REPORT

Report from: Professor Krasimira Stoyanova Prodanova, Ph. D.,
Professional field: 4.5. Mathematics,
Scientific speciality: Mathematical modeling and application of mathematics
Technical University – Sofia, Faculty of Applied Mathematics&Informatics

on a competition for occupying the academic position of **"professor"**
in the domain of Higher Education:
4. Natural Sciences, Mathematics and Informatics,
Professional field: 4.5. Mathematics,
Scientific speciality: Mathematical statistics and psychometrics,
announced in SG, Issue 28 от 02.04.2024 with the only candidate: **PhD Dimitar Vladislavov Atanasov, Assoc. Prof. in New Bulgarian University**

By Order No.3-PK-235/29.05.2024 of the Rector of New Bulgarian University I was appointed a member of the scientific jury for the competition for occupying the academic position of "Professor" in the professional field: 4.5. Mathematics, scientific speciality „Mathematical statistics and psychometrics", Faculty MF, Department "Informatics". At the first meeting of the jury I was appointed an author of a report (opinion).

I. Assessment of compliance with the minimum national requirements and the requirements of the New Bulgarian University

The competition for professor in direction 4.5 Mathematics (mathematical statistics and psychometrics) is announced according to the established legal order for the needs of the MF, Department of Informatics at New Bulgarian University.

The only applicant in the competition thus announced is **Assoc. Prof. PhD Dimitar Vladislavov Atanasov.**

The following documents required by the Law on the Development of the Academic Staff in the Republic of Bulgaria have been submitted: CV – European format, copies of Ph. D. and Assoc. Prof. diplomas, information on satisfying the minimal requirements for the position of "Professor" in New Bulgarian University, 10 scientific publications which do not repeat the ones submitted for the application for the academic position "Associate Professor", summaries of the main results and scientific contributions, author's statement on the scientific contributions and the citations noted.

In the competition documentation of Assoc. Prof. Dimitar Atanasov, written evidence is also presented, from which it is established that he also fulfills the additional requirements under Art. 58, para. 1 of the Ordinance on the Development of the Academic Staff at the New Bulgarian University (indicators by groups Ж, З and И in the table for individual assessment).

There is no proven plagiarism in the candidate's scientific works.

The candidacy of Assoc. Prof. PhD Dimitar Atanasov corresponds to the minimum national requirements and the additional requirements of the NBU for occupying the academic position of "professor" in professional direction 4.5 Mathematics.

II. Research (creative) activity and results

1. Evaluation of publications corresponding in volume and completeness to a monographic work, including an evaluation of the author's scientific and scientific-applied contributions.

The presented publications, which in terms of volume and completeness correspond to a monographic work, are two:

[1]. Dimiter M. Dimitrov, Dimitar V. Atanasov, (2020), *Latent D-Scoring Modeling: Estimation of Item and Person Parameters*, Educational and Psychological Measurement, Volume 81, Issue 2, pp.388-404.(SJR 1.87; Q1)
[2]. Dimiter M. Dimitrov, Dimitar V. Atanasov, (2021), *Testing for Differential Item Functioning Under the D-Scoring Method*, Educational and Psychological Measurement, Volume 82, Issue 1.(SJR 1.87; Q1)

The two publications presented are part of one of the main directions in the candidate's research activity. This is the development and application of an innovative methodology in the field of test evaluation.

In the practice of test evaluation, the so-called Item response theory (IRT) has acquired the widest application. Often the basic assumptions of this model are not satisfied, leading to a strong bias in the estimates of both the parameters of the test tasks and the assessed abilities of the individuals. This necessitates the search for alternative approaches. One such approach is a candidate-developed model popularly known as D-scoring. The publications address two aspects of the development of this model.

The research reviewed in [1] presents a latent (IRT-like) modification of a classical test scoring approach known as D-scoring (DSM). With this method, the parameters of the personality and the test question are placed on one scale and evaluated according to a model using a probability function defined in the interval (0;1), and the estimation of the parameters of the model is carried out by the method of maximum likelihood. Analytical expressions for the test information function and standard error of the model estimate are derived. The results of a simulation study show very good recovery of both test question and individual parameters. The proposed DSM-L framework can provide efficiency and flexibility in various scenarios of assessment, enrich the methodology of educational and psychological measurement, and motivate furder research on its theoretical development and practical applications.

In [2], an approach to testing for differential test item functioning (DIF) based on the D-scoring methodology (DSM) is proposed. According to the proposed approach, called the P–Z method of testing for DIF, the question response functions of two groups (reference and focal) are compared by transforming their DSM-estimated correct response probabilities into a normalized scale (Z-scale). Testing for DIF amounts to testing two statistical hypotheses of equal variances and equal mean Z-deviations for the reference and focus groups. The results of a simulation study support the effectiveness (low type error and high power) of the proposed P–Z method. One undoubted advantage of the considered method is that it is directly applicable in

differential test functioning testing. Recommendations for practical use and future research are also provided, including possible applications of the method in the context of IRT.

2. Assessment of the contributions in the other attached publications made after the appointment of the academic position "associate professor" and assessment of the requirement for peer review of the publications

Two of the remaining 8 publications, namely [4] and [9], published in 2020 and 2021 respectively, are related to the D-scoring methodology (DSM) and were published in the prestigious publication Taylor&Francis: *Measurement: Interdisciplinary Research and Perspectives*. (SJR 2019-0.367; Q1 and SJR 2020-1.293; Q1).

In [4], four person-fit statistics (PFS) are compared, namely: van der Flier's U3 statistic; U3 and Zd statistics modified according to DSM and the nonparametric HT statistic. The data were obtained through simulations under five conditions: type of response behavior (guessing and cheating), sample size, test length, percentage of inappropriate items, and percentage of inappropriate individuals. The conclusions are that Ud and Zd outperform U3 and HT in detecting inappropriate persons.

[9] looked at equating DSM-L latent method tests and comparing test scores between individuals taking different tests. The deviance results showed very high accuracy in recovery, which is strong support for the proposed approach to testing equating under DSM-L.

Publications [3], [5], [7] and [8] are devoted to statistical estimation of parameters of branching stochastic processes in the field of population dynamics. Models of the dynamics of COVID-19 infection using a class of two types of branching processes are considered. These models require only observations of daily statistics to estimate the average number of host-caused secondary infections and to predict the average number of unobserved infected individuals. The development of the epidemic process depends on the rate of reproduction, as well as on additional aspects such as immigration, adaptive immunity and vaccination. Typically, in existing deterministic and stochastic models, officially reported and publicly available data are not sufficient to estimate model parameters. An important advantage of the proposed models is the possibility of directly calculating the estimates of its parameters from daily available data. A site *http://ir-statistics.net/covid-19* was specially created, where the obtained results are updated daily. The software tools used for the evaluation are available and open source.

Articles [3] and [5] were published in *Comptes rendus de l'Académie bulgare des Sciences* (Im. F-0.3; SJR-0.16; Q3), [7] was published in the *Journal of Applied Statistics* (SJR-0.55; Q2), a [8] in *Stochastics and Quality Control* (SJR-0.32; Q3).

Publications [6] and [10] are devoted to the application of statistical methods for assessing the psychometric characteristics of high school students. In [6], these characteristics are for the Bulgarian adaptation of the scales "hope", "boredom" and "hopelessness" and were evaluated by a sample of 800 students. With the help of factor analysis, conformity with the theoretically defined three-factor structure is proven. In [10], some quantitative and qualitative assessments of the results of the first part of the matriculation exam held in 2022 for all those who studied the profiling subject "Informatics" in Bulgaria were made. To estimate the probability of a correct answer, the DSM-L approach was applied, which has significant advantages over IRT, as it avoids relatively complex computational procedures and related software. The estimation of the probability parameters was done using standard libraries implemented in the R and MATLAB environments: [Atanasov, D., 2020. Delta Scoring Library

for MATLAB *https://github.com/amitko/matlab-delta-scoring.git*]; [Atanasov, D., 2022. D-scoring approach. R package. *https://github.com/amitko/DScoring.git*]

Article [6] was published in *Psychological Thought* (SJR-0.19; Q4), and [10] in *Mathematics and informatics*, Volume 66 (1), 2023 (Im.F 2022 - 0.2; Q4).

3. Citations from other authors from other authors.

Associate Professor Dr. Atanasov has provided a list of citations that meets the national requirements. 88 citations of 11 articles are presented. All citations are visible in the world scientific databases WoS and Scopus.

From the attached self-assessment table, it can be seen that the candidate Assoc. Prof. D. Atanasov exceeds seven times the minimum requirements of 100 points for citations of his scientific works, which convincingly proves the international recognition of his results.

4. Evaluation of the results of participation in research and creative projects and application of the obtained results in practice.

Assoc. Prof. Atanasov has participated in research and educational projects: 18 national and 5 international. I believe that the candidate shows an indisputable potential for the integration of his research work with the modern aspects of teaching and learning activities.

III.   Learning and teaching activity

The candidate participated in the creation of the Bachelor's program "Information Technologies" for the specialty "Business Informatics", where he is the titular of several courses. He has developed courses on Data Warehouse and Game Theory. He participated in updating the courses on Theory of Probability and Mathematical Statistics at the departments of "Informatics" and "Cognitive Science and Psychology". He has developed study materials for 7 study courses (available at e-edu.nbu.bg). In English, he teaches "Probability Theory" and "Statistics in Behavioral Research". He is the scientific supervisor of 4 bachelor's and master's degrees with honors from the "Informatics" department.

He is the scientific supervisor of a doctoral student from the New Bulgarian University on the topic "Application of artificial neural networks for analysis and processing of video content".

IV.   Administrative and public activity

Assoc. Prof.   Atanasov is the head of the "Informatics" department. In addition, he is a member of the committee for evaluating full-time teachers at the Bachelor's Faculty, the program committee of the "Informatics" department and the faculty council of the Master's Faculty.

V. Personal impressions of the candidate (if any)

My personal impressions of D. Atanasov are from the period when he was an assistant at the Faculty of Mathematics&Informatics of Sofia University "St. Kliment Ohridski". I know him as responsible in his teaching activities and precise in his scientific activities.

VI. Opinions, recommendations and notes on the activity and achievements of the candidate

I have no critical remarks about the materials provided in the application. I believe that the candidate has an indisputable potential for participation in more national and international research projects. I hope that Assoc. Prof.   D. Atanasov has the potential to successfully defend

his dissertation not only among the doctoral students he currently supervises, but also many more students tempted by scientific research at the New Bulgarian University.

Conclusion

What has been presented up to this point, the ZRASRB and the rules for its implementation, as well as the specific requirements of the New Bulgarian University, give me the reason to express my **POSITIVE** assessment that the scientific contributions and pedagogical competence of the candidate meet the conditions for occupying the academic position of "professor" and I am convinced I will join the decision of the Scientific Jury to propose to **the Academic Council of the New Bulgarian University to elect Assoc. Prof. Dimitar Vladislavov Atanasov to the academic position of "Professor"** in professional direction 4.5 Mathematics (mathematical statistics and psychometrics).

Date: 03.07.2024

                              Signature:
                                / Prof. Krasimira Prodanova, PhD**/**