R E P O R T

on the competition for academic position “Associate Professor” in professional field 4.5. Mathematics, scientific specialty „Probability theory and mathematical statistics“, for the needs of the Institute of Mathematics and Informatics at the Bulgarian Academy of Sciences, announced in SG, issue 8/26.01.2024

with only candidate Assen Tchorbadjiev

This report is prepared by Prof. Ognyan Kounchev from the Institute of Mathematics and Informatics at the Bulgarian Academy of Sciences, as a member of the Scientific Jury on this procedure according to Order № 64/21.03.2024 of the Director of the Institute of Mathematics and Informatics.

The only applicant is Assen Georgiev Tchorbadjiev, department of ORPS of IMI-BAS.

1. **Information about the application**

To participate in the competition, the candidate Dr. Assen Georgiev Tchorbadjiev has provided a list of a total of 18 publications, incl. 17 publications in the databases Web of Science and Scopus, and one publication in a scientific journal, refereed and indexed in MathSciNet. A list of 15 citations is provided, as well as all required documents supporting the applicant's results.

According to the attached list of publications, Assen Thorbadjiev applied to the current competition with 18 publications. Publications can be sorted by place of publication as follows: in journals with an impact factor of 6 (of which 1 in Q2, 1 in Q3 and 4 in Q4), in 11 publications without an impact factor but indexed in Web of Science and/or Scopus, of which 9 with SJR. One article has been referenced in MathSciNet. The number of citations provided in Web of Science and/or Scopus is 15.

Of the submitted articles, two are independent and the rest are co-authored. In the 16 articles, there is no division of roles, for which equal participation is assumed.

2. Information about the applicant

According to the provided autobiography, the candidate Asen Chorbadjiev was born in 1978, he graduated from SU "St. Kliment Ohridski" with a master's degree in the field of Engineering Physics in 2006. During the period 2008-2013, he was a part-time doctoral student at the Institute for Nuclear Research and Nuclear Energy, Bulgarian Academy of Sciences, supervised by Prof. Yordan Stamenov. According to the provided biography, Asen Chorbadjiev has more than 5 years of work experience as a programmer. Asen Chorbadjiev joined after a competition in 2015 as a chief assistant in the Department of Variation, Probability and Statistics, IMI-BAN.

3. General characteristics of the scientific works and achievements of the candidate

Asen Thorbadjiev's scientific interests and his articles presented for the competition are in the following thematic directions: branching processes, geostatistics, applied data analysis to various physical processes and measurement methods in anthropology.

The methods used in the candidate's scientific research and the results obtained represent an original contribution to science and show that Asen Chorbadjiev has in-depth knowledge in the scientific field of the competition and characterize him as an established scientist in his field.

18 (eighteen) scientific papers were selected for participation in the competition, 2 (two) of which were independent and 16 (sixteen) were co-authored. I consider the candidate's participation in all works in which he is a co-author to be equal.

4. A brief analysis of the candidate's scientific and scientific-applied achievements, according to the competition materials

The first group of publications is in the field of Statistical modeling of cosmic rays and atmospheric, geomorphological processes, geostatistics.

One of the topics is a study of atmospheric aerosols on Mount Musala, related to the process of pollution transfer and cloud formation. The main approach is with automatic detection of Saharan sand. It is based on automated processing and combining of NASA Aqua/AIRS Dust Index satellite data and air transport trajectories using the HYSPLIT model.

Another topic is related to Arsenic pollution along the Ogosta River valley around Chiprovtsi. In this case, a clustering method using k-means (in English k-means) was applied for geomorphological division of the studied area, and using Generalized Linear Models of geochemical relationships of Arsenic concentration in selected wells, with Gaussian and gamma regressions distribution of the dependent variable. The results were published in a thematic journal in 2023 in [5]. The work is part of the TOPOMET project (КП-06-Н24/2. (The numbers of the articles are according to the list in the appendix **08_Reference for originality of scientific contributions.docx**)

In the works of Asen Thorbadjiev, the method for detecting changes in the regime, known as Change Point Analysis, is often used. Based on the use of a ready statistical package for Change Point Analysis, a model for automatic detection of the Forbush effect has been prepared. This is a physical process of a sharp reduction lasting several days in the intensity of the Galactic Cosmic Rays, as a result of modulation by particles from solar coronal eruptions. The proposed model is tested with data from the Musala Muon Telescope. The application of the developed model based on Change Point Analysis for the automatic detection of Forbush effect events is demonstrated with real data measured at Musala and referenced by data from a satellite of the US National Oceanic and Atmospheric Administration (NOAA).
The topic of branching processes first entered as a topic in Assen's scientific work during the preparation of his dissertation work.
Assen's first work (with Penka Meister) on the subject focused on investigating the influence of initial conditions on the development of branching processes following one of the well-known random distributions - geometric (shifted and unshifted), negative binomial and Pólya-Aeppli. In the article, the generating function of a supercritical Markov process with the listed distributions is calculated in an explicit form [9].
In paper [8], distributions of processes with more complex initial conditions are calculated, demonstrated in the case of a Poisson scheme.

These results were summarized in a publication [10] that coincided with the onset of the Covid-19 pandemic. The studied model turns out to be easily applicable in computer stochastic modeling of the time series of data on the number of people infected with the Corona virus. With all assumptions of data incompleteness, the initial distribution was estimated to follow a time-dependent Poisson process that is inhomogeneous.
Work on the general theory of branching processes has continued with the construction of models based on a random branching mechanism. The first such model is for a process generated by branching based on a probability distribution. As an initial step, the geometric distribution for subcritical and critical branching processes is chosen. The obtained results include a solution of the inverse Kolmogorov equation, which is described by special functions – Wright's function for the subcritical case and Lambert-W function for the critical case. In addition, the conditional marginal probability in the subcritical regime, the degeneracy probability and the density function for the critical case were found [12]. Analogous studies were made for the supercritical in article [14].
Other branching mechanisms were also considered, namely, when the branching mechanism follows a logarithmic distribution of positive integers, the number of measured particles at a random time $t>0$ was found to be a shifted extended Sibuya distribution.
The work related to Open Science at Assen should also be noted: a new computational software was created, partially included in the publications on the subject. The main goal is the parallel development of analytical and numerical methods, whereby the two approaches mutually enrich each other. For this purpose, the work on the development of a computational program library, together with parts of the open source programs, incl. the version used to predict Covid-19 is published on GitLab.
In the field of measurement anthropology, a parallel measurement has been carried out, showing that 3-dimensional laser scanning is compatible with the conventional craniometric method.
In conclusion, it can be said that the scientific results in the articles presented for the competition are novel for science and have direct application in various fields, and the proposed statistical methods are also often improved. In almost all works, it is noticeable that the applied approach is clearly defined: skills and knowledge of applied statistical methods are combined, skills in the application of numerical methods and their computer implementation (including the Avitohol supercomputer), and finally the achievement of a specific applied result that has practical significance is aimed at.
According to the documents presented by the candidate, Asen Thorbadjiev has 15 citations (without self-citations), a large part of which are from foreign authors.
It should be noted that Asen Thorbadjiev has participated in projects that are directly related to his doctoral studies. He participated in two national scientific projects with FNI: one at NIGGG on issues of heavy metal pollution, and the other at SU «St. Cl. Ohridski", on issues of branching stochastic processes. He also participated in an IMI project in the Consortium "National Center for High Performance and Distributed Computing", 2019-2023.
From the submitted documents and declarations it is clear that:

a) the scientific works meet the minimum national requirements (according to Art. 2b, paras. 2 and 3 of ZRASRB) and, accordingly, to the additional requirements given in the Rules for the conditions and regulations for acquiring scientific degrees and occupying academic positions in the Institute of Mathematics and Informatics at the Bulgarian Academy of Sciences, for occupying the academic position “Associate Professor” in the professional field of the competition;

b) the scientific publications submitted for the competition have not been used in previous applications for acquiring a scientific degree or occupying an academic position.

5. Critical notes and recommendations

I have no significant comments on the tender documentation. The documents and references submitted by the applicant are precisely prepared.
I have no critical remarks on the candidate's scientific work.
From the review of the materials submitted for the competition, it is clear that Dr. Asen Chorbadjiev works on current problems in probability theory and mathematical statistics, applying the developed methods creatively to Data Analysis in the most diverse areas, including in the analysis of the development of the Covid-19 pandemic.

6. Application conclusion

After my careful and critical reading of the documentation and the publications presented for the competition and my analysis of their significance and the scientific and scientific-applied contributions, I confirm that the scientific contributions of Assen Tchorbadjiev meet the requirements of the Act on Development of the Academic Staff in the Republic of Bulgaria, the Regulations for its application, and the Rules for the conditions and regulations for acquiring scientific degrees and occupying academic positions in the Institute of Mathematics and Informatics at the Bulgarian Academy of Sciences, for occupying the academic position "Associate Professor" in the scientific area and the professional field of the competition. In particular, the applicant meets the minimal national requirements in the professional field and no plagiarism has been established in the scientific papers submitted for the competition.

I give my positive evaluation for the application.

Based on the above, I recommend the Scientific Jury to propose to the Scientific Council of the Institute of Mathematics and Informatics at the Bulgarian Academy of Sciences to elect Assen Georgiev Tchorbadjiev, PhD to occupy the academic position "Associate Professor" in the professional field **4.5. Mathematics; scientific specialty „Probability theory and mathematical statistics",**

9.06.2024 г. Referee: .....

(Prof. D.Sci. Ognyan Kounchev)