout rates and the proportion of students admitted.

Finally, based on these findings, a set of proposed entrance score thresholds are presented, aiming to balance student retention with enrollment capacity. These thresholds offer a practical and data-driven approach to optimize the admissions process while maintaining accessibility and aligning with institutional goals for academic success

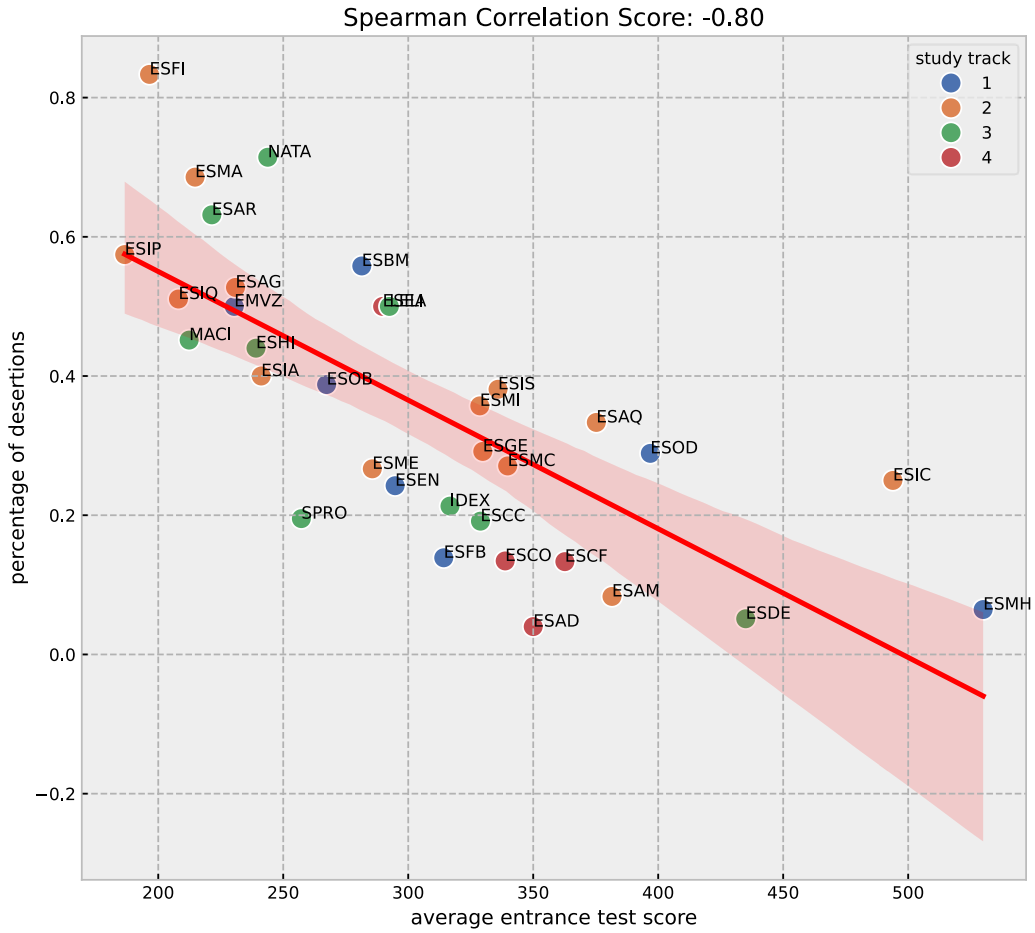

Figure 7: Dropout Rate vs. Average Exam Score by Study Track

Figure 7 depicts the relationship between dropout rates and average exam scores for the 2017 cohort, which each point representing a study program. The chart includes regression lines, showing a strong negative relationship between average exam scores and dropout rates, supported by Spearman correlation score of -0.8.

These values indicate a robust inverse relationship, where programs with higher average exam scores consistently exhibit lower dropout rates. The clustering of points near the regression line reinforces the consistency of this pattern, highlighting the predictive value of average entrance exam scores in forecasting student retention. A few outliers deviate from the trend, suggesting that additional factors may influence dropout in certain programs.

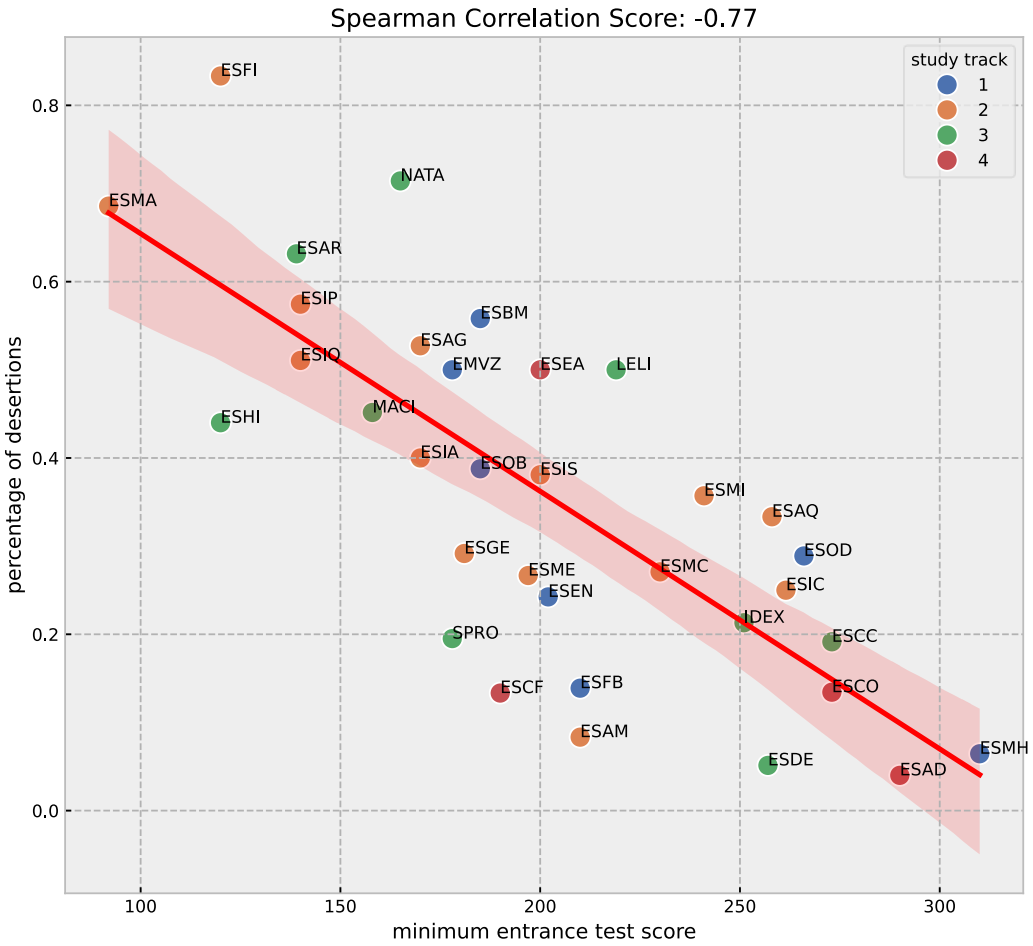

Figure 8: Dropout Rate vs. Minimum Entrance Exam Score by Study Track

Figure 8 shows the relationship between dropout rates and minimum entrance exam scores for the same cohort. Each point represents a program, and the regression lines depict a clear negative trend between minimum entrance exam scores and dropout rates. Programs with higher minimum entrance exam scores tend to have lower dropout rates, confirming the predictive importance of entrance thresholds, supported by Spearman correlation score of -0.77.

Together, these figures demonstrate a strong and consistent relationship between entrance exam scores and student dropout rates. The correlation values emphasize the importance of entrance exam scores in predicting retention outcomes. These insights support the use of exam scores as criteria in admissions policies aimed at reducing dropout rates and enhancing student success.

Given the indications observed in Figures 7 and 8, which highlight a strong negative relationship between exam scores and student dropout rates, it was decided to test whether it is possible to establish a threshold value for admission to the university. The goal of this analysis is to determine if a minimum entrance exam score can serve as an effective predictor of student retention, thereby optimizing the admissions process and reducing dropout rates. This threshold would aim to balance inclusivity while ensuring that admitted students have a higher likelihood of academic success and program completion.

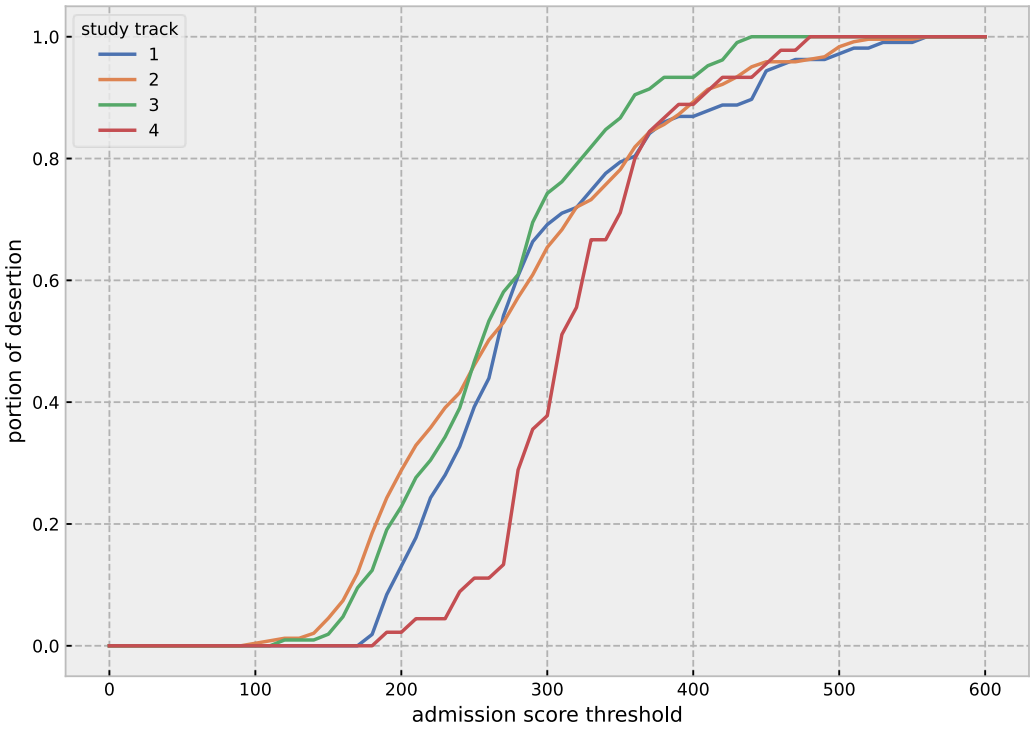

Figure 9: Portion of Dropout Removed by Entrance Score Threshold

Figure 9 illustrates the portion of student dropout that could be eliminated by applying varying entrance score thresholds. The curve shows a clear trend: as the threshold increases, a greater proportion of dropout is removed. This relationship indicates that higher thresholds effectively filter out applicants with a higher likelihood of dropping out.

At lower thresholds, the reduction in dropout is minimal, reflecting the inclusion of students with varying levels of preparedness. However, as the threshold rises, the curve steepens, showing a substantial decline in dropout rates. This trend plateaus at higher thresholds, suggesting diminishing returns when setting excessively high cut-off scores.

The figure highlights the potential of establishing an optimal threshold to maximize retention while maintaining accessibility. It underscores the importance of balancing admissions criteria to enhance student success without unnecessarily

restricting access to higher education. However, increasing the threshold may result in a significant reduction in the number of students admitted, as stricter score requirements would exclude more applicants from the admissions process. This trade-off underscores the need for careful consideration in determining an appropriate threshold that balances student retention with enrollment capacity.

To further explore this relationship, the figure 10 is calculated to analyze how varying the threshold impacts the proportion of students who meet the admissions criteria. This analysis will provide valuable insights into the potential effects of different threshold levels on the university's enrollment size, ensuring that the proposed threshold aligns with institutional goals and resource availability.

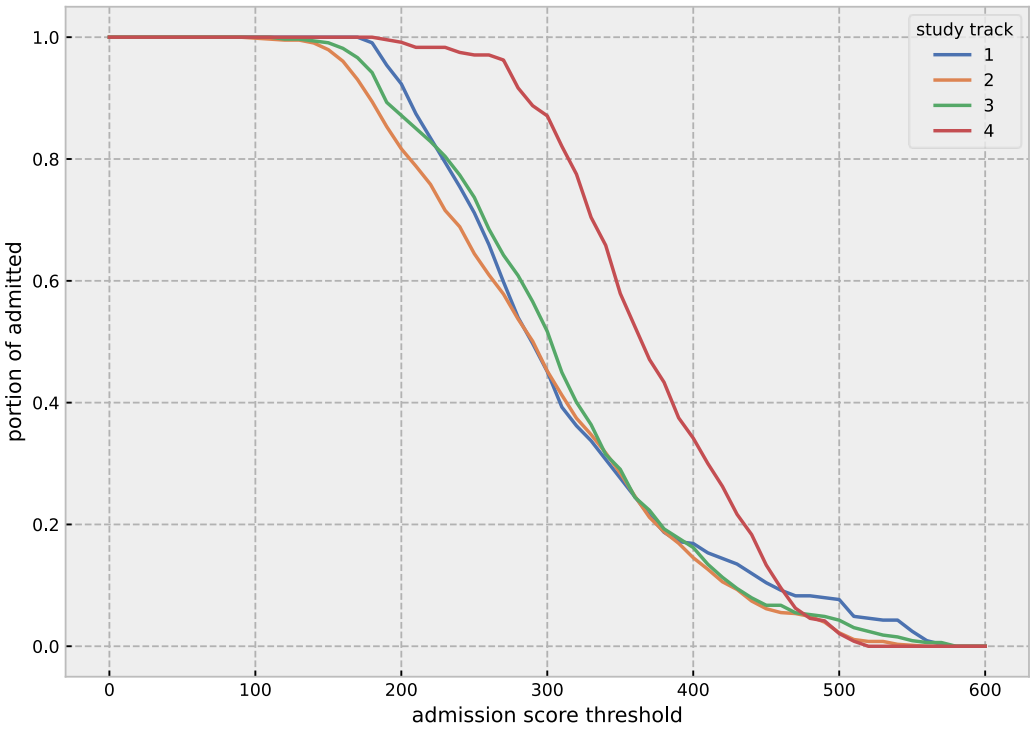

Figure 10: Portion of Admitted by Entrance Score Threshold

Figure 10 illustrates the proportion of applicants admitted as the entrance score threshold increases. The curve reveals a declining trend, where higher thresholds result in a progressively smaller portion of students meeting the criteria for admission. This decrease highlights the trade-off between raising the threshold to enhance retention and the potential reduction in the total number of admitted students.

At lower thresholds, the majority of applicants are eligible for admission, maintaining broad accessibility. However, as the threshold rises, the proportion of admitted students drops sharply, particularly at mid-range thresholds. This trend begins to level off at higher thresholds, where only a small fraction of applicants would qualify.

The figure underscores the importance of carefully balancing the entrance score threshold to ensure that while student retention is improved, the number of admitted students does not fall below sustainable levels. These insights are relevant for designing admission policies that align with institutional goals for accessibility and academic success.

Taking into account both criteria, the proportion of dropout removed and the proportion of admitted students when applying a threshold, Table 4 presents the proposed entrance score thresholds for each study track. The threshold represents the minimum score required to be admitted, aiming to balance student retention with the number of admitted students. These thresholds are designed to optimize retention by reducing dropout while maintaining an acceptable number of admitted students:

Table 4: Proposed Entrance Score Thresholds and Their Impact on Enrollment and Retention

Study Track	Threshold	% Reduction in admitted students	% Dropouts removed
1	220/600	16.56%	24.29%
2	200/600	18.32%	28.80%
3	200/600	12.84%	22.85%
4	300/600	12.91%	37.77%

This proposal represents a balanced approach to improving retention rates while minimizing the impact on enrollment capacity, aligning with the institutional goal of enhancing academic success and reducing dropout rates.

4.3. Relationship Between Exam Scores by Subject Area and Academic Performance

Figure 11 presents a heatmap showing the correlations between subject areas of the entrance exam and average course scores per semester, as well as cumulative averages, for each study track. The correlations range from negative to positive, highlighting the subject areas that most significantly correlate with academic performance.

For Study Track 1: Health and Biomedical Sciences, there is a moderate positive correlation for Verbal Reasoning (VR), Language (LA), and Biology (BI), while Mathematical Reasoning (MR), Arithmetic and Algebra (AA), Geometry and Trigonometry (GT), Physics (PH), and Chemistry (CH) show a moderate negative correlation. Notably, all subject areas have a positive correlation in the first semester. Over cumulative averages, the strongest positive correlations were observed for VR (0.24), LA (0.31), and BI (0.28).

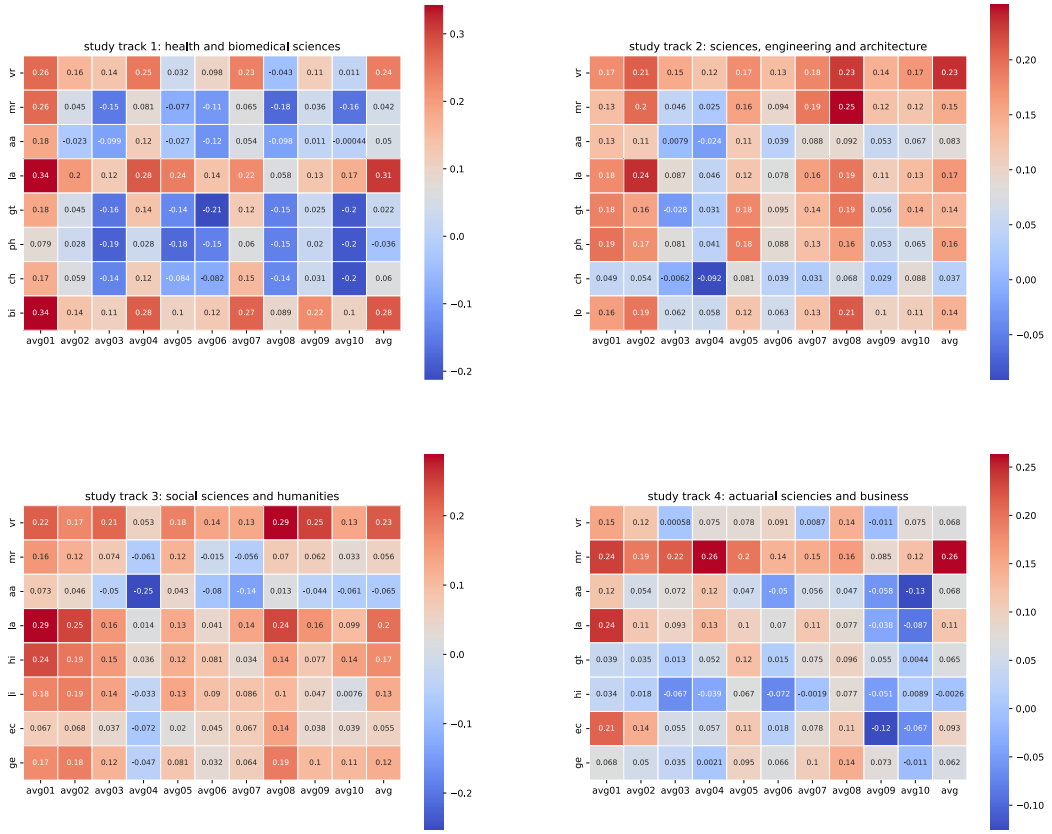

Figure 11: Correlation Heatmap Between Subject Areas of Entrance Exam and Average Course Score per Semester and Cumulatively Grouped by Study Track

For Study Track 2: Exact Sciences, Engineering, and Architecture, VR consistently shows a moderate positive correlation, followed by MR, LA, GT, PH, and Logic (LO), which also have moderate positive correlations. In contrast, AA and CH display weak correlations. All subject areas show positive correlations during the first and second semesters. For cumulative averages, the strongest correlation was VR (0.23), while MR, LA, GT, PH, and LO ranged between 0.14 and 0.17.

For Study Track 3: Social Sciences and Humanities, a consistent moderate positive correlation is observed for VR, LA, and Geography (GE). Additionally, History (HI), Literature (LI), and Economy (EC) show moderate positive correlations, while MR and AA have weak correlations. Positive correlations are evident in the first, second, third, fifth, and eighth semesters. For cumulative averages, the strongest correlations were for VR (0.23) and LA (0.2), while HI, LI, and GE ranged between 0.12 and 0.17.

For Study Track 4: Actuarial Sciences and Business, a consistent moderate positive correlation is seen for MR, while all other correlations are weak. For cumulative averages, the strongest correlations were for MR (0.26) and EC (0.21).

These findings emphasize how specific subject areas of the entrance exam influence academic performance differently across study tracks. The correlations provide valuable insights for refining admission criteria to align with the academic demands of each discipline.

5. Discussion

The findings of this study provide significant insights into the relationship between entrance exam scores and academic performance, as well as their implications for student dropout and retention. By analyzing entrance exam scores by subject area, average performance, and course failure rates, this study builds on existing literature while addressing region-specific challenges in Peruvian higher education.

The correlation analysis revealed that subject areas such as Verbal Reasoning (VR) and Language (LA) consistently exhibit positive correlations with academic performance across multiple study tracks. These findings align with existing research emphasizing the predictive value of language and reasoning skills for academic success (Baccaro & Shinyashiki, 2017; Aguilar-Ruiz et al., 2021). In Study Tracks 1 (Health and Biomedical Sciences) and 2 (Exact Sciences, Engineering, and Architecture), subject areas like Biology (BI) and Mathematical Reasoning (MR) also showed moderate positive correlations, highlighting their relevance to discipline-specific demands.

Interestingly, Study Tracks 3 (Social Sciences and Humanities) and 4 (Actuarial Sciences and Business) demonstrated unique patterns, where subjects like Geography (GE) and Economy (EC) were more strongly correlated with performance, suggesting that the alignment of entrance exams with program-specific skills may enhance their predictive validity. These findings suggest tailoring admission criteria to match program-specific academic requirements, as recommended by other studies (Yousafzai & Jamil, 2019; Poláčková & Svatošová, 2020).

Figures 7 and 8 highlighted a strong negative relationship between entrance exam scores and dropout rates, with Spearman correlation values of -0.8 (average scores) and -0.77 (minimum scores), respectively. These findings emphasize the critical role of entrance exam performance in predicting retention outcomes. Programs with higher average and minimum entrance scores consistently demonstrated lower dropout rates, underscoring the importance of academic preparedness at the time of admission.

The findings align with international evidence showing that entrance thresholds can effectively predict student retention (Sawyer, 2020; Ali et al., 2021). However, the presence of outliers in the data suggests that non-academic factors, such as financial challenges or institutional support, may also influence dropout rates. These findings highlight the need for a holistic approach that combines academic thresholds with broader student support systems.

Figures 9 and 10 illustrate the trade-offs associated with setting entrance score thresholds. While higher thresholds significantly reduced dropout rates, they also decreased the proportion of admitted students, highlighting the challenge of balancing retention with accessibility. The proposed thresholds (Table 4) aim to optimize this balance, with thresholds for Study Tracks 1 through 4 targeting

reductions in dropout rates between 22.85% and 37.77%, while maintaining an acceptable reduction in admissions (12.84% to 18.32%).

These results support research advocating for data-driven admission policies that consider both academic success and enrollment capacity (Golding & McNamarah, 2018; Diarsvitri et al., 2022). Importantly, the results emphasize that thresholds should be context-specific, accounting for institutional priorities and regional educational challenges.

Despite these valuable insights, this study presents several limitations. First, the analysis relied exclusively on academic records and entrance exam scores, lacking direct consideration of critical non-academic variables such as socioeconomic factors, psychological attributes, and personal motivations, all previously identified in the literature as influential predictors of student success (Iftikhar et al., 2023; Diarsvitri et al., 2024). Additionally, the predictive power of entrance exams appears to diminish over time; thus, the conclusions drawn about long-term academic performance must consider other potentially intervening variables, such as changes in personal circumstances or institutional support.

This study offers practical recommendations for refining admission policies at the National University Jorge Basadre Grohmann. By aligning thresholds with program-specific academic demands, the institution can enhance retention while maintaining equitable access.

6. Conclusions and Recommendations

This study provided a comprehensive analysis of entrance exam scores and their relationship with academic performance and student dropout at the National University Jorge Basadre Grohmann. The findings addressed the three main research objectives, offering valuable insights into the role of entrance scores in shaping student outcomes.

The study described the distribution of exam scores and academic performance, highlighting significant variations across study tracks and programs. The analysis established a robust negative relationship between exam scores and student dropout rates. Programs with higher average and minimum scores exhibited consistently lower dropout rates, as supported by Spearman correlation scores of -0.8 and -0.77, respectively. These findings underscored the predictive power of entrance exam performance for retention outcomes.

The analysis of entrance exam scores by subject area showed distinct correlations with academic performance across study tracks, highlighting the predictive value of specific skills. Verbal Reasoning (VR) and Language (LA) consistently demonstrated moderate positive correlations with cumulative averages across most tracks, while Biology (BI) and Mathematical Reasoning (MR) were notably significant in Health and Biomedical Sciences and Actuarial Sciences, respectively. Other subject areas, such as Geography (GE), History (HI), and Literature (LI), showed moderate positive correlations in Social Sciences and Humanities, reflecting discipline-specific academic demands. These findings

emphasize the importance of aligning admission criteria with program-specific requirements to optimize student success.

Overall, the study demonstrated that setting entrance score thresholds could effectively balance retention and accessibility. The proposed thresholds provide an evidence-based approach to reducing dropout rates while minimizing impacts on admission numbers.

Based on the correlations identified between entrance exam subject areas and academic performance, it is recommended to refine admission criteria by prioritizing subject areas that show stronger predictive value for success in specific study tracks. The proposed policy includes implementing minimum score thresholds tailored to each track, as outlined in Table 4, to enhance student retention while maintaining alignment with academic demands. This targeted approach ensures a data-driven admissions process that supports long-term student success.

7. Future Research

This study highlights the potential for further exploration using the available data to enhance understanding of the relationship between entrance exam scores, academic performance, and retention. Future research could leverage advanced data science techniques to uncover more complex patterns and interactions. Methods such as machine learning and predictive modeling could identify non-linear relationships and latent variables, providing deeper insights into student performance and retention dynamics. These techniques may also refine the identification of optimal entrance score thresholds and help predict long-term academic outcomes.

Another promising approach is the clustering of study programs based on performance metrics, retention rates, and other characteristics, independent of the current study track classification. This approach could reveal new groupings that reflect underlying similarities among programs, enabling more targeted analysis and tailored admission policies.

Expanding the analysis to include additional cohorts and examining trends over multiple years would help assess the consistency of the observed patterns. Such longitudinal studies would validate the robustness of the findings and uncover whether the relationships between entrance exam scores and academic performance evolve over time or remain stable across cohorts. To further validate the findings, future research should incorporate a broader set of variables, including non-cognitive skills, socioeconomic factors, and institutional support structures, thus offering a holistic understanding of student retention determinants. Expanding this analytical framework across multiple universities could enhance generalizability, offering broader implications for national education policy.

Given the evolving landscape of dropout prediction and student retention strategies, integrating machine learning and advanced statistical methods, as

demonstrated by recent studies (Pérez et al., 2018; Opazo et al., 2021; Gutiérrez et al., 2024), may provide higher education institutions with more precise tools for intervention. These insights underscore the need for context-specific research to tailor predictive models that enhance retention efforts in diverse academic environments.

By continuing to analyze and expand upon this dataset, future research can provide even more actionable insights for refining admissions policies, optimizing retention strategies, and supporting long-term academic success.

8. Acknowledgements

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