RESEARCH INSTITUTE FOR APPLIED PROBLEMS OF MATHEMATICS AND INFORMATICS: MAIN RESULTS

Yu.S. Kharin, e-mail: Kharin@bsu.by, E.N. Melnikova, e-mail: MelnikovaEN@bsu.by

Research Institute for Applied Problems of Mathematics and Informatics Belarusian State University, Minsk, Belarus

The Research Institute for Applied Problems of Mathematics and Informatics was founded in 2000 by order of the Council of Ministers of the Republic of Belarus and of the Rector of BSU. The Institute was created in order to develop topical scientific fields of applied mathematics and computer science.

The Institute includes 6 research laboratories: Statistical Analysis and Modeling; Modeling of Physical Processes; Applied Informatics; Analysis and Synthesis of Dynamic Systems; IT security; Mathematical Methods of Information Protection.

Main directions of research are:

- Computer data analysis (multivariate analysis, discriminant analysis, cluster analysis, data mining, time series analysis, forecasting);
- Statistical analysis and computer modeling for Complex Data Structures (robust procedures under outliers, missing values, censoring, spatio-temporal data analysis and forecasting);
- Statistical analysis of genetic sequences;
- Computer methods in medical diagnostics;
- Econometric analysis and forecasting;
- Mathematical modeling of physical processes;
- Mathematical and computer methods of information security;
- Information protection.

The Institute has experience in development of methods and software for computer data analysis:

- European research and academic projects financed by following Programs: INTAS, TEMPUS, REAP.
- International research contracts with computer companies from South Korea, Russian Federation. The objective of these projects was to develop the software and to make related technological research. The developed software includes computer modules for Statistical Analysis, Forecasting, Optimization and Simulation.
- National research contracts with more than 50 private and state enterprises from the Republic of Belarus, e.g., National Bank of the Republic of Belarus, National Unitary Enterprise "Minsk Automobile Plant", Belarusian Research Institute of Transport "Transtehnika", Research Institute for Oncology and Radiology, United Institute of Informatics Problems of the National Academy of Sciences of Belarus.

In practice, to get more reliable inferences from real data sets we need to use more adequate models for data and construct new statistical procedures. We develop methods and software for statistical analysis (prediction, pattern recognition, discriminant analysis, classification, time series analysis, analysis of discrete data, spatio-temporal analysis) for complex data structures (data with misspecification, distortions, outliers, missing values, censoring, etc.). Theory of our approach is published in many research papers including monographs [1, 2].

We offer solutions to the following topical problems in Medicine, Bioinformatics and Computer Analysis of DNA Sequences:

• Development of methods and algorithms for diagnostics of the coronary ischemic disease based on the parametric discriminant analysis in the different feature spaces:

statistics calculated from the wavelet coefficients, covariance functions and parameters of the Markov chains;

- Development of the robust discriminant analysis methods for diagnostics of malignant neoplasms on the basis of biochemical blood assay tests. Preliminary results show that robust discriminant analysis for diagnostics of malignant neoplasms increases the accuracy of diagnostics by 4-5% with respect to the classical decision rules;
- Development of algorithms and software for spatio-temporal cluster analysis in evaluation of geographical distribution of a rare disease;
- Development of methods and software for multiple precision recognition of coding segments in eukaryotic DNA. The basic weakness of the existed methods for recognition of protein-coding segments of eukaryotic DNA sequences is generated by errors in estimation of the boundaries for the coding segments. We are working on the project that is aimed to solve the following problems:
 - development of new mathematical models for protein-coding segments of eukaryotic DNA sequences based on multivariate probability distributions of nucleotides;
 - development of new mathematical models for protein-coding segments in eukaryotic DNA sequences on the base of new parsimonious high order Markov chains developed by our team;
 - development of methods, algorithms and software for recognition of proteincoding segments in eukaryotic DNA sequences based on the constructed mathematical models.

The Institute is organizer of following International Conferences:

- "Computer Data Analysis and Modeling" (3-annual International conference);
- "Information Systems and Technologies" (International conference);
- "Complex Information protection" (International conference).

References

- 1. Kharin Yu. Robustness in Statistical Forecasting. Heidelberg/ New York/ Dordrecht/ London: Springer, 2013.
- 2. Kharin Yu. Robustness in Statistical Pattern Recognition. Dordrecht/ Boston/ London: Kluwer, 1996.