

Jindřich Klůfa

Department of Mathematics

Faculty of Informatics and Statistics

Prague University of Economics and Business

## Introduction

Oral exams are becoming more and more important nowadays, when the objectivity of exam tests written in a distance form is not always ensured. Therefore, in this article we shall focus on the analysis of oral exams. We shall study exams in mathematics at the Prague University of Economics and Business. The number of possible points from the mathematics exam is in interval  $[0, 100]$ . These points are the sum of points from the mid-term test, the exam test and the oral exam. In winter semester of the 2020/2021 academic year, due to coronavirus, students could choose the distance form or the full-time form (with personal participation) of the oral exam in mathematics. The distance form of the oral exams was performed using MS Teams. We shall use the results of exams in the course Mathematics for informatics to compare the forms of the oral examination. In the second step, we shall study the dependence of the oral exams on the results of exam tests. The exam tests were performed in distance form with a strictly limited processing time. The oral examinations follow the exam tests within two days after the exam tests. The number of possible points in the exam tests and in the oral exams is the same (the number of points is in interval  $[0, 40]$ ). Results of this contribution can be used for improvement of the online education at the Faculty of Informatics and Statistics at the Prague University of Economics and Business.

## Materials and methods

The analysed data are the results in mathematics of 377 students in winter semester of the academic year 2020/2021 in the course Mathematics for informatics (ident 4MM106). These data are sorted according to ways of oral exam.

For study the differences of the full-time form and the distance form of the oral examination in mathematics we shall use t-test for independent samples and the same variance.

For the study the dependence of the number of points in the oral examination on the number of points in exam test we shall use methods of correlation a regression analysis, e.g. we shall use test of significance of correlation coefficient  $r$ . We shall verify the validity of the null hypothesis “the number of points in the oral examination does not depend on the number of points in exam test”.

## Results

Distributions of number of points in exams in mathematics in winter semester of the 2020/2021 academic year in the course Mathematics for informatics for full-time form and distance form of the oral exams are in Figure 1. Some fundamental descriptive statistics of these distributions are in Table 1. For example, average number of points in oral exam for full-time form is  $\bar{x} = 25.079$  and for distance form is  $\bar{y} = 27.639$ . The difference between these averages may be significant or may have occurred randomly. For objective decision we shall use t-test for independent samples.

	Full-time form of the oral exams	Distance form of the oral exams
Frequency	89	288
Average	25.079	27.639
Median	26	30
Modus	25	35
Std. Deviation	9.6675	10.1998
Kurtosis	-0.019	0.309
Skewness	-0.564	-0.894

Table 1: Descriptive statistics for number of points in oral exam

We shall test null hypothesis

$H_0$ : mean number of points in both forms of oral exam is the same.

For the decision on the validity of the hypothesis we shall compute statistic t. We have  $t = 2.0948$ . Critical value of t distribution is  $t_{0.05}(375) = 1.9663$ . Since

$$|t| = 2.0948 > t_{0.05}(375) = 1.9663$$

the hypothesis “mean number of points in both forms of oral exam is the same” is rejected at significance level 0.05. The difference between averages  $\bar{x} = 25.079$  and  $\bar{y} = 27.639$  is statistical significant. The results of the full-time form and the distance form of the oral exams differ significantly.

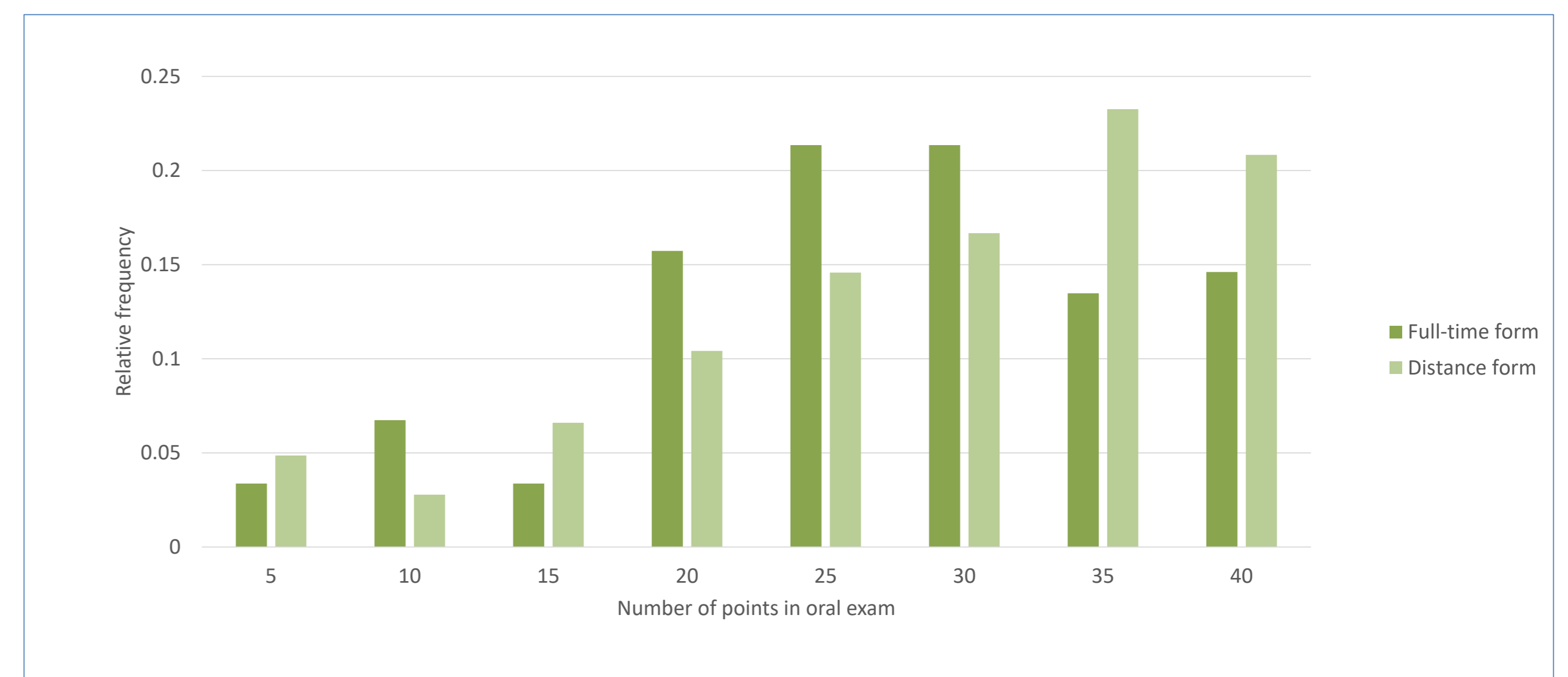


Figure 1: Distribution of number of points in oral exams in the course 4MM106

In the second step, we shall study the dependence of the oral exams on the results of exam tests. The exam tests were performed in distance form with a strictly limited processing time. The oral examinations follow the exam tests within two days after the exam tests. The minimum number of points to pass successfully the exam is 60. It seems that a student who has a lot of points from the mid-term test and the final test (close to 60) does not pay enough attention to the oral exam. If this hypothesis were true, the dependence of the oral exams on the results of exam tests would be negative.

For objective analysis of the problem, we shall use methods of regression and correlation analysis. The analysed data are the results of 89 students who passed the full-time oral exam. We shall assume a linear trend (see Figure 2), therefore we use correlation coefficient. The correlation coefficient is  $r = 0.341$ . We shall test null hypothesis  $H_0$ : the number of points in the oral exam does not depend on the number of points in the exam test. Statistic t is 3.38. Since  $|t| > 2.63$ , the null hypothesis  $H_0$  is rejected. The dependence of the oral exams on the results of exam tests is weak and positive. Regression line is  $y = 13.312 + 0.393x$ . The hypothesis of negative dependence of the oral exams on the results of exam tests was not confirmed.

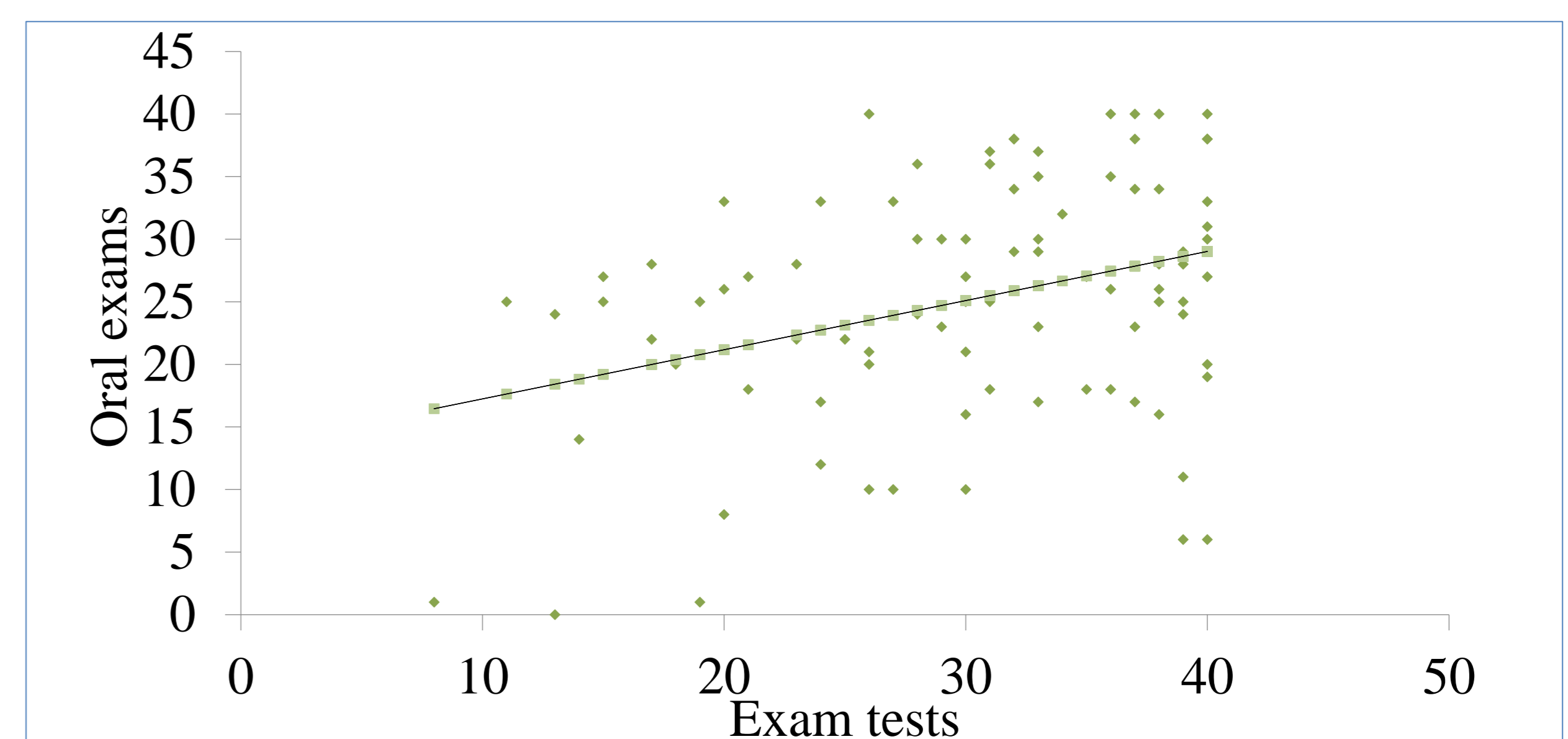


Figure 2: Dependence of the number of points in the oral exam on the number of points in the exam test in mathematics

## Conclusion

Students could choose at the time of coronavirus the distance form or the full-time form of the oral exam in math at the Prague University of Economics and Business. From results of the paper follow that there is a significant difference between results of the distance form and the full-time form of the oral exam. The distribution of number of points in the full-time form of the oral exam has a better shape (closer to normal distribution) than the distribution of number of points in the distance form of the oral exam. Moreover, average number of points in oral exam for full-time form is less than average number of points in oral exam for distance form. The results of the regression and correlation analysis further show that between the results of oral examinations and the results of exam tests there is a weak positive dependence. The hypothesis that a student who has many points from the mid-term and final test does not pay enough attention to the oral exam has not been confirmed.

## References

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