

REVIEW

by Acad. Ivan P. Popchev - BAS

of dissertation work for acquiring the educational and scientific degree

"Doctor"

in professional direction 4.6 "Informatics and Computer Science"

Doctoral program "Informatics"

Titled "Models and Methods for Optimizing and Management Portfolio
using Time Series"

by Krassimira Doneva Stoyanova- Chokova

By Order No. 66/23.03.2020 and No. 96/19.05.2020 of the Prof. G. Angelova, DSc - Director of IICT - BAS in accordance with Art. 4, para. 2 of the Act of Development of the Academic Personnel of the Republic of Bulgaria (ADAPRB) and with a decision of the Academic Council of IICT (rec. of proceedings No. 2 from 23.03.2020) for awarding of educational and scientific degree "doctor" in professional direction 4.6 Informatics and Computer Science, doctoral program "Informatics" by Krassimira Doneva Stoyanova- Chokova of dissertation work Titled "Models and Methods for Optimizing and Management Portfolio using Time Series" I have been appointed a member of the Scientific Jury.

When assessing the dissertation work, the terms ADAPRB, RAADAPRB (Decree No. 26 of 13 February 2019) and the Rules for specific requirements of IICT for the application of the law and therefore will be accurately delivered:

1. According to Art. 27 (1) of ADAPRB "the dissertation work shall contain scientific or applied research results that represent an original contribution to science. The dissertation shall show that the candidate has profound theoretical knowledge in the respective subject, as well as their abilities of independent scientific research."
2. According to Art. 27 (2) of ADAPRB the dissertation work should be presented in a form and volume corresponding to the specific requirements of the primary unit. The dissertation work should contain: title page; contents; introduction; presentation; conclusion - summary of the obtained results, accompanied by declaration of originality; bibliography.

According to RAADAPRB, the minimum required number of points by groups of indicators for "Doctor" are:

Group of indicators	Contents	Number of points
A	Indicator 1	50
G	Sum of indicators from 5 to 10	30

The scientific supervisor of the dissertation is Assoc. Prof. Vasil Gulyashki, PhD.

The aim of the dissertation is "to propose models and methods/algorithms for portfolio optimization using time series in the financial field."

To achieve this aim, the **following tasks** need to be fulfilled:

- To review the existing evolutionary single-criteria and multi-criteria algorithms for portfolio optimization.
- To propose a model for portfolio optimization that provide certain properties of the portfolio.
- To propose an approach/methodology for portfolio optimization using time series.
- To propose an algorithm for optimization and portfolio management with given criterion/a, which is sufficiently accurate and fast.
- To conduct numerical experiments for performance testing of the proposed models and algorithms.
- To develop a toolkit – a set of software modules in MATLAB to enable above tasks to be accomplished.

The dissertation is in volume of 130 pages, 17 figures, 22 tables and includes:

- Introduction (4– 5);
- Analysis of models and methods for portfolio optimization and management (**Chapter 1** , 6-45);
- Optimization by combination of FFA-PS. Hybrid evolutionary algorithm and methodology for portfolio selection (**Chapters 2** , 46 - 69);
- Results of numerical experiments (**Chapter 3** , 70 - 99);

- Conclusion (100 - 102);
- Contributions (103);
- Publications on the topic of the dissertation (1 0 4);
- Declaration of originality of results (105);
- Bibliography (106 - 1 22).
- Appendices (123 - 130).

Seven papers published in the period 2015 - 2020 are on dissertation:

- **1 publication is a chapter from book (No. 6);**
- 1 publication is in **journal SJR = 0. 125, Q3 (No. 7);**
- 5 publications are in conference proceedings (NNo. 1, 2, 3, 4 and 5);
- **All publications are co-authored.**

No citations were noticed.

The requirements of the RAADAPRB and specific requirements of IICT-BAS **are fulfilled.**

The obtained **results** briefly can be systematized as follows:

- A portfolio optimization model has been formulated for several periods, which is a modification of the Mean Variance (MV) model by Harry Markovic.
- The hybrid evolutionary algorithm has been formulated based on X. S. Yang's fireflies' method and R. Hook's and T. A. Jeeve's Pattern search method. The computational complexity of the Hybrid Evolution Algorithm allows it to be used successfully to solve large-scale optimization problems.
- Based on the proposed optimization model, relevant tasks are formulated, which are solved by the proposed Hybrid Algorithm and by standard *fmincom* solver by *Mathlab (Interior point)*.

Critical notes :

1. The title of the dissertation work is: "Models and Methods for Optimizing and Management ...". Neither in the aim, nor in the tasks, nor in the achieved results are found "models and methods" in the plural (!), And "management" is only in the aim, but not in the achieved

results. This determines *very serious differences* between the title and the content of the dissertation.

2. There are books, textbooks, articles, handbooks and dissertations of Bulgarian authors on the discussed topics, which are missing in the bibliography.
3. On page 53, statements from [181] are interpreted. The exact text on page 42 [181] is "when the correlation coefficient of asset returns is - 1, then the portfolio has a risk of 0, ...".
4. The dissertation lacks a "conclusion - summary of the obtained results" according to the requirements of Art. 27 (2) ZRASRB.
5. There is a certain incompleteness in bibliography, such as missing: ISSN or ISBN, year of publication, pages, etc.
6. Even the English title of the dissertation work is incorrect (optimizing!).

Questions on the dissertation work:

1. Why is a Hybrid Algorithm proposed by these two Firefly methods and the Pattern search method as an evolutionary algorithm for portfolio and method optimization? What other evolutionary algorithms can it be compared to? Examples!
2. How is selected solvers *fmincon*? What exactly is the criterion for choosing from the wide variety of software solvers - tools?
3. How are the historical data for the three assets for a ten-year period selected in Appendix 2 and the historical data for six assets for a period of 10 years and 11 months selected in Appendix 3?
4. Why are data from the financial markets in Bulgaria or from the pension funds in Bulgaria not included (pp. 71-72)?
5. What tools have been used to overcome the shortcomings of the time series, which are partially listed on page 19? Can examples be shown?
6. On page 103 it is written that "software modules have been developed, implementing the proposed Hybrid Algorithm...". What are these program modules and where are they presented in the dissertation?
7. Why "... larger tasks could be a guide for future research", p. 102?
8. Aren't other areas of future research suggested in informatics?

The reviewer believes that both critical remarks and especially dissertation questions can induce new directions for research.

The **Abstracts** in Bulgarian and English are in volume 30 pages, and present the thesis.

CONCLUSION

The dissertation work fulfills the requirements of ADAPRB, RAADAPRB and the specific requirements in IICT-BAS.

I give a **positive conclusion** for acquiring the educational and scientific degree "**Doctor**" to **Krassimira Doneva Stoyanova- Chokova** .

I propose to the Scientific Jury to unanimously vote for **Krassimira Doneva Stoyanova- Chokova** the educational and scientific degree "**Doctor**" on **4.6. Informatics and computer sciences, doctoral program "Informatics"**.

09.06.2020

Signature: .

**NOT FOR
PUBLIC RELEASE**

Acad. Ivan P. Popchev