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Review of doctoral thesis entitled:

'Building and evaluating the

Probabilistic Inflation Forecasting Expert System (PIFES)'

written under the academic supervision of dr hab. Teresa Kamińska, prof. nadzw.,

by Daniel Robert Michael Sonnet

1. The basis of the review

The resolution of the Council of Faculty of Economics of the University of Gdańsk, dated from December 20th 2018, confirmed by the letter of the Dean of Faculty of Economics, dr hab. Monika Bąk, prof. nadzw., from December 21st 2018, is the basis for the review, under which I was entrusted with the duties of a reviewer of this doctoral thesis.

2. General characteristics of the dissertation, hypotheses and research goal

The doctoral dissertation by Mr Daniel Sonnet falls under the category of interdisciplinary scientific works, the authors of which use knowledge from various fields (here: mathematics, informatics and economics) to solve basic research goals. The problems discussed in the thesis are connected with the issues of designing and implementing probabilistic expert systems for forecasting economic variables. The author formulates two research hypotheses: the first one: "The methodology used to build LEXMED can be

transferred to economics, and a Probabilistic Inflation Forecasting Expert System (PIFES) can be constructed" and the second one: "PIPES can be used to generate new insights between inflation and other economic variables".

The main goals, which the PhD student puts, are: design, construction and evaluation of probabilistic expert system based on the principle of maximum entropy and empirical demonstration that the system is a suitable tool supporting inflation forecasting.

The research goal was formulated in the correct and precise way. The research hypotheses are original in the light of the set tasks and they make it possible to achieve the main goal of the doctoral dissertation.

Evaluation of the content of the doctoral dissertation

The main part of the thesis consists of the introduction, four chapters and the conclusion. The work is supplemented with a comprehensive bibliography, a list of nineteen tables, fourteen drawings and an attachment. Each chapter contains an introduction to its contents and a summary of the considerations. The adoption of such a solution ensures that the order of the arguments is kept, facilitates the assessment of particular parts of the dissertation and proves the high skills of Mr Daniel Sonnet's statements.

The introduction contains all the elements relevant to the requirements of the doctoral dissertations. It justifies the selection of the research area, indicates the problem to be solved, describes the content of individual chapters. The author presents here the main goal of the dissertation, research hypotheses and characterizes the applied research method.

The first chapter contains an extensive review of the literature related to the implementation of the dissertation's objectives. Due to the interdisciplinary character of the research task the literature review is, first of all, related to the expert systems, their specificity and applications in economics. (subchapter 1.1). As the principle of maximum entropy was

applied, the author presented its use in economic sciences, going beyond the systems associated with inflation forecasting.

In the second chapter the doctoral student has undertaken a difficult task, due to the interdisciplinary nature of the work, the task of presenting definitions, theorems and models, based on which the construction of the probabilistic inflation forecasting expert system will be carried out. The author cites, among others, techniques of initial data processing, variable selection, generation of a probabilistic knowledge base, i.e. elements in the field of computer science. The econometric basis of PIFES system includes definitions, connected, among others, with: time series, stochastic processes, stationary process. The author evokes elements of the theory of economics connected with the creation of one of the versions of PIFES system, i.e. aggregate demand, Okun's law and Philips curve. The presentation of such a combination is intended to facilitate the reader's analysis of the third and fourth chapter of the work. It is worth noting that the references to the literature are clearly indicated, from which the cited definitions and models are taken.

The third chapter of the dissertation describes in detail the way in which individual elements of PIFES expert system are created. It is the key part of the dissertation. In the first part the author presents the construction procedure of probabilistic expert system, which comes down to fifteen steps, the last three of which are related to its evaluation. The doctoral student emphasizes the versatility of the proposed research procedure of constructing probabilistic expert systems, which can be used in forecasting other economic variables than inflation. This fact is worth emphasizing because it testifies the author's high qualifications. The chapter ends with technical details related to SPIRIT IT package and its use to prepare PIFES system.

The forth chapter is devoted to the evaluation of the constructed expert system and the verification of the set research hypotheses. For this purpose, the author generates over

forty different versions of PIFES system. Forecasts generated by the expert system are compared with model forecasts (benchmarks) obtained using neural networks and ordinary least squares regression techniques. The probabilistic expert system provides comparable results - the first hypothesis has been verified positively. The author also showed how PIFES system can be used to analyze various inflation scenarios, which gives the opportunity to analyze the interrelations of economic variables – positive verification of the second hypothesis.

The conclusion contains the summary of all stages of the creation of the probabilistic expert system, as well as the achieved results.

Assessment of the doctoral dissertation from the editorial point of view

The reviewed doctoral dissertation is written carefully. Each of the chapters begins with a short introduction presenting its subject, and ends with a summary. The conducted arguments are logical, the drawings and tables are legible. The work is correct in terms of the language. There are a few typing errors (for instance page 12 x_1 instead of x_2 in comparison (0.3) and x_3 in comparison (0.4), page 18 "from" instead of "form", page 27 "firs" instead of first, page 133 when classifying the dependent variable (Inflation) each category was labeled "range 1" instead of labels from "range 1' to "range 5", page 137 "add ition" instead of addition), but they have no impact on the rating of the editorial work.

General assessment of the dissertation

Turning to a detailed content-related assessment, at the outset, I would like to point out that the research efforts undertaken by the PhD student deserve recognition, both due to the subject matter of the research issues and due to the effort to obtain the most reliable results. The doctoral student coped with the solution of the posed research problem very well. He achieved the set research goal and verified the research hypotheses.

On the basis of the latest available scientific publications, the doctoral student conducted a broad and insightful critical analysis of the problems of creating expert systems and their applications in economics. The choice of the literature items quoted in the dissertation confirms the author's very good discernment in the field of research under consideration.

Due to the content of the dissertation, the qualification of the work for the discipline of economics is not doubtful. The presented issue of the dissertation is important and micro and macroeconomic analyzes. The scientific problem raised by the author is characterized by a high degree of originality. The author showed in his doctoral thesis advanced theoretical knowledge and the ability to conduct scientific work independently. In particular, it is worth emphasizing that the doctoral student understands the macroeconomic dependencies.

At every stage of constructing probabilistic expert system the author showed exceptional care that the results obtained were of the best quality. The doctoral student emphasizes the advantages and the limitations of the adopted solution at every step. He substantively argues the made choices.

During the defense of the dissertation, I would like the PhD student to refer to several specific issues:

1. How time-consuming and labour-intensive it is to modify PIFES system, for example adding new rules, taking into account the knowledge of additional experts, etc.?
2. Is it possible to prepare a version of PIFES system that will be able to generate forecasting in the longer period than average?
3. Will increasing the number of inflation categories, from the current five, improve the quality of forecasting?

The dissertation is prepared at a high substantive, methodical and editorial level. It is an original solution to the scientific problem, demonstrates the theoretical knowledge of the author and his cognitive inquisitiveness, as well as the ability to carry out scientific work and research experiments independently. Reading the thesis induces both, the acceptance of the carried out scientific project and provokes the discussion and the formulation of critical opinions. All this is the evidence of the doctoral student's research maturity.

Conclusion

The doctoral dissertation presented for review constitutes the original solution of the scientific problem presented in it and indicates Mr Daniel Sonnet's general theoretical knowledge in the discipline of economics. The doctoral student showed his knowledge of the undertaken subject and the ability to conduct his own scientific work independently.

Due to the cognitive contribution, Mr Daniel Sonnet's doctoral thesis submitted for the review fulfills the criteria used for the evaluation of doctoral dissertations, according to article 13 Act dated from March 13th 2003 dealing with degrees and academic title, i.e. it constitutes the original solution to the scientific problem, shows general theoretical knowledge in the issues of inflation forecasting, the construction of expert systems, and the ability to conduct scientific work independently. In relation to the above, I put forward the motion to the Council of Faculty of Economics of the University of Gdańsk to accept the dissertation for public defense.