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**Referee report on the habilitation of
Mgr. Lenka Filová, PhD.**

On 5th of October 2021 I was asked to write an evaluation of the scientific and educational achievements of the candidate on the basis of a printed thesis titled "Algorithmic search for Optimal Designs of Experiments" plus other informative material.

Let us begin with the thesis: it starts with a 30 page introduction into the theory of optimal experimental designs with a strong focus on the computational generation of such designs, generally shortly called design algorithms. This introduction covers the standard linear regression model with uncorrelated errors and reviews classical approaches for computing both approximate and exact optimal designs. This part is written very concisely and nicely lays out the fundamentals and notation for the main part of the thesis.

This main part consists of a collection of eight published, one at the time accepted but in the meantime published paper, and one yet unpublished paper all of the general area of design algorithms, some for computing approximate and some for exact designs, which I will briefly discuss in the next few paragraphs.

1.) Harman R, Filová L, Richtárik P (2020): A randomized exchange algorithm for computing optimal approximate designs of experiments. *Journal of the American Statistical Association*, 115(529), 348-361.

Herein the authors propose a new class of methods for constructing randomized exchange algorithms. They also succeed to show that these new algorithms, at least for D-optimality, converge and outperform existing methods. The paper is published in one of the most prestigious journals of our profession (top five!).

2.) Harman R, Filová L, Rosa S (2021): Optimal Design of Multifactor Experiments via Grid Exploration. *Statistics and Computing*. 31(70).

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This article again concerns approximate designs, particularly when the design regions are large grids, such as in multifactorial experiments. Instead of going for direct maximization local maximizers are employed to better explore the design space. This favourably compares to numerous alternative methods from the literature. The journal is with an impact factor of currently 2.388 another highly reputed journal which ranks in the first quartile of all Statistics & Probability journals according to Clarivate.

3.) Filová L, Trnovská M, Harman R (2012). Computing maximin efficient experimental designs using the methods of semidefinite programming. *Metrika*, 75(5), 709-719.

In this paper the authors demonstrate that maximin efficient designs are computable by semidefinite programming on a finite design region, thus enabling the use of standard toolboxes for calculating such designs. The journal *Metrika* is considered of high standard and is usually positioned in the second quartile of all ranked journals (see eg. Scimago).

4.) Filová L, Harman R (2013): Criterion-robust experimental designs for the quadratic regression on a square and a cube. *Communications in Statistics-Theory and Methods*, 42(11), 2044-2055.

Here results known for quadratic regression models in one dimension are extended to higher dimensions for different criteria. The outlet is a solid journal from the third quartile with a long tradition.

5.) Filová L, Harman R (2012): Criterion-robust designs for the models of spring balance weighing. *Tatra Mountains Mathematical Publications*, 51(1).

This paper strongly relates to paper 3 but concentrates on the application in so-called spring balance weighing experiments. Again semidefinite programming methods are employed to find the respective optimal designs. The journal is currently not covered by the standard ranking sites, but is perhaps the internationally most well-known Slovak mathematical journal.

6.) Filová L, Harman R, Klein T (2011): Approximate E-optimal designs for the model of spring balance weighing with a constant bias. *Journal of Statistical Planning and Inference*, 141(7), 2480-2488.

Spring balance weighing is again the topic in this article, where analytic and computational results are given for various design criteria. The *Journal of Statistical Planning and Inference* is, particularly in the design community, considered one of the most important and topical outlets and also ranks in the second quartile.

7.) Harman R, Bachratá A, Filová L (2016): Construction of efficient experimental designs under multiple resource constraints. *Applied Stochastic Models in Business and Industry* 32(1), 3-17.

Herein the general concept of resource constraints to cover several common types of experimental restriction is introduced. The authors also propose a fitting algorithm tailored for the situation. The professional magazine positions itself cross-disciplinary with a methodological focus and thus a good standing in the statistical community.

8.) Filová L, Prus M (2021): Computational aspects of experimental designs in multiple-group mixed models, submitted

is the only not yet published article of the collection. Herein the authors adapt the algorithm given in paper 7 for multiple group mixed models.

9.) Harman R, Filová L (2014): Computing efficient exact designs of experiments using integer quadratic programming. *Computational Statistics & Data Analysis* 71, 1159-1167.

The last two papers of the thesis are now concerned with the computation of exact designs, which is notoriously more difficult. In the first the authors propose to approximate the well established D-criterion and utilize integer quadratic programming for the optimization of the approximating criterion. The outlet is again of high reputation, typically ranging between the first and second quartile depending upon the ranking.

10.) Filová L, Harman R (2020): Ascent with quadratic assistance for the construction of exact experimental designs. *Computational Statistics*, 35(2), 775-801.

Here the authors introduce a new integer programming based approximation obviously extending the results and range of paper 8 such that the principle could be usefully applied to any difficult to evaluate design criterion. It is remarkable that this more general approach appeared in a slightly lower ranked (albeit still solid) journal.

Evaluation

Generally the thesis proves that the candidate has a very good record of publications and a strong command in a relevant field of Statistics and Mathematics. By Austrian (see for instance

and perhaps international) standards the requirements for habilitation are easily met. It struck me, that all the included (published) papers were indeed be coauthored by a particular other person. However, as Dr. Filová's record goes well beyond the mentioned selection, as can be seen from her Google-scholar record:

she has sufficiently demonstrated her independence elsewhere.

The other material was hard for me to judge as it was in Slovak. However even without knowledge of the language it was easy to guess that Dr. Filová has extensive teaching experience. Also the list of

conference presentations is impressive of which I have had the pleasure to witness some of them in person.

Summarizing, I can wholeheartedly recommend to grant Dr.Filová the title of Docent in Mathematics. Should you require further information I will gladly provide,
best regards



(Werner G. Müller)

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