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Students' performance at the Baccalaureate Exam during the COVID-19 pandemic – Evidence from Romania*

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Abstract

Countries face a major challenge in terms of learning inequalities and Romania makes no exception. Performing well at Baccalaureate exam is a very important topic for all students as this places at risk the number occupied university places and adds extra burden on the parent shoulders on top of existing COVID-19 pandemic concerns. Our research aims to evaluate the impact of demographic as well as educational characteristics on Baccalaureate performance and their influence in failing this exam. The dataset in the present research uses microdata extracted from the Ministry of Education database. ANOVA and logistical regression results highlight that these characteristics influence the probability to fail the exam in terms that males still have a higher probability to fail compared to females and rural candidates in Romania have less chances to pass compared to their counterparts. The highest performance was obtained by students with a theoretical background while the probability to fail is the highest for the ones with technological background or attending evening classes.

Keywords: Romania, baccalaureate exam, logistic regression, learning inequality, academic achievements

Introduction

The COVID-19 pandemic forced many countries to replace traditional face-to-face learning with online learning. Generally, children and adolescents registered lower academic performances and lower school attendance during the pandemic compared to the pre-pandemic period (Panagouli et al. 2021). Moreover, children from low-income families were considerably more affected by the shift from traditional learning to online learning compared to children from middle-income and high-income families due to the lack of access to a computer, poor nutrition and poor housing conditions (Garcia and Weiss, 2020). In this respect, differences in academic achievement are strongly influenced by social status and have extremely negative psychological effects on students (Goudeau et al., 2021). Analysing the drivers of socio-economic learning inequality, Di Pietro (2020) points out that the lack of non-financial and financial parent support (cognitive skills, availability, providing access to technology, providing adequate nutrition) as well the lack of digital resources are major factors that lead to a decline of learning outcomes in students from disadvantaged groups.

At country level, there is a significant gap in students' academic achievements as well as opportunities between developed countries and developing ones. For example, 82% of the students in Denmark completed their schoolwork independently

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during the pandemic, compared to only 45% of the students in Burkina Faso and 84% of the students feel confident about learning in the future compared to 27% in Burkina Faso (UNESCO, 2022).

There are significant differences in students' performances and educational opportunities during the COVID-19 pandemic by demographic characteristics. Students from rural areas often lack access to internet and electricity, affecting their academic performances (Balay, 2020). Moreover, poverty affects mostly women and young persons (Iftimoaei, 2021) and this might have a considerable impact upon students within a family. Some studies during COVID-19 pandemic indicate that students favoured online education, although they reflected uncertainty if the new setup matches the traditional one (Buzatu et al., 2020).

The aim of this paper is to analyse Romanian students' performance at the Baccalaureate exam during the COVID-19 pandemic. According to the Ministry of education (2021), 69.57% of the students who attended the exam in 2021 passed, with 5% higher compared to the 2020. The value added of this study consists in using advanced statistical techniques to gain insights on the factors that influence students' performances at the baccalaureate exam. Three research questions will be answered:

Q1. Is there a difference between students' performance at the Baccalaureate exam by demographic characteristics?

Q2. Is there a difference between students' performance at the Baccalaureate exam by educational characteristics?

Q3. To what extent the demographic chrematistics and the educational ones influence the probability to fail the exam?

Methodology

The study uses microdata regarding the Baccalaureate exam results, session June 2020-2021, made available by the Ministry of Education (Ministry of Education, 2021). For the first two research questions, the data is processed using a methodology similar to that of Ceban et al. (2021).

In order to measure students' performance at the Baccalaureate exam, the variable "Final Average obtained by a candidate" is considered. This encompasses the results of all the subjects a candidate took as part of the exam.

For the first research question, two demographic characteristics are taken into account: Sex (with variants: Males, Females) and Area of residency (with variants: Urban, Rural). As the "Final Average obtained by a candidate" is a scale variable and the other three variables are binary, a t-test is used to analyse differences in the final average by each binary variable category.

For the second research question, three educational characteristics are considered: school profile of the candidate (Sciences, Humanities, Technical, Sports, Services, Arts, Theology, Natural resources and environmental protection, Military, Pedagogical); track (Theoretical, Technology, Vocational) and type of learning (Full-time, Part-time, Evening courses). The ANOVA technique is used in order to assess the differences in the final average by each categorical variable.

In order to answer the third research question, a binary variable (Passed/Failed) taking the value 1 if the candidate failed and 0 otherwise, was used. This binary variable was used into several simple logistic regression models. The factor for each model is a binary variable defined based on the categories of each variable mentioned in the previous two paragraphs. The models are defined as follows:

$$Log\left(\frac{P}{1-P}\right) = \mathrm{b} + \mathrm{aX_i} \qquad (1)$$

$$where, P\ is\ the\ probability\ for\ a\ candidate\ to\ fail$$

In the above equation X_i corresponds to each of the following binary variables:

- Sex_F (equals 1 if the candidate is a female and 0 otherwise);
- Sex_M (equals 1 if the candidate is a male and 0 otherwise);
- Area_of_residency_RURAL (equals 1 if the candidate is from rural areas and 0 otherwise);
- Area_of_residency_URBAN (equals 1 if the candidate is from urban areas and 0 otherwise);
- Profile_Arts (equals 1 if the candidate has an arts background and 0 otherwise);
- Profile_Humanities (equals 1 if the candidate has a humanity background and 0 otherwise);
- Profile_Military (equals 1 if the candidate has a military background and 0 otherwise);
- Profile_Natural_resources_and_environmental_protection (equals 1 if the candidate has a natural resources and environmental protection background and 0 otherwise);

- Profile_Pedagogical (equals 1 if the candidate has a pedagogical background and 0 otherwise);
- Profile_Sciences (equals 1 if the candidate has a sciences background and 0 otherwise);
- Profile_Services(equals 1 if the candidate has a services background and 0 otherwise);
- Profile_Sports (equals 1 if the candidate has a sports background and 0 otherwise);
- Profile_Technical (equals 1 if the candidate has a technical background and 0 otherwise);
- Profile_Theology (equals 1 if the candidate has a theology background and 0 otherwise);
- Track_Technology (equals 1 if the candidate followed a technological track and 0 otherwise);
- Track_Theoretical (equals 1 if the candidate followed a theoretical track and 0 otherwise);
- Track_Vocational (equals 1 if the candidate followed a vocational track and 0 otherwise);
- Type_of_learning_evening_courses (equals 1 if the candidate attended evening courses and 0 otherwise);
- Type_of_learning_full_time (equals 1 if the candidate attended full-time courses and 0 otherwise);
- Type_of_learning_part_time (equals 1 if the candidate attended part-time courses and 0 otherwise).

Results

Table 1 presents the results of the t-test performed upon the "Final average obtained by a candidate" by several binary variables. The test concludes that there is a significant difference in performances by sex, area of residency and year of graduation. These results can be interpreted together with the boxplots in Figure 1. The median for the "Final average obtained by a candidate" is lower for males compared to females. Moreover, it is much higher in urban areas compared to rural ones. This result can be explained through the fact that many students from rural areas do not have the necessary resources to attend online schooling properly (World Vision Romania, 2020). Also, candidates that graduated in 2020-2021 have a median performance approximately 2 points higher than candidates from other promotions.

Table 1 t-test results for "Final average obtained by a candidate" variable by several binary variables; source: designed by the authors based on data provided by the Ministry of Education (2021)

Binary variable	t-stat	Test result
Sex (Males, Females)	t=61.361	Reject the null hypothesis that the means are equal
Area of residency (Urban, Rural)	t=-66.050	Reject the null hypothesis that the means are equal

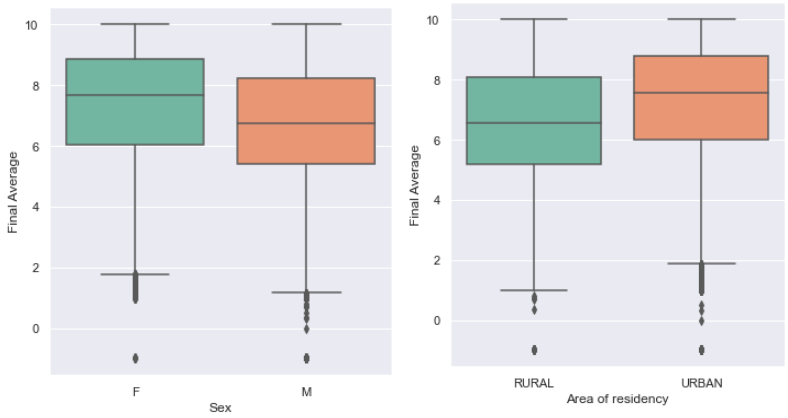

Figure 1 Final average obtained by a candidate at the Baccalaureate Exam by sex, area of residency and Year of Graduation respectively; source: designed by the authors based on data provided by the Ministry of Education (2021)

Tables 2, 3 and 4 present the results of the ANOVA technique performed upon the "Final average obtained by a candidate" variable by profile, track and type of learning respectively. All the results show significant differences by the variants of each categorical variable.

Table 2 ANOVA results for the "Final average obtained by a candidate" variable by profile; source: designed by the authors based on data provided by the Ministry of Education (2021)

	df	sum_sq	mean_sq	F	PR(>F)
Profile	9	133113	14790.33	5441.77	0
Residual	130648	355091.7	2.717927		

Table 3 ANOVA results for the "Final average obtained by a candidate" variable by track; source: designed by the authors based on data provided by the Ministry of Education (2021)

	df	sum_sq	mean_sq	F	PR(>F)
Track	2	98531.72	49265.86	16518.54	0
Residual	130655	389673	2.982458		

Table 4 ANOVA results for the "Final average obtained by a candidate" variable by type of learning; source: designed by the authors based on data provided by the Ministry of Education (2021)

	df	sum_sq	mean_sq	F	PR(>F)
type_of_learning	2	15369.68	7684.839	2123.494	0
Residual	130655	472835.1	3.618959		

Figure 2 displays the boxplots for the final average obtained by a candidate at the Baccalaureate exam by profile. The highest median can be observed for the candidates graduating from military profiles followed by those in sciences and humanities. The lowest median is registered for the natural resources and environmental protection candidates as well as for those with a technical background.

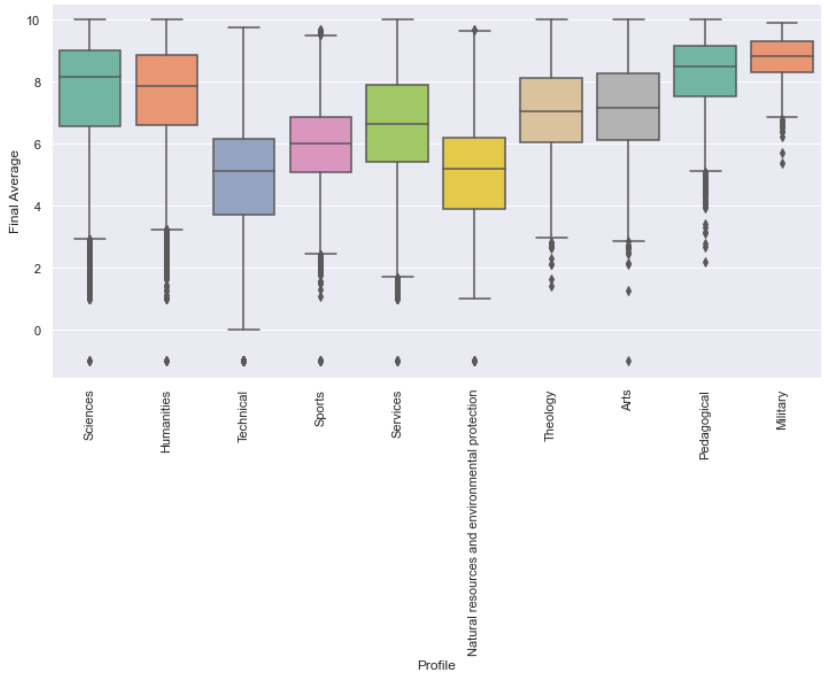

Figure 2: Final average obtained by a candidate at the Baccalaureate Exam by profile; source: designed by the authors based on data provided by the Ministry of Education (2021)

Box-plots for the final average obtained by a candidate at the Baccalaureate exam by track are presented in Figure 3. Students with a theoretical background obtained the highest performances. The median in this case is close to that registered for sciences and humanities students. Also, candidates with a background in technology have the lowest performances. The low performances in the latest case might be explained by the fact that students in technological high schools registered poor educational performances during their lower secondary education and the curriculum in such schools is not adapted to their needs (Pop, 2018).

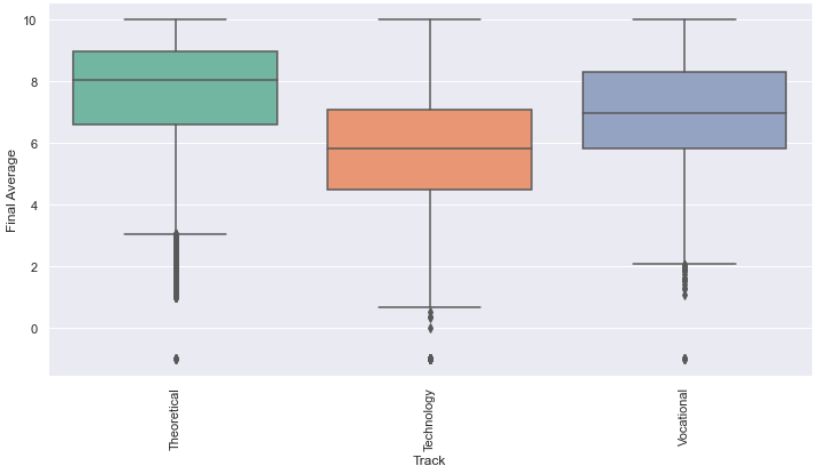

Figure 3: Final average obtained by a candidate at the Baccalaureate Exam by track; source: designed by the authors based on data provided by the Ministry of Education (2021)

Figure 4 presents box-plots for the final average obtained by a candidate at the Baccalaureate exam by type of learning. Candidates attending evening courses have the lowest performances. This is due to the fact that most of the candidates attending evening courses have a special professional or personal situation (Ciulac, 2014).

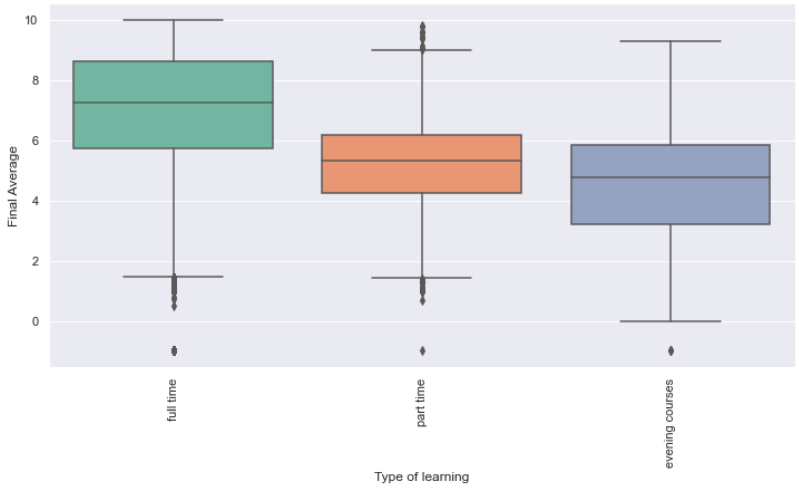

Figure 4: Final average obtained by a candidate at the Baccalaureate Exam by Type of learning; source: designed by the authors based on data provided by the Ministry of Education (2021)

Table 5 presents the results of the logistic regression models as defined through equation 1 in the methodology section. All the factors are significant with the exception of Track_Vocational.

Table 5 Results of the logistic regression models based on equation 1; source: designed by the authors based on data provided by the Ministry of Education (2021)

	intercept	std_error_intercept	estimator	std_error_estimator
Sex_F	-0.61	0.01	-0.44	0.01
Sex_M	-1.05	0.01	0.44	0.01
Profile_Arts	-0.83	0.01	-0.31	0.04
Profile_Humanities	-0.62	0.01	-1.04	0.02
Profile_Military	-0.83	0.01	-4.63	0.71
Profile_Natural_resources_and_environmental_protection	-0.93	0.01	1.79	0.03
Profile_Pedagogical	-0.82	0.01	-1.42	0.07

Profile_Sciences	-0.58	0.01	-0.89	0.01
Profile_Services	-0.91	0.01	0.40	0.02
Profile_Sports	-0.87	0.01	0.84	0.03
Profile_Technical	-1.09	0.01	1.94	0.02
Profile_Theology	-0.84	0.01	-0.14	0.05
Track_Technology	-1.43	0.01	1.58	0.01
Track_Theoretical	-0.08	0.01	-1.47	0.01
Track_Vocational	-0.84	0.01	-0.03	0.02
Type_of_learning_evening_courses	-0.87	0.01	2.21	0.07
Type_of_learning_full_time	1.10	0.04	-1.99	0.04
Type_of_learning_part_time	-0.86	0.01	1.76	0.06
Area_of_residency_RURAL	-1.07	0.01	0.67	0.01
Area_of_residency_URBAN	-0.40	0.01	-0.67	0.01

The probability to fail the Baccalaureate exam computed by each significant variable is displayed in Figure 5. Analysing the demographic factors, it can be concluded that males have a higher probability to fail compared to females while urban candidates have a higher probability to pass compared to rural ones. With regard to the educational factors, students attending evening courses have the higher probability to fail compared to their counterparts. Likewise, candidates with a technological background are most likely to fail the exam. The results are coherent to the performance analysis based on the "Final average obtained by a candidate".

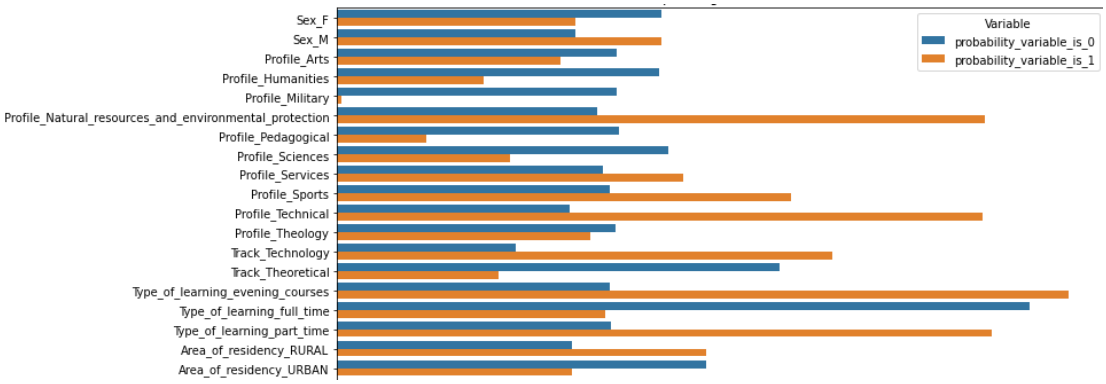

Figure 5 The probability to fail the Baccalaureate exam by significant factors; source: designed by the authors based on data provided by the Ministry of Education (2021)

Conclusions

Students' performance at the Baccalaureate exam is of great interest as socio-economic learning inequality gap widened during COVID-19 pandemic and many countries replaced traditional face-to-face learning with online learning followed by a hybrid learning environment. Our results based on the dataset with microdata from the Baccalaureate exam reveal that among candidates, males still have a higher probability to fail compared to females. In addition, rural candidates in Romania have less chances to pass compared to their counterparts.

Although students with a theoretical background obtained the highest performances, the highest probability to fail is seen among students attending evening courses and those with technological background. Such results are often explained as due to personal reasons and the underlying circumstances that these students face in terms of motivation or their socio-economic status. Furthermore, the results point to the fact that demographic chrematistics and the educational ones influence the probability to fail the exam. This is revealed through the fact that all logistic regression model factors are significant with the exception of vocational tack.

Improving understanding of the impact that different factors have on the probability to fail the Baccalaureate exam is an important first step to understand which groups are at greatest risk and to what extent socio-economic learning inequality is distributed.

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