REVIEW
regarding a competition for the academic position of
"Professor"
in the professional field 4.5 Mathematics,
for the needs of the Institute of Mathematics and Informatics (IMI),
Bulgarian Academy of Sciences,
announced in the State Gazette, Issue No. 63 of July 10, 2026, and on the IMI-BAS website

This review has been prepared by Prof. Ognyan Ivanov Kounchev, D.Sc., from the Institute of Mathematics and Informatics at the Bulgarian Academy of Sciences (IMI-BAS), in his capacity as a member of the scientific jury for the professional field 4.5 Mathematics, scientific area: Operations Research (Financial Mathematics). The review pertains to a competition announced pursuant to Order No. 73 dated July 23, 2026, issued by the Director of IMI-BAS, and published in the State Gazette, Issue 63, on July 10, 2026.
A single candidate has submitted documents for participation in the announced competition: Assoc. Prof. Tsvetelin Stefanov Zaevski, D.Sc., from the Institute of Mathematics and Informatics at the Bulgarian Academy of Sciences (BAS).

0. A brief introduction
The announcement of a procedure for a professorship in Financial Mathematics at IMI is a landmark phenomenon and gives us a very important reason to pay attention to the political-economic context related to this.
In this regard, it is important to remind that one of the main reasons for the creation of the Institute of Mathematics within the BAS on Oct. 27. 1947, is precisely the need of the Bulgarian state in the post-war period to "investigate state and state-guaranteed external bond loans". This is dictated above all by the fact that Bulgaria has to pay reparations. (For more details, see the article by Prof. Nikolay Yanev, "Fifty years of the Institute of Mathematics and Informatics at the BAS". Magazine of the BAS, booklet 3-4/1998)
The newly created IM was entrusted with the creation of three main commissions for work in applied areas of mathematics: a) Commission for demographic studies (Kiril Popov) b) Commission for mathematical studies of the representative method in statistics (Nikola Obreshkov) and c) commission for financial and mathematical research of state and state-guaranteed external bond loans (Kiril Popov). At IM, a work plan in 9 more purely scientific (theoretical) directions was approved (by the then Board of the BAS).
In other words, the first orderly tasks before the IM in 1947 were the burning problems of modernity - demography and the finance of bond loans.
Now we can ask ourselves the question: What are the burning problems of today's modernity, the solution of which can only be done by professional mathematicians? In other words, why should the Republic of Bulgaria support BAS and in particular IMI with its budget?
First of all, we should note that for one reason or another, financial-banking institutions and businesses in our country do not have special groups of experts (quants) who thoroughly master the latest theories and practices in the field, which have recently become very dynamic (it is enough to mention the cancellation of the Libor model, which shook the fixed income market to its foundations). On the other hand, mastery of modern financial instruments and the mathematics on which they are based is essential for the optimal management of financial risks and the fiscal policy of any country. This is an important reason for maintaining a dedicated base of experts in this field, and IMI has so far proven itself to be a suitable place where relevant experts have been housed; the announcement of the procedure for Professor of Mathematical Finance is another right step in this regard.

I. General Description of the Submitted Materials

First and foremost, it should be noted that the publications submitted for this competition show minimal overlap with the topics covered in the publications that formed the basis of Assoc. Prof. Zaevski's major doctoral dissertation (for which I also served as a reviewer). This highlights the breadth of his interests within the field of mathematical finance.

1. Details Regarding the Application

The documents submitted by the candidate for this competition comply with the requirements set forth in the *Law on the Development of the Academic Staff in the Republic of Bulgaria* (LDASRB), the *Regulations for the Application of the LDASRB*, the *Regulations on the Conditions and Procedures for Acquiring Academic Degrees and Occupying Academic Positions at the Bulgarian Academy of Sciences* (BAS), and the *Regulations on the Conditions and Procedures for Acquiring Academic Degrees and Occupying Academic Positions at the Institute of Mathematics and Informatics* (IMI-BAS).

To participate in the competition, the candidate, Assoc. Prof. Tsvetelin Stefanov Zaevski, D.Sc., has submitted a list of 16 items, consisting of publications in Bulgarian and international scientific journals and proceedings from scientific forums. Additionally, six (6) other documents—in the form of official notes and certificates from his employer—have been provided to substantiate the candidate's achievements.

The documentation is in proper order and accurately reflects the candidate's research and teaching activities, as well as his involvement in national and international scientific projects.

2. Candidate Information

Associate Professor Tsvetelin Stefanov Zaevski, D.Sc., graduated with a degree in Applied Mathematics from the Faculty of Mathematics and Informatics at Sofia University "St. Kliment Ohridski" in 1999, achieving excellent academic results. Between 2003 and 2013, he was a doctoral student at the Faculty of Mathematics and Informatics at Sofia University "St. Kliment Ohridski," where he defended his dissertation titled "Combined Itô and Lévy Processes" under the supervision of Professor Racho Denchev, D.Sc. In 2025, Assoc. Prof. Tsvetelin Zaevski defended a dissertation for the degree of Doctor of Sciences (D.Sc.) on the topic "A Method for Valuing American-Style Derivatives." From 2014 to 2021, the candidate served as an Assistant Professor at the Institute of Mathematics and Informatics of the Bulgarian Academy of Sciences (IMI-BAS), and since 2021, he has held the position of Associate Professor. From 2004 to 2009, Tsvetelin Zaevski was an adjunct assistant at the Faculty of Mathematics and Informatics, Sofia University "St. Kliment Ohridski," and he has served as an adjunct lecturer there since 2019.

3. General Characteristics of the Candidate's Scientific Works and Achievements

Tsvetelin Zaevski is actively engaged in the field of financial mathematics. He has also produced additional results in the fields of probability theory and differential equations, which demonstrate his mastery of the mathematical apparatus used in finance. Throughout his scientific career, he has published 63 articles, 50 of which have an impact factor according to Web of Science.

For this competition, Tsvetelin Zaevski has submitted 16 publications with an impact factor or impact rank. Categorized by quartile (Q), these consist of 6 in Q1, 6 in Q2, and 4 in Q3. The publications can be grouped into the following areas:

1. Keis probability distribution [1–5]
2. Perturbed differential systems [6]
3. Risk analysis [7–9]
4. American-style financial derivatives [10–15]
5. Yield curve [16]

Overall, I evaluate Tsvetelin Zaevski's scientific work positively. The submitted articles exceed the minimum national scientometric requirements (pursuant to Article 2b, paragraphs 2 and 3 of the Law on the Development of the Academic Staff in the Republic of Bulgaria – ZRASRB), as well as the additional requirements set by the Institute of Mathematics and Informatics at the Bulgarian Academy of Sciences (IMI-BAS) for the academic position of "Professor" within the scientific field and professional area of this competition.
These scientific publications do not overlap with works used in previous procedures for the acquisition of scientific titles or academic positions, nor have they been previously registered in the National Centre for Information and Documentation (NACID). I have no concerns regarding plagiarism in the scientific works submitted for the competition.
Tsvetelin Zaevski has presented 99 citations indexed in the Web of Science and Scopus databases, yielding 594 points—well above the required minimum of 140 points. The candidate also meets all other point-based requirements stipulated in the aforementioned documents.

4. Characteristics and assessment of the candidate's teaching activity
Tsvetelin Zaevski has delivered numerous lectures and practical exercises in Financial Mathematics at the Faculty of Mathematics and Informatics (FMI) of Sofia University "St. Kliment Ohridski".

5. Substantive analysis of the candidate's scientific and applied scientific achievements, as presented in the competition materials

Articles [1–5] investigate the Kies probability distribution and various modifications thereof. Regarding the mathematical techniques employed, it should be noted that the original distribution is transformed via a fractional-linear function—specifically, an exponential distribution—thereby mapping its domain onto the unit interval. Article [1] derives results concerning the 4-parameter Kies distribution; [2] examines nested distributions obtained through the composition of cumulative distribution functions; [3] investigates the probabilistic properties of the minimum and maximum of several random variables following the original Kies law; and [4] explores various mixtures of such distributions. Publication [5] discusses certain trigonometric transformations. Across all these works, the study addresses "saturation" in the Hausdorff sense—which can be interpreted as a "break point"—defined via a first-order approximation of the cumulative distribution function relative to a Γ-shaped curve connecting the sequence of points $(0,0) \to (0,1) \to (1,1)$. All these modifications have been tested using real-world data from the financial sector.
In these articles, Tsvetelin demonstrates a command of mathematical analysis and its application to problems in probability theory. Article [6] is devoted to the study of certain properties of the SIQR epidemiological model for childhood diseases (susceptible, infected, isolated (quarantined), and recovered individuals)—an analysis that can also be applied to other contexts, such as the synthesis of antenna patterns. Using the Andronov-Melnikov method, the study investigates the conditions under which a small perturbation leads to chaotic behavior. The specific form of this perturbation is further generalized into the characteristic function of a probability distribution.

Articles [7–9] fall within the field of risk management and were co-authored with a PhD student of Assoc. Prof. Zaevski. Article [7] (published in the reputable Elsevier journal *International Review of Financial Analysis*) examines two standard risk measures—VaR and AVaR (Expected Shortfall)—as well as a relatively novel risk measure based on expectiles. These are applied to five major financial models: the Black-Scholes model, the Heston model, the Bates model, an exponential model driven by a modified stable process, and a model incorporating stochastic volatility and jumps represented by a modified stable process. The use of stochastic processes to describe asset dynamics is particularly

valuable in risk analysis, as the events that define risk are rare and occur in the tails of probability distributions. Consequently, selecting an appropriate process is crucial for an accurate analysis. The article derives theoretical formulas for the three risk measures and applies the findings to historical data for the S&P 500 index. Publication [8] is primarily theoretical in nature and investigates the convergence set of the moment-generating function for the averaged log-returns within the Heston stochastic volatility model. These results also have practical applications, as initial volatility is a latent market signal, making its daily extraction problematic. Subsequently, these findings are applied in paper [9], which examines another relatively new risk measure—Entropy VaR. Formulas for the aforementioned models are derived, and an empirical comparison is conducted based on historical data for the S&P 500 index.

Publications [10–15] investigate various American-style financial derivatives. These topics were explored in Assoc. Prof. Zaevski's doctoral dissertation and are further developed here. Article [10] examines such futures contracts. It investigates the optimal exercise set and constructs an algorithm to approximate its boundary, thereby enabling the determination of the instrument's fair price. Publication [11] considers American options where the price of the underlying asset is raised to a power. This non-linearity results in varying price premiums depending on whether the position is near or far from the strike price—a distinction of practical importance to investors. Article [12] studies classical American options under the assumption of sub-optimal exercise. Drawing on analogies from real analysis, a specific "strip" (or band) is defined around the strict optimal boundary, within which the option may be exercised. After deriving the properties of this region, a method is constructed to approximate it and to establish bounds for the option's price. Publication [13] examines a specific type of American call option—sometimes referred to as "cancellable"—in which the issuer also holds the right to early termination. To exercise this right, the holder incurs a three-component penalty (a framework introduced by the author), consisting of a proportion of the standard payoff, a number of shares of the underlying asset, and a fixed monetary amount. It has been demonstrated that the optimal exercise region for the holder of such an option resembles that of a classic American option—comprising all points above a specific boundary. The optimal region for the issuer, however, exhibits a more complex structure. When the penalty is sufficiently small, the optimal region consists of a strip above the strike price for long maturities, the strike price itself for intermediate maturities, and is empty for very short maturities. Conversely, intermediate penalty levels render the first scenario (a strip above the strike price) impossible. Finally, very high penalties effectively transform these options into classic American options, in the sense that early termination is never optimal for the issuer. The problem of determining the critical values for the three penalty components—which delineate these three scenarios—is investigated in [14]. Publication [15] establishes a duality between cancellable American put and call options. It is worth noting that while similar results exist for standard American options, they do not apply to cancellable variants under the classical assumption of a fixed penalty. The cases of finite and infinite time horizons are examined separately.

Publication [16] addresses a completely different area of finance, exploring the yield curve under the assumption of single observations. To compensate for a lack of sufficient information, it is assumed that a classical affine model for the short-term interest rate—specifically, the Vasicek or the Cox-Ingersoll-Ross model—is applicable. A method has been developed to transform the available time series of prices into a time series for the short-term interest rate; subsequently, the model parameters that provide the best approximation are determined. This approach was tested using data on U.S. debt instruments. It should be noted that this research was motivated by, and applied to, the specific characteristics of the Bulgarian market for government securities.

Article [16] demonstrates the breadth of Assoc. Prof. Zaevski's interests and expertise within the field of mathematical finance, specifically regarding sovereign financial instruments. It is interesting to consider how these results might be applied in the post-LIBOR era.

6. Critical Remarks and Recommendations

I have no significant critical remarks. As a specific recommendation, I would suggest that the author explore how the results from article [16] might be applied in the post-LIBOR era. As a general recommendation—one I have offered previously—I would suggest that the author publish some of his work in the form of monographs suitable for use as educational materials. In my experience, the publication of well-written monographs or textbooks lends credibility not only to universities but also to research institutes, establishing them as academic institutions capable of delivering high-quality instruction at the graduate (master's and doctoral) level.

7. Personal impressions of the candidate

I have known Tsvetelin Zaevski since 2013, when I served as a reviewer for his doctoral dissertation. I also served as a reviewer for his higher doctoral dissertation (for the degree of "Doctor of Sciences").

8. Conclusion Regarding the Candidacy

Having reviewed the materials and scientific works submitted for the competition, and based on an analysis of their significance as well as the scientific and applied scientific contributions contained therein, I confirm that the candidate's scientific achievements meet the requirements set forth in the Law on the Development of Academic Staff in the Republic of Bulgaria (LDASRB), its Regulations for Application, and the relevant regulations of the Bulgarian Academy of Sciences (BAS) and the Institute of Mathematics and Informatics at the BAS (IMI-BAS) for appointment to the academic position of "Professor" within the scientific field and professional area of the competition. Specifically, the candidate fulfills the minimum national requirements for the professional area, and no plagiarism has been detected in the scientific works submitted for the competition.
I provide a positive assessment of the candidacy.

II. General Conclusion

Based on the above, I recommend that the Scientific Jury propose to the Scientific Council of the Institute of Mathematics and Informatics at the Bulgarian Academy of Sciences that it approve the candidacy of Tsvetelin Zaevski for the academic position of "Professor" in the professional field 4.5 Mathematics.

.7.9.2020 Prepared by:

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