



INFORMATION TECHNOLOGIES

DOI: 10.15587/2312-8372.2018.135483

ADAPTIVE MODELLING FOR FORECASTING ECONOMIC AND FINANCIAL RISKS UNDER UNCERTAINTY CONDITIONS IN TERMS OF THE ECONOMIC CRISIS AND SOCIAL THREATS

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The objects of the research are socio-economic processes in the context of structural transformations that take place as a result of socio-political crisis in the country. One of the most problematic points is absence of comprehensive study and lack of justification for prediction of anticipating potential threats in the humanitarian and social spheres and ways to overcome them aiming to stable and positive development of the national economy.

In the course of the study the system analysis and system theory methods, mathematic and econometric modelling methods were used. System analysis and system theory are used to study the state and behaviour of national economy and its subsystems in conditions of current uncertainties and risks characteristic of the social treatments and structure changes. Mathematical and statistical modelling methods and decision making theory were used for forecasting development of non-stationary nonlinear processes which identify modern state of Ukrainian economy.

The paper considers the problem of developing the methods for solving tasks of modelling and estimating selected types of risks with the possibility for application of alternative data processing techniques, modelling and estimation of parameters and states for the national economy and its components within the current condition of socio-political transformations and structural reforms. To find «the best» model structure it is recommended to apply adaptive estimation schemes that provide for an automatic search in a definite selected range of model structure parameters (type of distribution, model order, time lags, and nonlinearities). Also the adaptive estimation schemes proposed help to cope with the model structure and parameters uncertainties. The general methodology was proposed for solving selected problem of dynamic process forecasting and estimation of several kinds of socio-economic and financial risks using appropriate statistical data in computer based decision support systems.

Results of the research would be useful to other countries where approximately the same kind processes take place.

Keywords: adaptive modeling, uncertainty identification, risk estimation, decision support system.

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DOI: 10.15587/2312-8372.2018.141299

DESIGNING SECURITY OF PERSONAL DATA IN DISTRIBUTED HEALTH CARE PLATFORM

page 10–15

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The object of research is the design of EHR system capable for both patient-physician communication and secure and privacy preserving cross-organisational analytical collaboration. Constant patient monitoring and amount of quality data available for further analysis is crucial for more accurate medical recommendations and therefore general wellbeing. On the other hand, most of the current architectural approaches are subject to different vulnerabilities to data integrity and can't provide multi-party computations (MPC) proof from sensitive information leakage resulting in very fragmented datasets available for each clinic or health organisation. Another improvement area is edge level sensor network communication security.

In this paper it is proposed to split architecture into layers with dedicated security zones. This fragmentation allows to effectively segment infrastructure, allowing each element to apply to its own authentication and authorization requirements as well as secure data individually. Side effect of this approach is reducing network load and eliminating security and privacy issues by minimising sensitive data transfer (e.g. basic data gathering and processing is being performed on the smart sensors). Usage of Hyperledger is suggested for maintaining data integrity with off-chain database for optimizing transactions storage and speed. Utilization of MPC allows to share records between akin organisations for joint calculations and ml-models training without revealing actual data.

Suggested approaches allow building robust and flexible yet secure platform for sensitive data gathering, analysis and multi-party processing without revealing users' identities leveraging advantages of edge computing, Hyperledger and joint data calculations.

Keywords: PHR security, medical blockchain, sensitive data security, body sensor network security.

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SYSTEMS AND CONTROL PROCESSES

DOI: 10.15587/2312-8372.2018.138466

INVESTIGATION OF BACKGROUNDS FOR THE INNOVATIVE DEVELOPMENT OF THE HOSPITALITY INDUSTRY IN VARIOUS REGIONS OF UKRAINE

page 16–23

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The object of the research is a complex of theoretical and practical aspects of hotel and restaurant management organization in various regions of Ukraine. The biggest problems are the lack of strategic planning for most hotel and restaurant enterprises,

the lack of coordination of development plans of individual regions with the needs and current realities, and the inefficient use of labor resources.

The research used general scientific methods of analysis: economic and statistical methods of information collection and processing, methods of comparative, systemic, qualitative SWOT-analysis, as well as abstractions.

For effective introduction of innovations necessary is collaboration between travel agency and by hotel-restaurant enterprises, organs of power and state self-government. Increasing the competitiveness of hotel and restaurant enterprises and strengthening their positions in the market of services is possible thanks to the development of «green tourism», ethno-tourism, services with creative components and a benevolent tolerant atmosphere.

For this purpose it is necessary to extend the assortment of services and their quality, improve informatization on all stages. A necessity is an account of mentality of guests and desire of them to get maximal pleasure and benefit from a trip. Marketing strategies must have the stages that are easily controlled and, after a necessity, add to the changes. Such construction of development hospitality industry must strengthen a complexity and individuality of services. Expansion of spectrum of facilities of placing (suites of rooms, villas, houses for rest, out-of-town and guest houses, chalet and others like that) allows as good as possible to orientate the different groups of tourists and diversify the types of rest. Importance of strengthening is underlined, especially at regional level of work of public organizations. The union of proprietors of hotels must occupy more active position for lobbying of legislative initiatives, to be a link that unites businessmen and organs local power in the questions of strategic development of regions. The practical value of the got results consists in development of the scientific and practical going near effective organization of hotel-restaurant economy in the different regions of Ukraine, taking into account work of permanent enterprises. Drawn conclusion and recommendations can be basis for forming of strategic directions of the rational use of hotel-restaurant resources.

Keywords: hotel-restaurant business, strategy of innovation development, hospitality industry, service business, facilities of placing.

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DOI: 10.15587/2312-8372.2018.140535

ACCOUNTING OF SWITCHING DEVICE ERRORS FOR SYSTEM WITH SLIDING REDUNDANCY BASED ON DYNAMIC FAULT TREE

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The object of research is a non-renewable system with a single sliding reservation. Such system consists of two main subsystems, one redundancy and two switching devices. While both main subsystems are operable, the spare subsystem is in an unloaded state. The redundancy system is designed to replace

any major subsystem after its failure. Switching devices commute the main subsystems with a redundancy one. During the audit, it was revealed that the switching devices allow errors. In particular, a mistake of the first type, that is, they switch in advance, and a second type of error, that is, they pass the switching moment. This reduces the reliability of the system and leads to underutilization of the inherent resource.

An approach is proposed that quantitatively takes into account the influence of errors of the first and second type on the probability of failure-free operation of the system under study during its design. The approach consists of two stages. At the first stage, the reliability of the system is mathematically described by the dynamic failure tree. At the second stage, based on the failure tree, a Markov model is formed. Applying it, it is possible to calculate the probabilistic characteristics of the system.

The result is a mathematical relationship between the probability of trouble-free operation of the system and the parameters of the components of the system. In particular, the operating time to failure of the main and redundancy subsystems, as well as the parameters of switching devices that corresponds to errors of the first and second type. The form of presentation of the obtained results for the end user is a software product that automatically generates a family of graphs for reliability evaluation. Ignoring the errors of switching devices in the design of systems reduces their actual reliability, leads to underutilization of the reserve component resources, and also increases the probability of emergency situations.

Using a more accurate mathematical model makes it possible to monitor the errors of switching devices during the design of the system. The simulation results will be useful for selecting the parameters of the switching devices.

Keywords: reliability model, dynamic fault tree, sliding redundancy, switching device.

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DOI: 10.15587/2312-8372.2018.140901

DETERMINATION OF INVESTMENT ACCURACY AND FORMATION OF INFORMATION SUPPLY OF GEOECOLOGICAL MONITORING OF USE OF LAND

page 30–34

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The object of research is the technology of determining the investment attractiveness and the formation of information support for geoeological monitoring of land use. One of the biggest problems in modern approaches to determining the investment attractiveness and geoeological state of land use is the complexity of existing approaches and the lack of information support.

Methods are developed to assess the investment attractiveness and geoeological status of land use. These methods make it possible to develop measures for a comprehensive increase in investment attractiveness and determine the geoeological state of the land for the development of methodological recommendations for improving the efficiency of land use. The proposed approaches are of an analytical nature and are based on the method of analyzing hierarchies, the results of correlation regression analysis. Unlike the existing ones, they allowed to form a system environment for the quantitative assessment of the geoeological state and land use.

During the research, spatial, multifactorial, rating and economic approaches were used. It is revealed that these approaches do not have a clear sequence and do not fully determine the current aspects of land use.

According to the developed methods, an integrated approach is proposed to assess the investment attractiveness and geoeological state of land use. It is based on the results of mathematical modeling and makes it possible to obtain an integrated assessment of the geoeological state of land use.

As a result, these developments will provide land assessment and decision-making by stakeholders at the local, regional

and national levels. An integrated criterion has been developed that will allow to increase the level of land use and ensure their comprehensive assessment. The proposed recommendations will make it possible to clearly and reasonably influence the level of land use, and to resolve it in a timely manner. In comparison with the known approaches, the developed has a complex character and is based on successive stages of analytical calculations. This ensures the accuracy of the assessment and excludes the influence of objective factors in determining the investment attractiveness and geocological status of land use.

Keywords: investment attractiveness of lands, geocological monitoring, information support, land use.

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DOI: 10.15587/2312-8372.2018.141190

INVESTIGATION OF LASER RANGEFINDERS WITH SENSOR NETWORK INTERFACE

page 35–40

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The object of research is a laser rangefinder with a wireless sensor network interface protocol ZigBee, which in this study is proposed for the function of measuring the distance between objects. The main spheres of application are spheres where reliable information about the location of objects relative to each other is required. To increase the reliability, it is proposed to combine the possibility of measuring the distance between objects of sensor networks and data obtained from a laser rangefinder. These two methods are combined in one device.

One of the most problematic places is the error of the measuring equipment. Also, for the objects described above, various obstacles are typical, like mechanical (trees, hills, lowlands), and radio interference.

In the course of the research, the method of increasing the accuracy of measuring the distance of wireless sensor networks was used. To do this, they are combined with laser rangefinders, which are part of computerized distance measuring systems built on the basis of a combination of measurement methods of a different nature.

Site localization studies were carried out for the average deviation value when ranking in 1m (20 measurements), as well as on the progressive function of the required number of transactions. To calibrate the measured measurements, a minimum period of two-sided pass was calculated for the average value, when the receivers are in close proximity to one another (0.01 m). This average value on was calculated from each ranking measurements before converting to an immediate distance value.

The results confirm an improvement in the efficiency of the ranking by averaging a plurality of samples to an error value of 6.0 m. The accuracy of the method was constant throughout the test propagation range (within a radius of 250 m).

Keywords: sensor network, laser rangefinder, mechanical quantities, computerized measuring system, information-measuring system.

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MATHEMATICAL MODELING

DOI: 10.15587/2312-8372.2018.140351

RESEARCH OF 5-BIT BOOLEAN FUNCTIONS MINIMIZATION PROTOCOLS BY COMBINATORIAL METHOD

page 41–52

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The object of research is a combinatorial method of 5-bit Boolean functions minimization. One of the most problematic places for Boolean functions minimization is the complexity of the minimization algorithm and the guarantee of obtaining a minimal function.

Minimization protocols of the 5-bit Boolean functions are used in the course of the research, which are used when the structure of the truth table of a given function has a complete binary combinatorial system with repetition or an incomplete binary combinatorial system with repetition. The operational properties of the protocols for 5-bit Boolean functions minimization are based on the laws and axioms of the algebra of logic.

A reduction in the complexity of the process of 5-bit Boolean functions minimization by combinatorial method is obtained, increasing the probability of guaranteed 5-bit Boolean functions minimization. This is due to the fact that the proposed method of 5-bit Boolean functions minimization has a number of features to solve the problem of minimizing the logical function, in particular:

- the mathematical apparatus of the block-diagram with repetition makes it possible to obtain more information on the orthogonality, contiguity, uniqueness of truth table blocks;
- equivalent transformations by graphic images in the form of two-dimensional matrices due to the greater information capacity can with effect replace the verbal procedures of algebraic transformations;

– minimization protocols for 5-bit Boolean functions constitute a protocol library for the process of 5-bit Boolean functions minimization as standard procedures, so the use of a separate protocol for variables of 5-bit Boolean functions is reduced to carrying out one algebraic transformation.

Thanks to this, it is possible to obtain an optimal reduction in the number of variable functions without losing its functionality. The effectiveness of the application of minimization protocols for the 5-bit Boolean functions of the combinatorial method is demonstrated by examples of minimization of functions taken from the work of other authors for the purpose of comparison.

In comparison with similar known methods of Boolean functions minimization, this ensures:

- less complexity of the process of 5-bit Boolean functions minimization;
- an increase in the probability of guaranteed 5-bit Boolean functions minimization;
- improvement of the algebraic method of Boolean function minimization due to the tabular organization of the combinatorial method, the introduction of the image-transformation apparatus and the minimization protocols.

Keywords: minimization method, minimization of a logical function, block-scheme with repetition, protocols for minimization of Boolean functions.

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DOI: 10.15587/2312-8372.2018.141383

DEVELOPMENT OF GENERALIZED TECHNIQUE FOR FORMATION OF CHARACTERISTIC FUNCTIONS AND BALYUBA-NAIDYSH COORDINATES IN THE COMPOSITION METHOD OF GEOMETRICAL MODELING

page 53–58

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The object of the study is the technique for the formation of characteristic functions and Balyuba-Naidysh coordinates (*BN*-coordinates) in the composite method of geometric modeling. The existing methods of modeling economic, technological and any other processes on real objects are rather complicated, with significant limitations on the number of incoming factors.

One of the most problematic places is the complexity and narrow scope of each of the existing modeling methods, restrains their distribution and practical implementation on real business entities. Hence the need to develop a universal method for modeling multifactor systems. The closest to this is the composite method of geometric modeling (CMGM), the universality of which is ensured, first of all, thanks to the use of the intrinsic technique of generating characteristic functions and *BN*-coordinates.

The use of the Balyuba curves (*B*-curves) constructed in *BN*-coordinates in CMGM gives significant advantages to CMGM. One-, two-, three-parameter *B*-curve can be considered in the *n*-dimensional Euclidean space E^n . As a result, CMGM can be used to solve problems in *n*-dimensional space, and the result of the solution can be decomposed into *n* one-dimensional projections, on which it is easy to analyze the solution. This can be used, in particular, in information systems to support management decisions. A feature of the *B*-curves is that the *BN*-coordinates $p(t)$; $q(t)$; $r(t)$ are its parametric model, which is a constant. Applying a variety of variants of changing points, it is possible to obtain a lot of variants of *B*-curves, which is important for carrying out computer experiments in order to increase the adequacy of the constructed geometric model.

The principle of the formation of characteristic functions is the operation of multiplying parameters and artificially assigned coefficients. As a result of the definition the product at the node points becomes zero or one, and in the intervals between nodal points it changes from zero to one. The number of factors of the characteristic function is equal to the number of nodal points that the characteristic function interpolates. The *BN*-coordinates of one *B*-curve form a system of interrelated fractional-rational functions.

Thus, a generalizing technique for the algebraic formation of characteristic functions has been developed, and a transition from characteristic functions to *BN*-coordinates for the interpolation of three points has been determined. The technique used here can also be used for geometric interpolation of four or more points. The possibility of increasing the number of initial points of a geometric figure for *BN*-interpolation, extends the capabilities of models of multifactor processes and systems.

Keywords: Balyuba-Naidysh point calculation, formation of characteristic functions, parametric connection, multifactor modeling.

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