

REVIEW

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Member of the Academic Jury for a Promotion to the Academic Position of Professor

in the Field 4. Natural Sciences, Mathematics and Informatics.

I. Eligibility

The Promotion has been announced for the Academic Position of Professor in Field 4. Natural Sciences, Mathematics and Informatics, Professional Direction 4.1 Physical Sciences, Scientific Specialty of Meteorology (Stochastic Modeling in Meteorology and Hydrology) in Special Prognostics Division of Prognostics and Information Services Department in the NIMH. The announcement about the Promotion was published in State Bulletin No. 62/06.08.2019 stating a two-months-long period to submit the documents. The only participant of the Promotion is Ass.Prof Neyko Mateev Neykov, Head of Specialized Prognostic Group of Prognostics and Information Services Department in the NIMH. In 1971-1976 N. Neykov was a student in the Faculty of Mathematics and Mechanics of Sofia University (SU), which he was graduated from as a Master in Mathematics, Specialization of Probability Theory and Mathematical Statistics. Diploma No. 080147/12.11.1976. In 1993-1996, he was a free doctoral fellow in the National Meteorology and Hydrology Institute (NIMH) at Bulgarian Academy of Sciences (BAS) and defended a thesis named *Robust Methods in Multivariable Statistic Analysis* and acquired the Academic Degree of Candidate (updated to Doctor) of Mathematics, High Commission for Academic Degrees and Titles, Diploma No. 4271/28.06.1996. In 2016 he defended a thesis named *Robust Modeling through Trimming* and acquired the Academic Degree Doctor of Sciences, Diploma No. 000786/31.10.2016, BAS. In 1976-1977 he was a Part-Time Assistant in the Higher Food Industry Institute in the City of Plovdiv. In 1978-1988 he was successively a research fellow in Central Automation and Biological Experiment Laboratory at the Biology Center of Bulgarian Academy of Sciences (BAS). Since 1988 he is a research fellow in the NMHI at BAS. There, in 2000, he acquired the Academic Position of Ass. Prof. and was employed as the head of the Prognostic Models and Systems Division in Weather Prognostics Department. The papers submitted for participation in the promotion have been reviewed by a special commission under Order No. ДД 04-20/08.10.2019 that has established that the papers are valid and complete and the procedure can go on.

I have received the following documents: Application for Participation, Autobiography, Monograph as a Habilitation Work, List of Publications, and copies of them, Information on Contributions and Citations, as well as Information on compliance with the Minimum National Requirements and Additional Requirements of Academic Staff Development Law regarding NIMH at BAS of 05.11.2018.

The Autobiography has been made under European Model in compliance with the requirements. It contains a number of candidate's serious achievements. For example, an attached reference from the Faculty of Mathematics and Informatics of SU is stating that N. Neykov has given lectures on "*Multivariate Statistical Models*" and "*General Linear Models and Models of Extremal Events*" for 12 years (2006-2018). He was the tutor for seven successfully defended Diploma Theses. Besides, N. Neykov has given lectures on Statistics as a Multidisciplinary Training for Postgraduate Students and Young Scientists under European Operational Program. Information is attached on N. Neykov's participation in the total of 26 scientific

research projects and the topics of all of them are within Promotion's scope. Five of them were included into NIMH's Scientific Research Plan. Ass.Prof. Neykov has headed four out of these five projects. Besides, N. Neykov headed two international projects under "EBR" at BAS (with Germany and Finland). He participated also in a project with NFSI. In 1999-2015 N. Neykov took active part in 18 international projects with 17 of them headed by foreign representatives, and the rest one by a representative of NIMH. Besides, there is a Statement about his participation in 9 Agreements including external funding. He headed 4 of them. All these Agreements are in NIMH research area and are directly connected to Promotion's topic.

N. Neykov is widely internationally recognized: he is a member of International Association for Statistical Computing (IASC). In 2008-2012 he was a member of its Board of Directors for Europe. Since 2014 he is an Elected Member of ISI (International Statistics Institute). He is a member of the Union of the Physicists in Bulgaria and the Union of Mathematicians in Bulgaria. He was a member of Bulgarian Statistical Society Coordination Council. N. Neykov presented papers on a number of international conferences, organized trainings and seminars on statistical modeling in meteorology, hydrology and environment. The Review of famous experts *Hosking and Wallis*, published in 1997 by prestigious *Cambridge University Press* Publishing House in *J. of the Royal Statistical Society* regarding a monograph could be looked at a high professional recognition.

The attached List of N. Neykov's Academic Works comprises a monograph (habilitation work) and 20 published scientific articles, referred both in Bulgarian and foreign scientific journals (the majority of them). I will go through these articles in more details in the next Chapter. Three technical reports and a critical review are included separately. Now, I have to mention only that all the works are in English except one article in Russian. They have not been included neither when he took part in the promotion to Assistant Professor's position nor in his Doctoral Thesis. A very good 16-pages Information is submitted regarding N. Neykov's scientific works' contributions. There is separate Information on 56 quotations mentioned in well-known *Web of Science* and *Scopus* data bases. These two documents will be looked at in more details in the next Chapter of this Review. Finally, Information is submitted stating that N. Neykov covers National Information and Documentation Center's requirements for Academic Position of Professor. Though, not all scientific works and their citations as well as scientific projects are registered, the number of points in the assessment exceeds minimum requirements in all indicators. There is no doubt that if non-covered works, citations and projects were included the correspondent indicators would have much higher values.

The verification made did not show any shortage or violations in the procedure on candidate's eligibility for the Promotion. On the contrary, submitted materials high quality and full compliance with all formal legal requirements are obvious and corresponds to the required regulations.

II. Requirements for Scientific Research and Applied Activities

In general terms, N. Neykov's Scientific Research and Applied Activities could be described as creation of new stochastic methods and models in the field of meteorology, hydrology and environment; elaboration and development of statistical software to analyze such data and their application in particular problems solution. First among scientific works submitted for review is the monograph (habilitation work) named *Stochastic daily precipitation model for Bulgaria*, Regalia 6, Sofia, 2019, containing 267 pages. The rest 20 articles are

published as follows: 11 in foreign journals and 9 in Bulgarian journals. I would like to mention first the articles [7, SJR-Q1], [8, SJR-Q2], [11, SJR-Q3] и [14, SJR-Q1] published in serious international journals with IF. The papers [12, 18, 19 – Scopus] have been published in serious western proceedings. The articles [13, 15, 20, 21] have been published in the collection of international conferences organized in Slovenia, Serbia, Belarus, and Russia. Following articles have been published in leading Bulgarian journals: [2, 3] in Bulg. J. Physics, [5, 9, 10] in Bulg. J. Meteorology and Hydrology. The works [4, 16, 17] are in collections of reports from international conferences organized in Bulgaria, [6] has been published in Proc. of the 3rd Bulg. National Congress on Physical Sciences (2016). Of all these publications there are 5 written together with one co-author and 16 written together with two or three co-authors. Three technical reports are interesting too. There, on 175, 101, and 69 pages N. Neykov together with two co-authors state the results of three Bulgarian-German Grants that definitely fall into this Promotion's scope.

The monograph [1] consists of a preface, 6 chapters, appendix (10 pages) and literature (11 pages). Book's main idea and organization are very well explained in the preface. In general terms, this monograph offers and researches different stochastic models for daily precipitations measurement. Main part of them is practically different Time Series Models which different techniques have been used for. The results of particular applications are presented in multiple graphs, figures and tables.

Chapter 1 is 20 pages general introduction into book's topic looked at globally and compared to the problems in Bulgaria. Thus, in §1.4 and §1.5, seven main goals and tasks requiring new stochastic models' and new particular applications creation are well formulated and explained. Both the models and applications are described in detail in their development in each chapter. In §1.6 the basic structure of observed data is well explained. Chapter 2 (17 pages) starts with a brief review of the relevant literature, and in the next 8 paragraphs different stochastic aspects of daily precipitation modeling are formulated. This, in §2 basic model with its main features is generally described; provisional distributions, maximum likelihood functions are given too, and different research methods are discussed. In §3, logistic model is looked at about precipitation emergence probabilities $p(\cdot)$, and in §4 it is supposed that the density of aggregate precipitation probabilities $q(\cdot)$ would have their correspondent gamma distribution. In §6, hypotheses are looked at about regression parameters importance which practically depends on model choice. For this purpose, different tests could apply, in particular, Fisher и Wald. In §7, the criteria of Akaike (AIC) and the so called BIC (Bayesian Information Criterion) are suggested for this problem. A model of stationary Markov Chain is looked at in §8 for provisional precipitation probabilities with particular assessment given with real observations in Sadovo. In §2.9, a scheme is suggested for precipitations imitational modeling.

While the first two chapters are mainly theoretical, the following four chapters (3 – 6) regard particular observations which specific goals had been set for and correspondent statistical models have been constructed and validated. Research's main results are given in a wide range of graphs, figures, tables, computer simulations and other plots.

Thus, in Chapter 3 (43 pages) a non-stationary Markov model of first row is suggested with two conditions describing the emergence of precipitation and precipitation quantity depending on atmosphere predictors. Correspondent survey is presented in 7 paragraphs that can be briefly summarized as: unknown parameters

assessment, training excerpts formation (on Sadovo and Kneza Stations), model's qualities assessment, validation and simulative modeling. Main conclusions are well illustrated and presented in the last §3.7.

In Chapter 4 (19 pages) the survey regarding "weather generators" is continued from the previous chapter. In §4.2 auto-regressive models are looked at having as predictors the minimum and maximum temperatures assuming Gauss distribution of error. In §4.3 models' adequacy is verified and in §4.4 an algorithm for correspondent Tmin and Tmax generation is presented. Modeling results are compared with empiric data and are presented in tables and graphs that are well discussed in the final §4.7.

In Chapter 5 there is a survey practically studying §2.3 and §2.4 models overview using annual and seasonal precipitation information of 40 NMHI stations for the period 1906 – 2000 aiming to find climate changes connected to the precipitation and to simulate possible prognostics. The methodology, database, seasonal precipitation statistics, found assessments and comparisons to empiric data, and different possible scenarios are presented very well. The results are presented in big detail and correspondingly discussed both in the book and in author's information.

In Chapter 6 (60 pages) some of the models suggested in Chapter 2 are used to assess the parameters and validate based on stations network situated in Southwest Bulgaria. As in the previous chapter the results for constructed precipitation stochastic model are very well presented and explained and in the same time the serious difficulties are stated that appear and have to be overcome.

Finally, as a conclusion of this brief analysis of presented monograph (habilitation work) I would like to add that its scientific level is undoubtedly very high demonstrating skillfully the strength of both stochastic modeling and its applications based on profound knowledge of correspondent meteorological processes. I have no doubt that presented monograph surpasses the requirements of above mentioned laws and regulations as a habilitation work. As the works [2, 3, 16, 17, 23, 24] are described in the monograph, now I will briefly analyze and assess the rest articles following the natural division into groups suggested in author's information.

Article [7] was published in authoritative *Nat. Hazards Earth Syst. Sci.* (SJR-Q1) journal. It is presented in a separate group dedicated to daily precipitation in one station. The so called hybrid model has been constructed. It summarizes the model of Furrer and Katz (2008) using distributions with heavy tails to model the precipitation in Ihtiman for 1960-2007. The suggested stochastic model is demonstrated to have a number of advantages compared to the ones cited in the literature. Received particular applications are well explained and illustrated with comparative plots, graphs and tables.

The next group comprises of articles [6, 8, 9, 13, 15] where so called spatial type of daily precipitation models is looked at. These models are based on observations on a network of 40 stations evenly distributed on Bulgaria's territory for the time period of 1960-2000. The most important thing is that these models use Hidden Markov Chains that on their turn could be homogeneous and non-homogeneous in time. I have to mention that this a new modern tendency in stochastic processes theory development and its successful application in the field of meteorology deserves admiration. I'll try to present briefly each of these group's articles. The common thing between them is that everywhere, Non-Homogeneous Hidden Markov Models (NHHMM) are applied. The first article in this field was [15] published among the works of 23rd Danube

Conference in Belgrade in 2006 where NHHMM are suggested stating reasons why in the particular situation NHHMM with eight states are the most appropriate to use. The article [13] was published among the works of 24th Danube Conference in Bled (Slovenia) in 2008 and in a sense continues the previous work where only cold half periods of the year have been studied. European-Atlantic Sector's atmosphere data have been used and some conclusions have been done regarding Bulgaria's regional climatology. The article [9] was published in 2011 in *Bul. J. Meteo & Hydro*. NHHMM are applied in this work using data of correspondent dry periods. The results are well presented graphically. The work [8] was published in authoritative *Environ Ecol. Stat.* (SJR-Q2) journal in 2011. The used eight states NHHMM is described in detail. It is appropriately applied to wide range of atmosphere data. Taken those data model's parameters are assessed using the maximum likelihood method. On the other hand, model's order is assessed using BIC (Bayesian information criterion). Thus, a spatial model is created of daily precipitation in Bulgaria. Tables of climatic conditions and precipitation prognostics are presented. Article [6] was published in *Proc. 3rd National Congress on Physical Sciences, 2016, Section: Physics of Earth, Atmosphere and Space*. A spatial NHHMM was applied, but here a new daily precipitation simulation and approximation techniques was developed for a point where there were no stations. The general impression of this group of publications is that their scientific level is high due to NHHMM good knowledge and creative application and development, and on the other hand due to skillful use of databases connected to meteorological processes profound understanding. Besides, appropriate software instruments are successfully applied and creatively developed.

Next two works [4, 12] are connected to serious statistical research in the field of hydrogeology. Let's point out that [12] is actually Chapter 18 in the collective *Natural Groundwater Quality* monograph published in 2008 by the prestigious *Blackwell Publishing Ltd* in Oxford, England (Wos, SCOPUS) where, obviously, leading experts in this field from 12 European countries have been invited. Article [4] was published among the works of 27th Danube Conference celebrated in Bulgaria in 2017.

The group of articles [5, 14, 18, 19] is connected to an analysis of extreme values applied in regard of oncoming seas and flood water emergency risk. Theoretical work [14] published in authoritative *WATER RESOURCES RESEARCH, 2007* (SJR-Q1) journal deserves special attention. It offers a robust summary of one of Wilkes' classical statistic tests. Article [18] is published among the works of a European Conference in Edinburg (UK) under the title "*Foresight and Precaution*", 2001, in Rotterdam (SCOPUS), and [19] is published in *Proceedings of the 27th International Conference on Coastal Engineering, Sydney, Australia, 2001* (SCOPUS). In these two works flood waters in North Sea are studied as well as the maximum annual flow-off of the rivers in some regions in Western and Central Europe assessing extreme values parameters and using Wilkes' Test's robust analog. Article [5], published in *Bul. J. Meteo & Hydro (2017)*, is especially interesting, where the Black Sea waves statistical features with digital simulations carried out and flood water emergency risk assessment is considered using Shabla, Emine Cape and Ahtopol Stations data.

Article [10] published in *Bul. J. Meteo & Hydro (2010)*, is very interesting and topical. It studies NO₂ (Nitrogen dioxide) concentration in Sofia in 2001-2006 using summarized linear models with Tweedie distributions. This is a pretty complex mathematical apparatus but, in fact, it provides wider opportunity for some features simultaneous statistical modeling and in the same time contains some popular distributions as

specific cases. This research which is undoubtedly important for the society could be now thought of updating. Article [11] was published in authoritative *Natural Product Communications, 2009* (SJR-Q3) journal. Using a factor and dispersion analysis some optimal features in specific biochemical experiments' planning are defined. Work [21] is in Russian and was published in a collection of works of USSR Academy of Sciences (1982) in the field of information processing in the visual system. In the article some features of visual perceptions are assessed using non-linear regression models. Article [20] was published in *Proceedings of the Sixth International Conference, Minsk (2001)*. The work is in the field of so called trimmed robust estimations that were internationally acknowledged through Neykov and Vandev (1998) research. In presented article, except of other mathematical results connected to subcompactness, edge points of Poissonian and log-normal linear regression models have been found, which is important for the application.

Finally, I would like to underline that due to review's volume limitations, this brief characteristic does not give a complete notion of all N. Neykov's scientific achievements but he has presented them in the 16 pages author's information in an excellent manner. I completely agree with his conclusion grouping in eight points his most important scientific and applied results. I do accept as equal the participation of authors in all publications including in presented monograph though in some works N. Neykov's presence is more tangible having in view his entire scientific development and especially his internationally recognized theoretical contributions in the field of mathematical statistics. The latter is confirmed by the attached information about 49 citations in Web of Science & Scopus after 2017 made by only foreign authors in renowned journals, and his articles included into the "big doctoral thesis" defended in 2016. Analogical information on 56 quotations of scientific publications included in the present competition in prestigious journals mentioned by Web of Science & Scopus is presented separately. Of course, attached information is only an excerpt of N. Neykov's citation part of which I had an opportunity to look at for other reasons. As N. Neykov's participation in scientific research projects was presented in the Review's first part, now I would like to underline only that he headed 10 out of the 26 presented projects.

SUMMARY TABLE OF THE VOLUME AND TYPE OF SCIENTIFIC PRODUCTION

Candidate's number of points: A-50; B-100; C-100; D-205; E-112; F-555; TOTAL-1117.

Necessary number of points: A-50; B-0; C-100; D-200; E-100; F-150; TOTAL- 600.

Everything stated in this Review's Chapter allows us to conclude that candidate's scientific production and science metric indicators cover completely all requirements for the Academic Position of Professor.

III. Opinions, Recommendations, and Notes

I am following N. Neykov's scientific development for a long time already (I can even say, since he was a student) and I have excellent impressions of his lectures on seminars and international conferences. I would underline, his participation in National Stochastics Seminar which I am a chair of. Besides, I am a Reviewer of his Doctor of Sciences Thesis (in English) defended in the Institute of Mathematics and Informatics, BAS. I would allow myself to cite a part of this Review's Conclusion:

Presented thesis possesses all the qualities of a serious international monograph in the field of statistics. Interesting results that have been obtained started a new line in the field of robust estimation. One part of

the contributions is of definitely fundamental statistical nature, other part gives new methods and algorithms for optimal estimation and trimming. All these results are published in prestigious publications in the last 13 years but have already received a serious international response (more than 214 citations). Besides, they have been reported on a number of prestigious international conferences and symposiums with part of the lectures being under a special invitation.

Here I would like to direct a criticism to the candidate that he has not attached an author-summary of his thesis to these Promotion's materials. The same is valid for his previous PhD thesis. Because, in my opinion, the presence of even the "big Doctoral Thesis" would be sufficient for awarding the Academic Title of Professor.

I would like to mention that mathematics' development is due to both the problems that result out of its internal logics and cause-and-effect relationship and to the inflow of new problems and models emerging in the practice outside of it. The latter ones are especially valuable because they enrich mathematics and in the same time find applications that important for the society. Undoubtedly, big part of N. Neykov's scientific production belongs to the second category, i.e. it really belongs to the three subfields of Field 4. - Natural Sciences, Mathematics and Informatics. Natural sciences in this case mean mainly Meteorology and Hydrology.

Finally, I would like to underline his correctness, sympathy and responsiveness to other colleagues' problems and scientific guild as a whole, as well as the respect he enjoys both in the country and abroad.

Conclusion

The verification of materials submitted for the Promotion showed no procedure violations and fulfillment with all above mentioned requirements. As it was underlined in the previous chapters, N. Neykov's scientific production is on a very high scientific level as his science metric indicators are. He has presented himself as a participant and head of scientific and applied projects both in the country and on international level. His teaching activity, especially in Sofia University deserves admiration without any doubt. N. Neykov is an internationally acknowledged expert in the field of Stochastic Modeling and Statistic Methods Applications in Meteorology and Hydrology. This is due to both his high mathematical qualification and his profound penetration into the nature of hydro-meteorological processes and correspondent empiric data. This is combined with the skillful use and development of appropriate software.

Everything stated up to here gives me categorical reason to conclude that the only candidate Ass. Prof. Neyko M. Neykov undoubtedly satisfies all requirements of the Promotion for Academic Position of Professor in the NIMH. That is why, I appeal to the Academic Jury to vote positively for his election.

08.12.2019

REVIEWER:

/Professor Nikolay M. Yanev/