Comparison of Student Results before and during Covid-19 Pandemic

Abstract: The objective of this paper is to present the results from students taking the course of Mathematics for Economists at the Prague University of Economics and Business during the summer semester of the academic year 2019/2020 when the teaching and assessment was done remotely due to the COVID-19 pandemic and compare these results with the results obtained by the students who took the course in the corresponding semester of the year 2018/2019.

The mid-term test scores, final test scores, and final grades from 669 students taking the course in the summer semester of the year 2018/2019 and from 737 students taking the course in the summer semester of the year 2019/2020 were analysed and compared. The students performed significantly better during the online assessment. Some lessons were learned and certain changes were implemented in the subsequent academic year to make the assessment more comparable to the previous academic years.

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Introduction

The outbreak of the COVID-19 pandemic and subsequent government restrictions in early March 2020 hit the universities in the Czech Republic unprepared. The Prague University of Economics and Business was in the third week of the summer semester of the academic year 2019/2020 when the in-class teaching was forbidden. The rest of the semester continued via distance learning, which was a new challenge for both students and teachers.

The objective of this paper is to present results of the students who took the course of Mathematics for Economists in the summer semester of the year 2019/2020, verify whether these students scored differently when compared to the students in the summer semester of the year 2018/2019, discuss the differences and come up with some lessons learned.

Materials and methods

Data description

In order to investigate the changes in the students' performance in the summer semester 2019/2020, the corresponding semester from previous year, i.e. the summer semester 2018/2019, was selected for comparison. The content of the course was the same in both semesters and similar number of students were enrolled: 669 in the summer semester 2018/2019 and 737 in the summer semester 2019/2020.

Course description

The course of Mathematics for Economists used to be taught and assessed in the same way for many years before the pandemic. During the 13 weeks students attended non-compulsory lectures (90 min/week) and non-compulsory exercise sessions (90 min/week). The continuous assessment of students consisted of the mid-term test worth 20 points written around week 9 of the semester, final test worth 40 points written in exam period and theoretical oral exam worth 40 points. All parts of the assessment were closed book. The points were then summed up and final grades were determined using university regulations presented in Table 1. Students had only one attempt to each part of the assessment unless they were graded with 4+, when they could retake the final test and oral exam once more.

After the sudden outbreak of the COVID-19 pandemic and closure of the university, the situation the teaching was interrupted for around 2 weeks and the remainder of the semester was then taught via distance learning. The content of the course was not reduced, and all required topics were covered and examined.

The assessment was modified in the following way. An online mid-term homework assignment, which replaced the usual mid-term test, was assigned to students in Week 10. Students received five problems from their tutor and had to send scanned handwritten solutions within a week. The final test was online and open book. Students received 8 problems and had to send their handwritten solutions within 70 minutes. The students registered on the same exam date were then split among the examiners for the theoretical part of the exam.

Statistical methods and software

Descriptive statistics were calculated for the mid-term test score and the final test score (*mean, standard deviation, median, 1st quartile, 3rd quartile, minimum, maximum*). The distribution of the scores was also visualised using boxplots. The Mann-Whitney *U* test was used to assess whether the scores between the two semesters differ. The null hypothesis of the test states that the distribution of the scores is the same in both semesters, while the alternative hypothesis states that the two distributions differ. For more details about the test see, e.g., Pecáková (2018).

The contingency table showing final grades by semester was assessed using the Cochran-Armitage test. The test tests the null hypothesis that there is no association between final grades and semester vs the alternative hypothesis that the association is present between grades and semester. The grades were also visualised using bar charts. For more details about the test see, e.g., Agresti (2012).

The statistical analyses were performed using the statistical software R 4.0.4 and its packages. All statistical tests were performed at the 5% level of significance.

Results

Mid-term test and final test

The difference in the distribution of scores is noticeable and the students scored much better during the mid-term assignment. The average score during the mid-term assignment in the summer semester 2019/2020 was 17.16/20, while in the regular mid-term test in the summer semester 2018/2019 the average score was 11.31/20. The null hypothesis is rejected using the Mann-Whitney *U* test, hence the difference between the mid-term test scores in two semesters is statistically significant (p-value<0.001).

The same observations can be observed for the final test score, i.e. student performance improved during the online assessment (average score in summer semester 2018/2019 was 23.53/40, while in the summer semester 2019/2020 students gained on average 31.54/40). Using the Mann-Whitney *U* test we reject the null hypothesis, hence the difference between the final test scores in the two semesters turns out to be statistically significant as well (p-value<0.001).

Final grades

The contingency table of semester by final grade is presented in Table 1. These counts are also visualised in Figure 1. It can be observed that the distribution of final grades was different in both semesters and students scored better during the online assessment. The mode grade was 2 in the summer semester 2019/2020, while it had been 3 in the preceding year. The difference between the distribution of grades between the semesters is statistically significant as the null hypothesis is rejected using the Cochran-Armitage test (p-value<0.001).

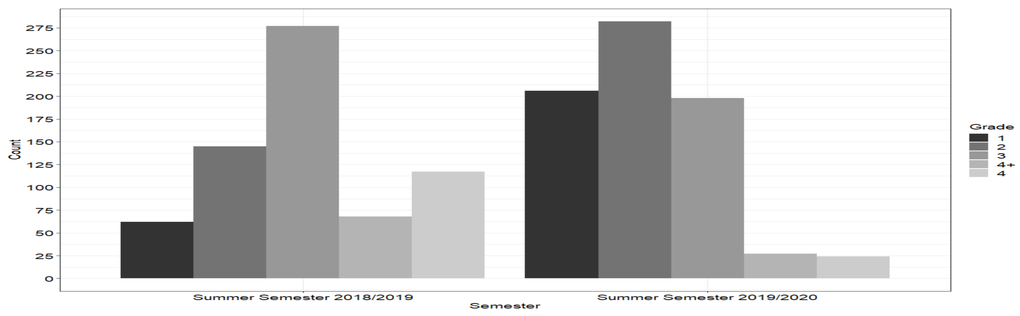

Figure 1: Final grades by semester

Summer Semester	1	2	3	4+	4	Overall
2018/2019	62	145	277	68	117	669
2019/2020	206	282	198	27	24	737
Overall	268	427	475	95	141	1406

Table 1: Contingency table of final grades by academic year

Conclusion

In conclusion, when assessing the online assessment and teaching during the summer semester 2019/2020, the improvement in student scores can be observed for all analysed variables: mid-term test score, final test score, final grades. These differences were mainly driven by the change in the way of assessment and change from closed-book to open-book.

An extended analysis of the student performance using the data from the academic year 2020/2021 including the assessment of implemented changes is being planned.

References

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