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# A Quantitative Analysis of University Admission Results for Hungarian Ethnic Minority Students in the Carpathian Basin

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**Abstract:** This study analyses the higher education admission results of Hungarian ethnic minority students in Hungary originating from Central and Eastern European countries (Serbia, Croatia, Slovenia, Slovakia, Ukraine, and Romania) by secondary education background (national system vs. foreign system) and school-leaving qualification background (advanced and intermediate levels in Hungary and their native country). Students ( $n = 759$ ) take (or have taken) part in undivided (5-year) and bachelor (3-year) programs at universities in Hungary and, for historical reasons, live as ethnic minorities in their home countries in the Carpathian Basin. There are significant differences in the number of students according to their secondary education background. Of the admitted students, 83.7% graduated from a national system secondary school and 16.3% from a foreign system secondary school before entering higher education. Using a Mann–Whitney U-test, we confirmed that the admission scores of students from the national secondary education system are significantly different from the scores of students who graduated from a foreign secondary education system ( $p < 0.001$ ). The results of the Jonckheere–Terpstra test demonstrated that students with advanced-level exam results performed significantly better than those who entered higher education with intermediate-level or native country examination results ( $p < 0.001$ ). However, there is no detectable difference ( $p > 0.05$ ) between students who graduate at the intermediate level and students who graduate with a native country certificate. A regression model, based on the median admission scores, exhibited a trend of improving results for foreign students. The  $R^2$  quadratic determination coefficient is 0.705. This study provides insights into the educational pathways and decisions of Hungarian students residing abroad, underlining the influence of the national context and public education systems on their educational trajectories.

**Keywords:** graduation results; cross-border mobility; national minority students; secondary school system; education statistics; tertiary education



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## 1. Introduction

Tertiary education has become the most adaptable and diverse level of education, providing a wide range of programs that cater to various interests and career goals. From practical, profession-focused courses to research-intensive degrees designed to prepare students for advanced academic pursuits, tertiary education offers a multitude of options. These diverse pathways equip students with the requisite skills and knowledge to excel in their chosen fields [1]. The trend of international mobility in higher education is evolving, extending beyond the traditional student and faculty exchanges to include the transfer of educational programs and online courses. Governments are implementing a variety of strategies to boost student mobility. Some countries offer financial support to their students to pursue studies abroad, while others set numerical targets to attract more international students and provide resources to lure top talent [2]. Student mobility in the Carpathian Basin differs from classical student mobility in several aspects. The first difference is the

government's national policy, which includes focused and active support for Hungarians living outside its borders. As part of this, since the early 1990s, Hungarian students from abroad who wish to continue their studies in Hungary can apply for a scholarship. The second difference is the closed geographical environment, whose borders are defined by the Carpathian Basin as a mesoregional space as well as a microcosm characterised by a geomorphological unity [3]. This is organised along ethnic lines and represents a one-way study migration of Hungarian youth from the neighbouring countries to Hungary [4].

The diversity of ethnicities in Central and Eastern Europe today is largely a result of a complex mix of historical events that unfolded over centuries. These include patterns of settlement, voluntary and forced migrations, changes to borders, and expansion of specific countries' political and economic influence. The ethnic composition of the region is primarily shaped by the presence of indigenous groups. The main characteristic of Europe's indigenous minorities is that they did not become citizens of their country of their own free will, but their fate was decided by the post-war border settlements [5,6]. National minorities are typically concentrated in border regions of countries, often close to their homelands [7]. These include the Slovenian national minorities in Slovenia's four neighbouring countries (Croatia, Hungary, Austria, and Italy) [8], the Serbian minority in the post-Yugoslav states (Slovenia, Croatia, North Macedonia, and Montenegro) as well as in some neighbouring member states of the European Union (Hungary, Romania, and Bulgaria) [9], the Ukrainian national minority in Poland [10], and the Hungarian ethnic minority living in the Carpathian Basin [11], whose population has been rapidly declining since 1991 [12]. The network of schools teaching in Hungarian is arguably the most extensive of the institutions established by the ethnic communities residing in this region. The education of Hungarians living abroad in their mother tongue is generally understood as a form of education guaranteed by the majority state, based on minority rights, in which the Hungarian language is used as the language of instruction. Upon completion of the compulsory education phase (10th grade in Romania, up to 16 years in Slovakia, 9th grade in Ukraine, and 8th grade in Serbia), Hungarian-language education provides all children with a full state-recognised certificate. After completing secondary education, students can obtain a vocational qualification or a school-leaving certificate. At the graduation examination (except in Serbia), in addition to their mother tongue, students also need to demonstrate their knowledge of the state language [13].

Tertiary education takes secondary education to the next level, offering more advanced and intricate learning experiences. Institutions, like universities, play a vital role in society by fostering innovation, driving economic progress, and enhancing individual well-being, ultimately contributing to the overall betterment of society [14]. Higher education admission systems in Europe are different. Some countries, such as the United Kingdom (England) and Sweden, rely on standardised tests, but most European countries have an open or centralised system based mainly on school-leaving exams. These include France, Germany, Slovenia, Italy [15], and Hungary. In Hungary, students are admitted to higher education institutions through a transparent points-based system. The points total is determined by combining scores from three categories: study points (up to 200), school-leaving exam results (up to 200), and additional points (up to 100). Under this system, students must indicate their preferred institution when they apply and, if accepted, cannot alter their preferences afterwards [16]. Hungarian students living across the border can enter Hungarian higher education via two different scoring systems. On the one hand, they have the possibility (under the same rules as Hungarian citizens) to apply for the Hungarian baccalaureate at the advanced level or intermediate level; on the other hand, they can also apply for admission on the basis of their school-leaving qualification grades acquired in their home country. In this case, as each country has a different system of assessment, the way in which admission scores are calculated is also different, but their points are converted into study points, school-leaving exam points, and additional points during the admission procedure in the same way. The applicant's score is calculated in the way that is the most favourable for them [17]. Admission scores play a crucial role in determining access to

higher education. Understanding trends in scores can provide valuable information for both prospective Hungarian students abroad and the education policy makers.

In this study, we employed a statistical analysis to examine the admission results of students from six countries (Serbia, Croatia, Slovenia, Slovakia, Ukraine, and Romania) by secondary education background (national system in Hungary vs. foreign system) and school-leaving qualification background (advanced level in Hungary, intermediate level in Hungary and their native country) (Table 1). The students in question live as a Hungarian ethnic minority in the Carpathian Basin (except for Austria) in Central and Eastern Europe. By comparing the time factor and admission scores, our aim is to illustrate the statistical differences that distinguish between students in national system and foreign system secondary schools and the results of the school-leaving examinations.

**Table 1.** Grouping of students entering tertiary education by secondary education background and school-leaving qualification background.

Secondary Education Background	Hungarian NATIONAL System The proportion of students who entered higher education on the basis of a school-leaving certificate issued by a public educational institution in Hungary.	ADVANCED-Level Exam This group includes students who have obtained their advanced-level school-leaving certificate from a Hungarian public education institution.	School-Leaving Qualification Background
		INTERMEDIATE-Level Exam This group includes students who have obtained their intermediate school-leaving certificate from a Hungarian public education institution.	
	FOREIGN System The proportion of students who entered higher education on the basis of a school-leaving certificate issued by a public educational institution in a foreign country.	NATIVE Country School-Leaving Examination This group includes students who have obtained their intermediate school-leaving certificate from a foreign country’s public education institution.	

According to the Government Decree [17], a foreign or foreign system school-leaving examination subject with the same designation may also be considered to be an advanced-level examination subject if the foreign education system allows for the examination to be taken at more than one level and the candidate has passed the examination subject at the highest level. However, for the purposes of this research, only those examination procedures that were credibly certified during the admission procedure were considered to be Hungarian advanced level and Hungarian intermediate level. All foreign secondary school certificates were considered to be foreign country certificates. The results of the data processing allow for the assessment of the university entrance readiness of Hungarian ethnic minority students from abroad, as well as the evaluation of their admission skills and competences. It is anticipated that their admission performance, as measured by scores, will highlight differences between secondary school systems. In addition, the university threshold scores for each bachelor program will ensure comparability with other students seeking higher education.

**Hypothesis 1 (H1):** *The admission results of Hungarian minority students from abroad have shown an improving trend over the past seven years.*

Research question 1: By comparing the scores for the years 2017–2023 on a median basis, can a change be detected or is there a describable trend in the admission results? In the absence of other research on this topic, we can only use as a reference database [18] the dataset containing the minimum threshold scores (admission threshold) for full-time undergraduate courses in Hungarian higher education. This trend also gives an indication of changes in the admission results of Hungarian students from abroad. For example, a positive shift in the median of the admission scores compared to the previous year may reflect an improvement in the results of the students admitted and vice versa.

**Hypothesis 2 (H2):** *The secondary education background has an impact on the performance of Hungarian students living as minorities abroad.*

Research question 2: Is there a detectable difference in student outcomes when analysing admission data based on the secondary education background completed? We assume that there is a detectable difference between the admission results of students who graduated from a secondary school of the Hungarian national system and students who entered higher education on the basis of scores from a secondary school in a foreign system. We believe that the reasons for this can be found in the differences between the school systems [19–21].

**Hypothesis 3 (H3):** *Students can be divided into distinct groups based on their school-leaving qualification background.*

Research question 3: Which group of students stands out from the rest in terms of their school-leaving qualification background? Are there any elements of the groups whose results do not show significant differences? To what extent do the results of students with a native school-leaving qualification differ from those of students with an intermediate level and advanced level? In our opinion, the results of students graduating at the advanced level and intermediate level are different in Hungary. Students with advanced levels receive extra points in the scoring process, which means that they can achieve better results than students who only have intermediate levels. Students also tend to plan their exams strategically, which influences their academic decisions [22]. After passing the school-leaving examination in their native country, students undertake a further knowledge assessment, namely the Hungarian national matriculation examination. This assessment serves to reinforce and consolidate knowledge [23], as well as develop competencies, thereby enhancing the efficacy of the assessment process.

#### *Related Research*

Hungarian research in this field predominantly employs qualitative methods, with relatively little exploration of quantitative analysis.

The specificities of the Hungarian admission systems have been the subject of numerous studies in recent decades [24–30]. Some of these analyses compare the Hungarian example with other European systems [31–34]. Additionally, there have been many studies on the number and proportion of foreign students studying in Hungarian higher education [35–42], including publications related to the socio-cultural integration of students [43,44]. The mobility for study purposes of Hungarian students, who are national minorities in their home countries [45–51], and their social status in relation to education [52,53] are even more widely studied, mainly by native Hungarian-speaking researchers in Hungary and neighbouring countries. However, there are significantly fewer publications that examine the quantitative analysis of the institution selection criteria of students pursuing higher education in Hungary [54,55], or study the context of admission results [31,56], or the improvement of the predictive validity of composite admission scores [57]. There are only a few Hungarian studies that focus on the admission and academic achievement of Hungarian students from abroad [58], but typically we found mostly international examples [19–22,59–61].

The results of our study provide valuable insights into the differences in higher education admission results for Hungarian students from Central and Eastern European countries, particularly in relation to their secondary education and examination backgrounds. To place these findings within a broader scientific context, we may draw upon existing research in the fields of educational mobility, ethnic minority students' access to education, and the impact of different educational systems on academic performance. This study addresses a significant gap in the existing literature by exploring several key areas related to student admission trends, particularly in the context of Hungarian students

pursuing studies abroad. Additionally, it contributes to several crucial domains within the broader field of education and comparative educational analysis [62,63]. On the one hand, it provides a strong empirical basis for understanding how student performance changes over time through trend analysis of educational attainment, and on the other hand, it analyses the impact of schools on student performance, all through academic achievement [64]. The findings open the way for further research into policy, international educational standards, and local educational interventions. International research suggests that assessment policies have a significant impact on academic achievement. Higher stakes, stricter performance criteria, and higher standards for retaking exams are associated with better outcomes [65]. Course policies that affect the impact of graduation certificates and opportunities to retake exams also affect student performance, with effects varying by student ability [66]. In many countries, public universities are highly sought after due to the lower tuition fees compared to private institutions. Admission to universities and specific departments is determined by a composite score that includes the results of entrance exams. As a result, students' academic performance at the earlier stages of their education, such as in high school, plays a crucial role in their chances of accessing higher education [67]. These statements are particularly applicable to the population in our study. However, there are also studies that contradict these findings. The alignment between prior education and university entrance exams in Turkey is controversial. Disparities between schools in terms of educational quality, resource allocation, and curriculum have been found to undermine the reliability of these exams [68]. A recent analysis has shown that trends in academic performance differ by the year of admission and the type of admission. Moreover, the data for 2018 and 2020 showed statistically significant interaction effects between enrolment period and admission type, suggesting that academic achievement trends over time differ based on the type of admission. The article employs a longitudinal analysis to examine students' academic progress from the point of admission to enrolment [69]. These studies highlight the importance of motivation, self-regulation, and time management in mediating the relationship between policy and academic outcomes [70]. However, measuring changes in educational attainment over time is challenging. The complexity of defining and measuring trends requires careful consideration of methodological approaches and alternative formulations to accurately capture changes in educational performance [71]. Accordingly, our study provides a valuable methodology for the analysis of similar data series in different contexts, both in Hungary and in other countries, with a special focus on the Carpathian Basin.

Nevertheless, the historical context of national development continues to influence differences in educational attainment between co-ethnic groups [72]. The minority aspects of this study also draw attention to the cross-border influence of national ethnic or linguistic enclaves and their impact on higher education systems. Linguistic and ethnicity-based student migration refers to the movement of students across borders, often influenced by language or ethnic identity. In the context under discussion, Hungarians living beyond the borders of Hungary often migrate to Hungary for higher education. Language and cultural contacts make it easier for them to study in Hungary, and the education policy of the Hungarian government offers special quotas and scholarships to encourage Hungarian students to attend higher education in Hungary [73]. There are many examples of similar language-ethnic migration for study purposes within Europe. The Czech Republic and Slovakia have experienced significant migration trends since the 1990s, particularly in higher education. An increasing number of Slovak students, often from well-educated, middle- to upper-class families, are migrating to Czech universities [74]. Research on Finnish-speaking and Swedish-speaking Finns reveals complex migration patterns and educational mobility. Swedish-speaking Finns are over-represented in migration to Sweden, influenced by their minority status in Finland and their cultural affinity with Sweden [75]. The situation of ethnic Moldovans from Transnistria is particularly noteworthy for graduates of Romanian-language schools, as many of them pursue further education in Romania. Their decision to migrate is influenced by a more diverse mix of push and pull factors [76]. Turkish Cypriot

and other ethnic Turkish youth often migrate for higher education, driven by a variety of factors. Economic considerations, such as the lower cost of living in Turkey, and the higher quality of education, are important pull factors [77]. Cultural capital, including parental expectations and language skills, as well as social connections through previous visits, influence the decision to study in Turkey [78]. Their case also has a specific link with the group of students in our study, namely the Cypriot students who have returned home and face language challenges [79]. This language barrier reflects the limited support provided by the state to repatriated Cypriots, which may contribute to their migration elsewhere for higher education opportunities.

However, the case of the group under study shows a significant difference in that the Hungarian state does not support these students due to the brain drain, but rather because of their return to and stay in their wider homeland. Our study is a pioneering research work on the enrolment trends of a group of students who have been encouraged by Hungarian policy support. The results show the pace of progress and thus provide positive feedback to policy makers through the expansion of scholarship opportunities or the introduction of specific financial support schemes, especially for those who demonstrate their academic potential through advanced-level exams.

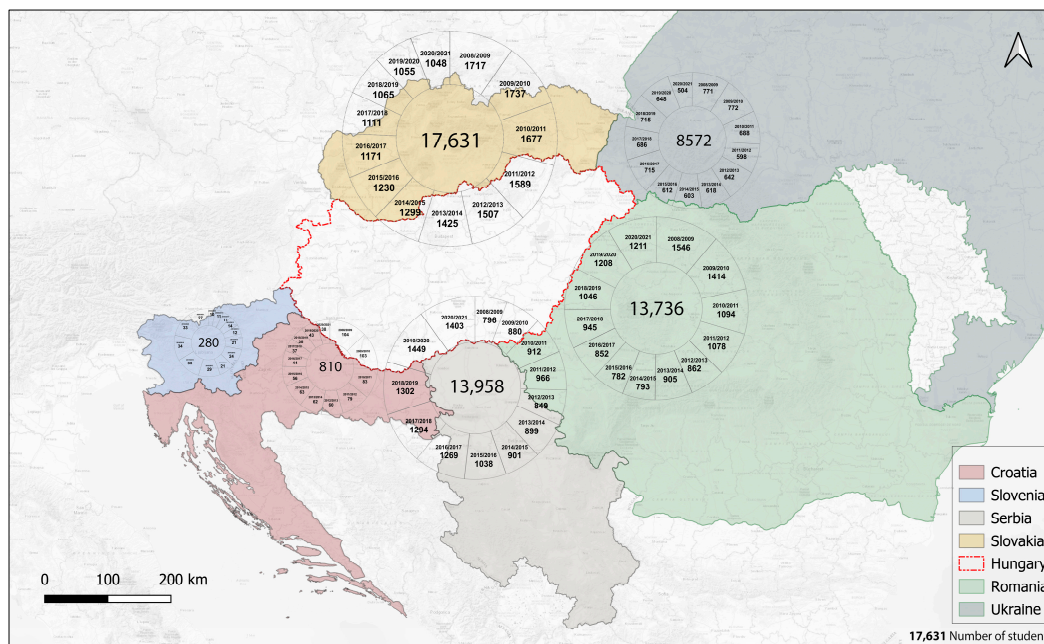
## 2. Materials/Data and Methods

Recent advancements in research have been significantly accelerated by the introduction of more rigorous, precise, and reliable methodological approaches. The rapid development of information and communication technologies (ICTs) has enabled researchers to collect data and identify relationships at a much faster pace than was previously possible, allowing for the investigation of complex problems that would have been impractical or cost-prohibitive just a decade ago. Additionally, researchers' commitment to conducting unbiased studies of all relevant facts has driven the refinement of methodological developments, ultimately leading to more effective problem solving [80]. A well-defined research methodology is crucial because it enables other researchers to replicate the study, thereby verifying the accuracy and reliability of the findings [81]. This section presents information on the research design, study population, and data analysis, which ensures research integrity and reproducibility.

### 2.1. Description of the Area

Over the ten-year period between 2008 and 2017, there were 17–32,000 students with foreign citizenship enrolled in Hungarian higher education institutions [42]. By 2019, their number has already exceeded 38 thousand. In almost 20 years, their share has increased from 3.4% to 13.5% [40]. In 2020, the number of Hungarian students living abroad was 5644, which is only 15% of the total number of foreign students [18]. The target group of this study includes Hungarian ethnic minority students living outside the national border of Hungary, but studying in Hungary in the framework of bachelor (BA/BSc) and undivided programs. The share of these students has decreased by 14% over the period 2008–2020 compared to the number of students in higher education. The mean number of students enrolled in higher education programs at the bachelor (BA/BSc) and undivided levels is 4231 per year, with a minimum of 3683 in the 2014/2015 academic year and a maximum of 4944 in the 2008/2009 academic year.

According to the analysis of the data for the specified period, a significant proportion of international students attending Hungarian institutions traditionally originate from densely populated Hungarian communities located beyond national borders. Notably, the highest number of students during this timeframe originated from Slovakia, with a total of 17,631 individuals, whereas the lowest number—only 280 students—came from Slovenia. Figure 1 shows notable declines in student enrolment observed in Romania (78%), Slovakia (61–65%), and Ukraine (61–65%), whereas Croatia experienced a moderate decline of 37%. Conversely, significant increases were recorded in Serbia (a rise from 796 to 1403 students) and Slovenia (a rise from 10 to 27 students).



**Figure 1.** Number and distribution of students by region from ethnic minorities living outside the country's borders studying in Hungary in bachelor (BA/BSc) and undivided programs, 2008–2021.

## 2.2. Reference Database

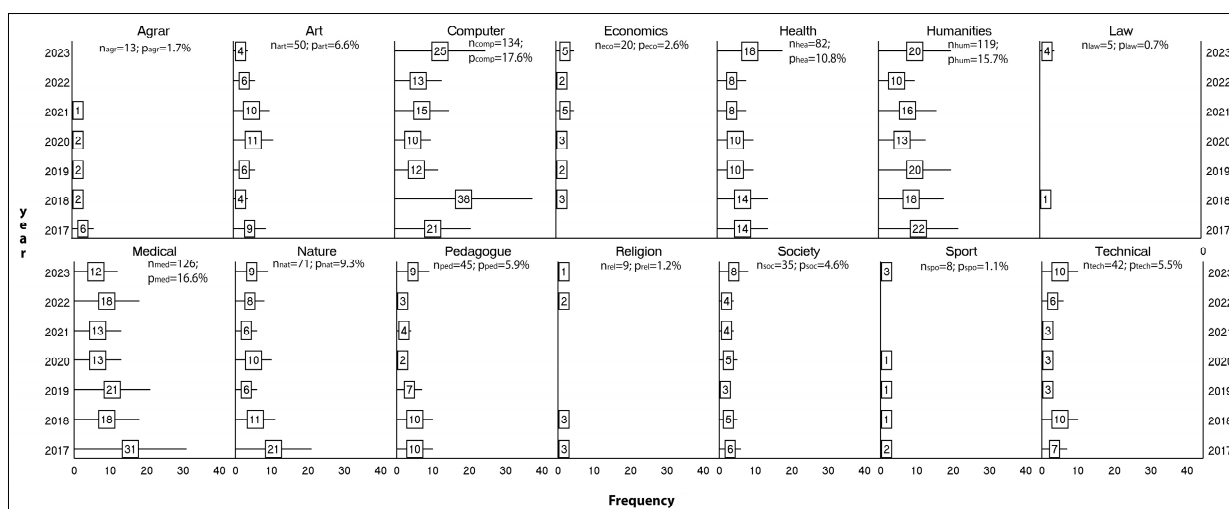
For the comparison of the *H1* research question of the dataset, we used the public database of the Education Authority of Hungary containing data on the minimum cut-off points (admission thresholds) of the entire Hungarian higher education system. To meet the requirements of the sample data and statistical programs, data cleaning was performed. The entire database (38,715 degree thresholds) was narrowed down to bachelor and undivided courses (23,786), and this was then narrowed down to full-time courses (18,092). This was further filtered to the higher education institutions to which students in our sample database were admitted (9394), and then the score thresholds were filtered to measurable data (8442). Over the period under review, the average annual distribution of the data is 14%.

## 2.3. Sample Database

The data of the population analysed are from the student database of the scholarship admission records of the Márton Áron Special College [82]. The College aims to strengthen the minority Hungarians' sense of belonging to the nation and their attachment to the Hungarian cultural heritage, and to prepare its members for independent activities aimed at the development of science and culture as a centre of value-preserving and value-creating Hungarian intellectual life. The original dataset contained data on 1812 students (bachelor, master, part-time and doctoral). After data reduction in Microsoft Excel, the sample size was reduced to 759 ( $n = 759$ ), which represents 2–4% of the total number of Hungarians living outside the borders and studying in Hungary in bachelor (BA/BSc) and undivided programs each year. Figure 2 displays the distribution of students across various fields of study over a period of seven years (from 2017 to 2023).

Each field of study is represented in a separate panel, with the number of students ( $n$ ) and their percentage ( $p = n_{\text{field}}/n$ ) of the total student population ( $n = n_{\text{agr}} + n_{\text{art}} + n_{\text{comp}} + n_{\text{eco}} + n_{\text{hea}} + n_{\text{hum}} + n_{\text{low}} + n_{\text{med}} + n_{\text{nat}} + n_{\text{ped}} + n_{\text{rel}} + n_{\text{soc}} + n_{\text{spo}} + n_{\text{tech}}$ ) indicated for each year. The whiskers extending from the boxes show the range of the data points (number of students). The sample comprises students from 29 higher education institutions in 14 different disciplines, with 5 major study areas accounting for 70% of the total database. The Humanities account for 15.7%, Computer Sciences for 17.6%, Medical and Health Sciences for 27.4%, and the Natural Sciences for 9.3%. The distribution of the

other disciplines is below 5%. Some fields, such as Medical and Health Sciences, show a more consistent number of students over the years. Others, like Computer Sciences and Humanities, show more significant fluctuations.



**Figure 2.** Number and proportion of students in the sample database by field of study between 2017 and 2023.

#### 2.4. Data Processing and Data Analysis

In the data analysis, we focused only on Hungarian students from beyond the border who identified as an ethnic minority and who had completed secondary school in either the national system or the foreign system. We did not examine data from students from each region separately. The admission scoring methodology for the master's degree (MA, MSc) is completely different, so students of this program could not be the subject of the present research. For descriptive statistics and mathematical statistics for the analysis of variance methods and nonparametric methods, we used IBM SPSS 29.0 and PAST 4.16 software. To visualise the geospatial data, we used the open-source Quantum GIS version 3.36.1. Microsoft Excel programs processed the data in spreadsheets and Adobe Photoshop 2022 was used for post-processing the images. Using univariate data analysis [83], we summarised the data, described the characteristics of the variable, provided primary insights into the data structure, and described the relevant information. The normal distribution was analysed with a Kolmogorov–Smirnov test on the reference database using Lilliefors significance correction, and with a Shapiro–Wilk test on the sample database with the Monte Carlo method ( $n = 9999$ ), based on the assumption that the large random sample mimics the pattern of the entire population. We used a boxplot chart to graphically display [84] the median values [85], which are one of the most important central indicators in statistics. This reveals the relationship between the students' admission results (admission score), the time factor (year of admission), and the school-leaving qualification background (Hungarian advanced level or intermediate level, native certificate). A histogram was used to graphically represent the properties of the metrically scaled recording outcomes. We depicted the underlying probability distribution of the data by plotting and superimposing the values at each point on a dot-plot diagram [86]. Of the nonparametric methods, we applied the Jonckheere–Terpstra test [87] to compare the results of more than two groups (components of the school-leaving qualification background), and we determined the level of significance. The Mann–Whitney U-test was used to validate the difference in scores for the secondary education background (national system vs. foreign system). The trend in the admission results is demonstrated by regression model tests fitted to the medians. To prove this, we employed the linear model procedure of curve estimation. Since the linearity of the variables is different, we refined the data using the quadratic equation parabolic model.

### 3. Results

#### 3.1. Patterns in Alterations of University Admission Results

The analysis of admission scores without group disaggregation was examined using median-based regression models. To prove our hypothesis, we used methods of descriptive statistics to aggregate the data, and examined the distribution of the dataset and the relationships found in the samples. There was no relevant research available to prove our theory, so we chose a reference database [18] that contained data on the admission threshold for courses offered by Hungarian higher education institutions in the general procedure, i.e., the admission threshold for a student to enter a defined degree program at a given higher education institution. We compared the admission results of students in our sample database against that admission threshold.

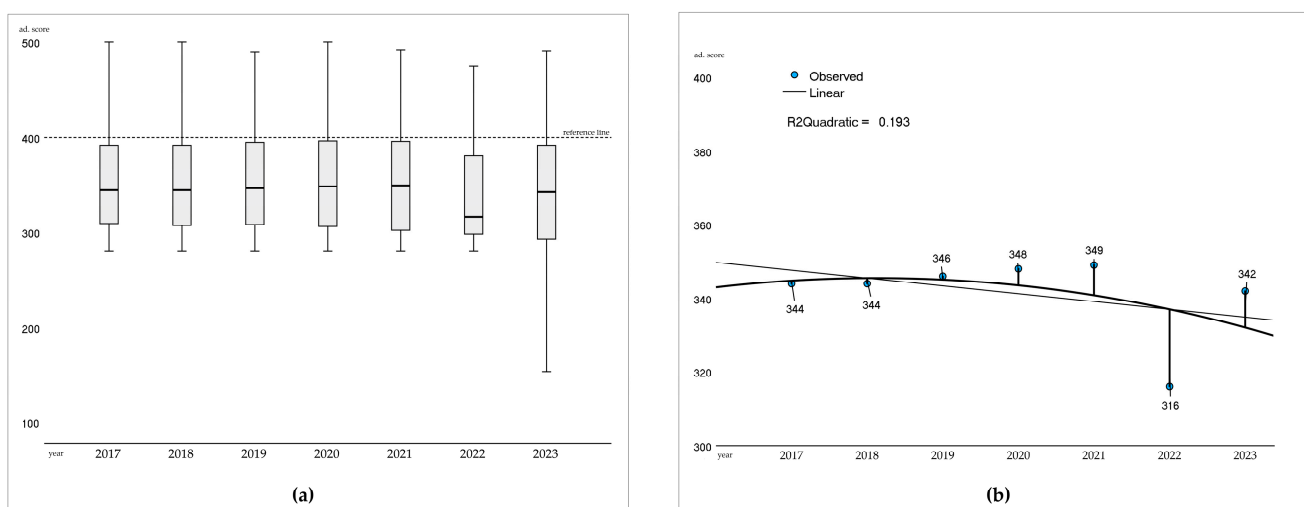
##### 3.1.1. Analysis of the Reference Database

The database contained information on 8442 university courses including admission threshold data ( $n = 8442$ ), with a mean of 346.5 and a median of 342 points. Normal distribution calculated with Lilliefors significance correction yielded a  $p$ -value of less than 0.001, indicating that the distribution of scores is not clustered around the mean, but moves away from it. The analysis concluded that the data points were dispersed around the mean with approximately 2778.9 mean squared deviations. This is a high level of variation and is an indication of a significant spread between the scores. The annual comparison of the datasets is illustrated in Figure 3a using a boxplot graph. The diagram clearly shows that the interquartile range (IQR) of the scores did not reach the value of 400 points at any time during the period under review ( $Q3 < 400$ ), meaning that more than 75% of the threshold values were below this value for the seven years under study. The middle values varied between 316 and 349 points. During the first five years, the median of the threshold values barely changed, with only a slight increase of one or two points observed. However, in 2022, a significant decrease occurred (down to 316 points), which adversely affected the linearity of the database. By applying the curve estimation method, we confirmed a visible trend. Approximately 15.9% of the variation in median values ( $R^2$  linear = 0.159) can be explained by the change in time factor, indicating that their relationship is negligible. Furthermore, the estimation procedure yielded a slope coefficient of  $-2.107$  points per year (b1), suggesting that the median of thresholds is assumed to decrease by an average of 2.107 points annually in the future (Figure 3b). We refined the data using the parabolic model of a quadratic equation (quadratic model). This model better represents the data because it captures a slight curve in the trend rather than a straight line. The  $R^2$  quadratic determination coefficient was 0.193, with a normal  $p$ -value greater than 0.05 for the medians, indicating a consistent decreasing pattern over time. Based on the results, the variables of the reference base did not differ significantly, but a parabolically decreasing, negative relationship could be confirmed, which was solely explained by the decrease in point values observed in the last two years.

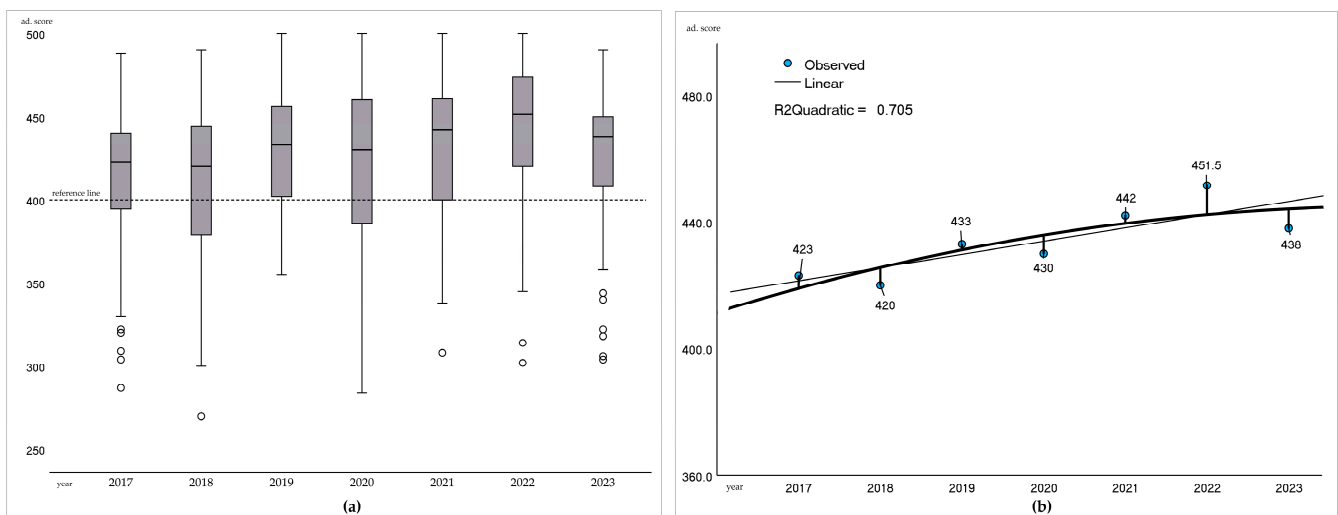
##### 3.1.2. Examination of the Sample Database and Comparison with the Reference Database

Univariate analysis of the sample data ( $n = 759$ ) yielded the following results. The database has a mean of 422.84 points and a median of 432 points. The data points are expected to deviate from the mean by around 43.28 units (variance: 1871.3). The  $p$ -value derived from the Monte Carlo simulation was less than 0.001. The data deviated significantly from the normal distribution, and showed a skewness of  $-0.785$ . This negative skewness indicates that the data are slightly skewed to the left, meaning more values are above the mean than below it. A kurtosis value of moderately platykurtic 0.329 was obtained, so the scores are slightly flatter than the normal distribution, with fewer extremes (high scores) and a more even distribution around the mean. The distribution symmetry, centre, and dispersion of the data are shown on the boxplot in Figure 4a. More than 70% of the results are above 400 points. We identified several outliers, mainly observed at the beginning and end of the period under study. These are scores of students that significantly deviate from the general pattern of the dataset. Although they have a significant impact

on the statistical indicators, they cannot be considered erroneous results. The medians of admission scores for the years 2017–2023 range between 420 and 451.5 points and suggest a positive linear relationship. To prove the trend in the data, the curve estimation procedure was used with the linear model procedure shown in Figure 4b. Approximately 67.9% of the change in the median of the admission scores can be explained by the change in the time factor (linear  $R^2 = 0.679$ ), so a moderate positive correlation can be confirmed. In curve estimation,  $R^2$  (the coefficient of determination) measures how well a model explains the variability in the dependent variable (in our case, the admission scores). An  $R^2$  value ranges between 0 and 1 in all cases. A higher  $R^2$  value (closer to 1) indicates that the model perfectly explains the year-to-year variation in admission scores; i.e., it fits the data well. A lower  $R^2$  value (closer to 0) indicates that the model explains a smaller proportion of the variation; i.e., the model is not an ideal fit to the data. However, the model error lies in showing the annual increase in admission scores as linearly infinite, despite the upper limit being 500 points. This assumption is not realistic, because admission scores cannot increase infinitely. To eliminate this and for better comparability with the reference database, we applied the quadratic model, resulting in a coefficient of determination of 0.705. This means that 70.5% of the variance in scores can be explained by the time factor—i.e., there is a mathematically demonstrable trend for admission scores to improve from year to year—and more accurately reflects the levelling off of scores as they approach the ceiling. On average, the estimation procedure yielded a slope coefficient of 4.179 points per year (b1). The data verify that annual medians of admission results show a moderately strong positive correlation, and the analysis based on the period 2017–2023 illustrates a trend of improving results for Hungarian students abroad. The tendency is parabolically upward, but static. To provide evidence of the difference between the two samples, a statistical test was performed using the Jonckheere–Terpstra test. The standardised test statistic is 33.093, with an asymptotic significance ( $p$ -value) less than 0.001. Rejection of the null hypothesis was carried out in the examination between the two groups. The mean of the sample population is 77 points higher than the mean of the reference population, while the median value is 92 points higher. The lower quartile (94 point) and the upper quartile (62 point) of the sample population differ significantly from those of the reference population. The average deviation of data points from the mean value, as indicated by the standard deviation, is 9.45. Based on the model procedure, it can be stated that the comparative analysis did not indicate a relationship between the two samples. The examined students' admission scores in our sample are significantly higher than the entrance threshold of the reference database.



**Figure 3.** Annual analysis and evolution of the reference database admission score. (a) Yearly comparison of admission cut-off data (2017–2023); (b) linear and quadratic regression analysis of admission cut-off medians (2017–2023).

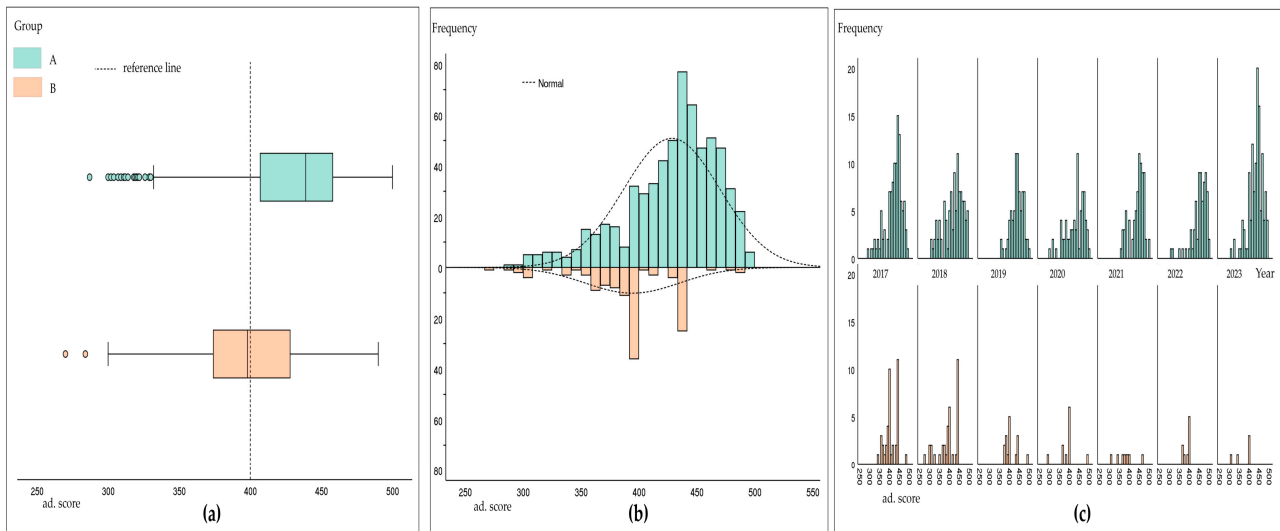


**Figure 4.** Annual analysis and evolution of the sample database admission scores. (a) Yearly comparison of admission score data (2017–2023); (b) linear and quadratic regression analysis of admission score medians (2017–2023).

### 3.2. Analysis of Admission Results Based on Secondary School Background

There is a significant difference in the number of students based on their secondary school background. A total of 83.7% (635) of admitted students entered higher education with results from a national system (group A), while 16.3% (125) entered higher education with results from a foreign secondary school system (group B). In the univariate statistical analysis, it was found that the scores of the students in group A were substantially higher. The differences between the two groups are illustrated by a boxplot in Figure 5, plot (a). The interquartile range (IQR) for group A is between 407 and 458 points, while for group B it is between 374 and 428 points. The median score for group A was 439 points and for group B only 398 points. In addition to the quartiles, it is also worth looking at the differences in the reference line drawn at 400 points, which better reflects the admission rates of the two groups. While for group A more than 84% of the results are above 400 points, for group B the proportion is only 30%. Based on these data, we can assume that there is a difference between the results of students with a national system secondary education background and those with a foreign system secondary education background, which we have supported with mathematical evidence. To verify the difference between the two groups, we first tested the normal distribution of the entire dataset using the Shapiro–Wilk test, which yielded a  $p$  (Monte Carlo) value of less than 0.001. The difference between our two independent groups was then compared using the Mann–Whitney test. The results of the test provide strong statistical evidence that the medians of the two groups are significantly different. With a Mann–Whitney U-value of 20,196 and a z-score of 8.5884, the test gives a  $p$ -value of less than 0.0001, indicating a highly significant difference in the admission scores between the two groups. Plot (b) overlays histograms and Kernel Density Estimates (KDEs) of admission scores for groups. For group A, there is a high frequency of scores between 400 and 500 and a prominent peak around 430 points. For group B, there is a distinct peak around the 400-point value; the KDE curve suggests a unimodal distribution, but shows a broader peak compared to group A. The annual breakdown of the data allows further analysis, illustrated in plot (c). Group A students' scores show a consistent distribution pattern each year, with most scores clustered between 400 and 500, and the highest frequencies appear to be stable with some fluctuation over the years. For group B, the distribution pattern for each year shows a greater degree of variability. In 2017, 36% of 152 students (40 students) entered higher education with a foreign system certificate, before the number dropped to 5 in 2023, just 4% of the annual total. Their results have also steadily deteriorated. The highest score obtained was 400 points, compared to a maximum

of 490 points for students with a certificate from the national system (123 students). Group A tends to have higher median scores and a narrower distribution range compared to group B. Over the years, group A maintains a relatively stable distribution, while group B shows more fluctuation and variability in score distributions. Overall, the analysis shows that students with a national system school-leaving certificate have a sizeable advantage over students who have graduated from a foreign system secondary school. This disparity is consistent across multiple years and is statistically significant.



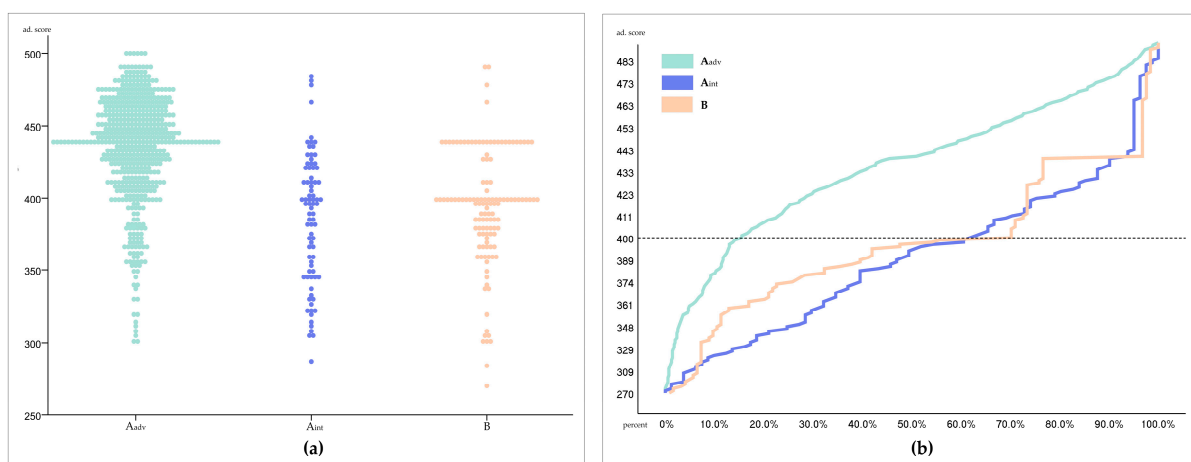
**Figure 5.** Differences in admission results by secondary education background. (a) Variation in results between national system and foreign system students; (b) frequency of histographic distribution of results between groups; (c) annual distribution of group results by histographic frequency.

### 3.3. Analyses of Admission Data Based on School-Leaving Qualification Background

We examined the differences in the statistical indicators of the three groups on the assumption that the results of students from different school-leaving qualification backgrounds differ because of the additional points that can be obtained. The size of the groups is determined by the breakdown used in Section 3.2. The difference is that we divided group A into students with an advanced-level school-leaving qualification background ( $A_{adv} = 554$  students) and those with an intermediate-level school-leaving qualification background ( $A_{int} = 81$  students), while students with a foreign secondary school background were grouped based on their native country certificate ( $B = 125$  students). The distribution of the data points is plotted in Figure 6a in a dot-plot density diagram, which effectively illustrates the size of the groups and the distribution of the results. The distribution of the group  $A_{adv}$  scores suggests a high degree of variability, with relatively few students at lower scores and then a widening range above 400 points. Many values exceed 450, indicating the presence of students with exceptional performance. The  $A_{int}$  group is much more narrowly distributed, with a more varied but also lower spread of scores, with only a few students scoring highly. Group B shows medium variability, with most students scoring in the middle of the range, between 360 and 400 points, with a high consistency. The cumulative distribution line in Figure 6b shows the initial slope of the  $A_{adv}$  group that scores up to about 17%, then flattens and becomes more consistent, indicating a gradual accumulation of scores. About two-thirds of the students in groups  $A_{int}$  and B score below 400 points, with very few scores above 80%.

From previous calculations, we know that our sample ( $n = 759$ ) is not normally distributed, so we compared the ordered alternatives of the independent samples using the Jonckheere–Terpstra test. The test is used to assess whether there is a monotonic (consistently increasing or decreasing) relationship between the groups. The results of the pairwise comparisons test the null hypothesis that the groups are equally distributed.

Significance values were adjusted by Bonferroni correction for multivariate tests. Table 2 shows the results of the test study. The  $p$ -value of 0.073 for the  $A_{int}-B$  group indicates that there is no significant trend between them; the adjusted  $p$ -value of 0.219 further confirms this and makes the result even less significant. This means that any observed differences in scores between these two groups are likely due to random variation rather than a systematic trend. The difference between the  $A_{int}-A_{adv}$  groups and the  $B-A_{adv}$  groups is statistically extremely significant, with a probability of occurrence by chance alone being less than 0.001%. The test statistic shows a strong negative value, indicating that the trend is actually decreasing in the opposite direction of what was expected. The results of the diagrammatic analysis and statistical test prove that students who select the advanced-level exam perform significantly better, achieving exceptionally high scores. Their results are significantly different from those of students with both the intermediate-level and the native certificate. Conversely, the scores of students with an intermediate-level certificate are not significantly different from those of students with a certificate from their native country.



**Figure 6.** Differences in admission data by school-leaving qualification background. (a) Breakdown of data points by advanced-level, intermediate-level, and native-level results; (b) percentage distribution of admissions by advanced-level, intermediate-level, and native-level results.

**Table 2.** Pairwise comparison results of the Jonckheere–Terpstra test for the total sample.

Sample 1–Sample 2	Test Statistic	Std. Error	Std. Test Statistic	Sig.	Adj. Sig.
$A_{int}-B$	5624.500	414.449	1454	0.073	0.219
$A_{int}-A_{adv}$	8378.000	1541.992	−9117	0.000	0.000
$B-A_{adv}$	14,571.500	1970.889	−10,034	0.000	0.000

#### 4. Discussion

According to Erdei [4], since the 1990s, young Hungarians living in the Carpathian Basin as ethnic minorities have been present in Hungarian higher education in significant numbers. His study revealed that this type of mobility is unidirectional, organised on an ethnic basis, and moreover, influences the academic careers of Hungarian ethnic minority students already at the time of choosing a secondary school institution. The higher education system [30], which has undergone several reforms since the change of regime, is now based on graduation points [16] from public education and offers Hungarian ethnic minority students two pathways to access higher education in Hungary [18]. This research used a statistical approach to explore these possibilities, looking for detectable differences that characterise admission results in recent years. On the one hand, we wanted to find out if university admission results of Hungarians living beyond the borders of Hungary show any pattern or trend in seven years’ time. On the other hand, the disaggregation of the sample database into groups allowed us to analyse the students’ admission scores and

compare the results of each group based on their secondary education background and their school-leaving qualification background.

Our first hypothesis is confirmed. A significant difference was found between the indicators of the reference database, with the 2017–2023 tertiary admission cut-offs, and the sample database. The relationship between the annual data of the median variables is shown to follow a curvilinear pattern by parabolic fitting of the quadratic model. While the median scores of the reference database have fallen slightly over the years, the scores of the students in the sample data have risen significantly; i.e., there is a tendency for their results to improve, which is a novel finding in this area of research. In investigating this issue, we found that the admission scores of students in the sample database were measurably higher than the admission thresholds in the reference database. For the reference data, only 40% of the thresholds are above 361 points, compared to over 89% for the sample data.

Another important conclusion, which can be described as novel, is that secondary education background has an impact on the admission results of the Hungarian ethnic minority students. Using the Mann–Whitney test, we confirmed our second hypothesis stating that students with a certificate from a national secondary education system would perform better than students with a certificate from a foreign secondary education system. The data demonstrate a significant discrepancy between the two groups. The breakdown into more detailed annual data also shows that the number of students with national secondary school-leaving examinations is steadily increasing and their results show an improving trend. In contrast, the number of students in the foreign system of secondary education is gradually decreasing. The same applies to their performance.

In proving the third hypothesis, partial results have been obtained. Using the Jonckheere–Terpstra test, we proved that the students who passed their graduation exams at the advanced level performed much better in the admission process than those who entered higher education with the intermediate-level or a native school-leaving qualification ( $p < 0.001$ ). There were no detectable differences between the results of students who had completed the intermediate level and those who had been admitted on the basis of a native country certificate ( $p > 0.05$ ). Not only the results of the students but also the number of students differ considerably between the three groups. A total of 73% of the students were admitted to higher education with an advanced level, 11% with an intermediate level, and 16% with results from their native country.

The impact of secondary education background and school-leaving qualification background on their admission results is a complex issue in which several factors are involved. The field is mainly analysed from sociological, educational, and mobility perspectives by native Hungarian researchers in Hungary and neighbouring countries [47,53,88]. However, these studies have not addressed student performance or the underlying reasons for it. However, the relationship between university studies and entrance examination results has been analysed by several international researchers. Birch and Miller studied the impact of secondary education background on academic performance through regression estimation and associated the type of secondary school with the distribution of first-year university grades [59]. Kelchtermans and Verboven analysed their participation in higher education on the basis of individual datasets of secondary education students in Flanders, highlighting the important role of secondary school background as one of the most important characteristics impacting on the decision to participate [19]. Pérez-Pulido, M.O et al. conducted a statistical analysis of admission scores at the University of Santander, Colombia. The results showed that students from private schools and Santander schools performed better [20]. These statements are consistent with our finding that students with certificates from national system secondary schools have been shown to outperform students with certificates from foreign system secondary schools, i.e., that secondary school background has a strong influence on admission performance.

While the study by Kupiainen categorises students based on their school-leaving qualification background, it also explores the underlying motivations behind their choices. The researchers suggest that many students may choose an exam that aligns with their

ability and willingness to put in the effort, in order to maximise their potential [22]. The claim cannot be ignored in the context of our results. Indeed, the students in the sample database do not choose between the national system and the foreign system of school-leaving examinations because of the constraints of the Hungarian admission system, but in order to achieve the goal that will give them the best chance of success in their university application. The reason for this is that they can apply to Hungarian higher education having already passed the foreign system exam—they are not forced to take another exam—yet every year more and more students choose the new (national system) exam to achieve the best results. This can also be linked to the claim that the success of students is to be found in the repeated knowledge assessment. This reinforces and consolidates knowledge. Win and Miller identified effects of both immersion and reinforcement [23].

One of the limitations of this study is that it uses only quantitative data and does not examine the motivation of students and the reasons behind their choice of the school-leaving examination. Another limitation is that the sample database focuses on a relatively narrow cross-section, a group of scholarship holders whose results are assumed to be better than average, but this cannot be proven in the absence of previous studies. The results of the research can be considered novel, because no study analysing and processing similar data is available in Hungary. The present study can be considered as a preliminary one, because we see the possibilities of regional disaggregation of the study area as a future research direction. These include the presentation of the regional admission results of students entering Hungarian higher education from the Hungarian-speaking areas of the Carpathian Basin, and the breakdown and analysis of the results by higher education institution and field of study. Also, we would like to highlight some special fields that are more popular and attractive to students because of their marketability (medicine, health, IT, etc.). The significance of this study is that it provides a comprehensive picture of the transition from secondary school to university of Hungarian students living as ethnic minorities outside the country's borders, which makes their results comparable with those of students from other regions or even with those of students of Hungarian nationality.

## 5. Conclusions

This study used a statistical method to examine the admission data of 759 students who live as ethnic minorities in their home country and who continued their higher education in Hungary, based on their school-leaving qualification background and secondary education background. Over the seven-year period under study, the results of the students showed an improving trend, with the number and results of students graduating from national secondary schools being significantly higher than those from foreign secondary schools. Students with an advanced-level certificate performed better than both intermediate and native certificate holders. However, there was no detectable difference in the performance of students with intermediate-level certificates compared to students with native-level certificates. The analysis of the data series for the period 2017–2023 reveals not only a general trend of improvement, but also nuanced dynamics that require deeper investigation. The positive linear relationship between time and admission scores highlights a steady increase in academic performance, but this trend needs to be put in context with the theoretical upper limit of 500 points. The results of this study indicate a steady improvement in performance, which may be considered a favourable sign of the effectiveness of the education policy system in supporting minorities living across the border. On the basis of our findings, we can formulate proposals to provide incentive or support mechanisms (such as scholarships, tutoring, or additional resources for exam preparation) to ensure that students of Hungarian nationality living abroad can take the advanced-level exam in Hungary, instead of relying on certificates from their home country. In practical terms, these findings offer useful insights for educational policy makers and institutions. The ongoing improvement in admission results among students from minority communities indicates that current support mechanisms are effective but could be strengthened with more targeted incentives. For instance, expanding scholarships, offering preparatory

tutoring, and creating specialised exam resources would increase access to Hungarian advanced-level exams, which have been shown to provide students with a competitive edge. Mentorship programs that connect cross-border students with university students or graduates from similar backgrounds could guide them on study requirements, learning techniques, and exam preparation strategies. Tutors with a strong understanding of the Hungarian education system could also offer structured and curriculum-aligned support to fill knowledge gaps and build students' confidence. Moreover, the noticeable performance gap between students from national and foreign secondary school systems suggests a need for curriculum alignment or bridging programs to help minority students meet the expectations of Hungarian higher education. Overall, the analysis shows that students from national system schools have a significant advantage over students from foreign system schools. This difference is consistent across grades and statistically significant, highlighting areas for further investigation and consideration in the education and admissions context.

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