ABSTRACT AND REFERENCES

MATHEMATICS AND CYBERNETICS - AND APPLIED ASPECTS

A METHOD FOR BUILDING A FORECASTING MODEL WITH DYNAMIC WEIGHTS (p. 4-8)

Victor Syneglazov, Olena Chumachenko, Vladyslav Gorbatiuk

The forecasting task and some of the main problems, that occur while solving it, were examined in the paper. The main existing forecasting methods, that unfortunately do not take into account these problems, were listed together with their short description. We propose a new approach for building the forecasting methods, which considers some of the mentioned problems. Based on this approach, we constructed a new forecasting method, called ‘linear regression with dynamic weights’, which finds concrete values of weights for the input factors depending on the values of the factors themselves. To test the forecasting abilities of the method we used the set of real time series, for which we built a forecasting model using the proposed method, the “ancestor” method – pure linear regression and the group method of data handling. By analyzing the results we show that the new method produced (on average) better forecasting error than the linear regression, and for some time series its error was better than the group method of data handling produced. In a conclusion we suggested some ways for the future improvement of the method

Keywords: time series forecasting, linear regression, Bayesian model averaging, neural networks

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PRESENTING THE BASIC ESSENCE OF LIMITING GENERALIZATIONS PARADIGM BY ALGEBRA PREDICATE STRUCTURES (p. 9-15)

Vitaly Bulkin, Yuriy Prokopchuk

At the present stage of computer technology advancement, there are problems of using sequential algorithms and exclusively binary encoding. These problems require creating computational tools with a new design and using non-binary coding techniques. In this study, a method of formal representation of elementary tests, their domains and pattern systems in the language of predicate algebra was developed for the first time.

Formalization of the recalculation rules between the domains of different levels of generality, using the mathematical tool of the algebra of predicates, was carried out. The developed mathematical models, specifying the rules for domain value recalculation, are represented as the corresponding AP structures. For a hardware implementation of the obtained models, the method of presenting algebra-predicate structures in the form of associative-logic converters was used.

The obtained AP structures can be used for creating intelligent parallel-action systems, operating in real time

Keywords: paradigm of limiting generalizations, directed graphs of domains, pattern systems, algebra of predicates, algebra-predicate structures

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ADAPTIVE POLYNOMIAL NEURONETWORK PREDICTING MODEL OF TIME SERIES AND ITS TRAINING (p. 16-20)

Olena Mantula, Serhiy Mashtalir

The relevance to develop new predicting methods is caused by their vital importance in solving various tasks of industrial, agricultural, financial-economic, medico-biologic and ecological systems.

The problem of predicting non-stationary non-linear time series under limited amount of a priori information is considered in the paper. To solve it, the method for synthesizing polynomial neural networks, which is an alternative to multilayer perceptrons and radial-basis neural networks, the use of which has several drawbacks, limiting their use in solving many practical problems is proposed. The advantage of the proposed predicting method over traditional neural networks is the ease of numerical implementation, essential reduction in time to perform the operation, this method allows to handle significantly non-stationary processes, containing both irregular trends, and sudden jumps, and allows to complicate the architecture of neural networks without the need to recalculate already adjusted synaptic weights. Training by epochs, used in training multilayer networks can be used for training such neural network. That is why, since only one hidden layer is studied, the considered neuronetwork model is still configured faster than the standard three-layer perceptron

Keywords: predicting model, polynomial orthogonal neural network, Chebyshev polynomials, ortho-synapse, synaptic weights

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SOME METHODS OF AUTOMATIC GROUPING OF OBJECTS (p. 20-24)

Natalia Kondruk

Cluster analysis is relevant and widely used in information systems, medicine, psychology, chemistry, biology, public administration, philology, marketing, sociology and other disciplines. However, the wide use causes coherence and unambiguity problems of the mathematical apparatus for cluster analysis. In particular, taking into account that clustering data can have different physical meaning and that the objects similarity criteria are not universal and can be defined for different applied problems in different ways, building alternative (to the already known) similarity coefficients, which meet the emerging needs for grouping objects of new applied problems is relevant. Therefore, the purpose of the paper is to improve the efficiency of solving the cluster analysis problems by developing general methods and algorithms for clustering objects based on the "angular" and "length" metrics and binary relations. General method for clustering objects based on fuzzy binary relations is developed in the paper. Semimetrics, characterizing the proximity degree of vectors of object features by the "angular" and "length" similarity are determined. Clustering algorithms, based on grouping objects by the introduced angular and length semimetrics are built. Software implementation of this method has shown its effectiveness in solving various applied problems and ease of use

Keywords: cluster analysis, cluster, fuzzy binary relations, objects splitting, clustering objects

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INFORMATION TECHNOLOGY OF FORECASTING NON-STATIONARY TIME-SERIES DATA USING SINGULAR SPECTRUM ANALYSIS (p. 24-30)

Anna Chistyakova, Boris Shamsha

The information technology of forecasting non-stationary time series data, which cannot be reduced to stationary is proposed in the paper. Today, this time series class is often found in various fields, including economics, sociology, and is characterized by nonlinear trend, presence of several periodic components with variable frequency and amplitude, high noise level. Identification of non-stationary time series components is achieved using the method of singular spectrum analysis (SSA), which does not require a priori information about the time series structure. It is proposed to use several phase spaces, which can be constructed using different parameter of time window length in the SSA method, for building the models of predicting and identifying the most stable time series components. It is assumed that the time series is described by linear recurrence formulas, the coefficients of which are calculated in various phase spaces. Forecasting results are characterized by stability and efficiency as the non-stationary time series data analysis is performed in various states of the system and the most significant components are considered. The proposed information technology allows to select the amount of con-

sidered phase spaces in the forecasting model and their dimensions, as well as to make an effective short-term forecast of non-stationary time series data.

Keywords: time series, forecasting, information technology, singular spectrum analysis, phase space

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THE STATISTICAL MODEL OF MECHANICAL MILKING DURATION OF FARMYARD MILKING INSTALLATION (p. 31-37)

Volodymyr Kucheruk, Yevhen Palamarchuk, Pavlo Kulakov, Tatiana Gnes

Based on the conducted theoretical studies, a statistical model that establishes the functional relationship between statistical characteristics of the milking duration of the farmyard milking installation for animal tied housing and statistical characteristics of the animal preparation time, statistical properties of the milking time, number of animals, number of milking machines, type of milking machine was developed. The model takes into account the use of milking machines with the milking process control function and milking machines without this function. The developed statistical model of the milking duration of the farmyard milking installation will allow to improve the accuracy of determining the productivity of the milking installation in its designing or upgrading, develop a methodology for designing data-measuring systems of parameters of technological processes of milking and dairy rooms and automatic control systems of livestock farms. The results of the theoretical studies were proved by the experimental data. The discrepancy between experimental results and theoretical calculations does not exceed 12 % that indicates the adequacy of the developed model

Keywords: milking, milking duration, animal preparation, statistical model, farmyard milking installation

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IMITATING MODELLING OF DATA PROCESSING IN INFORMATION SYSTEM (p. 37-42)

Michail Safonov

The information system with using distributed databases, where inquiry processing is performed in the order of the queue at each workstation is described. It is found that predictive methods are focused on the narrow use and not suitable for widespread use in information systems. The operation logic of the imitating model in terms of events, related to issuing commands from the main system to the control object is described. The steps to ensure that the data on the duration of executing the commands, received from control objects, turned into the probability density of random variables are defined. The relative frequency of events in the system is determined. Using predictive methods and knowledge about previous states of information system, progressive function, which can provide information about its future states with a certain probability, is formed. As well as all other imitating models with discrete events, this model describes the situation with the queue, in which data flows arrive from control objects before constructing the information system model. The considered system consists of one queue and N workstations (N control objects in information system). The queue is set by sequence of processing control objects in the initial priorities, calculated based on the workstation parameters. Empirical and theoretical functions of the system states are created. During the imitation, it was found that the average deviation of the theoretical distribution from empirical does not exceed 10 % that indicates the feasibility of using the exponential function as predictive for the given system with the queue.

Time of staying of the simulated system in the steady state is estimated and is equal to 2.7 seconds. It is concluded that this time is enough to predict the next state of information system that will allow timely and uniform load distribution among the workstations.

Keywords: imitating modeling, queue, inquiry processing, queuing system, empirical function

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ESTIMATION OF PARAMETERS OF POLIGAUSSIAN MODELS BY MAXIMIZATION METHOD OF POLYNOMIAL (p. 43-46)

Anatoliy Chepinoga, Serhii Zabolotnii, Elena Burdukova

Perspective direction for solving various problems of processing signals and random sequences is application of poligaussian models (gaussian mixtures). To estimate the parameters of these models in this paper first time is suggested to use a maximization method of polynomial (method Kunchenko). This method uses a moment-cumulant description of random variables. It is positioned as an alternative between the method of moments and maximum likelihood method.

The article presents the results of estimating the parameters of the bigaussian model to approximate the empirical probability density. Were calculated coefficients decrease estimation variance. And also assessed the adequacy of the approximation using the chi-square test. According to the results of the research can be concluded about the big advantage of method Kunchenko over method of moments and the approximation of its efficiency to the maximum likelihood method.

Further studies are aimed at estimation of parameters of poligaussian models of higher orders and development on their basis the generators of random sequences

Keywords: poligaussian distribution, maximization method of polynomial, moment-cumulant description, statistical modelling

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INSTABILITY IN DYNAMIC BALANCE OF VOLTERRA-LOTKA SYSTEMS WITH PERTURBATIONS IN THE RIGHT SIDE (p. 47-50)

Mohammad Rakan Abed Alnabi Alja'afreh

The basic effects and patterns that characterize the model of coexistence of two species with weak sinusoidal external effect on the reproduction rate is considered. Solving Lotka-Volterra differential equations describes the behavior of the elementary ecosystem. Numerical solutions for exposure frequencies, close to the frequency of the unperturbed system cycle are found. The stability of such a non-autonomous system is investigated.

It is determined that the sinusoidal effect on the population, e.g., by changing the reproduction rate of one or both species because of seasonal changes in nutrition or hunting leads to a nonperiodic system dynamics, having the type of degenerate 2-dimensional non-resonant torus. Various forms of irregular behavior of "predators" and "victims" appear in the phase portraits for similar perturbations. All this confirms that even relatively simple models of ecosystems reveal their instability, i. e., sensitivity to small external perturbations

Keywords: Lotka-Volterra model, stability problem, phase space, attractor, chaos, non-resonant torus.

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METHOD FOR CONSTRUCTING APPROXIMATING CURVES FOR EVALUATING AND PREDICTING THE FLOOD WATER LEVEL (p. 50-54)

Oksana Klapoushchak

The developed method for predicting the flood water level allows to analyze statistical data from meteorological stations (precipitation, humidity deficit and wind speed) to predict the water level in rivers during floods.

The method for constructing approximating curves was performed on the basis of statistical data on the Prut River level and meteorological data (precipitation amount, air humidity and wind speed) from meteorological stations in the cities of Yaremcha, Kolomyia and Chernivtsi during the flood waters from 24.07.08/03 to 25.07.08/15.

The obtained results and the proposed method will allow to predict flood waters, and the more data from meteorological stations the more accurate the weather forecast that will allow to reduce economic costs and avoid casualties during flood waters. Currently, studies of the influence of one meteorological data on the other, and their impact on rising the water level in rivers using contingency factor are carried out. Having revealed the correlation of data from meteorological stations and data on the water rise level, further studies will be directed at determining the model adequacy. However, the proposed model has confirmed the fact that the 100 m/house and more [18] cause catastrophic river water level rise, and also gives grounds to confirm the model adequacy

Keywords: flood water level, meteorological data, approximating curves, statistical data, predicting

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DATA ANALYSIS OF COMPLEX OBJECTS USING A MODIFIED CLUSTERING ALGORITHM (p. 55-59)

Tetyana Shatovska, Olga Dorogko

At the present moment, the development of universal and reliable methods and approaches suitable for processing information from various fields, including the solution of problems that may arise in the medical field, is an urgent problem. In the treatment of complex diseases of the musculoskeletal system, whose etiology is not fully disclosed and requires additional investigation, is no exception. As a result of the analysis, it was concluded that for solving such kind of problems with ambiguous, variable data it makes sense to use a modified clustering algorithm.

The algorithm allows to apply specific, the most suitable method for current data at each stage of the study. The study of the final stage of the algorithm – integration of similar classes for obtaining the final partition.

The idea of considering a complex object – the musculoskeletal system appeared as the result of analyzing specific articles of the complex object.

As a result of the studies it was concluded that the modified clustering method with integrating similar classes for obtaining the final partition makes sense to use in experiments with a complex object – the musculoskeletal system. Experimental data will be presented with the development of the problem under consideration.

Keywords: clustering, modification, modified clustering method (the Chameleon algorithm), hierarchy, graph

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ASSESSMENT OF INVESTMENT RISK IN IMPLEMENTING ENTERPRISE PROCUREMENT PLAN (p. 60-64)

Tatiana Katkova

The problem of assessing the risk, arising from implementing the enterprise procurement plan is considered in the paper. The task of forming the procurement plan is reduced to solving a non-trivial problem of rational allocation of total investment between private investment projects, which together determine the selected procurement strategy.

This problem is formulated as an optimization problem of mathematical programming with nonlinear separable objective function and linear constraints.

The allocation efficiency criterion is profit, expected from implementing the procurement plan.

The real difficulty in solving this problem is that the parameters of the objective function are random variables. Therefore, for any allocation of investment funds, which satisfies the constraints, the allocation efficiency criterion value also becomes random. In this connection, there is a specific problem of estimating the uncertainty level of the result of funds allocation between investment projects and the risk of possible solutions.

The problem is solved as follows. First, statistical estimation of probability-theoretic characteristics of the objective function parameters is performed. Furthermore, by expanding the target function in a series, its linearization is made. After that, the calculation of the mathematical expectation and variance of a random value of the criterion is conducted that allows to determine interval estimates of the expected value of the profit, expected from implementing the selected procurement plan.

It is clear that the obtained plan efficiency estimates are more informative than point and can be used when selecting the rational investment plan

Keywords: investment risk, decision-making, procurement plan

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