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REFEREE'S REPORT FOR HABILITATTION
FOR DR. MARTINA HANČOVÁ

At the outset, I would like to point out that in principle I was only able to evaluate the scientific papers included in the habilitation. This is because the rest of the attached materials were in Slovak, which prevented me from reading them. For this reason, I have limited myself to evaluating the nine papers that constitute the habilitation achievement.

EVALUATION OF THE SCIENTIFIC ACHIEVEMENTS

1. The first paper was published in *Proceedings of 15th European Young Statisticians Meeting* (year of publication 2007, individual work) is on a general class of linear regression time series models called the finite discrete spectrum linear regression models (FDSLRM[1]). This paper is a continuation of the research from the Ph. The paper basically consists of two theorems. The first one gives a block matrix form of the BLUP (best linear unbiased predictor) for a general FDSLRM. The second theorem compares the MSEs (mean square errors) of BLUPs for models: CLRM, FDSM and GFDSLRM. This is fairly straightforward work, yet the properties shown are interesting and relevant.

2. Another paper appeared in the respected journal *Metrika* (year of publication 2008, 2 citations[2], individual work, IF'20 = 1.057[3]). In it, the author proposes a "natural" estimation of variance in GFDSLRM. Besides, the paper shows a number of properties (e.g. asymptotic unbiasedness) of the proposed estimators. The paper is enriched by

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[1] FDSLRM is a parametric family of time series models whose trend are given by linear regression and error terms are a linear combination of uncorrelated zero-mean random variables and white noise.
[2] Citations of papers given according to Web of Science (as of 12/09/2021).
[3] Impact Factor 2020

two examples. This is a well written article that shows interesting facts about GFDSLRM.

3. The third paper was published in the journal *Statistika: Statistics and Economy Journal Statistika* (publication year 2017, 1 citation, teamwork – 2 coauthors). Unfortunately, this is not a journal of the highest reputation. This is the first paper in this series on the kriging method. In statistics, originally in geostatistics, kriging is a method of interpolation based on Gaussian process governed by prior covariances. Under suitable assumptions on the priors, kriging gives the BLUP at unsampled locations. Interpolating methods based on other criteria may not yield the BLUP. In this article authors describe the use of kriging to forecast economic time series. Additionally, the authors performed simulations (written in R language, 4 scenarios). The main result of the paper is a theorem that gives the explicit form of moments (up to the sixth). The proof of the theorem is provided in the Appendix and is not particularly complicated or novel.

4. The next publication appeared in the relatively well-known journal *Statistical Papers* (publication year 2021, 0 citations, teamwork – 3 coauthors, IF'20 = 2.234). This work presents the application of convex optimization and empirical BLUPs to estimate variances in time series kriging. Everything happens in the FDSLRM model. The authors proposed new alternative variance estimators in FDSLRM. This approach uses the previously proposed by candidate "natural" variance estimators. Several properties of the proposed estimators are further shown. The paper is complemented by numerical simulations and examples on real data (3). The obtained results are more precise and faster than those used so far (10-100 times faster). Moreover, a toolkit (in R and Python) has been developed to enable the use of the proposed methods. For the moment these are notebooks in Jupyter and library in R language. From a mathematical point of view, this is probably the best work. The proposed estimators contribute something. Also, we can see practical applications.

5. The fifth paper appeared in the journal Historical Biology (publication year 2020, 3 citations, teamwork – 5 coauthors, IF'20 = 2.259). Unfortunately, it is not a mathematics journal, but more of a biology journal, particularly paleontology and archaeology. This is a typical application paper. Simple methods were used: principal component analysis (PCA), multiple regression, non-parametric bootstrap, and

correlation analysis. From the point of view of mathematics (statistics), this work adds nothing new. However, it is very interesting, and I really like such applications of statistical methods in practice.

6. Paper #6 appeared in the American Journal of Physics (publication year 2004, 35 citations, teamwork – 2 coauthors, IF'20 = 1.022). It is a journal concerning physics. The paper itself is intended for students. The mathematics used is at an elementary level.

7. Paper seventh has not yet appeared in print (even digitally). As of September 12, 2021, it is still placed in the arXiv electronic archive of scientific preprints (publication year 2021, teamwork – 2 coauthors). Consequently, it has not gone through the regular review process. This paper is about computational mathematics. Authors explore four computational ways of the gamma difference distribution with the different shape parameters resulting from time series kriging, a forecasting approach based on the BLUP, and linear mixed models. They present results of numerical studies and demonstrate that the proposed open tool implemented in Python is fast, highly accurate, and very reliable. It combines numerical inversion of the characteristic function and the trapezoidal rule with the double exponential oscillatory transformation. The proposed tool outperformed the speed of the analytical computation function in CAS software (Mathematica and SageMath) by 1.5-2 orders. At the precision of scientific numerical computational tools, it exceeded open SciPy, NumPy, and commercial MATLAB 5-10 times. The paper is quite interesting, but mathematically there is nothing new in it. It does, however, make some contributions to computational mathematics (statistics) and for that reason is worth appreciating.

8. The eighth paper appeared in the Central European Journal of Operations Research (publication year 2021, 35 citations, teamwork – 3 coauthors, IF'20 = 2.345). This is a decent operations research journal that is closer to computer science than to mathematics. This is a typical paper in applications of mathematics (statistics). The authors proposed different strategies to model a kidney transplant waiting list. They model the arrivals of patient donors as two independent Poisson processes. Additionally, they investigated four strategies for allocation. Finally, an experiment with four factors (four-way ANOVA with Tukey correction method) was performed. The experiments were analyzed using R. Additionally, nonparametric bootstrap was

used to confirm the results of the analyses. All in all, this is a solid work in applications of mathematics. Interesting applications and data.

9. The latest paper appeared in *Proceedings of ICETA 2020* (year of publication 2020, teamwork – 3 coauthors). This is another application paper. The authors show a statistical research methodology for big educational data. They first use the Python language to prepare the data, and analyze it using R. In my opinion, this is a fairly straightforward work in mathematics (statistics) applications.

It should be noted that two publications ([1], [4]) were published before the PHD was obtained. Even worse, the paper [4] is the one that has by far the most citations. Overall, the candidate's works do not impress. They are mostly papers on applications of mathematics, and the methods used are not sophisticated. The papers in theoretical mathematics (statistics) do not introduce any new research tools. However, they are solid works that deserve some recognition. So this point of her work is rather positive.

BIBLIOMETRICS (as of September 12, 2021)

According to the Scopus database, the candidate has 14 indexed papers and 86 citations. The Hirsch index is 3. According to the Web of Science database, the candidate has 15 indexed papers and 80 citations. The Hirsch index is 4. Finally, Google Scholar indexes 38 candidate papers. The number of citations is 218 and the H-index is 6.

Total number of citations (for papers in a habilitation thesis): 42
Total IF'20 (for papers in a habilitation thesis): 8.917

For a mathematician these are not bad achievements. However, could have been higher. Especially when it comes to the nine papers indicated in the habilitation thesis.

EVALUATION OF FURTHER ACADEMIC ACTIVITIES

As far as I have been able to find out from the Slovak documentation, the candidate has shown great organizational and educational activity. This point of her work is therefore definitely positive.

FINAL CONCLUSION

In my opinion, there are serious gaps in academic achievement. However, the indicated publication record meets the minimum requirements for this situation. I would like to emphasize again that the evaluation of the other achievements was difficult for me because of the use of Slovak language only. From what I was able to read this part of the acquis is much better. **The overall suitability of the candidate to obtain the title of docent based on the presented work I rate positively.**