The Effects of Preparatory Course on the Mathematics Exam Results: Case Study

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Abstract:

In this paper, we verify the relation between the score from the final test held in preparatory course and the exam success rate of undergraduate mathematics in the winter semester 2020/2021 at the Faculty of Business and Economics of Mendel University in Brno. There is a strong need to support success rate of undergraduate mathematics courses because of low mathematics knowledge obtained at high school reported by many sources. The environment where the preparatory course has been introduced is described.

Logit model with subsequent threshold optimization is employed to test the effect of preparatory course. This is significant, as well as the form of study, the type of high school and gender. Finally, we can recommend preparatory course or similar activity for improving success rate of mathematical courses, although this cannot be the main cause of student success.

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Introduction

- For years, universities in the Czech Republic have faced the problem of persistent decline in students' knowledge of high school mathematics.

- The Department of Statistics and Operation Analysis at Mendel University in Brno organizes an intensive one-week preparatory high school math course, which takes place in early September before the start of the semester.

- For objective assessment of the possible effect of the prep course we are dealing also with other factors that affect the student's success in university course, such as the type of high school, gender, and the score from the admission procedure.

- The objective of our research is to assess whether the mentioned preparatory course is significantly effective in improvement the success rate in undergraduate mathematics for coached students over their uncoached peers.

Materials and methods

Characteristics of the explored dataset

Char.	Total	MT	MT1	AMT	MT pres	MT comb	MT EAM	PREP
Count	953	465	201	287	379	86	416	98
Female	55	57	35	66	59	53	57	74
G	39	44	37	34	44	44	45	42
OA	16	19	10	15	21	14	19	26
SOS	27	20	30	35	18	30	20	15
CZE	82	82	77	84	81	87	82	82
SK	11	13	10	8	14	12	13	15

Table 1: Selected characteristics of datasets. Except Count, all values are in percent. CZE means share of students from the Czech Republic and SVK is the share of student from the Slovak Republic. MT EAM means students from the study program Economics and Management, PREP denotes participants of the preparatory course.

Undergraduate courses:

- **MT** – Mathematics
- **MT1** – Mathematics 1
- **MT pres** – full-time study of MT
- **MT comb** – part-time study of MT
- **AMT** – Applied Mathematics

High school type:

- **G** – grammar school
- **OA** – business academy
- **SOS** – the secondary vocational school and high school of technical or informatics field

Final multiple-choice test of the preparation course (maximum 6 points):

- **Above** – students receive score 5-6
- **Average** – students receive score 3-4
- **Below average** – students receive score 1-2
- **Absent** – students did not participate

Methods

- The success rate of undergraduate course was predicted by logit model.

- The set of predictors: gender, nationality, the type of high school, the mathematics course at University, the form of study, the year of enrolment to University, the score of the preparatory course test.

- Threshold optimization techniques were employed.

Results

- Analysis of deviance (see Table 2) indicates that **score of the prep course is statistically significant factor**. AUC characteristics of the estimated model is 0.671.

Factor	d. f.	Deviance	Mean deviance	Deviance ratio	p-value
Score prep course	3	9.612	3.204	3.20	0.022
Form of study	1	10.273	10.273	10.27	0.001
High school type	3	20.033	6.678	6.68	<.001
Gender	1	21.789	21.789	21.79	<.001
Course	2	5.993	2.996	3.00	0.050
Residual	942	1049.304	1.114		
Total	952	1117.004	1.173		

Table 2: Analysis of deviance for generalized linear model for the Total dataset

- Figure 1 and Figure 2 illustrate the results after employing threshold optimization methods, which increased the sensitivity from the previous 5.8 % to 59.2 %.

Figure 1: Predicted probability of success in a mathematics course based on score of the preparatory course test for different datasets
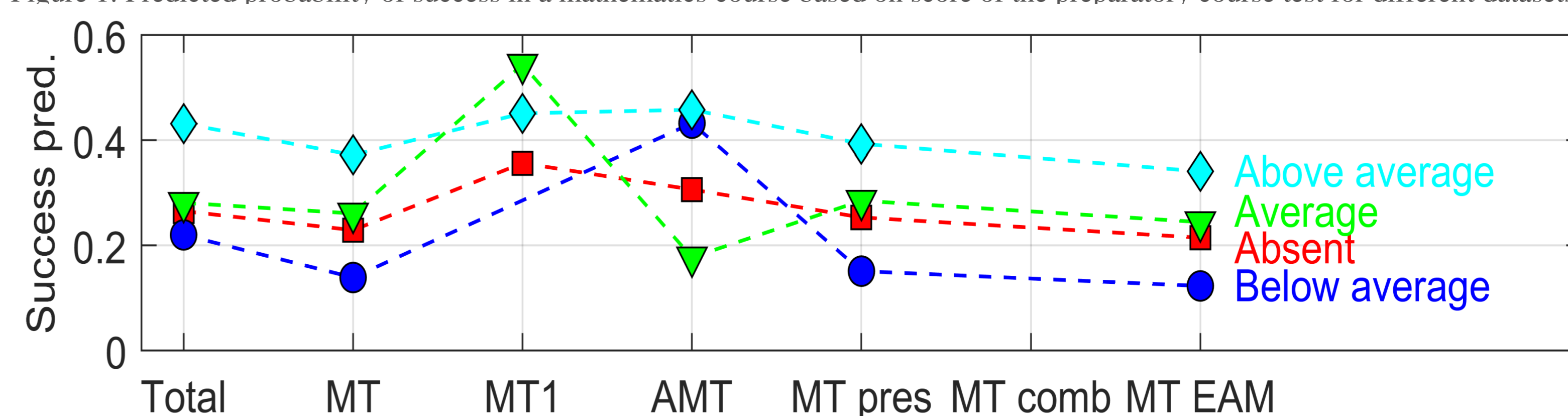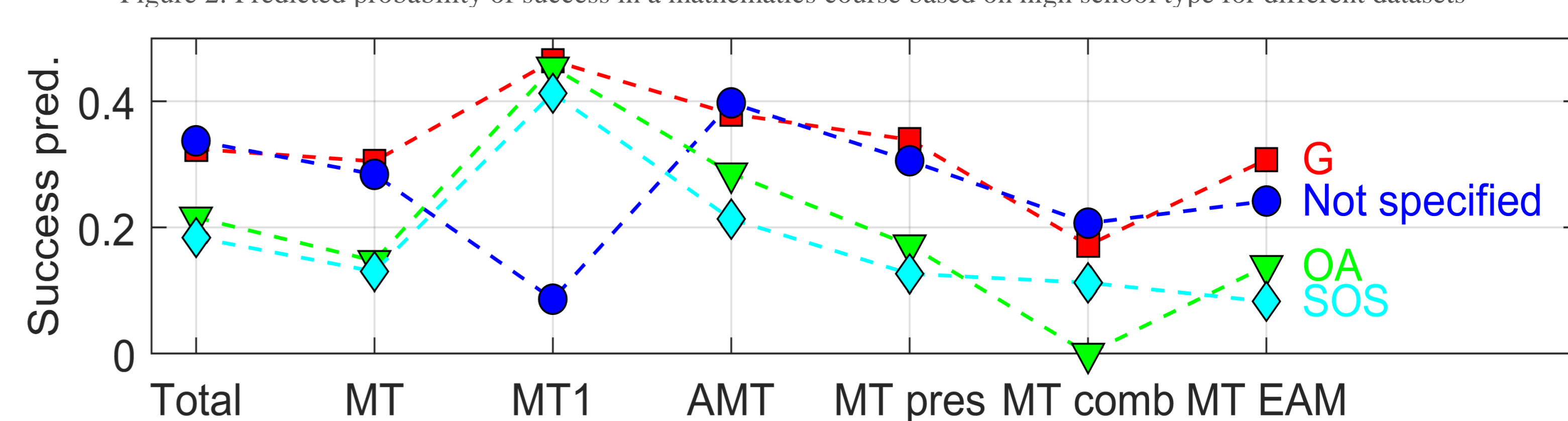

Figure 2: Predicted probability of success in a mathematics course based on high school type for different datasets

Conclusion

- The preparatory mathematics course has a positive effect on success rate in undergraduate mathematics courses.

- In general, we recommend providing preparatory course or some other support to improve students' ability in high school mathematics with the goal at least maintain the level of mathematical competencies required for Industry 4.0.

References

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