

## REPORT

on a competition for the occupation of an academic position “Professor” in the area “Natural Sciences, Mathematics and Computer Sciences”, professional direction 4.5 Mathematics (Probability Theory and Mathematical Statistics) announced for the needs of Shumen University “Bishop Konstantin Preslavski” (SU), Department of Econometrics and Mathematical Modeling of the Faculty of Mathematics and Informatics (FMI); the competition is announced in the State Gazette No. 63 on August 6, 2022

This report is prepared by **Prof. DrSci in Mathematics Ljuben Mutafchiev**, Professor Emeritus at the American University in Bulgaria (with a deserved right for pension) in the capacity of a member of a scientific jury on professional direction 4.5 Mathematics (Probability Theory and Mathematical Statistics) approved by Order No. ПД – 16-20 /04.10.2022 of the Provost of SU

**Only one candidate** has applied for participation in the announced competition, namely: **Assoc. Prof. Dr. Pavlina Kalcheva Jordanova** from SU.

### **I. General description of submitted materials**

**1. Application data.** On October 7, 2022, a Commission for the Verification of the Documents (approved by Provost Order No. ПД-16-197/04.10.2022 of SU) has established the legitimacy of the submitted documents and decided to allow Assoc. Prof. P. Jordanova to participate in the present competition. On October 11, 2022, the Scientific Jury of the competition established that the candidate satisfies the minimum national requirements stated in article 2b, paragraph 2 and 3 of ЗПАСРБ (the Republic of Bulgaria Academic Staff Development Law) and allowed the evaluation of the candidate according to the requirements of article 3, paragraph 3.

In order to participate in this competition, the applicant Assoc. Prof. P. Jordanova has presented a list of **24** titles of publications as follows: **1** university textbook, **1** exercise textbook, **1** monograph, **20** articles published in research editions (journals and proceedings editions) and **1** editorial introduction published in a special issue of a journal. The above issues were published in the period 2016-2022. Among all 21 articles **13** are published in editions with positive impact factor. The exercise textbook, the monograph and 3 articles are published independently. The other publications are in co-authorship. The high level of the editions of the publications of Assoc. Prof. Jordanova and her successful collaboration with scientists from Bulgaria and abroad are impressive. **All** other required documents in support of the applicant’s achievements are also presented (e.g., diplomas, documents for her associate professor promotion, citation inquiry, information on the fulfillment of the minimal national requirements, information on the additional characteristics for the scientific area of

the competition, copies of the publications, information on the candidate's participation in scientific projects, editorial boards, research organizations, conferences, seminars and scientific juries), which support the scientific and pedagogical achievements of the candidate.

**2. Details on the applicant.** Assoc. Prof. Jordanova has received her master degree in Mathematics with specializations in: econometrics and Education in Mathematics and Computer Science from the FMI of SU in 1996 and 1998, respectively. In 2006 she defended her PhD thesis at the Institute of Mathematics and Informatics (IMI) of the BAS and received the educational and scientific degree "doctor" in the area of Probability Theory and Mathematical Statistics. In February, 2014, she has been promoted as an "associate professor" at SU. Assoc. Prof. Jordanova has participated in several research seminars and courses, some of them organized by famous international institutions and organizations, such as IRMA (Strasbourg, France), International Association of Computational Statistics, European Research Fund, International Biometric Society, publishing companies Elsevier and Taylor & Francis. In the period 2015-19 Assoc. Prof. Jordanova has been a principal investigator of a project on Scientific and Technological Development of the Technological University "Federico Santa Maria" (Valparaiso, Chile). She has also participated in projects for bilateral collaboration between Bulgaria and Austria in 2018-19. She has been also an Erasmus lecturer at the University of Aveiro (Portugal), Johannes Kepler University (Linz, Austria) and University "Kazimir the Great" (Białystok, Poland) as well as an invited lecturer at the Center of Statistics and Applications in Lisbon (Portugal). On a national level, Assoc. Prof. Jordanova has been the main leader of 6 projects of SU and has also participated in 3 projects with the Bulgarian Ministry of Education and Science and in 12 projects of SU. She is a member of several professional and scientific organizations in Bulgaria and abroad (American Mathematical Society, International Statistical Institute – ISI, International Association for Statistical Computing, International Association for Statistical Education). In 2015 she received a scholarship from ISI, which allowed her to participate in the 60<sup>th</sup> World Congress of this organization in Rio de Janeiro (Brazil). Finally, let me point out the active editorial activities of the candidate. She was an invited editor of a special issue of Journal of Applied Statistics, associated editor of the journals Stochastic Analysis and Applications and Research in Statistics and a member of the editorial board of other 4 international journals and a collection of research articles published by SU.

### 3. General characteristics of the applicant's scientific work and achievements

The information on the fulfillment of the minimal national requirements (MNR) for the academic position "Professor" and on the additional characteristics applicable to the area of the high education "Natural Sciences, Mathematics and Computer Sciences" and the author's inquiry **reflect correctly** on the applicant's research contributions. The scientific interests of Assoc. Prof. Jordanova (including also those from the general list of all publications) are from the scientific area of the announced competition. Generally speaking, they are from the area of probabilistic and statistical analysis of observed extremes, estimation of the parameters that characterize the tails of probability distributions and applications of models of random processes and statistical estimation to problems from actuarial and financial mathematics. The results, obtained by the candidate, show her deep knowledge and good command in usage of the necessary probabilistic and statistical tools, as well as her strong interest in mathematical finances and risk analysis. Further on, I shall describe how the legal requirements for the academic position "Professor" at the FMI of SU are satisfied.

From the submitted materials it follows that:

- for group **A** of characteristics, Assoc. Prof. Jordanova has **50** points (p.) and the MNR is **50** p. (scientific degree "doctor");
- for group **B** of characteristics, Assoc. Prof. Jordanova has **0** p. and the MNR is **100** p.;
- for group **B** of characteristics, Assoc. Prof. Jordanova has **100** p. and the MNR is **100** p. (research work that qualifies for the academic position "Professor");
- for group **Γ** of characteristics, Assoc. Prof. Jordanova has **879** p. and the MNR is **200** p. (Characteristic  $\Gamma 7$ : 864 p., Characteristic  $\Gamma 8$ : 15 p.);
- for group **Δ** of characteristics, Assoc. Prof. Jordanova has **364** p. and the MNR is **100** p. (46 quotations in the period 2014-2022, indexed by Scopus international data base);
- for group **E** of characteristics, Assoc. Prof. Jordanova has **133** p. and the MNR is **100** p. (Characteristic E15: 30 p., Characteristic E16: 20 p., Characteristic E18: 40 p., Characteristic E19: 3 p., Characteristic E20: 20 p., Characteristic E21: 20 p.).

The scientific works submitted by the applicant do not repeat those of previous procedures for the acquisition of the academic position "Associate Professor" and for the academic degree "Doctor". There is no plagiarism established by the law in the scientific

works submitted for the competition. The MNR for occupation of the academic position “Professor” are satisfied.

**4. Characterization and evaluation of the applicant’s teaching activities and university service.** Assoc. Prof. Jordanova **has started** her work and service in **1996** at SU, where she is working until now. Since **March 1, 2014**, she occupied the academic position “**Associate Professor**”. She actively participated in both the bachelor and the master program of SU. She had **lectures** in various areas of stochastics, such as: Probability Theory, Probability and Statistics, Probability and Statistics - part II, Random Processes, Statistics, Statistics with Excel, Econometrics, Mathematical Statistics, Statistics and Econometrics, Theory of Risk Management, Financial Mathematics, Statistics and Models of Dependency, Random Processes and Analysis of Dynamical Series, Queueing Theory. She had also **seminar exercises** on several stochastic courses, as well as on Calculus, Mathematical Analysis II, Projective and Analytical Geometry, Mathematics III and IV and Statistical Methods in Biology. Assoc. Prof. Jordanova has also wide experience in teaching **laboratory exercises** on Information Technologies, Electronic Tables, Practices in Informatics, Multimedia Technologies. She has been **lecturing in English** not only at SU but also in Austria, Poland and Portugal. She has been a supervisor of **6 master theses** and a **leader** of the master program “Statistics and Econometrics”. Assoc. Prof. Jordanova has also a long experience in the university service. She has participated in: student admissions, statistical analysis of data at the Department of Social Pedagogy of SU, treatment of inquiry data at SU, state exams and scientific juries.

The facts given above allow me to conclude without hesitation that Assoc. Prof. Jordanova is helpful mathematician, statistician and teacher in the team of the FMI of SU.

**5. Comprehensive analysis of the scientific and applied achievements of the candidate as they are given in the materials submitted for the competition.** Among the **20** research publications for the present competition, **12** are published in editions with impact factor. The impact factor distribution is as follows: **3** articles are in the region of Q1, **1** – in Q2, **7** – in Q3 and **1** – in Q4. (Here  $Q_i$ ,  $i=1,2,3,4$ , is the  $i$ -th Web of Science quartile of the distribution of the impact factor of the scientific editions in the year in which Assoc. Prof. Jordanova has published.) The articles are published in highly prestigious international journals. The list of the quotations since 2013 is respectful. It contains 46 publications in

journals with research applied aims and scope. Further, I shall make a brief review of the scientific contributions of the applicant following the distribution into different areas and the corresponding numeration in the list of publications submitted by Assoc. Prof. Jordanova.

**A (articles [7,8,11] and the enclosed monograph).** These studies are motivated by an idea due to the American statistician Tukey for the box-plot construction, which allows one to identify outliers (suspicious large or small values) in a sample of a given random variable. For variables whose probability densities have graphically heavy tails, Tukey's theory does not give a unique result in practice. More precise conclusions can be derived introducing the concept of a  $p$ -bound (left or right), where  $p$  is a parameter which varies in the interval  $(0,0.5)$  and can be fixed by the investigator. All observations of a random variable which are less than the left  $p$ -bound or greater than the right  $p$ -bound are called outside values. The candidate has presented a detailed study on the probabilities of occurrence of outside values as functions of the parameter  $p$ . She described their influence on the weight of the tails of the probability densities and obtained in this way a new classification of the tails of the probability distributions. Many concrete examples of popular distributions with heavy tails are considered and the corresponding probabilities for outside values are computed.

**B (articles [1,3,4,9,19] and the enclosed monograph).** This group of studies concerns the statistical estimation of those parameters which determine the behavior of the extreme values of the underlying random variable. For this purpose, the corresponding empirical equivalents (statistics) are introduced. The outside sample values introduced in A. play here an important role. It is shown that, under certain conditions, the relative frequencies of the  $p$ -outside values are asymptotically unbiased, weakly consistent, asymptotically normal and asymptotically effective estimates of the corresponding characteristics of the weights of the tails of the underlying random variable. The candidate has also studied variables whose distribution functions have regularly varying tails (i.e., their behavior is determined by an exponential function whose parameter remains constant whenever their arguments grow). Here the statistical estimates obtained by the candidate depend on ratios of order statistics from a random sample of independent observations. It turns out that (see [19]) the independence assumption on the sample observations can be relaxed and replaced by the existence of sliding means in order to obtain estimates of the same type.

*C (articles [10,13,16,18,20]).* Models of random processes which have applications to actuarial sciences and estimation of probabilities for bank failures are studied. They include a multidimensional modification of the actuarial risk process of Cramer-Lundberg, multidimensional sums with equal number of random summands, which model the number of requests in risk processes for which the counting process is a mixed Poisson process and the mixing variable has a Pareto distribution. Generalizations of the Variance-Gamma process, which can be represented as a difference of two independent renewal processes with Gamma distributed intervals between the renewals, are also considered.

*D (articles [2,12,14,17]).* These studies analyze financial time series, suitable for modeling the behavior of the bank interest rate of credits and deposits and the share returns and other kind investments. It is known that during the last several years some non-typical phenomena for financial modeling were observed, such as oscillations around zero of the modeled process and asymmetry in the distribution of the random errors. The main aim of the studies in this area is to improve the existing methods for analysis in order to take into account the new non-typical phenomena. Using suitable deterministic transformations of the time and normalizing the error term, the candidate obtained characterizations of the underlying random processes in terms of probability distributions, Laplace-Stieltjes transforms, means and moments of higher order, Markov properties, asymptotic normality. New properties and generalizations of already known models are obtained.

*E (articles [5,6,15]).* This is also an applied area, based on data from research centers in Chile. Here, except the classical regression method, the method proposed in **A** and the estimates proposed in **B** are applied. They are needed because of the heavy tails of the distribution of the random error. Ignoring statistically non-typical observation, it is shown that a classical result for the trend line of the observations is valid. The methods and estimates proposed in **A** and **B** are also applied for samples of small size and the results are compared with those obtained using regression analysis and the Kolmogorov-Smirnov criterion.

The above review shows that candidate's contributions given in the materials submitted for this competition are characterized by introducing and proving validity of new hypotheses and propositions and by the development of new approaches and methods of study. Significant part of the publications is directed to applications. I consider that the authors of the joint publications have equal contribution.

**6. Critical remarks and recommendations.** The materials submitted for the present competition and required by ЗРАСРБ are prepared correctly and accurately by Assoc. Prof. Jordanova. I have no critical remarks and recommendations on the scientific publications of the applicant.

**7. Personal impressions on the applicant's work.** I know Assoc. Prof. Jordanova from her research presentations at the regular seminar on Probability and Statistics in IMI - BAS. I was also a member of the scientific jury which awarded her the academic position "associate professor". My impressions from the work of Assoc. Prof. Jordanova are **excellent**.

**8. Conclusion on the application.** After I became acquainted with the materials and scientific works submitted for this competition and on the basis of the above analysis of the significance of the scientific and applied contributions, **I confirm** that the scientific achievements of the applicant satisfy the requirements of ЗРАСРБ, the Regulation for its implementation and the Regulation for the development of the Faculty of SU. As I pointed out earlier, the candidate satisfies the MNR in the professional direction 4.5. Mathematics (Probability Theory and Mathematical Statistics). My evaluation for this application is **positive**.

## **II. GENERAL CONCLUSION**

On the basis of the report given above, I **recommend** to the Scientific Jury to suggest to the body of competence of the election from the Faculty of Mathematics and Informatics at SU "Bishop Konstantin Preslavski" **to elect Pavlina Kalcheva Jordanova** to occupy the academic position "Professor" in the Professional Direction 4.5 Mathematics (Probability Theory and Mathematical Statistics).

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