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YURII YERMOLIEV 80th ANNIVERSARY

Yuri Yermoliev graduated from Taras Shevchenko State University of Kyiv (TSSUK) (Department of Mechanics and Mathematics) in 1959 and started his academic career at the Institute of Cybernetics (IC), Academy of Sciences of UkrSSR. Y.Yermoliev obtained his Ph.D and Dr.Sci. degrees (Physics and Mathematics) in 1964 and 1970, respectively, at the IC (supervisor – V.Michalevich). Y.Yermoliev has been Head of the Department of Mathematical Methods of Operations Research at the IC in 1971–1992 and Professor of TSSUK (Chair of Economic Cybernetics) since 1972. Professor Y.Yermoliev was elected Corresponding Member and Member of the Academy of Sciences of UkrSSR in 1976 and 1988, respectively.

Academician Y.Yermoliev has been working at the International Institute for Applied Systems Analysis (Laxenburg, Austria) during 1979–1984 and since 1991, taking part in projects on methodologies and applications, editing the book of Springer Series in Computational Mathematics (1988) and the book series of Lecture Notes in Economics and Mathematical Systems devoted to coping with uncertainty (2009), robust solutions (2010), managing safety of heterogeneous systems (2012), dynamic stochastic optimization (2013). Academician Y.Yermoliev is the author of numerous refereed articles on stochastic quasigradient methods and their applications, robust decisions, topical issues of applied systems analysis.

Academician Y.Yermoliev has created the recognized international school in stochastic optimization supervising about 50 PhD students. Y.Yermoliev was awarded the State Premia (1972, 1981), the Kjell Gunnarson's Risk Management Prize of the Swedish Insurance Society (1997), the title of Pioneer in Stochastic Programming of the Mathematical Programming Society (2005), the title of Honorary Professor at the China University of Mining and Technology (2015).

All participants of an international conference “Problems of Decision Making under Uncertainties” are sincerely congratulating Yuri Yermoliev on his 80th birthday and wishing him good health, happiness, prosperity, inspiration and many more academic advances.

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ON MAKING ETHICAL DECISIONS: PROCESS AND REALITY

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The object of the present paper is the world-view research about how we need to make distinctions between competing choices and take consequences into account when making ethical decisions. It is well known, that ethics is a system of moral principles. They affect how people make decisions and lead their lives. Ethics is concerned with what is good for individuals and society and is also described as moral philosophy. Modern thinkers often teach that ethics leads people not to conclusions but to 'decisions'. In this view, the role of ethics is limited to clarifying 'what's at stake' in particular ethical problems. Philosophy can help identify the range of ethical methods and value systems that can be applied to a particular problem. But after these things have been made clear, each person must make their own individual decision as to what to do, and then react appropriately to the consequences. We must note here, that situation ethics rejects prescriptive argues that individual ethical decisions should be made according to the unique situation. Rather than following rules the decision maker should follow a desire to seek the best for the people involved. There are no moral rights - each case is unique and deserves a unique solution [5].

The paper outlines ethical decision-making refers to the process of evaluating and choosing among alternatives in a manner consistent with ethical principles. In making ethical decisions, it is necessary to perceive and eliminate unethical options and select the best ethical alternative. Ethical decisions come from a place of conscience. For many, conscience is simply an internal source of reward and punishment. But according to *an American psychologist, researcher and moralist Lawrence Kohlberg*, conscience is only one of several ways in which values are represented in the personality. Kohlberg believes there are higher levels of moral development and these are acquired in stages. According to Kohlberg, punishment orientation is the stage in which actions are evaluated in terms of possible punishment, not goodness or badness. The next stage in ethical decision-making is where motivation to make a choice is based on authority orientation. In order, this is where emphasis is on upholding law, order and authority as doing ones' duty or in doing that which will please others and give immediate praise. The final stage is morality of individual principles where behaviour is directed by self-chosen ethical principles that tend to be

general, comprehensive or universal. High value is placed on justice, dignity and equality [3].

The paper discusses that the process of making ethical decisions requires: commitment - the desire to do the right thing regardless of the cost, consciousness - the awareness to act consistently and apply moral convictions to daily behaviour and competency - the ability to collect and evaluate information, develop alternatives, and foresee potential consequences and risks. Castes or groups in society may have their own moral syndromes that simplify the types of decisions they make. *An American-Canadian journalist and moralist Jane Jacobs* claims there are two irreconcilable moral syndromes that arise from those contrasting views: Guardian Syndrome and Trader Syndrome [2]. *An American economist and moralist Paul Adler* defined markets, hierarchies, and communities as three different ways to resolve and make an ethical decision [1]. *An American scientist, linguist and moralist George Lakoff's* theory of moral politics states that these arise from family role differences ultimately, with a moral code emphasizing the logos or "rule" of the father as being the source of the motivations of the political "right", and one emphasizing the more merciful moderns or mother-like view as being moral source for the "left"[4].

The paper concludes that the best decisions are both ethical and effective. What does it mean? Ethical decisions generate and sustain trust; demonstrate respect, and are consistent with good citizenship. These behaviours provide a foundation for making better decisions by setting the ground rules for our behaviour. Effective decisions are effective if they accomplish what we want accomplished and if they advance our purposes. A choice that produces unintended and undesirable results is ineffective. The key to making effective decisions is to think about choices in terms of their ability to accomplish our most important goals. This means we have to understand the difference between immediate and short-term goals and longer-range goals. An ethical decision is one that engenders trust, and it's indicative of responsibility, fairness and caring. Making an ethical decision consists of reviewing among different options, eliminating those with an unethical standpoint, and finally choosing the best ethical alternative.

References

1. Adler Paul, *The Firm as a Collaborative Community: The Reconstruction of Trust in the Knowledge Economy*, First Edition, New Zealand, Published by "United Book Company", 2000 (In English).
2. Jacobs Jane, *Systems of Survival: A Dialogue on the Moral Foundations of Commerce and Politics*, New-York, Published by "McGraw-Hill Companies", 2005 (In English).

3. Kohlberg Lawrence, the Philosophy of Moral Development: Moral Stages and the Idea of Justice, Series: "Essays on Moral Development", Volume One, London, "Wiley Publishing", 1991 (In English).
4. Lakoff George, Moral Politics: How Liberals and Conservatives Think, Third Enlarged Edition, Chicago, Published by "La Salle University Press", 2002 (In English).
5. Weber Max, the Protestant Ethic and the Spirit of Capitalism, Edited by Rey Chow, New York, Published by "Columbia University Press", 2002 (In English).

ABOUT K -THEORY OF HOMOLOGY BASED ON REGULAR PARTITIONS

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Let LP_2 be a category of pairs of locally compacted paracompact spaces and their own mappings.

For the pairs $(X, A) \in LP_2$, arbitrarily chosen locally-finite fixed simplicial (cell) complex K , arbitrary Abelian additive group G and any integer $n \in \mathbb{Z}$, there is built so-called n -dimensional K group of projection K -chains $C_n^K(X, A; G)$ of spaces pairs (X, A) over a group of coefficients G , based on regular partitions, and at the same time, a chain complex of groups $C_* = \{C_q(X, A; G), \partial\}_{q \in \mathbb{Z}}$, where K -boundary operator ∂ .

Factorgroup denote by $H_n^K(X, A; G)$ and is named by n -dimensional K -group of Baladze-Chogoshvili homology of pairs $(X, A) \in LP_2$ over a group of coefficients G , based on regular partitions.

In order to study basic properties of the developed K -theory of Baladze-Chogoshvili homology H_*^K , on the basis of complex K and chain complex $C_* = \{C_q(X, A; G), \partial_q\}_{q \in \mathbb{Z}}$ there is build a bigraded complex

$C_{*,*} = \{C_{p,q} \mid p, q \in \mathbb{Z}\}$ and its total complex. Further, the spectral sequence is constructed on a decreasing filtering of the total complex. It has been established that the second member of this sequence is as follows: $E_{p,q}^2 \approx H^p(K; H_q(X, A; G))$. The given theory verifies the validity of Eilenberg-Steenrod axiom and two Milnor axioms with the help of comparison theorem.

The paper deals with all the above mentioned issues.

FRAMEWORK OF THE DECISION SUPPORT SYSTEMS BY NEUTROSOPHIC SETS

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Good decision-making requires an accurate assessment of the current and evolving situation, as well as a clear understanding of the options available for dealing with a given situation. On the other hand, efficient decision-making requires aggregating the information that describes the different parameters of the environment. This aggregation is usually performed applying multi-criteria decision making methods. The acquired initial information usually embraces a lot of the vagueness of the elements, which cannot be processed applying traditional crisp form. Neutrosophic sets are applied to correctly model uncertain initial information.

These investigations were based on Leader Behavior Description Questionnaire. There were considered 12 subscales as ground of formalization for system of criteria of leader behavior. The system of criteria allowed evaluating numerical values of basic characteristics of leadership and using all the tools of multiple-factor estimation for analysis of groups of individuals.

Consider formalized representation of problem. Let X be set of individuals which should be evaluated from point of view leader behavior, $X = \{x_1, x_2, \dots, x_n\}$. Each element $x_i \in X$ is evaluated by set of criteria $K = \{k_1(x), k_2(x), \dots, k_m(x)\}$ which characterize main leadership qualities.

The general problem consists in ordering elements of set X on the ground of criteria $k_1(x), k_2(x), \dots, k_m(x)$. In other words the problem assumes constructing rating of $x_1, x_2, \dots, x_n$ based on scalar multiple-factor estimates formed from $k_1(x), k_2(x), \dots, k_m(x)$. Particular case of the general problem consists in choosing “best” element of set X , i.e. individual with best general level of leader behavior.

THE IMPACT OF INDUSTRY CHARACTERISTICS ON FIRMS' EXPORT INTENSITY: A CASE OF LITHUANIA

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The interaction between the enterprise personality and the international business activities with the use of direct exports in 2011-2013 years are explored using a large-scale survey of 353 firms in Lithuania covering the manufacturing, whole sale and other sectors. Using this sample, we assess the use of two types of export, namely any export and direct export. The assessment is developed, first, by using descriptive statistics to compare the features of the different types of enterprises and position within the enterprise in the sample: the owner, director/general manager and other heads of businesses. This descriptive analysis is completed with a test of equality of means. This enables us to check whether the differences between the means of the different variables used for analyzing the two types of export in the sample, are significant. For nominal variables, there are used a Chi-Square test, for ordinal variables a “U” Mann-Whitney test and for continuous variables an ANOVA. In order to compare the results among companies, Lee (2006) used the same type of test.

Finally, a third element of evaluation is added: the use of statistical regression estimation based on the General Linear Model (GLM), so as to evaluate the existence of dependence relations between the export nature and size, both of owner and director/general manager leadership style businesses. This kind of statistical analysis has been applied because the dependent variable was constructed as dichotomous.

It should be noted that although no published works have been found on businesses internationalization and leadership style which specifically use the General Linear Model, Lansberg and Astrachan (1994) used this model to analyze issues regarding the management of the family business, in particular, family relationships and their influence on the succession process.

THE IMPACT OF MOTIVATION FACTORS ON VIP PROTECTION DEPARTMENT'S EMPLOYEES: A CASE OF LITHUANIA

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Taking in the consideration the complexity of the object in this study, investigation of the empirical study was divided into few parts. One of these parts connects three studies based on different empirical research methodology. The study was devoted to analyse the context of turnover tendency situation in the VIP protection department and to identify the main reasons for leaving the Department in recent three years according to the Interior Service Statute Article 53. Moreover, the evaluation of factors, which encourages employee turnover, was done. This study concluded primary data collection and analysis. The collected data let us to determine the VAD interviewed employees' satisfaction and dissatisfaction after conducted factorial analysis. After this analysis were identified latent (invisible) factors which affecting employees' satisfaction and dissatisfaction with a job. The additional experts study was chosen because of its logical analysis of the problem. This empirical study was chosen like the most appropriate for evaluation the factors influencing employee motivation to work from the Department chief's side. According to the Department employee and experts' survey, linear logistic regression model was generated. It allowed predicting whether employee will be thinking about leaving or not.

Summarizing the results of the investigation, it was found that all employees, who regularly think to leave, want to quit because of high workload and stress at work. Often thinking to leave employees chose small salary, upward needs and downward of the social guarantees.

The designed linear regression model let determine the most important motivation factors. Also calculations showed, that if incentives and motivating factors are excluded, employees will be thinking to leave the Department. It was also found that for people with higher education must be given special attention.

SECURITY ENHANCEMENT IN WIRELESS LOCAL AREA NETWORKS

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Security is a very important issue for wireless Local Area Networks (LAN) because the communication signals, spread in the environment, are available to be caught. Therefore, companies and an individual customer should be aware of any potential problems they face and they should take the appropriate measures.

Any system, which needs protection, has its weak points that can be partially or altogether used by an attacker. Correspondingly, one of the approaches for the development of security mechanisms is the analysis of all those threats and alleged attacks that face the system, and taking into consideration the fact that the system has drawbacks as well. The security mechanisms should ensure security to avoid all the above mentioned threats, attacks and drawbacks. For example, the hackers' attack can be resulted in getting an unauthorized access to network system or just disrupt the system and steal the information of company. The attack represents an attempt to circumvent the security control mechanisms of a computer. The attack can cause the change or loss of information or data. The examples of attacks are: data stolen from the transferable environment and devices, obtaining illegal privileges, misleading the data, modification of information, network flow analysis, etc.

For instance, by using different software tools any intruder can easily find unprotected packages of a wireless network and fully get all of its data.

At the initiative of network administrator in wireless LAN or with the help of automated security system in automated mode it is necessary to scan the network periodically. It would help to reveal the drawbacks of network and carry out the logical and structured process of security monitoring. Network scanning allows to organize the process of checking a computer network of any scale and collecting information. During the network scanning it is possible to scan both individual IP addresses and all the IP addresses. It is also possible to scan for a specific interval.

The article deals with all the above mentioned issues precisely.

GENERALIZED CONTROL SYSTEMS AND OPTIMIZATION ALGORITHMS

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Science-based support of optimal decision making under real-life uncertainties needs solutions of complex optimization problems. We consider control optimization problems in search for optimal control functions u of a given control system

$$f_1(t, s, x(t, s), u(t, s), \frac{\partial x(t, s)}{\partial t}, \dots, \frac{\partial^{\alpha_x^1} x(t, s)}{\partial t^{\alpha_t^x} \partial s^{\alpha_s^x}}, \frac{\partial^{\alpha_u^1} u(t, s)}{\partial t^{\alpha_t^u} \partial s^{\alpha_s^u}}) = 0$$

that minimize a given functional

$$J(x, u) = \iint_{D_0} f_0(t, s, x(t, s), u(t, s), \frac{\partial x(t, s)}{\partial t}, \dots, \frac{\partial^{\alpha_x^0} x(t, s)}{\partial t^{\alpha_t^x} \partial s^{\alpha_s^x}}, \frac{\partial^{\alpha_u^0} u(t, s)}{\partial t^{\alpha_t^u} \partial s^{\alpha_s^u}}) ds dt,$$

and satisfy given constraints

$$\iint_{D_l} f_l(t, s, x(t, s), u(t, s), \frac{\partial x(t, s)}{\partial t}, \dots, \frac{\partial^{\alpha_x^l} x(t, s)}{\partial t^{\alpha_t^x} \partial s^{\alpha_s^x}}, \frac{\partial^{\alpha_u^l} u(t, s)}{\partial t^{\alpha_t^u} \partial s^{\alpha_s^u}}) ds dt \leq 0, \quad l = \overline{1, n_1},$$

$$h_i(t, s, x(t, s), u(t, s), \frac{\partial x(t, s)}{\partial t}, \dots, \frac{\partial^{\alpha_x^i} x(t, s)}{\partial t^{\alpha_t^x} \partial s^{\alpha_s^x}}, \frac{\partial^{\alpha_u^i} u(t, s)}{\partial t^{\alpha_t^u} \partial s^{\alpha_s^u}}) = 0, \quad i = \overline{1, n_2}.$$

Many known numerical algorithms for calculating approximate solutions of such general optimal control problems are based on an adequate reductions of the initial optimal control problem to the problem of nonlinear programming with the use of adequate difference approximations for partial derivatives. We construct optimization algorithms to refine the calculated approximate solutions using various optimality conditions.

For convex problems we prove theorems of convergence to a generalized solution. In case of linear optimization problem the optimal solution is calculated by accelerated algorithms using interior point methods.

ON-LINE NEURO-FUZZY BIG DATA AUTOENCODER FOR DEEP NEURAL NETWORKS AND ITS RAPID LEARNING

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Data compression task is one of the main problem of Data Mining (Data Reduction). For its solving a lot of approaches, which operate in batch mode, are proposed. Inherent part of deep neural networks is an autoencoder [1], which solves this task based on neural network approach. Such systems as autoassociative perceptron «bottle neck» and restricted Boltzmann machine are the best known. These systems process an information in batch mode. Under the conditions when data are fed in on-line mode (one by one), for example, from VLDB or cloud, and their volume is practically unlimited, the well-known approaches of data reduction become ineffective. In the paper the architecture of neuro-fuzzy autoencoder and its learning algorithm are proposed. Such approach allows to solve data compression (reduction) tasks in on-line adaptive mode. This system is autoassociative «bottle-neck» modification of neuro-fuzzy Kolmogorov's network and is based on two-level fuzzy rules system. Such system implements the multiresolution approach and in accordance to Kolmogorov-Arnold theorem and Yam-Nguyen-Kreinovich one is universal approximator.

The nodes of autoencoder are neo-fuzzy neurons, which contain the set of non-linear synapses with triangular membership functions that satisfy to unity partitioning. This fact allows to reduce a number of tuned synaptic weights, which are needed to define in each current instant of discrete time that, in turn, it accelerates the learning process. The tuning process of the autoencoder is based on the error backpropagation algorithm, but, due to using the triangular membership functions, whose derivations are constant, we can implement the speed optimization of learning algorithm using approach [2]. Proposed autoencoder is simple in numerical implementation, is characterized by high speed of information processing and provides high quality of data compression.

References

1. Schmidhuber J. Deep learning in neural networks: An overview // Neural Networks. – 2015. - vol. 61. – PP. 85-117.
2. Otto P., Bodyanskiy Ye., Kolodyazhnyi V. A new learning algorithm for a forecasting neuro-fuzzy network. – Integrated Computer Aided Engineering. – 2003. – 10(4). – PP. 399-409.

ON REPLICATED NEURAL NETWORKS VULNERABILITIES

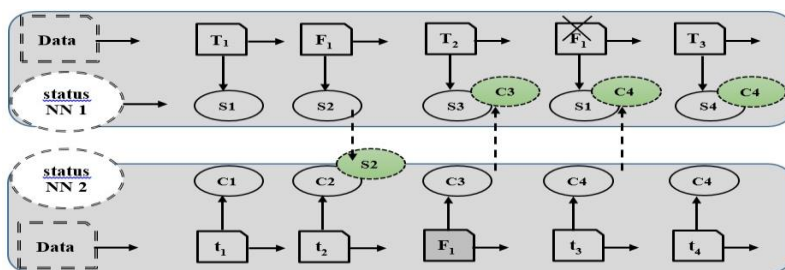
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In [1] is seen how compromised data in the machine learning (ML) system based on neural network (NN) will lead to degradation of the ML due to loss of opportunities of constant training of NN..

Even worse situation will be in case of 2 or more replicated NN that process data in different channels in ML, which can meet the same facts from different sources. This case will summarize the work of its NNs. For example, the data that increased the weighting coefficients of connections in NN, is summarized in replicated conditions and regularly distribute to all



NNs. For example, the first NN works with raw data and in case of the detection of compromised data F_1 , as in case with only one NN [1], may roll back to the previous correct state ($S1$). A second NM works with secondary-tertiary sources, in which compromised data is not always recognized, but they "improved" their condition. And this compromised state ($S4$) (having improved weight in relations) goes into replicated states and finally is written in the 1st NM instead of the right $S1$. Accordingly, the decisions made from this ML will be compromised. Thus, the ML system with one NN emerges from the compromised state more easily. So there is a choice between using one super powerful NN and a distributed network of replicated NNs that compromised more easily.

References

1. Bondarchuk Y.V. About risks discrediting machine learning // XXIX International conference "Problems of decision making under uncertainties" (PDMU-2017). 10-13.5.2017, Mukachevo, Ukraine, – P. 24.

BUILDING OF SYSTEM FOR FINDING ALGORITHM WITH ADAPTATION RULES

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The process of expert systems creation has changed significantly over the last years. Due to the emergence of special tools time of their development was greatly reduced and complexity decreased. But the requirements for the complexity of the process also increased [1]. For many of these processes there is a relevant and important evolutionary adaptation of rules. And it needs a development of appropriate tools which will not only make decision-making possible, but will also reflect the features of the system and allow to work effectively with dynamic input data.

We consider the problem with evolutionary and adaptive rules for determining points in time.

Denote them: R_i , where $i = \overline{1..n}$. (1)

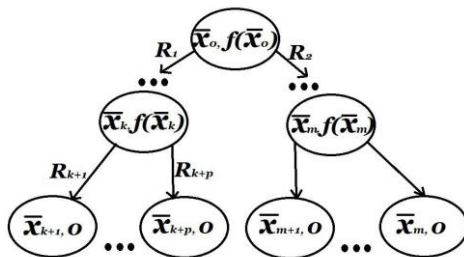
Rules can be added or changed at any point of time. Each rule has input and output state, and also weight of the rule, which can be interpreted as an expense:

$$R_i : \bar{x}_i \rightarrow \bar{y}_i (w_i). \quad (2)$$

On input is the initial state $\bar{x}_0$. We need to find a function of compositions of rules with the minimal amount of weights, which has transferred from the initial state to the final state:

$$F = R_{i1} \circ \dots \circ R_{ik}, F(\bar{x}_0) \in X^*. \quad (3)$$

The rules have input and output states, so we used tree structure (pic. 1). Root - is the initial state. If there are several initial states, we introduce an artificial state that will integrate them. For speed dynamic recalculation of rules segment tree is chosen as data structure [2].



pic. 1 Structure of segment tree

In the vertices of the trees we record minimal weight of subtree using the evaluation function (4). Program calculates this value using recursive bypass by formulas (4, 5)

$$f(x_k) = \min(f(x_{k+1}), \dots, f(x_{k+p})) + w_k, \text{ where } \forall i \in \overline{1..p} R_k : \bar{x}_k \rightarrow \bar{x}_{k+i} \quad (4)$$

$$f(x^*) = 0, \text{ where } x^* \in X^*. \quad (5)$$

When adding a new rule, we do not need to recalculate all tree, but only a subtree which new rule is attached (removed) to (from). If the calculated value at some point is more than the value in the parent vertex you can stop the calculation. It follows from (4). Since the height of the tree is $\log(n)$, then the count of values takes $\log(n)$ in the worst case.

For example we have n rules, so to preserve the tree segments we need to save all the values and their connections:

$$O(n * \log n).$$

Construction of such tree will take as it is enough to recursively bypass all the vertices and calculate their minimum value, which is a simple operation. Adding new rules or deleting old rules takes only $O(\log n)$, which means only one branch pass. A composition function calculation takes $O(\log n)$.

References

1. Expert systems. electronic journal. Available at: https://uk.wikipedia.org/wiki/Експертні_системи
2. Segment tree. electronic journal. Available at: http://e-maxx.ru/algo/segment_tree

MINIMIZATION OF ROAD CONGESTIONS USING MULTIFUNCTIONAL JUNCTIONS

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Road traffic congestion is one of major problems of modern society negatively impacting an overall economic development and influencing a climate change.

The report presents cumulative economic losses due to road congestions and analyzes their causes. The analysis pinpoints several problems related to ineffective allocation of work places and streets, insufficient integration of private and public transport, and ineffective road junctions. All these elements produce an excess of vehicles causing the congestion. Currently used congestion mitigation methods and measures are evaluated from the perspective of their effectiveness.

A concept of multi-modal city transportation system is presented. Its main accent is concentration of work places and multi-modal public transport hubs in easily accessible locations on intersections of major radial city roads. The concept would allow accumulating a substantial portion of private vehicles and eliminating their number from the streets. Special multifunctional junctions could be used to achieve this result. These junctions have one special feature distinguishing them from the conventional junctions – they not just distribute traffic flows without intersections, they also utilize their area for an additional infrastructure. It is crucial that the infrastructure can be reached without intersecting other traffic flows. Therefore, they become junctions of an uninterrupted flow with an added functionality. One of such junctions – the Pinavia junction – is presented in detail together with its mathematical model used for its optimization. The junction is then analyzed from the perspective of ecology and economy. It is also compared to the most popular conventional interchanges. The junction needs only two levels although it is functionally superior and substantially less expensive compared to a traditional four-level stacked interchange. Also, its safety, capacity and functionality exceed that of a “clover-leaf” junction. In conclusion, the new-generation multifunctional interchanges may be used as key elements of congestion-free city transportation systems.

RUSSIA'S AGGRESSION IN UKRAINE AS AN OUTCOME OF FUZZY SYSTEMIC ENVIRONMENT

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Russia's invasion in Ukraine in February 2014, annexation of Crimea and its support for proxy war in the Donetsk region have been results of the fuzzy systemic environment. It is obvious that Russia's military had plans how to invade Crimea and defend it prior to the February 27th, as the Sevastopol is of strategic importance to maintain one of largest naval bases. However, it is important to discuss what elements allowed Russia to choose intervention over multiple other foreign policy strategies?

The explanation is provided basing analysis on the neoclassical realism theory and its research methodology. In short term period (days – months) states take decisions in the fixed international environment. States have to react to crisis and resources available to them, facing opportunities or pressures of the system, while precise actions are outcomes of their domestic elements.

Russia had favorable distribution of power in the relation towards Ukraine. Russia was certain that relative military capabilities will be in its favor, as a consequence of political disarray in Ukraine and later defections of military as well as commanding personnel supports this argument. For the West, Moscow's decision to intervene was unexpected as normative approach was totally different. Ukraine lacked capabilities and resolve to resist which was lowered by deceptive military tactics even more. Russia had not had certainty that favorable balance will persist, so it acted when the opportunity emerged. Russia had higher clarity for its actions compared to the West.

It also has to be noted that Russia had permissive strategic environment which allowed it to use military. According to census of 2001 the 60 percent of Citizens of Crimea have been ethnic Russians and Russian language dominated in the peninsula. Decision of Ukrainian Parliament to change of law on state language created even greater support for Russia by Russian speakers. This ensured popular support for the intervention in Crimean peninsula. The same is true for eastern part of Ukraine. Ukraine is not a member of NATO and an example of Russian – Georgian war indicated that in case of an attack, NATO will be passive.

Finally – the elements of leader image and Russia's strategic culture played a defining role in decision to intervene.

THE STOCHASTIC VOLATILITY MODEL

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Consider the Bleck-Shoels model in the proposed form [1]

$$ds / s = \mu dt + \sigma dw_t, \quad dB_t = rB_t dt, \quad (1)$$

where s - asset rate, μ, σ - constants, r - current interest rate, B_t - current share price, w_t - standard Wiener process.

This financial market model with regard stochastic volatility is not objective to real statistic. In the proposed model the dependence of volatility from time describes the real behavior of the system only on local intervals. That's why, the task is to build a model that describes the real property market. Since the distribution of the average volatility relatively real market data is not Gaussian, the changes that occur over time in the market characterized by Semi-Markov process [2].

Then the first equation is determine by the stochastic differential equation:

$$ds / s = \mu(t, x)dt + \sigma(t, x)dw_t,$$

where the functions μ (the share price taking into account dividend payments) and σ (the historical volatility taking into account not normal distribution) depend on two components: t - time, x - the Semi-Markov process in terms of setting the task [2]. The second equation for stochastic volatility has a representation:

$$d\sigma_t = a(\sigma_t)dt + b(\sigma_t)dw_t,$$

Where σ_t - volatility over time interval t , a, b - some functions.

References

1. Gormin A. A., Kashtanov Y. N. The weighted variance minimization for option pricing. Journal of Monte Carlo Methods and Applications. – 2007. – vol. 13, № 5-6. – PP. 333 - 351;
2. Кукурба В.Р. Непрерывная процедура стохастической оптимизации с полумарковскими переключениями в схеме диффузионной аппроксимации. / Кукурба В.Р., Чабанюк Я.М. // Кибернетика и системный анализ. – 2013. – Том 49, № 6. – С. 92-100.

DIFFICULTIES REGARDING PRACTICAL REALIZATION OF ECTS SYSTEM

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Although we generally positively evaluate the Bologna process and the credit system offered by it, we realize that not all the educational transformations are successful and there are some certain difficulties. As a rule, all innovations usually face some obstacles and ECST system is not an exception. Thus, the solution of problems requires a scientific approach, analysis of the results and developing of the new best options. Therefore, we would like to draw attention to the educational process and the determining factor of student mobility - the introduction of the credit transfer and accumulation European system, its practical realization and further development.

So, the difficulties, regarding practical realization of the ECTS system, are the following:

- the correspondence between the curriculums and ECTS credits and the agreement with partner universities;
- the overcoming the language barrier with the purpose of partnership with European universities;
- the identification of directions and specialties in compliance with market requirements;
- the deficiency of financial resources needed for the implementation of ECTS credit system.

The introduction of the ECTS system in the country requires taking into account the European experience. The involvement of as much as possible universities in the system is necessary for the innovative development of country's national education.

The Paper deals with all the above mentioned issues.

DECISION-MAKING IN CURRICULUM CREATION ON THE BASIS OF CREDIT SYSTEM

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The credit system of curriculum and program creation considers the modular teaching organization. The essence of the modular teaching is to define each modules of curriculum maximally separated. In this case, the problem is arisen, such as the decision-making of modular block separation. This problem is derived from the fact that the teaching material that is covered in the module should be so completed block that can make possible to construct the general content with keeping the logics of the material. This makes the decision-making process very difficult due to many reasons.

It is obvious: $S = S_1 + S_2 + \dots + S_n$;

where:

$$S_1 = S_{11} + S_{12} + \dots + S_{1n}; \quad S_2 = S_{21} + S_{22} + \dots + S_{2q}; \quad \dots \quad S_n = S_{n1} + S_{n2} + \dots + S_{nk}.$$

In our case, during building the modular teaching, the decision-making process is based on the module content formation with the following methodology. The structural graph of subject is built (see the figure 1), which is systematically called as the goal tree or tree graph. In the goal tree, there are given the links of inside the subject and between subjects. Then, the topics from the logical structural graph in the educational elements, which are modular structure, are selected, they are necessary for studying the specific educational element, which contributes us to provide its maximum autonomy, to reach the content complexity of educational materials. In the educational element content, there are given the other subjects' tasks, which are indicated in the links between the subjects. We can replace some blocks and modules of educational materials without its external analysis as the modules are the separated and completes structures at all.

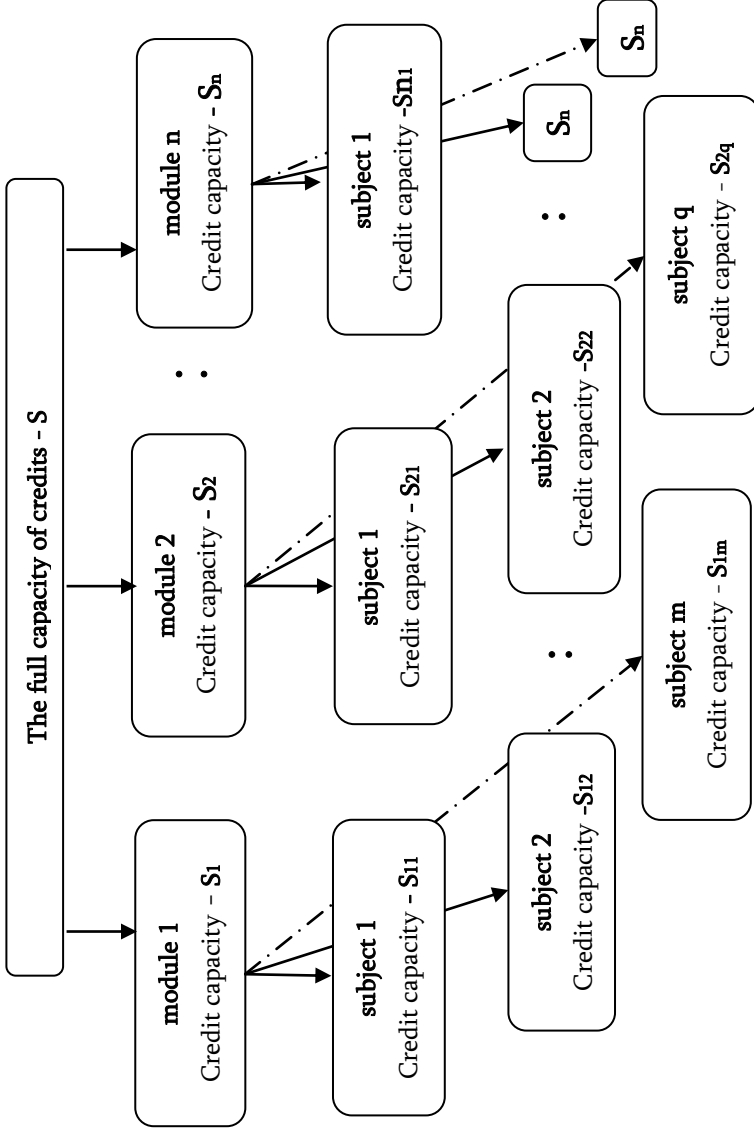


Figure 1.

The certification system of curriculum and program creation is easily obeyed to the optimization rules. In this case, the creation of optimization criteria has the great importance. The task of curriculum creation optimization can be analyzed in the different points of view. For example, it is necessary to select for the specialty (professional action) in the curriculum, to sort out more important materials in sequence and to divide into the semesters.

For optimization task solving, the following criteria can be used:

- Criteria, which makes maximization of curriculum credit cumulative rate for the module professional preparation;
- Criteria, which makes maximization of curriculum credit cumulative rate for general subjects;
- Criteria, which defines the module positioning optimality due to the semester, however, it is sometimes necessary to select the criteria, which makes minimization of total rate of time break between the modules that are informatively connected in compliance with the close relationship of links.

It is obvious that with these criteria, there is necessary to work out the systematic limits, which give us the curriculum creation model. With the interactive implementation of this model, there will be the possibility to work out the curriculum in the automated regime.

A MULTIOBJECTIVE INTEGER LINEAR OPTIMIZATION MODEL FOR RENEWABLE ENERGY SUPPLY PROBLEM

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Replacing fossil fuel based energy generating units with those using renewable energy sources is an important step for Ukraine towards development of energy efficient systems and reducing harmful emissions into the atmosphere [1]. Problem of selecting an optimal mix of renewable energy sources for particular region in order to meet energy demands of that area can be described by multi-objective integer linear mathematical model [2].

Any of the following objectives can be considered in the model:

- a) minimize total cost of the system, total maintenance cost, pollution emission;

b) maximize total energy generation, reliability of the system, life span, total revenue.

These objectives are subjected to different constraints such as energy demand, budget, carbon dioxide emission constraint, life time of components constraint, number of energy generating units of particular type, etc.

Pareto optimal solution of described mathematical problem will provide optimal number of energy generating units that are based on particular type of renewable energy source.

References

1. Dolinsky A.A. Heating Strategy for Ukrainian settlements (to discuss the project of Energy Strategy of Ukraine until 2020, 2030 and 2035) / Visnuk of NASU. – 2015. №4, – PP. 98-105 (in Ukrainian).
2. Semenova N.V. Vector problems of discrete optimization on combinatorial sets: methods of research and solution / N.V. Semenova, L.M. Koleschkina. – Kyiv, Nauk. dumka, 2009. – 266 p. (in Ukrainian).

MULTICHANNEL NETWORK MODELS WITH THE RENEWAL AND SEMI-MARKOV INPUT FLOWS

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We will consider r systems of the type $[GI(SM)/M/\infty]$ with a multidimensional input flow customers $(v_1(t), \dots, v_r(t))$, where $v_i(t) = y_i(t) + y_{r+1}(t)$, $y_i(t)$, $i=1, r$ are independent renewal flows and $y_{r+1}(t)$ is a semi-Markov process with a finite state space S . We suppose, that next conditions are true: a) $[M\tau_k^i]^{-1} = \lambda_i \neq 0, \beta_i = D\tau_k^i < \infty, \tau_k^i$ is an interval of the k -th revival, $i=1, r$.

b) $[\sum_{k \in S} m_k \pi_k]^{-1} = \beta \neq 0$, m_k is the mean value of the sojourn time in the state k , π_k is the stationary distribution of the embedded Markov chain.

c) $\mu_i^{(n)} = \mu_i / n + o(1/n)$, $i=1, 2$, μ_i is a rate of service.

d) $n^{-1/2}(y_{r+1}(nt) - \beta nt) \rightarrow \sigma w(t), n \rightarrow \infty$.

For sequence of processes

$$\xi_n(t) = (\xi_n^1(t), \dots, \xi_n^r(t)), \quad n \geq 1, \quad t \in [0, T],$$

$$\xi_n^1 = n^{-1/2} (X_i^{(n)}(nt) - \alpha_i n), \quad i = 1, r$$

($X_i^{(n)}$ is a number of customers in i -th system), where $\alpha_i = (\lambda_i + \beta) / \mu_i$, $i = 1, r$ the following theorem is true.

Theorem. The sequence of processes $\xi_n(t)$ converges in uniform metric to diffusion process with infinitesimal mean $(a_1(x), \dots, a_r(x)) = (-\mu_1 x, \dots, -\mu_r x)$ and diffusion matrix B , $B = \|b_{ij}\|_{i,j=1}^r$, where $b_{ii} = \lambda_i + \beta \lambda_i^3 + \sigma^2 + \beta$, $i = 1, r$, $b_{ij} = \sigma^2$, $i \neq j$

References

1. Griffiths R.S. and Milne R.K. A class of bivariate Poisson process. I. Multivar. Anal. – 1978. – 8. – PP. 380-396.

THE TRANSFORMATION OF DISCRETE SINGULARITIES

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The main goal of the report is an application of discrete singularities methods to modeling of the flow with complex geometry of moving boundaries [1-3]. Algorithms that regularize the method of discrete singularities are presented.

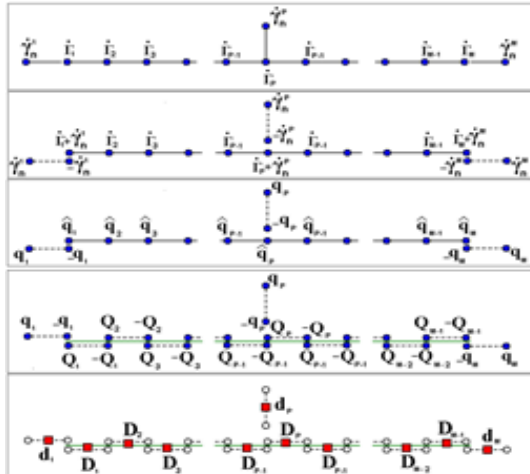


Fig.1

Algorithms of transformation (through single-valued functions) allow us to determine the derivatives of characteristic functions

The conversion algorithm from the vortex to the dipole representation is shown in Fig. 1. Transformation systems discrete vortices to system of discrete singularities higher order allows to obtain the distribution of continuous dynamic system characteristics in the entire region of its borders flow is at any given time.

$$\begin{aligned} \frac{\partial \phi(x, y, t)}{\partial t} = & \sum_{j=1}^{M-1} \left(\vec{D}_j \bullet \vec{V}_j(x, y, \bar{x}_j(t), \bar{y}_j(t)) + \sum_p \left(\vec{d}_p \bullet \vec{V}_p(x, y, \bar{x}_n^p(t), \bar{y}_n^p(t)) \right) \right) - \\ & - \sum_{j=1}^M \Gamma_j(t) \left(\vec{V}_j(x, y, x_{0j}(t), y_{0j}(t)) \bullet \vec{W}_d(x_{0j}(t), y_{0j}(t)) \right) - \\ & - \sum_{p=1}^P \sum_{i=1}^n \gamma_i^p \left(\vec{V}_i(x, y, x_i^p(t), y_i^p(t)) \bullet \vec{W}_v(x_i^p(t), y_i^p(t)) \right) \end{aligned}$$

References

1. Cherniy D., Dovgiy S., Meleshko V. Proc. IUTAM Symposium "Vortex Dynamics: Formations, Structure and Function", Fukuoka, Japan. – 2013. – PP.126-127.
2. Cherniy D.I. Proc. XIV International Symposium "Discrete Singularities Methods in Mathematical Physics" – 2009. – PP.185-187.
3. Dovgiy S.A., Lifanov I.K., Naukova dumka, Kiev, 2004.

ABOUT DETERMINATION OF OPTIMAL INSURANCE FEE

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We will assume that the number of insurance contracts N , which are in the insurance portfolio, is a random value. Each insurance contract with the number j corresponds to the value S_j that we call the insured amount. Let Y_j - the value of the suit for the j -th agreement. We will also assume that random variables X_j and S_j are independent. Note that this is the essence of the F -model [1, p.248].

Suppose also that for each insurance contract, the insurance fee Z_j is determined $Z_j = zS_j$ where z - some constant for all insurance contracts (insurance rate). Note that in the considered model fees are random variables depending on S_j which distinguishes it from classical statements of a problem.

Let's assume that claims under insurance contracts are large. In particular Pareto distribution with parameters $a > 0, \lambda > 0$. Then under these assumptions for z_0 - the optimal insurance rate is valid the following ratio:

$$z_0 \sim \frac{\lambda}{a-1} + \frac{\sqrt{\frac{a\lambda^2}{(a-1)^2(a-2)}}[1+V^2]^{1/2}\Psi(Q)}{[N-V^2\Psi^2(Q)]^{1/2}}.$$

We also note that for $V = 0$, this result is practically reduced to classical [2, p.238].

References

1. Korolev V.Y. Mathematical foundations of risk theory./ V.Y.Korolev, V.E.Bening, S.Y.Shorgin. – M.:Fizmatlit, 2011. – 620 p.
2. . Chistyakov V.P. A theorem on sums of i.i.v and its applications to branching processes / V.P. Chistyakov // Teor. Probabiliyu Appl. – 1969. – № 9 – PP. 640-648.

PROFESSIONAL MILITARY EDUCATION. PREPARING FUTURE COMMANDERS FOR MAKING DECISIONS UNDER UNCERTAINTIES

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The security environment evolves rapidly and employment of military power becomes more and more complex. Military commanders face “compressed battlespace and levels of warfare” and act in complex social, cultural and economic environment. Despite the level of command and control, all future military commander require comprehensive knowledge stretching out of typical “military toolbox” to be effective in achieving objectives of crisis response operations.

Case studies” serve as a way to improve future commanders’ skills to act in complex environments. Along with introduction to theoretical approaches to decision making under certainties and simulation and modeling, case studies proved to be effective in preparing future commanders.

Polish perspectives related to professional military education will be discussed to present best practices in preparing future commanders for making decisions under uncertainties. Lessons learned will be presented to spark discussion on possible improvements in professional military education related to military decision making under uncertainties.

DECISION MAKING IN SCHOOL RESOURCE MANAGEMENT

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The school, as a general education place and public socialization institution, has the important role in all stages of state social-economic development. Nowadays, the following tasks need to be researched over the whole world, such as whether the school performs own function, what kind of situation is at the world’s schools, what kind of problems exist in the school education system.

It is obvious that one of the main functions of schools is to provide the possibility of development and self-development of teachers and pupils. The process management is based on the laws, examples, management principles, and it includes the following: creation of necessary monitoring and controlling conditions, essential management means, management methods, management function implementation, etc. All these are implemented on the basis of school manager’s decision that should be derived from the modern principles of pedagogical personnel management.

The decision-making in pedagogical personnel management cannot be effective if it is not based on the essential principles and conditions, such as personal development and educational activities, educational goals’ formation, pupils’ aspiration for the higher animated goals in the educational process, teachers’ and pupils’ motivation.

The management process should be implemented from the very crucial point, such as the school manager position. The school manager is authorized to make a decision, issue an order and use as the human as other

school resources. The essence of the authorization is formed in the following way (fig. 1):

The action of Subject and Object is obeyed to the balance principle of authority, where the authority power of person A on person B equals to the dependence power of person B on person A. The influence level of a manager on the school personnel equals to their dependence level on a manager.

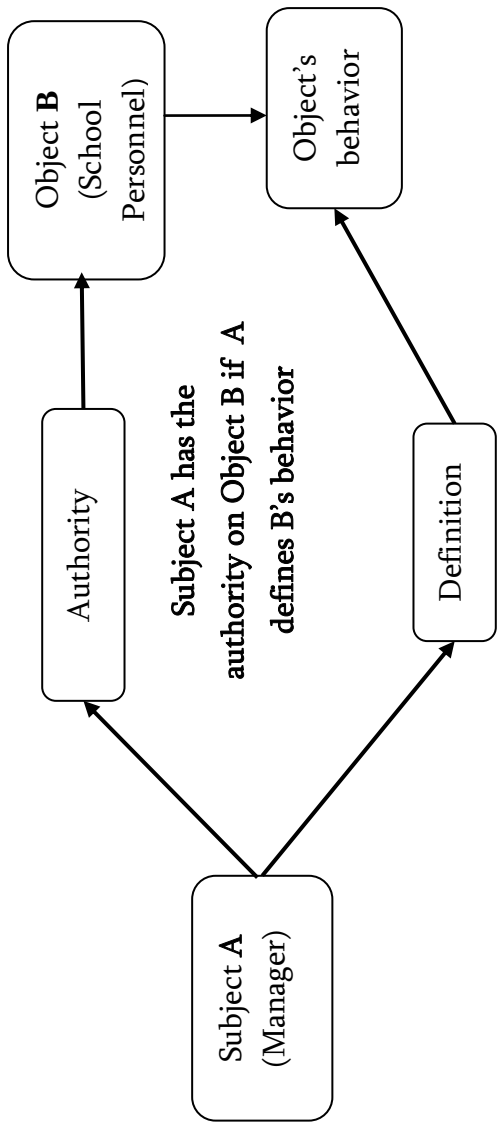


Figure 1.

According to the formula of American Researcher Geert Hofstede, Authority distance = influence of a manager on a subordinate, a subordinate's influence on a manager.

In the human resource management, the personal promotion is very important. It is the fundament of management and should be preceded by any administrative action implementation. As the influence of a teacher on pupils is very important, as the influence of a manager is decisive on personnel development, who performs the work that is crucial for the organization's development. The school manager should form the person-oriented decision-making management strategy, individuals-directed approach, recognition of each subordinate's influence.

A NOVEL STRONGLY CONVERGENT METHOD FOR VARIATIONAL INEQUALITIES OVER THE SET OF SOLUTIONS THE EQUILIBRIUM PROBLEMS¹

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Let H be a real Hilbert space with inner product $(\cdot, \cdot)$. For operator $T: H \rightarrow H$, set $M \subseteq H$, and bifunction $F: H \times H \rightarrow R \cup \{+\infty\}$ we denote by $VI(T, M)$ and $EP(F, M)$ sets

$$\{x \in M : (Tx, y - x) \geq 0 \quad \forall y \in M\} \quad \text{and} \quad \{x \in M : F(x, y) \geq 0 \quad \forall y \in M\},$$

respectively.

We are interested in approximate solution of problem

$$\text{find } x \in VI(T, EP(F_1, M_1) \cap EP(F_2, M_2)). \quad (1)$$

Motivated by the idea of Korpelevich's extragradient method and Antipin's extensions the extragradient method to equilibrium problem, we'll introduce a new and efficient method for solving problem (1). One variant of this method is following.

Select $x_1 \in H$ and generates the sequence (x_n) iteratively by

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$$\begin{aligned}
v_n &= \text{prox}_{\lambda_n F_1(x_n, \cdot)} x_n, & y_n &= \text{prox}_{\lambda_n F_1(v_n, \cdot)} x_n, \\
w_n &= \text{prox}_{\lambda_n F_2(y_n, \cdot)} y_n, & z_n &= \text{prox}_{\lambda_n F_2(w, \cdot)} y_n, \\
x_{n+1} &= z_n - \alpha_n T z_n,
\end{aligned}$$

where $\lambda_n > 0$, $\alpha_n > 0$.

This method uses the proximity operator. Principal difference here, at each iteration, we solve strongly convex programming problems only instead of a auxiliary equilibrium programming problems.

COMPUTER TECHNOLOGIES USED IN EDUCATIONAL PROCESS

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The analysis of scientific research of computer technologies, used in educational process, has shown the significance and opportunities of information technologies and educational systems built by modeling for the intellectual and emotional-personal development of a student. Therefore, the scientists-researchers and practitioners, employed in the field of education, spend a lot of time working in this direction.

When the speech is about scientific grounds of computer technologies used in educational process, the attention is mostly paid to the construction of information models for technical purpose objects. Such models would give the opportunity to expand theoretical and experimental researches, to get physical researches closer to the real properties and characteristics of an object.

The projection and modelling of computer technologies, used in educational process, from a scientific point of view, should be conducted considering the fact that it is the basis for deep knowledge of the characteristics of the studied object, the guarantee of professional skills development

The paper deals with the scientific grounds of computer technologies used in educational process.

ROUTING SECURITY ENCHANCEMENT IN WIRELESS LOCAL AREA NETWORKS

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The main components of Wireless Local Area Networks (LAN) are: network Interface Radio Plate, access points, routers.

The article deals with the enhancement of routing security.

A router transmits information packages from one network to another, choosing the best channel in the nearest point to transfer the package. Routers use the Internet Protocol (IP) package name and routing tables. They also use the IPs for determining the best way to transfer each package.

A wireless LAN router allows the Ethernet multiport routers to perform the functions of built-in access points. As a result it becomes possible to combine the Ethernet with wireless networks.

The routers use the Network Address Translation Protocols (NAT), that allow many network devices to jointly use one IP address, presented by the Internet Service Provider (ISP).

Through joint efforts NAT and DHCP allow some network devices (such as personal computers, notebooks and printers) to work in the Internet using only one IP address.

Therefore, the router should be used when more than one user of the local network needs to be connected to the Internet and only one IP address, represented by the provider, can be used.

The wireless local networks security is a very important issue, as the communication signals, spread in the environment, are available to be caught.

As for routing in wireless networks, there is a number of routing protocols designed for wireless networks, but they actually do not take into consideration the security issues. Therefore, it is necessary to take some additional measures to ensure safety in the Wireless LAN.

Various methods have been developed for the routing security enhancement in wireless local area networks.

The research deals with the all above mentioned issues.

AN EDUCATIONAL CREDIT AND ITS MEANING

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Students must collect a certain number of credits within the educational program. Accumulation of credits play a decisive role in determining student qualification. In this case ECTS is an excellent opportunity. ECTS makes the understanding and comparing of educational programs easier. This system can be used for any kind of program, regardless of its type.

In order to facilitate the implementation of the Bologna process, many European countries have adopted ECTS as a credit accumulation system.

An educational credit measures a student's work capacity, which is necessary to acquire certain competencies, i.e. to master the material, to perform any kind of assignment. The introduction of ECTS means that educational programs and the entire educational processes should be oriented on a student, because they are based on a student's academic load. A correct calculation of a student's academic loading requires the correctly set goals, the possible results expected after the program completion. The objectives of the educational program are desirable to be determined by outcomes and competences of the study. These comparatively new terms denote the following well-known features: the study outcomes show what a student needs to know, understand or do after the completion of a short or long term educational process, i.e. what general or specific competence acquisition is promoted by this or that program.

A student-oriented approach considers a higher education institution as a student's supportive guidance in the process of developing his own educational path. A higher education institution helps a student to rely on the individual learning style and experience.

The paper deals with all the above mentioned issues precisely.

ON THE ISSUE OF CHOOSING THE NEURON ADAPTIVE EDUCATIONAL SPEED IN THE LAST HIDDEN LAYER OF A NEURAL NETWORK

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It is known that in the standard back propagation error algorithm there is a problem of choosing the optimal educational speed of a neural network because the educational process is extremely sensitive to this parameter both from the viewpoint of the educational speed and the accuracy of forecasting, as well as in terms of the risk of retraining the network. According to the back propagation algorithm, the educational speed of a network is selected in such a way as to minimize the root-mean-square error rejection across the whole network scale. This principle works well for small networks. However, in the case of large networks it is extremely inefficient. In order to cope with this drawback, it is necessary to use different educational speed for various hidden layers of the neural network.

The analysis of the given paper shows that for the last hidden layer of a multilayer neural network, the adaptive educational speed should be selected as follow:

$$a_2(t) = \frac{\sum_i C_i \sum_j (y_j - t_j) w_{ij}}{(F'(0))^2 \sum_j (\sum_i C_i w_{ij})^2},$$

where

$$C_i = \gamma_i F'(S_i) \left(1 + \sum_k y_k^2 \right).$$

Here j is an output layer of the neural network, i is a last hidden layer, k is a penultimate hidden layer.

The above given expressions allow to select the optimal educational speed for the networks with several hidden layers. The conclusions are confirmed by numerous experiments.

PROGNOSES DEFINING CONDITIONS FOR REQUIRING SPECIALISTS IN THE REGION

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Disbalance in staff politics in the region, with other factors, creates the fact that there is no conception worked out on the scientific level for regulating this process. Mentioning this conception we speak about existing the reliable informative data, which insures recording exact number and classification of specialists, which correspond to the specifications of developed fields in the regions, mainly in directions and requirements.

Analyzing the recorded staff data will help us to define potential abilities of the personal resources. According to prognoses basis of the recorded potential abilities and regional economic requirements of the region, it must be defined how to prepare the personnel for high educational institutions and professional-training centers. There is also one problem which arises during prognoses process. There is no statistic recording and corresponding unites method.

As literature analyze showed us, the regional requirements on specialists, is caused by many factors and these factors significantly changed after entering the market economy. These facts require changing existing methods and it's mandatory to create new method. This problem is urgent nowadays and it requires scientific research and practical realization of received results. Working out the problems analyzing, prognosis and then regulating of specialists in the labor market in the regions is directly linked with the politics of the educational system of the country, which comprise social, demographic, technical, economic, cultural and the main factor: educational problems.

For this reason, we decided to formulate the main prognoses defining problems for ensuring specialists in the regional level, which correspond to the requirements of market economy today. We studied theoretical and practical researches of local and foreigner scientists' which are about prognoses problem of requiring specialists.

We paid attention about these problems in our research.

DIFFICULTIES OF CREATING EFFECTIVE COMPUTER TEACHING TOOLS

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On the basis of our research we have identified those main factors that prevent the creation of effective computer teaching tools. Among these factors the most important one is the fact that a teacher, who creates computer simulators and multimedia tools, does not have sufficient knowledge and skills necessary for the software projecting. The development of educational multimedia is an interdisciplinary process and the knowledge of one certain area is not enough. A computing specialist should necessarily be involved in such a project. At the same time the specialist's presence somehow complicates the preparation and implementation of the project.

The second obstacle refers to secondary schools and higher education institutions that are still not equipped with those necessary modern technologies which ensure the development of high quality computer-based education.

However, despite the existing obstacles, we should carry out certain scientific researches in this direction, which would improve the existing situation. It is necessary to conduct an analysis that let us find out the possibilities of their use in educational process and outline ways to improve these opportunities.

The paper deals with all the above mentioned issues.

FORMATION OF STUDENT ACADEMIC MOBILITY SYSTEM MODEL

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The implementation of the student's academic mobility decision-making interactive mode requires working out such a database that would include all the possible supportive information, necessary for a student to conduct quantitative and qualitative data analysis.

First of all, a student should be able to determine what kind of information he needs to make a right decision.

We have defined the following list of information data or factors of student academic mobility:

- **List of the universities** that announce mobility;
- **List of the universities abroad** that are desirable for a particular student;
- **The existing terms and conditions** for mobility in a presumed country and in its universities;
- **The qualitative data for presumed university mobility:** historical data, traditions, reputation / prestige of a university, the staff of professors and teachers.

The quantitative indicators for presumed university mobility:

- a) **The indicators of internal (intra-university) mobility:** the contingent of students accepted by mobility, varying according to the faculties (schools) and specialties, etc.; the local indicators.
- b) **The quantitative indicators of the external university mobility:** the number of students transferred from another university, remained there and left the university according to the specialties for the last years (approx. 5 years).

The research is focused on the all above mentioned issues.

THE OPTIMIZATION OF COMMUNICATION SYSTEMS WITH THE POINT OF VIEW OF COMPRESSION OF INFORMATION

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Any phenomenon or processes are constructed on the nature of information and the determination of its features those are reflected in material qualities: symbols, signs, drawings, equation, formulas, voice, melody and etc.

Hence how much the nature of information is large so it is necessary to solve the processing and realization of its problem in any sciences which is achieved by optimization of the system. The compression of information and safety represent its main essence with spending of minimum time and fast realization, e.g. hieroglyphic written language – whole idea is put into one symbol, but putting whole idea into separate signs has the distinct advantage. The hieroglyphs are very economic and quicker with a point of view of compression and writing. That is the optimal phenomenon has a place in the process.

Theme Actuality: Increasing of quality in the control theory and cybernetics, receiving of information and taking a decision. The determination of entropy in Theory of information with 2 ways: I-Discussion of information gives the endless length code sequence and II-Discussion of information source gives code sequence of fixed N quantity, where N is big number and subordinate the law of big numbers.

MATHEMATICAL CALCULATION OF CARGO CONSOLIDATION ON THE VESSEL

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Cargo consolidation in storerooms performs on the bases of the following requirements:

1. Fulfillment of the cargo compilation condition.
2. Cargo within loading gage and long sized are placed in the central loading storerooms.
3. Small and large scale cargos are placed in front and back storerooms as possible.
4. It's not recommended to place rolling barrel kind cargo in front and back storerooms.
5. Each time, when it's possible, consolidation of cargo is performed so that the total quantity of the cargo in specific storeroom should be equal to the weight calculated for this specific storeroom; and the volume of the cargo handled should be equal to the vessels' capacity of the cargo.
6. To fulfill the condition of inadmissibility of unloading operations in the storerooms.
7. "Heavy" cargo should be placed in the hatchways as long as it's possible and the "light" cargo – on the twin deck and upper deck.
8. Loose and bulk cargo should be placed below the general cargo and should be divided by the horizontal waterproof partitions.

The maximum loads of the storerooms are determined based on the stability of the deck, which is characterized by a limit of 1 m^2 (technical match).

Maximum load of the storerooms are defined by formula:

$$P_{TB \text{ max}} = 0,7 W_{TB}.$$

where $P_{TB \max}$ – twin deck maximum load;
 W_{TB} – twin deck maximum selection (bulk) m^3 ;
 $P_{Tp \max} = W_{Tp}$
 $P_{Tp \max}$ – hatchway maximum load, t.;
 W_{Tp} – hatchway capacity (bulk) m^3 ;

Distributed weights on the storerooms are planned quantity of the cargo. The total amount of the cargo distributed on the storerooms represents the whole load of the vessel. Calculation of the weight distributed in the storerooms is performed by the formula:

$$P_j = W_j * Q_c / W_c$$

W_j – me- j capacity of the storerooms, m^3 ;
 Q_c – vessel load, t.;
 W_c – capacity of the vessel with the bulk cargo, m^3 .

Appropriate algorithm and the computer based program is created using above mentioned formulas.

FOR DECISION MAKING IN ECONOMIC AND MANAGEMENT SCIENCES

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The paper tells that managerial process consists in planning, the organization of actions on performance of plans and the control over end results. Many industrial firms on own experience were convinced, that planning is the means allowing them to define character, forms and sequence of the future actions during the long period. Bosses who form starting positions for achievement of optimum distribution of intra-firm resources, first of all, participate in work on intra-firm planning delegate the powers necessary for an effective utilization of these resources. From persons by whom powers are delegated and resources are given, the creative approach to use of resources is required. Progress in this direction depends on skill of managers to use the newest theoretical positions, various analytical toolkits for search of the best communications of the present with the future, for the decision of problems of definition of the

purposes. Industrial firms in every possible way aspire to raise validity of plans, seeing in it an additional source of the growth. Large corporations use the services of planning and for the control of performance of obligations suppliers. Many foreign experts continuously emphasize that sense of intra-firm planning, finally [5]. It is reduced to definition of decisions which are required to be accepted today for maintenance of effective activity of firm, its growth in the future. The sense of planning is precisely enough defined by American engineer, management consultant and *Professor at the Penn State University Hugo Diemer from the Texas University*: "Function of planning - to look ahead; to plan - means to define in advance the future rate of actions" [2]. By his definition, planning includes decision-making concerning: "A choice both short-term, and long-term strategy of firm; developments of focusing lines and actions which help to carry out objects in view or to overcome menacing situations; Establishments of standards of operative activity which are used as base for control; revision of earlier plans in a view of varying conditions" [2].

The paper underlines that many scientists and economists of the different countries (*Frank Gradon, Neil Brady, Karl Fernstrom and Bethel Lawrence*) recognize that planning – "the most difficult and responsible site in all work on the organization of efficient control not only because process of definition of the purposes, a final choice of a direction of activity and development of the corresponding program in conditions of the market is exclusively combined, but also owing to complexity of all subsequent work on performance of plans because of variability of a conjuncture and necessity of specification and updating of plans" [4]. They warn industrial firms against simplicity and recommend defining, on the one hand, at the organization of system of planning interrelation of problems and steps on creation of hierarchy of plans, and with another to provide the monitoring system of work of firm and necessary corrections. For this purpose the management is obliged to find an effective way of a combination of the key variables describing problems and people. Statement of the purposes and maintenance with their strategy and rules promotes the decision of this problem. The motivation and the control also play an essential role in maintenance of efficiency of performance of tasks. For the manager each specific goal opens an opportunity for its individual creativity which development should be promoted by sufficient organizing independence [3].

The paper emphasises that the effective control assumes constant interaction with all other functions of management - planning, organizational activity, distribution of resources and a management of

people. The organization of the control is considered one of the challenges facing to modern management. It is connected with expansion and complication of activity of major concerns, concentration and diversification. The administrative control, being a necessary condition of functioning of any economic mechanism, in modern conditions receives the further theoretical development and practical perfection on the basis of improvement of methods of the administrative account and the automated processing of the information, application of analytical methods of decision-making the system analysis [5]. In essence in any field of activity of industrial firm, including production management, selling, the finance, the staff, et cetera, the general both specific methods and procedures of the control can be found. At the same time various levels of management have absolutely various information needs. Efficiency of the administrative control plays the major role in maintenance of ability to live of industrial firm. The problem of the administrative control consists in maintenance of achievement of the planned purposes, realization of scheduled decisions by the organization of streams of the industrial information. The control includes gathering, processing and an estimation of the information on results of activity of various industrial divisions, drawing up of the reporting, revealing of deviations from the established purposes and the reasons of these deviations and definition of the actions necessary for achievement of the purposes [1].

References

1. Brady Neil Ethical Managing: Rules and Results, New-York, "Macmillan Publishing", 1997.
2. Diemer, Hugo Industrial Organization and Management, Chicago, La Salle University Press, 1995.
3. Gradon Frank Organization and Management, London, "Wiley Publishing", 2004.
4. Fernstrom Karl Organization and Management of a Business Enterprise, New-York, "MIT Press", 2005.
5. Lawrence Bethel Essentials of Industrial Management, New-York, "McGraw-Hill Companies", 1999.

MODELING OF PROGRAM SYSTEMS SUPPORTING DECISION-MAKING IN WEAKLY STRUCTURED SITUATIONS BASED ON MODELING EXPERT KNOWLEDGE

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Weakly structured unique situations are the most difficult for analysis and supporting decision-making. They are typical for monitoring tasks in the administrative and operational areas. The characteristics of the situation can often be represented only qualitatively. In addition, formalization process of the model situation should be preceded by the analysis of situations and the development of options for solutions. That there is a revealing of the main features, the connections between them and the strength of the influence of some characteristics on others. In poorly structured situations, this process should occur in close collaboration with experts, and for some complicated areas such work without serious computer support is very time-consuming.

Modern Decision Support System (further DSS) should include methods of structuring the situation, an advanced user interface for working with experts, tools for editing and customizing models, as well as visualizing the entire process of building a model, analyzing the results of modeling their interpretation and explanation. Of course they are should include methods of analysis, evaluation and decision-making modules. The architectures of modeling systems for weakly structured situations that meet these requirements is currently at the beginning stage.

In case mentioned above the priority issues in R&D process for DSS are the following:

- 1) R&D principles for constructing models and software systems for DSS in poorly structured situations based on expert knowledge modeling.
- 2) Develop the structure of the knowledge representation model.
- 3) Develop models of functional and conceptual systems of the field of knowledge.
- 4) To develop a method for structuring a situation for its representation in the knowledge field model and methods for tuning cognitive models based on the indirect determination of the force of the influence of the characteristics.

DEVELOPMENT AND VALIDATION OF A METHOD FOR ARMORED PERSONNEL CARRIER M113 RELIABILITY

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This paper deals with the analysis of the factors and aspects covered by Reliability Theory and relevant for the discussion of armored personnel carrier M113 reliability. The paper examines and presents indicators for the assessment of armored personnel carrier M113 reliability and quantitative functions for the evaluation of engine technical conditions. Although it has received little research attention so far, the integrated effect of the Lithuanian climate on armored personnel carrier M113 is also examined. Findings of quantitative criteria analysis intended for reliability assessment under difficult conditions have not been publicly reported as these evaluations have been made by manufacturers of military vehicles.

Armored personnel carrier M113 operating conditions refer to the manner of use, the intensity of operation, and the different types of engine loads and their sequences. They also refer to the culture and qualifications of drivers, servicemen and maintenance personnel as well as the provision of repair and diagnostics equipment, etc.

Research of the case under consideration has been conducted in Lithuania. In order to collect precise and accurate data, vehicles used by the Lithuanian Army were selected for the research. The most widely used transporter is the armoured personnel carrier M113, but the last time that these transporters were delivered to combat units was in 2006. Therefore, in addition to being 30 years old, they have been operated in the Lithuanian climate for more than 10 years. Their courses of operation, failures, and repairs can be tracked and captured more precisely than those of civilians, because all of that information is recorded in data logs.

ON A COOPERATIVE GAMES IN LITHUANIA LOGISTIC SHARE COSTS SCHEME

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The supply scheme to transport hub with the further delivery to the other cities is considered as a cooperative game.

Let some cargo is supplied to some transport node, followed by the delivery to the other destination points. It's clear, that it's more advisable to use the circular route rather than the set of all radial routes.

The question is how to share the saving among the agents? To resolve this problem, the cooperative game theory is applied.

The original characteristic cost function of the game is induced as length of the shortest circular route among the hub point and the cities (destination points) that belong to coalition. Then the reduced characteristic function is calculated as a saving value as follows:

$$W(S) = \sum_{i \in S} V(i) - V(S) .$$

All of the destination points but not hub are considered as players.

For such characteristic function the Shapley value, the nucleolus and the τ -value are calculated.

The biggest Lithuanian cities, such as Vilnius (V_n), Kaunas (K_n), Klaipeda (K_l), Siaulai (S_l) and Panevezys (P_n) are selected for calculations.

The cooperative game is considered for two cases. If the cargo is delivered by ship, then Klaipeda is selected as hub, if by railway - then the hub is Vilnius. It turns out, that in both cases all of the other cities are located at close directions from hub. As a consequence, the characteristic function is turns out to be convex and the core of the game is not empty.

The distances for calculations are taken from della.ua service, as they are by roads. The shortest circular route, that include all mentioned cities is $V_n-P_n-S_l-K_l-K_n-V_n$ 705 km. long.

The Shapley value, the nucleolus and the τ -value are calculated.

References

1. Curiel I. Cooperative game theory and applications // Springer US, 1997. – 192 p.
2. Schmeidler D. The nucleolus of a charecteristic function game // SIAM J on Applied Mathematics, 1969. – vol 17, №6. – PP. 1163–1170.

MODEL THE SPATIAL-TEMPORAL EVOLUTION OF TWO SPECIES DWELLING A COMMON TERRITORY

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A second-order parabolic PDE system with random parameters is proposed to model the spatial-temporal evolution of two species dwelling on a common territory. For the associated stochastic Cauchy problem, the global stability and long-time behavior are studied in a probabilistic weak functional-analytic framework under appropriate conditions on the data.

We presented a new stochastic PDE model to describe of two animal species and proposed an approach to studying the condition of existing of solution this problem for the underlying stochastic Cauchy problem. Further, under additional conditions on the diffusion and source terms, the exponential stability in the mean square was discussed.

Works [1,2,3] of Ukrainian and foreign scientists-experts in dynamical system such as Dautray, R., Lions, J.-L., Okubo, A., Levin, S. A., Pokojovy M. are used as methodological base of this paper.

References

1. Dautray, R., Lions, J.-L.: Mathematical Analysis and Numerical Methods for Science and Technology, Springer-Verlag, Berlin, 1992. – Vol 5. – PP. I-XIV, PP. 1–739.
2. Okubo, A., Levin, S. A.: Diffusion and Ecological Problems. Modern perspectives, Springer Verlag, New York, Berlin, Heidelberg, 2001. – PP. 1–467.
3. Dzhalladova I., Pokojovy M.: On a Quasilinear PDE Model of Population Dynamics with Random Parameters, Proceeding, MITAV, Brno, 2017. – PP.20-24.

MINIMAX PROBLEMS FOR RANDOM FIELDS FROM OBSERVATIONS IN PERFORATED PLANE

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In engineering, geology, automatic control etc., one often has a number of data points, obtained by sampling which represents values of stochastic processes or random fields for a limited number of values of the

independent variable. It is often required to interpolate (i.e. estimate) the value of processes or fields for an intermediate value of the independent variable. Methods of solution of linear estimation problems for stochastic processes and random fields were developed by A. N. Kolmogorov [1], N. Wiener, A. M. Yaglom, M. I. Yadrenko. Traditional methods of solution of these problems are employed under the condition that spectral densities are known exactly. In practice, however, complete information on spectral densities is impossible in most cases. To solve the problem the parametric or nonparametric estimates of the unknown spectral densities are found or these densities are selected by other reasoning. Then the traditional estimation methods are applied provided that the estimated or selected densities are the true one. This procedure can result in a significant increasing of the value of the error as K. S. Vastola and H. V. Poor have demonstrated with the help of some examples. This is a reason to search estimates which are optimal for all densities from a certain class of the admissible spectral densities. These estimates are called minimax since they minimize the maximal value of the error.

The problem of estimation of linear functionals which depend on the unknown values of a homogeneous random field $\xi(k, j)$ in the “perforated” [3] region $K \subset Z^2$ from observations of the sum $\xi(k, j) + \eta(k, j)$ at points $(k, j) \in Z^2 \setminus K$ is investigated. Formulas for calculating the mean square errors and the spectral characteristics of the optimal linear estimate of functionals from observations in perforated plane are derived in the case where the spectral densities are exactly known. Formulas that determine the least favourable spectral densities and the minimax (robust) spectral characteristics are proposed in the case where the spectral densities are not exactly known while a class of admissible spectral densities is given.

References

1. Kolmogorov A.N. Selected works of A.N. Kolmogorov / A.N. Kolmogorov // Vol. II: Probability theory and mathematical statistics., Ed. by A. N. Shirayev. Mathematics and Its Applications. Soviet Series. 26. Dordrecht etc.: Kluwer Academic Publishers. – 1999. – 597 p.
2. Moklyachuk Mikhail P., Shchestyuk Nataliya Yu., Florenko A. Interpolation problems from random fields from observations in perforated plane, / M.P. Moklyachuk, N.Yu Shchestyuk, A. Florenko /Математичне та комп’ютерне моделювання, Кам’янець-Подільський НУ, Сер. Техн. науки. – 2017. – Вип. 14. – С.83–97.

RESEARCH OF DYNAMICS OF ONE DEMOGRAPHIC MODEL

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The report is considered non-linear model dynamics. We introduce a parameter that is weighted population size $w(x) = \sum_{j=1}^n \alpha_j x_j$, where $\alpha_j > 0$, $j = \overline{1, n}$ - constant, reflecting the effect of age on vital population growth rate. Then the individual fecundity f_i class, $i = \overline{1, n}$ is a function of the form $f_i = a \tilde{f}_i g[w(x)]$, where $\tilde{f}_i$ - maximum result of average class reproduction rate, relating to age class, $g[w]$ - dependence of density decline to fertility, a - the probability of survival of individuals age first grade until the transition to the second class. Can input that $g[w] = \frac{1}{1 + (cw)^\alpha}$. Then the system will look like $x(k+1) = L[w(x(k))]x(k)$, where $L[w(x)]$ is the Lesli matrix.

Set $R_f = \tilde{f}_1 + p_1 \tilde{f}_2 + p_1 p_2 \tilde{f}_3 + \dots + p_1 p_2 \dots p_{n-1} \tilde{f}_n$. Following take place.

If the system parameters are such that $1 - R_f > 0$, than the only equilibrium of system (1) is start of coordinates $x(k) \equiv 0$, $k = 0, 1, 2, \dots$. If $1 - R_f = 0$, than the system (1) also has a single equilibrium $x(k) \equiv 0$, $k = 0, 1, 2, \dots$. If $1 - R_f < 0$, then there are two states of equilibrium $x(k) \equiv 0$, $x(k) \equiv x^*$, $k = 0, 1, 2, \dots$,

$$(x^*)^T = \left(\frac{w^*}{R_\alpha}, p_1 \frac{w^*}{R_\alpha}, \dots, p_1 p_2 \dots p_{n-1} \frac{w^*}{R_\alpha} \right),$$

$R_\alpha = \alpha_1 + p_1 \alpha_2 + p_1 p_2 \alpha_3 + \dots + p_1 p_2 \dots p_{n-1} \alpha_n$, where w^* - root of the equation $ag[w]R_f = 1$.

EQUILIBRIA IN SUPPLY CHAIN NETWORKS

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Denote Q_{ij} a volume of product in transaction between the retailer $i=1, \dots, m$ and the demand market $j=1, \dots, n$; denote s_i the security level of retailer i . Let the investments of retailer i to its cybersecurity equal to $h_i(s_i) = \alpha_i \left[(1-s_i)^{-0.5} - 1 \right]$, where α_i is its multiplier; $h_i(s_i) \leq B_i$, where B_i is an upper bound. The probability of successful cyberattack on retailer i is $p_i = (1-s_i)(1-\bar{s})$, where $\bar{s} = \frac{1}{m} \sum_{k=1}^m s_k$ is the security level of supply chain network (SCN). Denote $\hat{p}_j(Q, s)$ the function of price on demand market j , where $Q \in R_+^{mn}$ is the matrix of all transactions Q_{ij} , $s \in R_+^m$ is the vector of security levels s_i . At $p_i = 0$ the profit of retailer i equals to

$$f_i(Q, s) = \sum_{j=1}^n \hat{p}_j(Q, s) - \left(c_i \sum_{j=1}^n Q_{ij} + \sum_{j=1}^n c_{ij} Q_{ij} \right),$$

where c_i and c_{ij} are the processing costs and the transaction costs of retailer i , respectively. The expected utility of retailer i is

$$E(U_i) = (1-p_i) f_i(Q, s) + p_i [f_i(Q, s) - D_i] - h_i(s_i),$$

where D_i is the financial damage to retailer i at $p_i > 0$. Denote $K_i \equiv \{(Q_i, s_i) : 0 \leq Q_{ij} \leq \bar{Q}_{ij} \forall j; 0 \leq s_i \leq u_{si}; h_i(s_i) \leq B_i\}$ the feasible set of retailer i , where $\bar{Q}_{ij}$ and u_{si} are given upper bounds. The Cournot–Nash

equilibrium $(Q^*, s^*) \in K \equiv \prod_{i=1}^m K_i$ of SCN satisfies to

$$\begin{aligned} E(U_i(Q_1^*, \dots, Q_{i-1}^*, Q_i, Q_{i+1}^*, \dots, Q_m^*, s_1^*, \dots, s_{i-1}^*, s_i, s_{i+1}^*, \dots, s_m^*)) \leq \\ \leq E(U_i(Q^*, s^*)) \quad \forall (Q_i, s_i) \in K_i, \quad \forall i = 1, \dots, m. \end{aligned}$$

COMPUTER LINGUODIDACTICS IN ENGLISH LANGUAGE TEACHING

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Computer Linguodidactics belongs to an interdisciplinary field of knowledge and deals with the development of information technologies, the theory and practice of computer training in general. This discipline was formed as an independent direction in language teaching in the end of 1980s. It is caused by the technological development of all spheres of human activity, accompanied by the continuous improvement of information communication technologies. The use of information technologies in language teaching occurs in two areas: teaching the native language and teaching the foreign language, the last of which represents the subject of our research.

Foreign language teaching has recently become most fruitful due to the use of information communication technologies. The requirements for the professional communication and information competence of a teacher have been changed with the development of a computer, databases, networks. A characteristic feature of the modern technologies development is the fact that computer companies work out such programs for users (teachers), which allow them to create a tutorial program without a programmer's help. In addition, the training programs, created for work on a local computer, are also freely available on the Internet.

We should also mention such a form of distance learning as a system of "content management", where a teacher can independently create an educational space on the Internet, connect an unlimited number of databases, admit students to various materials, resources, etc.

The improvement of the language teaching methodology in the format of a web page requires the further development of Computer Linguodidactics as a new scientific discipline that explores the peculiarities and regularities in the development of foreign language teaching in new conditions.

COMBINATORIAL BALANCE LAYOUT PROBLEM OF CYLINDRICAL OBJECTS

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Balance layout optimization problems have a wide spectrum of practical applications. In particular, these problems arise in space engineering for rocketry design [1]. Their distinctive feature consists of taking into account behavior constraints of a satellite system that specify the requirements for system's mechanical properties such as equilibrium, inertia, and stability. In some publications balance layout problems of cylinders are studied. Mathematical models and solution algorithm are provided. We consider an optimization balance layout problem of a given collection of cylindrical objects in a container divided by circular racks onto sub-containers. Free sliding of each object on a given rack is only allowable. For analytical description of non-overlapping and containment constraints the phi-function technique is used. We provide mathematical model of the problem that, unlike existing ones, takes into account the combinatorial features of the problem, associated with the generation of partitions of the set of objects placed inside the subcontainers when designing the layout. A solution strategy is proposed, which involves nontrivial procedures: generation of, so-called, "partition" n-tuples; construction of starting points from the feasible region; local optimization, employing NLP solvers. This approach uses the multi-start method to find "good" feasible solutions.

Computational results are provided for the balance layout problem in order to: minimize the deviation of the center of mass of the system from a given point; minimize the radius of the base of the cylindrical container, taking into account the equilibrium of the system. To show the efficiency of our approach we provide the collection of inspiring instances, illustrated with pictures.

References

1. Modeling and Optimization in Space Engineering. Series: Springer Optimization and Its Applications, Vol. 73, Fasano G, Pinte'r J.D. (Eds.), XII. – 2013. – 404 p.

THE DECISION MAKING IN IMPLEMENTING JOINT STUDY PROGRAMMES IN EUROPE: A CASE OF EUROPEAN JOINT MASTER'S IN STRATEGIC BORDER MANAGEMENT

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Joint study programme means a study programme approved and jointly provided by at least two higher education institutions with its main components being integrity of content of the parts of study programmes provided by the partner higher education institutions and the study results, physical and virtual mobility of both students and lecturers. Since 2015 European Joint Master's in Strategic Border Management (EJMSBM) has been implemented. This joint study programme is very special: it is a result of cooperation of European universities located in five countries (Estonia, Latvia, Lithuania, the Netherlands and Spain) and FRONTEX (European Coast and Guard Agency). This study programme is financed by FRONTEX, therefore the agency is involved in the application process. The Joint Master's programme reflects one of Frontex's core commitments to support training and professional education of national border guards by establishing common training standards at the European level.

The paper aims at discussing the process of decision making during the creation and implementation phase of EJMSBM and to reveal the problems related with programme accreditation.

EJMSBM initial single accreditation was done by European Consortium for Accreditation in higher education in 2015 and an accreditation for the 6 years was issued to members of the academic consortium consisting of the Defence Academy of the Netherlands; National University for Distance-Learning Education, Spain; Mykolas Romeris University, Lithuania; University of Salamanca, Spain; Rezekne Academy of Technologies, Latvia; Estonian Academy of Security Sciences. Subsequently, the national quality assurance agencies of consortium partners' countries issued several national accreditations for different periods. This suspended the ability to have the next single accreditation due to different national legal contexts.

THE DEFENCE OF THE STATE: BETWEEN INDIVIDUAL DECISION AND STATE POLICY

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The majority of contemporary threats to state security, such as informational and cyber-attacks, and adversary intelligence service activities are of non-conventional origin. A primary means to address non-conventional threats is organization of a robust civic resistance plan. Citizens can resist aggression both taking part in armed state defense as well as engaging in non-violent civilian resistance - civil defense. These measures are especially relevant as the success of non-violent resistance campaigns is scientifically proven to be significantly higher than that of violence-based [1, 2].

The key elements for successful civil resistance are the civilian population's will to resist the aggressor, as well as their determination to fight for state's independence in all possible ways [3]. The fate of the state depends on the aggregate effect of individual decisions. Civil and patriotic education along with promotion of responsible participation in a democratic life of the state and civil society of Lithuania, will strongly influence individuals' decision making processes and contribute to state's protection against external threats and dangers. [4]

The personal decisions of the people who would form the civil resistance rely on government policy and civil education during peacetime. The success of civil education for state defense depends on state's socio-economic and cultural policies as well as widespread understanding of Lithuanian values and history.

References

1. Chenoweth Erica & Lewis Oregon A., Nonviolent and Violent Campaigns and Outcomes (NAVCO) Data Project v. 2.0 Codebook. University of Denver, 2013a.
2. Chenoweth Erica & Lewis Oregon A., Nonviolent and Violent Campaigns and Outcomes Dataset, v. 2.0., 2013b.
3. The strategy of the Republic of Lithuania for citizen's preparation for state defense, 2010.
4. Petrauskaitė Audronė, Kazlauskaitė Rolandair Gedminienė Rasa, State protection and defense. Vilnius: General Jonas Žemaitis Lithuanian military academy, 2016.

INTELLECTUALIZATION PROBLEMS OF «SMART ENTERPRISE» AS A BASIC OBJECT OF THE DIGITAL ECONOMY

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Intellectualization problems of a management system for virtual enterprise have been examined. The possibility for application of mathematical methods and information technologies for decision making processes is considered. Models for decision quality evaluation with the usage of trade-offs have been proposed.

The problems of high-enterprises with a flexible architecture and dynamic management system. The basic concepts, ideas, methods of creating virtual enterprises based on intelligent information technology. The new technology of implementing control tasks based on system design, control theory, business process-and predictive modeling.

Consider the technology of intellect and virtual enterprise for the production of innovative products through the application of new information and communication technologies.

The concepts and technologies of a smart enterprise creation are suggested. The smart enterprise is considered as a production innovation based on the high level of knowledge about the system, highly productive methods of intellectualization of management processes and models of creative thinking.

The main concepts. The smart enterprise is a flexible system with the Distributed Artificial Intelligence for industrial automation that provides an enterprise with the efficient functioning and support.

Methods and algorithms. The management system uses the concept of creative thinking. It represents the set of scenarios that allow processing the image of the controlled process in order to get an appropriate image of controlling operations. Using the Intelligent Sensor Systems as a technical basis for the Smart enterprise in the digital economy one of the problems how to create new intelligent technologies is solved. These new intelligent technologies turn out to be the most constructive and economically sound when developing modern digital automated management systems.

Summary. The smart enterprise as a basic element of the digital economy constitutes its future in many respects. The smart enterprises of the digital economy especially need artificial intelligence systems.

THE NUMERICAL METHOD OF COMPLEX ANALYSIS FOR DECISION MAKING IN MODELING OF FILTRATION PROCESSES IN MULTIPLY-CONNECTED CURVILINEAR LEF- LAYERS

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The constructive approach to the mathematical description of complex filtration processes, in particular, processes of displacement in technogenic-deformable reservoirs of water or oil and gas, modeled by special structures – LEF-layers, was developed in previous works on the basis of synthesis of numerical methods of complex analysis (conformal and quasiconformal mappings), numerically-analytic methods of summary representations and task decomposition method. However, in cases of multiply-connected curvilinear LEF-layers that simulate the interaction of several injection and operational wells in the productive stratum, the complexity of the application of this approach lies in the incomplete certainty of the shape of the domain of complex quasipotential, which depends the influence of many factors: the configuration of the physical region, in particular, the mutual placement of wells, the ways of imaginary incisions of the domain to bring the multiply-connected domain to a single-connected, the relationship between the values of boundary potentials etc.

The new approach to the classification of cases of flows formation, which allows us to unify the formulation of tasks on the inversion of quasiconformal mappings, their differential analogues, and algorithms for solving was proposed. We have used a combination of methods of quasiconformal mappings with methods of summary representations by G.M. Polozhii.

In spite of the ambiguity of the quasiconformal mappings of the multiply-connected LEF-layers, in most cases the flows formation we have fact that the domain of complex quasipotential by put special imaginary incisions of the physical domain can be reduced to a polygon whose sides are parallel to the axes of the coordinates and which is considered as a set of rectangles, in a certain way "glued" together. This allows us to take full advantage of the numerical-analytic method of summary representations for solving to the corresponding subtasks and, in particular, to parallelize the computational process.

THE EFFICIENCY ASSESMENT OF TRAINING FOR THE UNEMPLOYED IN LATVIA

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The current situation in labor market and the relatively high unemployment rate in Latvia set higher demands on the organization of training in the public employment service system. The purpose of the carried study was to develop a methodology for assessing the efficiency of courses for the unemployed as outcomes on the proposed training. The assessment problem of training efficiency, despite the large number of works in the field ([1], [2], [3], [4]), with reference to the system of training of the unemployed, is complicated because of the specifics of the contingent of trainees, terms and objectives of training. Efficiency in such a system is multidimensional and multicriterial. The empirical base of the research was the data of the research of the unemployed who went through training courses. During the adaptation of the questionnaire, the factor structure of the phenomenon was revealed and segmentation of the respondents in the space of the identified factors was carried out. The analysis of selected clusters with decision trees allows predict efficiency of training a priori.

References

1. Creed, P. A., Bloxsome, T. D., & Johnston, K. (2001). Self-esteem and self-efficacy outcomes for unemployed individuals attending occupational skills training programs. *Community, Work & Family*, 4(3), Pp.285-303.
2. Hipp, L., & Warner, M. E. (2008). Market forces for the unemployed? Training vouchers in Germany and the USA. *Social Policy & Administration*, 42(1), PP.77-101.
3. Laskova, J., & Brokane, L. (2014). Opportunities and Motivation for Training Unemployed in Latvia. *Procedia-Social and Behavioral Sciences*, 116, 649- PP.655.
4. Lanka, A., & Mūrnieks, E. (2006). Vocational education and training in Latvia: the problems and solutions. *The Transformation of Vocational Education and Training (VET) in the Baltic States-Survey of Reforms and Developments*, PP.47-68.

POINTS OF REFERENCES IN EUROPEAN UNION COLLECTIVE DECISION-MAKING

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Since the beginning of European integration process in 1950s the European elites have been trying to define what, from their point of view, the European-level polity *is* or ought to be. Analyzing this particular segment of elite discourse political scientists have identified various sources of legitimation and justification for European level of governance – ranging from 1) the democratic input of European citizens to 2) the economic output of the single European market to 3) the consolidation of historical European heritage and identity. Each of these sources of legitimacy translates into a vision of the EU as either 1) a political community of *all-inclusive* civic participation, 2) an economic community of *diffuse* material benefits, or 3) a cultural community of *particular* historical experience and *exclusive* markers of identification. Justification has a clear-cut effect on the common EU foreign policy as far as collective decision-making is concerned. Examples of these effects are found in EU decision to impose sanctions on Russia in 2014 after the annexation of Crimea and war in Eastern Ukraine.

INTERNET MARKETING DECISION MAKING: ANALYZING THE MARKET POSITION OF COMPANY'S WEBSITE

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Internationally used systems of data collection and data processing on functioning of Internet websites, Internet commercials and behavior of Internet audience have gathered a huge volume (Big Data) of primary marketing information. However, due to the absence of necessary methodological base, the deep analytical processing of collected primary marketing information is not carried out. But the management in the upper echelons of the company need this information for decision making. CEO do not require primary information about hits and hosts, what they do require is aggregated information about market positioning, turnover, profit, and economic effectiveness in a certain market sector, concerning a

certain product, service or marketing campaign. The article suggest the System of Indicators to Determine the Market Position of Company's Website for effective decision making.

ON AN APPROACH TO MATHEMATICAL MODELING OF GAMING DYNAMIC PROCESSES

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Modeling of control processes by multicomponent dynamic systems leads to the appearance of new mathematical models and schemes that consider the initial system in the form of a hierarchical structure of the subsystems obtained on the basis of decomposition. This approach is of special interest in the study of gaming dynamic problems when there are restrictions on the resources of the system.

The models and methods of optimal allocation of resources considered in this report are based on the game setting of the problem or to a certain extent rely on the elements of the game approach. As the complexity of the physical situation that is being studied increases, the volume and heterogeneity of aspects that need to be reflected in the mathematical model increase, which usually leads to the loss of such important qualities as visibility and convenience for analysis. One of the most acceptable methods for decomposing models is to replace them with a system of smaller models related to each other in terms of input and output characteristics, that is, replacing a complex model with a multi-level hierarchical system of simple models. The advantages of such a replacement, except for practical convenience in carrying out computational work, is that the models and methods of each level can to a large extent be independently investigated. In this paper, we considered models relating to a higher level of hierarchy that rely on models and methods of lower hierarchies. Only knowledge of all the features of the studied model and models that provide for it all the generalized characteristics, as well as knowledge of the structure of the optimal solutions of the problem, which are solved on the basis of this model, can allow more efficient use of information obtained with the specific model and obtain a reasoned answer when Solving practical issues related to the distribution and use of limited resources.

Some dueling situations and methods of their solution by numerical methods are considered. The method of optimal distribution of single-type and multi-type means of dueling with the account of contradictory goals is

proposed. Numerical results of modeling the behavior of multicomponent gaming dynamic systems with a hierarchical structure are obtained.

MATHEMATICAL MODELS OF INFORMATION SPREADING PROCESS WITH REGARD TO SOCIAL INFLUENCE

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The processes of information spreading occurring in a society are characterized by chaotic dynamics, the modeling of which leads to the emergence of new mathematical structures and schemes that are characterized by a statistical (incomplete) repeatability.

When implementing algorithms for modeling social processes, calculations require significant time expenditures. Therefore, for further use of the methodology, it is necessary to develop options for algorithms optimization, as well as to create new methods for formalizing processes that take place taking into account the peculiarities of the information spreading. This is especially important in modern conditions of the broad influence of social networking tools on information processes in society.

In this paper the process of information spreading through communication within a given target audience has been simulated and investigated. The proposed approach uses original methods of modeling the process of penetration (spreading) of the impact of information on a given target audience. An approach based on the model of information exchange in a network of neural-like elements is used. Simulation of the process is carried out in conditions of the possibility of communication of each person of the target audience with an arbitrary number of other participants in the network. Formation of the results is carried out with the help of a given set of users' trust to each other and a given threshold level of the receptivity of the input information of the target audience.

The algorithm for simulating the process of information spreading is based on the representation of network elements in the form of a graph whose vertices are described by the parameters of susceptibility to input information and mutual trust, which can be obtained using, for example, the theory of dynamic social influence of B.Latane [1].

References

1. Nowak A., Szamrej J., Latané B. From private attitude to public opinion: a dynamic theory of social impact // Psychological Review. – 1990. – Vol. 97. – P. 362–376.

THE STRUCTURE OF BUILDING THE CITY'S SOCIAL-ECONOMIC PROCESS MANAGEMENT INDICATED MODEL

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With the city's social-economic process' indicated management model, the decision-making and problem-solving process will be simplified. For building the indicated management model, at first, the main indicators should be defined. The indicators are different due to the type of city. In general, the following are considered as the indicators: demography, the unemployment rate in a year, real income of population, housing resources, educational data, rate of children outside of care, the number of low income families, the capacity of main capital investment, service revenue of business, budget taxes and non-taxable income, evaluation of executive and local government performance by the population, etc.

The general structural model of indicated management, in our case, is the unity of specific elements of city's social-economic system, interaction between these elements and their connection with the external world (environment, society).

The structural model solves the social and economic issues.

The social issues are: social infrastructure creation; housing and utility service development; healthcare and education development; creation of housing and social-cultural development conditions; public service and trade assurance; contributing to employment; providing the construction, energy systems, living materials recovery; sanitary, transport service, etc. organization; creation of sustainable life, etc.

The economic issues are: city's infrastructure development; systematic invest policy administration in the city; interregional and inside the regions' communication development; united economic space creation; decreasing the irrational expenses, etc.

In the report, there are presented the following directions of structural model implementation: social-economic development strategy, management decision-making coordination, decision-making realization.

ELECTRONIC SYSTEM OF MAJORITARIAN MP'S BUREAU FOR MAKING DECISIONS

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The work of majoritarian MPs in the majoritarian district is maintained by the bureaus, which contribute to the MP's effective performance and communication development with citizens.

The majoritarian MP has the authority to make a decision in the extreme situation for the citizens' problem solving. Due to the current situation, in many cases, the majoritarian MP has the less possibility to solve the citizens' problem as the majoritarian MP's bureau is not maintained with the essential technical and communication means.

Besides the different subjective and objective reasons, there is one main reason, which hinders the MP to make an appropriate decision, and therefore, the perfect functioning and elector's problem-solving cannot be realized. The main reason of this is that there is not information database that can contribute to the MP's bureau functioning. It is obvious that the automated management of bureau's effective functioning can be done with the information database.

As the sociological research and bureau survey showed the automated management system and appropriate information database of bureau's functioning is very important in order to contribute to the bureau's effective implementation of goals and objectives defined within the regulation. Moreover, it is necessary to engage this system in the electronic system of Parliamentary office for the effective management of bureaus.

The automated management system of majoritarian MP's bureau functioning has the great practice use not only in the Parliamentary work, but it can be also used in any industrial, institution, public management, business structure or educational institutions and other offices.

In the report, we review the technology of building the electronic system of majoritarian MP's bureau contributing to decision-making. The system provides the communication between the majoritarian MPs and citizens, and vice versa, communication of citizens with bureau. The creation of automated management conception for bureau's effective functioning includes: creating the automated archives, automated administration, automated document files and directories.

APPROXIMATE SYNTHESIS FOR DISTRIBUTED OPTIMAL CONTROL PROBLEM WITH COST FUNCTIONAL OF SUPERPOSITION TYPE

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In this paper, we focus on the finding effective methods of control for complicated infinite-dimensional systems, initiated in the works [1],[2]. Finding control in the feedback form or synthesis plays important role here. In [3] it was proposed and justified a procedure for constructing approximate optimal synthesis for a wide class of distributed processes in micro-inhomogeneous medium. We use some known facts on G-convergence theory from [4]. In this paper, we consider the optimal control problem in the feedback form for a parabolic equation with rapidly oscillating coefficients and not-decomposable quadratic cost functional with superposition type operator [5]. In general, to find the exact formula of optimal synthesis is not possible for such a problem because we can not directly apply the Fourier method. But the transition to the homogenized parameters greatly simplifies the structure of the problem. Assuming that the problem with the homogenized coefficients already admits optimal synthesis form, we ground approximate optimal control in the feedback form for the initial problem.

References

1. Lions J.-L. Optimal control of systems, governed by partial differential equations. – Springer, 1971.
2. Fursikov A.V. Optimal Control of Distributed Systems. Theory and Applications. – AMS, 1999.
3. Kapustyan O.V., Kapustian O.A., Sukretna A.V. Approximate bounded synthesis for distributed systems. – Lambert Academic Publishing, 2013. – 225 p.
4. Zhikov V.V., Kozlov S.M., Oleinik O.A. G-convergence of parabolic operators // Russian mathematical surveys. – 1983. – 36. – PP. 9-60.
5. Appell J. Nonlinear superposition operators. – Cambridge University Press, 1990.
6. Kapustian O.A., Sukretna A.V. Approximate averaged synthesis of the problem of optimal control for a parabolic equation // Ukrainian mathematical journal. – 2004. – 56. – PP. 1653-1664.

THE INSIGHTS INTO THE IMPACT OF PERSON- ORGANIZATION VALUE CONGRUENCE ON ORGANIZATIONAL COMMITMENT

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The paper investigates the relationships between person-organization value congruence, organizational commitment and intention to stay. Value congruence and organizational commitment dimensions were selected considering analysis of scientific publications [1], [2], [3]. Each of the study variables was measured by applying previously validated and commonly used scales: value congruence, organizational commitment and intention to stay.

The data was obtained through questioning of personnel from Lithuanian Armed Forces. The survey confirmed findings of earlier studies that organizational commitment is positively related to intention to stay and value congruence is positively related to both organizational commitment (especially emotional commitment) and intention to stay. The results of regression analyses revealed that intention to stay can be predicted by emotional commitment and congruence of moral values; and emotional commitment can be predicted by congruence of physical values. Finally, the recommendations for various stakeholders were presented and the directions for future investigations are suggested. Considering limited number of investigations in the context of Armed forces, the study appears to be promising research, focused on the retention of professional soldiers.

References

1. Allen, N. J., Meyer, J. P. (1996). Affective, continuance, and normative commitment to the organization: An examination of construct validity. *Journal of Vocational Behavior*, 49, PP. 252–276.
2. Jaiswal K. R., Dash, S., Mishra A. (2016). Why do indian military officers want to leave? An empirical investigation. *Armed forces & Society*, 42(2), PP. 386–406.
3. VVeinhardt J., Gulbovaitė E. (2015). Asmeninių ir organizacijos vertybių kongruencijos diagnostinis instrumentas. *Organizacijų vadyba: sisteminiai tyrimai*, 73, PP. 161–190.

DECISION-MAKING ON INTEGRATION OPTIMAL MODEL SELECTION IN THE INTEGRATED TEACHING

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The integrated teaching currently represents the special educational demand. It is considered as the social and educational integration actual problem. This problem is derived from the fact that there are not any scientific and functional organizational methods and means for the differentiated educational system development and improvement.

The concept “Integrated Teaching” was paid the scientific attention after the scientific-technical progress reached the unprecedented success. However, this advancement, such as the formation of the rapidly-developing contiguous disciplines, was followed by the concomitant actions. Some of the scientific fields were differentiated that was an obviously logical and natural phenomenon. But it showed us the necessity of revealing the links, studying and analyzing them in details, and advancement at the new level, which had existed before the mentioned process among the given, and later differentiated, discipline parts. The latter is the innovative development of the integrated educational process. It is worth to say that the innovative development of the modern educational process is characterized with some peculiarities, which studies and scientific analysis need to be paid attention. The implementation of the innovative system of the integrated educational process created the wider development basis for the integration optimal model selection systematic approach and integrated teaching practice.

In the report, we review three principles of the decision-making on integration optimal model selection, such as the diagnostic principle of integration, correction principle, decision-making for the selection of the different level model of integration. We pay great attention to the problem discussion and solution of the teachers’ involvement in the implementation process of all three principles. This gives us the possibility to create the new model of the integrated teaching effective management, which will be oriented on the modern information-communication technologies of teaching and innovative approaches. Besides this, in that case, we receive the two decision-making areas, such as the external and internal directions. This is considered more interesting as the external direction of decision-making is based on the effective results made with the external forces. With the external forces, there are meant the subjective and objective

phenomenon, which are in the close correction with the country's educational process effective management. The internal forces represent the human and educational resources of an educational institution. The integration of both of them in one space provides the effective management of integrated educational process.

OPTIMAL PACKING OF ELLIPSOIDS

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We consider the problem of optimal packing a given collection of unequal ellipsoids into a container of minimal sizes. The problem is NP-hard and has multiple applications in modern biology, mineralogy, medicine, materials science, nanotechnology, as well as in the chemical industry, power engineering etc. Examples of applications: the formation and growth of crystals, the structure of liquids, crystals and glasses, the flow and compression of granular materials, the thermodynamics of liquid to crystal transition, a robot arm and other elements in a scene are approximated by three-dimensional ellipsoids, chromosome organization in the human cell nucleus and other.

In particular, many works have tackled the optimal ellipsoid packing problem (see, e.g., [1-2]) and the interest in finding effective solutions for placement problems of ellipsoids is growing rapidly.

To describe non-overlapping, containment and distance constraints we derive phi-functions, adjusted phi-functions, quasi-phi-functions, adjusted quasi-phi-functions. We formulate the general problem in the form of a nonlinear programming problem. Mathematical models for subsequent problems are constructed, in particular, the optimal packing problem of ellipses, allowing continuous rotations, in a minimum volume rectangular container; the optimal packing problem of non-oriented ellipsoids approximated by convex polytopes in different containers. Efficient algorithms are developed for solving the ellipsoids packing problems, employing fast stating point algorithms and special local optimization procedures. This allows us to search for feasible and local-optimal solutions. We provide computational results illustrated with figures.

The model can be realized by the current state-of-the art local or global solvers, such as IPOPT, BARON LindoGlobal GloMIQO.

References

1. Uhler, C., Wright, S. J.: Packing Ellipsoids with Overlap. (2013). SIAM Review, 55(4): PP. 671-706.
2. Choi, Y. K., Chang, J. W., Wang, W., Kim, M. S., Elber, G. Continuous collision detection for ellipsoids. (2009) IEEE Transactions on Visualization and Computer Graphics, 15(2): PP.311-324.

DISSIPATIVE PROPERTIES OF GENERALIZED ORNSTEIN-UHLENBECK PROCESS

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Considering the stochastic process, which is given by the solution of the evolutionary equation [1]

$$du^\varepsilon(t) = -\beta C(u^\varepsilon(t), x(t/\varepsilon))dt + \sigma(u^\varepsilon(t), x(t/\varepsilon))dw_t, \quad (1)$$

where $u(t), t \geq 0$, – evolution, $C(u, x) \in C^2(R^d, \bullet)$ – regression function, w_t – Wiener process, $\sigma(u, x)$ – diffusion, $x(t), t \geq 0$, – Markov process, ε – small series parameter, β – positive coefficient.

There exists generator Q [2] for $x(t), t \geq 0$, in the form

$$Q\varphi(x) = q(x) \int_x Q(x, dy)[\varphi(y) - \varphi(x)].$$

Limited evolution $u(t)$ is obtained as a solution of equation

$$du(t) = a(u)dt + \sigma(u)dw(t). \quad (2)$$

Here

$$a(u) = -\beta \int_x C(u, x)\pi(dx)$$

and limited diffusion $\sigma(u)$ is received from equation $\sigma(u)\sigma^*(u) = B(u)$, where

$$B(u) = 2 \int_x \sigma^2(u, x)\pi(dx).$$

The operators $C(x)$, $C_1(x)$, $\tilde{L}(x)$ are determined in the forms, respectively,

$$C(x)\varphi(u, x) = C(u, x)\varphi'(u, x),$$

$$C_1(x)\varphi(u, x) = \frac{1}{2}\sigma^2(u, x)\varphi''(u, x),$$

$$\tilde{L}(x)\varphi(u, x) = [a(u) + \beta C(u, x)]\varphi'(u, x) + \frac{1}{2}[B(u) - 2\sigma^2(u, x)]\varphi''(u, x).$$

Theorem. Let there defined the Lyapunov function $V(u) \in C^3(R^d)$ for the determined system

$$\frac{du(t)}{dt} = a(u),$$

which fulfills conditions

$$C1: |C(x)R_0\tilde{L}(x)V(u)| < M_1V(u), M_1 > 0;$$

$$C2: |C_1(x)R_0\tilde{L}(x)V(u)| < M_2V(u), M_2 > 0.$$

Additionally, the following inequalities

$$a(u)V'(u) < -c_1V(u), c_1 > 0,$$

$$\sup_{R^d} \|\sigma(u)\| < c_2, c_2 > 0$$

are satisfied.

Then the initial process (1) is asymptotically dissipative [3].

Remark. If averaged regression function and averaged square of limited diffusion, respectively, have a representation

$$\int_x C(u, x)\pi(dx) = u(t),$$

$$\int_x \sigma^2(u, x)\pi(dx) = 2,$$

then the limited process (2) is the generalized Ornstein-Uhlenbeck process.

References

1. Кінаш А.В. Асимптотична дисипативність дифузійного процесу. / А.В. Кінаш, Я.М. Чабанюк, У.Т. Хімка // Математичне та комп'ютерне моделювання. Серія фізико-математичні науки. Збірник наук. праць. Ін-т кібернетики ім. В.М. Глушкова, Кам'янець–Подільський нац. ун-т ім. І. Огієнка. – 2014. – Вип. 11. – С. 77–87.

2. Koroliuk V., Limnious N. Stochastic Systems in Merging Phase Space. - World Scientific Publishing, 2005.
3. Kinash A.V. Asymptotic dissipativity conditions of the generalized Lorenz system. / A.V. Kinash, Ya.M. Chabanyuk, U.T. Khimka // XXVII International Conference «Problems of Decision Making Under Uncertainties». Abstracts. May 23–27, 2016, Tbilisi–Batumi, Georgia. – Київ. – 2016. – P. 93–94.

OPTIMIZATION OF THE TOTAL PRODUCTION TIME BY SPLITTING COMPLEX MANUAL ASSEMBLY PROCESSES

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In this article the minimization of the learning content in the total assembly time is studied. Research is based on manual automotive wiring harness assembly, with unstable demand, fluctuating order quantities and enormous product variety. Such instability in manual production environment results that assembly is always at the start-up or learning phase, thus, operational times are greater than standard and operational efficiency is significantly reduced [1].

Since a lot of research is done on learning time calculation, there is still lacking of studies that address learning time reduction in such production situation [2]. The methodology proposed in this article addresses reduction of learning time by splitting and simplifying complex assemblies of automotive wiring harnesses. Experimental results from the company indicate that this approach enables to optimize learning time and increase operational efficiency.

References

1. Tilindis J., Kleiza V. Learning curve parameter estimation beyond traditional statistics, Appl. Math. Model. 45 (2017) PP. 768–783.
2. Grosse E.H., Glock C.H., Müller S. Production economics and the learning curve: a meta-analysis, Int. J. Prod. Econ. 170 (2015) PP. 401–412.

INTERVAL FORECASTS OF SHARE PRICES

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Interval forecasting of stock prices is proposed. A strategy for building a transition matrix of Markov chain P , based on historical data of the stock market, is provided. We are considering the question of determining the probability $p_{ij}^{(n)}$, that given the chain is in state i today, it will be in state j at n days from now. Also we calculate the probabilities of the stock prices occurrence in a future based on matrix P^n , where $n=1,2,3...$

Simulation and empirical studies show that our proposed evaluation technique for interval forecasting can provide a more objective decision for traders in stock prices forecasting [1, 2].

References

1. Kotsiuba I. Simple stop loss procedure to measure expected return of the portfolio / I. Kotsiuba. – Columbia International Publishing, 2016. – Vol. 3 № 4 – PP. 198-205
2. Marcek D., “Stock Price forecasting: Statistical, Classical and Fuzzy Neural Network Approach” in MDAI, V. Torra and Y. Narukawa, Eds, vol. 3131. Springer, 2004.

SYNCHRO-INFORMATION'S 24x7 MONITORING TOOL FOR MODERN DIGITAL NETWORKS DECISION MAKING

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Synchro-information parameters continuous monitoring as a digital networks management system's part can provide a higher level of the networks transparency, reliability and quality. That's why a synchronization signals monitoring is actual as a statistically important data source for decision making process.

As a basic monitoring parameters the authors consider TIE (Time Interval Error) parameter defined in ITU-T G.810 as well as a statistically calculated secondary parameters as Maximum Time Interval Error (MTIE) and Time Deviation (TDEV). Also, using such monitoring together with a modern IEEE1588 precision time protocol's synchro-information transfer method in IP-based networks, it's possible to predict hypothetical cyber attacks beginning.

Synchronization parameters measurement and monitoring solutions can be considered as basic approach to polychannel monitoring conception proposed in [1] and can be modified for a possible customer needs and different statistics automatic calculation and various masks applying.

References

1. Konovalov, G., Kostik, B., Koval, V., Shkliarevskiy, I. "Timing information's 24×7 monitoring as an important factor of network synchronization quality support", 2013 International IEEE Symposium on Precision Clock Synchronization for Measurement Control and Communication (ISPCS-2013), 22-27 september, Lemgo German, 2013. - PP.89-94.

INFORMATION TECHNOLOGY FOR AUTOMATED TRANSLATION FROM INFLECTED LANGUAGES TO SIGN LANGUAGE

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Information technology to implement automated translation from inflected languages to the sign language which is an essential element for the creation of new computer systems for training and communicating of the deaf is proposed [1]. The model of representation of inflected and sign language dictionaries were improved, which significantly reduced the memory amount required to store dictionaries. Unlike the existing approaches the words of the language are stored at the database as a combination of appropriate indexed sets of basic word forms and inflections with the help of which the word is automatically generated.

The mechanism for the representation of relations between words of the inflected language and gestures of the sign language was developed, which allowed aligning the Ukrainian words by corresponding gestures. The advantage of this representation is the simplicity of building and editing the

relationships between words and gestures and the possibility to build the relationships between words and gestures, using buildings the text corpus.

The information technology of the automated translation from inflected languages to the sign language with the ability to continuously expand and improve the translation quality was developed. The advantage of this technology is a relative simplicity (for the translation system based on rules) of its expansion and enhancement of the translation quality as a result of self-learning.

The experimental software was implemented to build both the Ukrainian and sign language dictionaries, to build a set of correspondences between the Ukrainian and sign language grammar, to test the translation effectiveness. The web service that implements the functionality of the automated translation based on the proposed information technology was built.

References

1. Barmak O., Krak Iu., Romanyshyn S. Text to gestures translation for inflected languages. – LAP LAMBERT Academic Publishing. – 2017. – 100p.

DIFFERENT APPROACHES IN SAMPLE SURVEY

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Let us consider a population consisting of N elements labeled $1, \dots, N$,

$$\{u_1, \dots, u_N\}.$$

The main problem of data surveys is the large size of a population that needs an unlimited amount of resources. Sample surveys help to estimate the parameters of the general population, and at the same time to minimize the cost of resources.

Let y denote a variable, and let y_k be the value of y for the k th population element. We assume that the values y_k are unknown at the outset. Suppose that an estimate is needed for the population total of y ,

$$t = \sum_U y_k.$$

General notation for a sample is s .

Ordinarily, sample selection is carried out by a series of randomized experiments. Collectively, the series of experiments will result in a selected sample s .

Definition: Let us consider the estimation of population total $t = \sum_U y_k$,

and let us examine the estimator which called the π estimator:

$$\hat{t}_\pi = \sum_s \frac{y_k}{\pi_k}.$$

Systematic sampling refers to a set of procedures that offer several practical advantages, particularly its simplicity of execution. A first element is drawn at random, and with equal probability, among the first a elements in the population list.

Result: Under the Systematic design, with the sampling interval a , the π estimator of the population total $t = \sum_U y_k$ takes the form $\hat{t}_\pi = at_s$, where t_s

is the sample total of y , and s is a member of the set of possible samples $\{s_1, \dots, s_a\}$.

In stratified sampling, the population is divided into nonoverlapping subpopulations called strata. A probability in the different strata are independent. Stratified sampling is a powerful and flexible method.

Result: In a stratified sampling, the π estimator of the population total $t = \sum_U y_k$ can be written

$$\hat{t}_\pi = \sum_{h=1}^H \hat{t}_{h\pi},$$

where $\hat{t}_{h\pi}$ is the π estimator of the population total in the h -th strata.

Using data from StatVillage as a general population and building samples with the help of both of these methods it should be denoted that

- Estimates received using Stratified method are more accurate in comparison with real data;
- Systematic method is easier in practical use.

References

1. Carl-Erik Sarndal, The calibration approach in survey theory and practice. Component of Statistics Canada, Catalogue no. 12-001- X Business Survey Methods Division, 2007. – 21 p.
2. Sharon L. Lohr Sampling: Design and Analysis, Arisona State University, 1999.

CONCEPT OF PROCESSING DECISION MAKING MODEL IN THE SYSTEM OF MUNICIPAL MANAGEMENT

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As a result of the reforms carried out in Georgia past years, appeared the demand for implementation of the entirely new system of city government/self-government, this was caused by the fact that self-governing organs were granted new rights and functions. Executive-judicial base has also changed, because of all this old systems of municipal management became useless and they do not respond to the new demand for modern systems of management. Therefore, it became necessary to process new system of decision-making, which will be oriented on powerful technical and program tools and which will ensure processing and keeping of large informational data in real time period. All this leads us to the building of the integrated system of governing, which will be adapted to the global missions, primary to the optimal management of the social-economic objects. As analyzes show there has not been carried out sufficient scientific researches, so, there is vacuum in the technology of decision-making of municipality management in Georgia.

Foreign practice, studied and analyzed by us do not respond to the realization of the new demands of municipal management, that's why our aim is to work out systemic approach of municipal management. We will use comprehensive analytical, modeling and optimizing resources of modern informational technologies which are connected to the theory of management, the basics of mathematics and cybernetics. This ensures usage of complex models of optimal decision-making in the process of municipal management and informational-analytical assistance.

The report will present:

- The concept of creating econometric model of municipal management, which will enable us to carry out thorough social-economic analyzes and forecast the city development;
- Processing the functional structure of the city operational management complex;
- Processing the management model of the city working resources and demographical processes;
- Concept of the model of financial processes of the municipal management.

These models adequately characterize city's social-economic development factors. Concerning the general evaluation of the city development, we offer indistinct model of integral assessment of the city's strategic development. This model will give us possibility to observe social-economical changes of the city, furthermore, it will provide efficient monitoring of the city management and bring systematizing elements in the process of decision-making.

POLYHEDRAL COHERENT RISK MEASURES UNDER IMPRECISE SCENARIO ESTIMATIONS

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For making optimal decisions under uncertainty, it is important to quantify the risk. Different risk measures (functions) can be used for this.

A successful example of such measures is the class of polyhedral coherent risk measures (PCRM), which has theoretically attractive properties and contains a number of popular risk measures [1-2]. Besides, the use of PCRM allows us to reduce a wide class of problems of stochastic programming and robust optimization to appropriate deterministic optimization tasks [3]. The PCRM mathematical apparatus was introduced for known probabilistic distributions of random variables (r.v.) and then developed for the case of imprecise scenario probabilities.

The application of this apparatus to the case of imprecise scenario estimates, when we know only lower and upper estimates of scenario values of r.v., is proposed. Then r.v. are compared in a partial order determined by PCRM of the estimates. This allows us to modify results obtained with the use of PCRM for a wider class of uncertainty conditions. For instance, the case of imprecise scenario estimates and its combination with imprecise scenario probabilities are such ones.

As applications, problems of portfolio optimization on the reward-risk ratio are considered.

References

1. Kirilyuk V.S. The class of polyhedral coherent risk measures, *Cybern. Syst. Analysis*, 2004. – 40(4). – PP. 599-609.
2. Kirilyuk V.S. Polyhedral coherent risk measures and optimal portfolios on the reward-risk ratio, *Cybern. Syst. Analysis*, 2014. – 50(6). – PP.724-740.

3. Kirilyuk V.S. Risk measures in stochastic programming and robust optimization problems, *Cybern.Syst.Analysis*, 2015.– 51(6).– PP. 874-885.

THE ROLE OF MEDIA LITERACY EDUCATION IN TACKLING AGGRESSIVE PROPAGANDA AND FAKENEWS

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Increased flow of information and ongoing technological media revolution challenges contemporary societies in variety of new unprecedented ways. Authoritarian states are eager to abuse this new media environment and resort to aggressive propaganda techniques in order to achieve their political goals. Societies are now tackled with the phenomenon of Fake News, audiences are unable to distinguish between facts and lies, reality and fiction, journalism and deliberate manipulation. This creates a need to formulate and implement comprehensive Media Literacy education programs and incorporate them into contemporary education system.

This presentation will focus on Lithuanian experience in developing Media Literacy initiatives in country's educational system. It will focus on the expertise of Nordic countries in this field. Considering today's political reality, Media Literacy education for young generation is an extremely important field to concentrate on. Lithuania is implementing the first steps in Media Literacy education, researching the media needs of young and ethnically diverse audiences in different regions of Lithuania. The lessons learned from those initiatives and the findings of the focus group research will be the spotlight of this presentation.

MULTICRITERION MODEL OF PROMOTION AND SALES STIMULATION OF ELECTRIC VEHICLES

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The main objective of this work was mathematical modeling of a problem of promotion and sales stimulation of an electric vehicle in a multicriterion optimization problems class:

$$\{D_0, \{f_i(x), i \in I\}\} \quad (1)$$

where D_0 – area of permissible solutions, $f_i(x), i \in I$ – set of criteria,
 $J = \{j = 1, \dots, n\}$ – set of variety of electric vehicles on the market on sale,
 x_{1j} – number of orders for electric cars of j -brand, $j \in J$,
 x_{2j} – number of orders for hybrid cars of j -brand, $j \in J$, x_{3j} – number of orders for premium class electric cars of j -brand, $j \in J$, with the price over 60 000 €, a_{1j}, a_{2j}, a_{3j} – discounts when purchasing appropriate electric cars, $j \in J$,

$$D_0 = \left\{ \begin{array}{l} x_{1j} \geq 0, \quad j \in J, \\ x_{2j} \geq 0, \quad j \in J, \\ x_{3j} \geq 0, \quad j \in J, \\ \sum_{l=1}^3 \sum_{i=1}^M \sum_{j=1}^n (d_{ij} * x_{lj}) \leq p, \\ \sum_{j=1}^n (a_{1j}x_{1j} + a_{2j}x_{2j} + a_{3j}x_{3j}) \leq b, \\ \sum_{j=1}^n x_{1j} \geq \sum_{j=1}^n x_{1j}, \end{array} \right. \quad (2)$$

n – number of kinds of electric cars and vans that are on sale,

M – amount of marketing programs,

p – marketing budget,

b – governmental subsidy for purchasing electric vehicles.

The set of criteria $\{f_i(x), i \in I\}$ may include sales, market share, the cost of chargers, and performance characteristics such as speed, power, power reserve, etc.

ANALYSIS OF THE MARKET OF ELECTRIC VEHICLES

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The paper analyzes the market of electric vehicles with the goal of constructing mathematical models to support decision-making in this domain [1].

The analysis is carried out for Germany, where the introduction and usage of electric vehicles is actively supported by the government. But the country lags behind the goal put by the chancellor - to reach 1,000,000 electric cars on its roads by 2020 - due to lack of incentives for buyers. Therefore, in 2016, a project for marketing electric vehicles with a budget of € 1,000,000,000 was approved, of which 600 million euros were reserved for state subsidies for the purchase of electric cars, which will last until 2019. Purchasers of an electric vehicle with an electric drive, which are obliged to own it for at least 9 months, receive a state subsidy, that is, a discount of € 4,000, and for hybrid vehicles - € 3,000. In addition, when purchasing electric cars for private usage, buyers receive a full subsidy in size of € 5,000, and for corporate usage - of € 3,000. Premium carbuyers whose car has a price of over € 60,000, are not eligible for these discounts. The state is more interested in stimulating the acquisition of fully electric vehicles, not hybrids. Also, there is an additional bonus program of companies for certain brands of electric vehicles, for example, the company's Nissan discounts of € 1,000 for Leaf and NV 200 electric vehicles in Vienna.

In order to achieve the desired level of sales, the following sets are formulated according to the three criteria: annually by 2020 - to double sales, increase the market share from 15% to 30%, and reduce the cost of batteries in electric vehicles by 1.5 times.

The above information from the conducted analysis is the basis for modeling tasks of system and multicriteria optimization of stimulation of sales and promotion of electric vehicles.

References

1. Manovytska D. Decision-making problems in the tourist business connected with the use of electromobiles. PDMU-2017, May 10-13, 2017, Mukachevo, Ukraine, PP.74-75.

PROGRAMMING ON TYPE 2 FUZZY SETS

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In this report we review the definition, operations and basic properties of the type 2 fuzzy sets that have appeared up to now in the literature.

Later we investigate the problem of maximizing the function on the type 2 fuzzy set (a fuzzy set whose membership function takes fuzzy values). The idea of decomposition of fuzzy set on the set levels consists the basis of the method of solving this problem. It is shown that the set of "optimal" solutions to this problem is also a type 2 fuzzy set. Fuzzy membership function of this set is defined by fuzzy mapping. Its membership function is constructed. Since this function uniquely determines this set, it is called a reliability function of the type 2 fuzzy set. There are proved theorems that allow to simplify the construction of reliability function. It is shown that the support of the set of "optimal" solutions can be represented as a set of Slater's optimal alternatives to the three-criteria optimization problem. In this problem membership degree of type 2 fuzzy set of solutions is maximized in addition to the objective function of the original problem, as well as the value of the reliability function is maximized too.

We also enumerate some of the applications in which programming on type 2 fuzzy sets have been used [1,2].

The proposed approach to solving optimization problems on type 2 fuzzy sets develops the known methods of fuzzy mathematical programming.

References

1. Mashchenko S. The problem of the mathematical programming with the fuzzy set of indexes of constraints. *Cybernetics and systems analysis*. 2013. – 49(1). – PP. 62 – 68, (DOI) 10.1007/s10559-013-9485-4.
2. Mashchenko S.O., Morenets V.I. Shapley Value of a Cooperative Game with Fuzzy Set of Feasible Coalitions. *Cybernetics and Systems Analysis*. 2017. –53(3). – PP. 432-440, (doi)10.1007/s10559-017-9944-4.

AUTOMATED SYSTEM OF CITY'S BUDGET PLANNING AND PERFORMANCE CONTROL

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The government of any country needs the financial resources for the function and duty implementation. These resources are depicted in the country's state and local municipality budget. The main source of the resource mobilization is the income of country's citizens. Therefore, the budget should be planned transparently, purposefully and wide public engagement and the expenses should be effective.

It is obvious that the society should be engaged in all the stages of budget formation and not only in the budget expense monitoring process.

The decision-making process in the budget planning and expenses is always problematic. All these are defined in the budget formation stage. At first, the budget goals are defined, and then capacity of essential financial resources.

The monitoring of budget expenses can be done in three ways: 1) to check if there is corruption (it is more law enforcement structure's responsibility, and there is not paid attention to this issue); 2) how the accumulated finances are spent that needs the report analysis, and 3) how effectively and purposefully budget is spent, which study needs the complex approach.

In Georgia, besides the successful income policy, the important challenges and problems are in the budget expense decision-making. Obviously, the alternative set of budget expenses is variable that makes difficult to make priorities. For solving this problem, there is necessity to create the modern technologies, scientific methods and recommendations.

In the report, we discuss the automated system creation of city's budget planning and performance control, which help to realize the following: budget projecting; budget project discussion and approval; budget performance control; budget performance report creation and approval.

ESTIMATES OF SOLUTIONS TO ONE-DIMENSIONAL LINEAR STOCHASTIC BOUNDARY VALUE PROBLEMS UNDER UNCERTAINTY CONDITIONS

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Let a realization of the vector random process $y(t) \in R^N$ of the form

$$y(t) = H(t)x(t) + \eta(t), \quad t_0 < t < s \leq t_1, \quad (1)$$

be observed. Here $x(t) \in R^N$ is a solution of the linear stochastic equation

$$dx(t) = A(t)x(t)dt + \sigma(t)dw(t), \quad t_0 < t < t_1, \quad (2)$$

satisfying boundary conditions

$$B_1x(t_0) = C_1\xi_1, \quad B_2x(t_2) = C_2\xi_2, \quad (3)$$

$H(t), A(t), \sigma(t)$ are matrix-valued functions of dimension $N \times n$, $n \times n$, $n \times m$, respectively, with continuous entries on the intervals $[t_0, s]$ and $[t_0, t_1]$, B_k are $n_k \times n$ -matrices, $k=1,2$. C_k are $n_k \times p_k$ -matrices, $k=1,2$, $\eta(t)$ is a vector random process having zero mean, $E\eta(t)=0$ and correlation matrix function $R(t, \tau) = E\eta(t)\eta^T(\tau)$ with square integrable entries on $(t_0, s) \times (t_0, s)$. $w(t)$ is a vector standard Wiener process, ξ_1 and ξ_2 are vector random variables with known zero means and correlation matrices. Assume also that the boundary value problem adjoint to the problem

$$\frac{dx(t)}{dt} = A(t)x(t), \quad B_1x(t_0) = 0, \quad B_2x(t_1) = 0,$$

has only the trivial solution.

Denote by $\hat{x}_L(t)$ a linear estimate of function $x(t)$ with respect to observations (1) and by $\sigma(x, \hat{x}_L, R)$ the mean square error of estimation which has the form

$$\sigma(x, \hat{x}_L, R) = \left\{ \int_{t_0}^{t_1} E |x(t) - \hat{x}_L(t)|^2 dt \right\}^{\frac{1}{2}}.$$

We suppose that function $R(t, \tau)$ is unknown and belongs to G , where G is some given set in the space of square integrable functions.

Let $\sigma_1(x, \hat{x}_L) = \sup_G \sigma(x, \hat{x}_L, R)$. We study the problem of existence of the estimates $\hat{x}_L(t)$ which minimize the guaranteed error of estimation. Under suitable hypothesis on the set G , we show that such estimates are expressed via solutions of boundary value problems of special type.

References

1. Shestopalov Y., Podlipenko Y., Nakonechniy O. Estimation of Parameters of Boundary Value Problems for Linear Ordinary Differential Equations with Uncertain Data // Advances in Pure Mathematics. – 2014. - Vol. 4, № 4. - PP. 118-146.

TASKS OF OPTIMAL CONTROL FOR ONE-DIMENSIONAL BOUNDARY PROBLEMS WITH VARIABLE STRUCTURE UNDER UNCERTAINTY

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Let the vector-function $x_k(t) \in R^{n_k}$ is the solution of boundary problem

$$\frac{dx_k(t)}{dt} = A_k(t)x_k(t) + B_k(t)u_k(t) + C_k(t)f_k(t), \quad t_{k-1} < t < t_k, \quad k=1, 2$$

with boundary conditions

$$C_0x(t_0) + C_1x(t_2) = b_0$$

and conditions in a point t_1 in the form of

$$D_1x(t_1) + D_2x(t_1) = b_1$$

where $A_k(t)$, $B_k(t)$, $C_k(t)$ are the matrix functions of dimensions $n_k \times n_k$, $n_k \times m_k$, $n_k \times p_k$, $k=1,2$ respectively, which elements are square integrable on appropriate intervals. b_0 and b_1 are preset vectors. $u_k(t)$ are the sectionally continuous control functions. $f_k(t)$ are the unknown functions from the sets G_k , $k=1,2$ which belong to spaces L_2 . C_0 , C_1 , D_1 , D_2 are such matrices that there is a unique generalized solution of relevant boundary problem.

Let denote as $I(u)$ the matrix with elements $I_{k,j}(u)$, $k=1,2$, $j=\overline{1,N}$ that have a form

$$I_{k,j}(u) = \sup_{f_k \in G_k} |x_k(t_j) - x_{kj}|^2,$$

where $x_{k,j}$ are preset numbers.

In this work we investigate the conditions for the existence of vector Pareto minimum of the function $I(u)$ for the case when the control function $u(t)$ belongs to the convex closed set. Numerical methods for determining of the Pareto optimal control are proposed.

PROBLEMS OF DECISION SUPPORT SYSTEM FOR SYSTEM ANALYSIS OF INNOVATIVE TREATMENT METHODS

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A health protection of population is priority direction of social politics of the states. A meaningful place in the solution of problems of national health care occupies development of medical science. Thus one of basic methods of overcoming of problems in the national systems of healthcare there is the use of potential of scientists-physicians with the aim of development and application of the newest curative, diagnostic and prophylactic methodologies, that assists upgrading of medicare and maintenance of health of population.

Within the framework of solution of the tasks included by national projects, researches dealing with informative support of innovative curative methodologies acquire special value: simulation of development of disease under the action of innovative curative methodologies; a comparative analysis of efficiency of curative methodologies; evidence of decision-making at the choice of tactics of treatment; prognostication of the financial providing of treatment, which is necessary in medical insurance.

The analysis of information models in area of medical scientific activity shows on a necessity of developments of set of methods for decision support, optimization and management. The solution of problems of medical innovative activity is related to development of information models of development and distribution of diseases (in case of epidemiological disease), description of their progress (in case of multi-stageness).

References

1. Nakonechny A., Marzeniuk V. "Uncertainties in medical processes

ESTIMATES OF SOLUTIONS TO THE POISSON EQUATION IN UNBOUNDED DOMAINS UNDER UNCERTAINTY CONDITIONS

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Let realizations of the random processes and random variables of the form

$$y_k(x) = \int_{R^n} h_k^{(1)}(x, v) \varphi(x, v) dv + \xi_k(x), \quad a < x < a_1, \quad k = \overline{1, N_1},$$

$$y_k = \int_{a_1}^b \int_{R^n} h_k^{(2)}(x, v) \varphi(x, v) dx dv + \eta_k, \quad k = \overline{1, N},$$

be given, where $a < a_1 < b$, R^n is n -dimensional Euclidean space ($n \geq 1$), $h_k^{(1)}(x, v)$ and $h_k^{(2)}(x, v)$ are prescribed square integrable functions in the domain $(a, a_1) \times R^n$, $\xi_k(x)$ and η_k are random processes and random variables having finite second moments with $E\xi_k(x) = 0$, $E\eta_k = 0$, $E\eta_k^2 = \sigma_k^2$, $\varphi(x, v)$ is a solution to the Poisson equation

$$\Delta \varphi = f(x, v), \quad a < x < b, \quad v \in R^n,$$

$\varphi(a, v) = \varphi(b, v) = 0$, $f(x, v)$ is an unknown square integrable function that vanishes outside the bounded domain $(a, b) \times D$.

Assume that unknown correlation functions

$R_k(x_1, x_2) = E\xi_k(x_1)\xi_k(x_2)$ belong to the sets

$$V = \left\{ (R_1, \dots, R_N) : \int_a^{a_1} q_k^2(x) R_k(x, x) dx \leq 1, \quad k = \overline{1, N_1} \right\}$$

and functions $f(x, v)$ belong to the sets

$$G = \left\{ f : \int_a^b \int_{R^n} f^2(x, v) dx dv \leq q_0^2 \right\},$$

respectively, where $q_k(x), k=1, N_1$, are given continuous functions on the interval $[a, a_1]$, q_0 is a prescribed number. Denote by $\hat{\varphi}(x, s)$ a linear with respect to observations estimate of function $\varphi(x, v)$.

The linear guaranteed estimate $\hat{\varphi}$ and the error σ of the guaranteed estimation are determined from the condition

$$\begin{aligned}\sigma^2 &= \min_{\hat{\varphi}} \max_{V, G} \int_a^b \int_{R^n} E(\varphi(x, v) - \hat{\varphi}(x, v))^2 dx dv = \\ &= \max_{V, G} \int_a^b \int_{R^n} E(\varphi(x, v) - \hat{\varphi}(x, v))^2 dx dv.\end{aligned}$$

For finding such estimates and estimation errors, we have applied the Fourier transform with respect to variable $v \in R^n$ to the both sides of the Poisson equation. As a result, the problem of estimation of the solution to the Poisson equation has been reduced to the problem of estimation of a solution to one-dimensional boundary value problem of the form

$$\frac{d^2 \tilde{\varphi}}{dx^2} - |w|^2 \tilde{\varphi} = \tilde{f}(x, w), \quad \tilde{\varphi}(a, w) = \tilde{\varphi}(b, w) = 0.$$

where $\tilde{\varphi}(x, w)$ and $\tilde{f}(x, w)$ are the Fourier transform of $\varphi(x, v)$ and $f(x, v)$.

For the guaranteed and approximate guaranteed estimates and estimation errors, we obtain their explicit representations.

References

1. Nakonechnyi O., Demydenko S., Losieva M. Mean square estimation of solutions and right-hand sides of Poisson's equation under uncertainty // XXVIII International Conference "Problems of Decision Making under Uncertainties" (PDMU-2016), Brno, Czech Republic, August 25-30, 2016 p. - PP.79-80.
2. Shestopalov Y., Podlipenko Y., Nakonechniy O. Estimation of Parameters of Boundary Value Problems for Linear Ordinary Differential Equations with Uncertain Data // Advances in Pure Mathematics. – 2014. - Vol. 4, № 4. - PP. 118-146.
3. Nakonechnyi O., Veres M. Minimax methods of estimation in linear problems with parameters. – Kyiv – 2007. – 116 p.

GUARANTEED PREDICTIVE ESTIMATION IN MODELS OF INFORMATION CONFRONTATION

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Let there be a certain social community of $\bar{L}$ people, potentially subject two information flows. $L_1(t)$, $L_2(t)$ the time t -depended number of people who have accepted one of the information flows. Information is spread in the community along internal (interpersonal communication of the member of social community) and external threads (mass media).

Let us denote by $L_1(t), L_2(t), t \geq t_0$ the solution of differential equations with initial conditions:

$$\begin{cases} \frac{dL_1(t)}{dt} = (\alpha_1 + \beta_1 L_1(t))(\bar{L} - L_1(t) - L_2(t)), L_1(t_0) = L_{10}, \\ \frac{dL_2(t)}{dt} = (\alpha_2 + \beta_2 L_2(t))(\bar{L} - L_1(t) - L_2(t)), L_2(t_0) = L_{20}, \end{cases}$$

where α_1, α_2 – are the known value of external control parameters; β_1, β_2 – are the unknown parameters of interpersonal communication and belong the given bounded closed set G from space R^2 .

Denote the observed vectors $y_1, y_2, \dots, y_N$ from the spaces $R^{m_k}, m_k \in \{1, 2\}$:

$$y_k = H_k L(t_k) + v_k, k = \overline{1, N}, t_1 < t_2 < \dots < t_N, L(t) = \begin{pmatrix} L_1(t) \\ L_2(t) \end{pmatrix},$$

where H_k – given matrix of dimension $m_k \times 2$, v_k – the observed errors from sets $V \subset R^{m_1} \times \dots \times R^{m_N}$.

Let us denote $V = \{(v_1, v_2, \dots, v_N) : \psi_l(v_1, v_2, \dots, v_N) \leq \gamma_l^2, l = \overline{1, s}\}$.

Denote the set G_y :

$$G_y = \{(\beta_1, \beta_2) : \psi_l(y_1 - H_1 L(t_1), y_2 - H_2 L(t_2), \dots, y_N - H_N L(t_N)) \leq \gamma_l^2, l = \overline{1, s}\} \cap G.$$

Denote also sets $\mathcal{I}_1(y), \mathcal{I}_2(y)$:

$$\mathcal{I}_j(y) = \{L_j(t_{N+1}, \theta) : \theta \in G_y, j = \overline{1, 2}, \theta = (\beta_1, \beta_2)\}.$$

Let denote by $\bar{\mathcal{I}}_j(y)$ the minimal convex sets contain the sets $\mathcal{I}_j(y), j = \overline{1, 2}$.

Definition. The guaranteed predictive estimation of $L_j(t_{N+1}, \theta)$ is said $\hat{L}_j$ which satisfies the conditions:

$$\min_{L_j \in \bar{\mathcal{I}}_j(y)} \max_{L_j^{(1)} \in \bar{\mathcal{I}}_j(y)} |L_j - L_j^{(1)}| = \max_{L_j^{(1)} \in \bar{\mathcal{I}}_j(y)} |\hat{L}_j - L_j^{(1)}| = \sigma_j, j = \overline{1, 2}.$$

Theorem. Let satisfying the above conditions. Then can be written:

$$\hat{L}_j = \frac{1}{2} \left(\max_{\theta \in G_y} L_j(t_{N+1}, \theta) + \min_{\theta \in G_y} L_j(t_{N+1}, \theta) \right),$$

$$\sigma_j = \frac{1}{2} \left(\max_{\theta \in G_y} L_j(t_{N+1}, \theta) - \min_{\theta \in G_y} L_j(t_{N+1}, \theta) \right), j = \overline{1, 2}.$$

We apply the numeric algorithm of estimation parameters for a special type of functions $\psi_l(v_1, v_2, \dots, v_N), l = \overline{1, s}$ and set G .

References

1. Nakonechnyi O.G. Best-mean estimates in models of information confrontation/ Nakonechnyi O.G.// Abstracts XXIV International Conference “Problem of decision making under uncertainties”. – Cesky Rudolec, Czech Republic. September 1-5, 2014. – PP.114-115.
2. Nakonechnyi O.G. Confrontation problems with the dynamics Gompertzian systems/ Nakonechnyi O.G., Zinko P.M.// Journal of Computational&Applied Mathematics. – 2015 – №3 (120) – PP. 50-60.
3. Nakonechnyi O.G. Estimates of unsteady parameters in model of information confrontation/ Nakonechnyi O.G., Zinko P.M.// Abstracts XXVIII International Conference “Problem of decision making under uncertainties”. - Brno, Czech Republic. August 25-30, 2016. - PP.82-83.
4. Nakonechnyi O.G., Shevchuk I.M. Mathematical model of information spreading process with non-stationary parameters/ Nakonechnyi O.G., Shevchuk I.M.// Bulletin of Taras Shevchenko National University of Kyiv Series Physics & Mathematics. – 2016 - №3 – PP. 98-105.
5. Mikhailov A.P. Models of information conformation / Mikhailov A.P. and Marevtseva N.A. // Mat. Model. – 2011– №10, PP.19–32.
6. Chen P.P. Entity-relationship modeling: historical events, future trends, and lessons learned / P.P. Chen // Entity-Relationship Approach to Software Engineering: international conference, November 27-30, 2001, Yokohama, Japan: proceedings/ – 2001. – PP.71-77.

LEAST SQUARE METHOD IN MATRIX MULTIPLE REGRESSION: THEORY AND APPLICATIONS

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The class of matrix functions with the set of matrix arguments - matrix multiple regression - is offered for formulation and solution of prediction problem on the base of Least Square Method.

The mathematical apparatus of Singular Value Decomposition and Moore-Penrose pseudoinverse technique [1, 2] are used to provide a successive solution of prediction problem in the case. The conception of cortege operators makes it possible to extent in constructive way correspondent methods on matrixes Euclidean spaces [3, 4]. LSM-estimation algorithm [4] in unknown parameters estimation in Wolfram Mathematica is realized. Application of the methods proposed was demonstrated for predictions of basic macroeconomic indicators of Ukrainian economics. The approach is verified on statistical data [5] about economic indicators of Ukraine for the period of 2007 -2016, and results of calculations are presented. As shown in the example, matrix multiple regression can be effective prediction instrument in economics with acceptable planning processes accuracy.

Referenses

1. Moore E.H. On the reciprocal of the general algebraic matrix / Moore E.H. // Bulletin of the American Mathematical Society. - 1920. - № 26 – PP. 394 - 395.
2. Penrose R. A generalized inverse for matrices/ Penrose R. // Proceedings of the Cambridge Philosophical Society. – 1955. – №51. – PP. 406 - 413.
3. Donchenko V. “Feature Vectors” in Grouping Information Problem in Applied Mathematics: Vectors and Matrixes / V. Donchenko, T. Zinko, F. Skotarenko // Problems of Computer Intellectualization: international conference, Institute of Cybernetics NASU, ITHEA. – Kyiv, Ukraine, - Sofia, Bulgaria. – 2012. – PP. 111-124.
4. Donchenko V.S. Matrix multiple regression / V.S. Donchenko, O.V. Tarasova // Bulletin of Taras Shevchenko National University of Kyiv. Series: Physics & Mathematics. – 2015. – № 2. – PP. 133–138. (in Ukrainian).
5. Official web-site of the State Statistics Service of Ukraine [Electronic resourc] - Mode of access: <http://www.ukrstat.gov.ua>.

LOGICS OF PARTIAL NON-DETERMINISTIC PREDICATES

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The apparatus of mathematical logic is widely used in various logical systems oriented on subject domain modelling and programming. One of the specific features of such systems is a usage of partial non-deterministic mappings over incomplete data. Here we propose new classes of such systems: composition-nominative logics of partial non-deterministic quasiary predicates.

In [1] incomplete data were treated as the class ${}^V A$ of partial mappings from a set of names V into a set of basic data A ; partial non-deterministic predicates were treated as relations on ${}^V A \times \{T, F\}$. Such predicates were described by their truth and falsity domains. In this paper we generalize this notion to the notion of General Non-Deterministic (GND) predicate. Now such predicates are described by three domains: truth, falsity, and undefinedness. Thus, a predicate P can yield on $d \in {}^V A$ one of the following sets of values: $\{\uparrow\}$, $\{T\}$, $\{F\}$, $\{T, F\}$, $\{T, \uparrow\}$, $\{F, \uparrow\}$, $\{T, F, \uparrow\}$ where $\uparrow$ means that P can be undefined on d . We denote these sets as $\uparrow$, T , F , TF , $T\uparrow$, $F\uparrow$, $TF\uparrow$.

We describe first-order languages and composition algebras of *GND*-predicates. In particular, propositional composition $\vee$ is defined as follows:

$Q \quad P$	T	F	TF	$\uparrow$	$T\uparrow$	$F\uparrow$	$TF\uparrow$
T	T	T	T	T	T	T	T
F	T	F	TF	$\uparrow$	$T\uparrow$	$F\uparrow$	$TF\uparrow$
TF	T	TF	TF	$T\uparrow$	$T\uparrow$	$TF\uparrow$	$TF\uparrow$
$\uparrow$	T	$\uparrow$	$T\uparrow$	$\uparrow$	$T\uparrow$	$\uparrow$	$T\uparrow$
$T\uparrow$	T	$T\uparrow$	$T\uparrow$	$T\uparrow$	$T\uparrow$	$T\uparrow$	$T\uparrow$
$F\uparrow$	T	$F\uparrow$	$TF\uparrow$	$\uparrow$	$T\uparrow$	$F\uparrow$	$TF\uparrow$
$TF\uparrow$	T	$TF\uparrow$	$TF\uparrow$	$T\uparrow$	$T\uparrow$	$TF\uparrow$	$TF\uparrow$

For logics of *GND*-predicates we introduce a special logical consequence relation and investigate semantic properties of the proposed logics.

References

1. M. Nikitchenko, O. Shkilniak and S. Shkilniak. Pure first-order logics of quasiary predicates. In *Problems in Programming*, 2016, 2–3, – PP. 73–86 (in ukr).

DIFFERENTIAL EQUATIONS WITH SMALL STOCHASTIC SUPPLEMENTS UNDER LEVY AND POISSON APPROXIMATING CONDITIONS

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The methods, proposed in this paper, allow to study model of stochastic evolution

$$du^\varepsilon(t) = C(u^\varepsilon(t), x(t / \varepsilon^2))dt + d\eta^\varepsilon(t), u^\varepsilon(t) \in \mathbb{R} \quad (1)$$

where $x(t)$ is an uniformly ergodic Markov process in a standard phase space $(X, \mathbb{X})$, defined by generator

$$\mathbf{Q}\varphi(x) = q(x) \int_X P(x, dy) [\varphi(y) - \varphi(x)],$$

on Banach space $B(X)$ of bounded functions $\varphi(x)$ with supremum-norm

$$\|\varphi\| = \sup_{x \in X} |\varphi(x)|.$$

We consider the case when system disturbance is defined by impulse process in nonclassical approximation schemes.

References

1. Korolyuk V.S., Limnios N. Stochastic systems in merging phase space. –Singapore: World Scientific, 2005. – 330 p.

THE USE OF SPATIAL REGRESSION MODELS TO THE ESTIMATION OF DEMAND FUNCTION

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These papers contribute to the construction of the demand functions for some food products groups in the regions of Ukraine, taking into account the presence of spatial effects. For this purpose, regional data about the average consumption of meat, milk and fish in 2002-2015 are used. Retail prices for the above-mentioned food products and per capita incomes of the population are selected as explanatory variables. For the identification of spatial autocorrelation in regional data, the indices of spatial autocorrelation should be calculated [1]. The presence of spatial autocorrelation is diagnosed for all the products under consideration, although a significant influence of spatial effects on the level of meat consumption has been detected only since 2005. The positive values of the obtained Moran indices indicate a directly proportional dependence of consumption levels of meat, milk and fish in a given region on their consumption levels in neighboring regions. In order to build demand functions, the spatial autoregressive panel data model (SAR) is used [2].

The obtained models allow to make a conclusion that the consumption of meat, milk and fish is negatively affected by the sizeable income, the decrease in food prices is more significant for the increase in demand for them. In addition, for all three models, a significant and positive coefficient of spatial autocorrelation was obtained. Therefore, the consumption of meat, milk and fish in the region, depends on the level of their consumption in neighboring regions.

References

1. Pisatti M. (2012). Spatial Data Analysis in Stata. Working paper. University of Milano-Bicocca.
2. Belotti F., Hughes G., Mortari A. P. (2013). XSMLE - A Command to Estimate Spatial Panel Models in Stata. Working paper. CEIS, University of Rome Tor Vergata.

COMBINED METHOD OF TEXT DATA TONE EVALUATION

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There is a method of text tone evaluation (sentiment analysis) in computer linguistics. Tone is an evaluation of emotions, which are expressed in some text. The relevance of this task lies in the fact that we can estimate the attitude of society to a product or event based on some textual information.

Programmatic implementation of this method is a most actual nowadays, because the amount of analyzed data is far beyond human possibilities. Algorithm of tone evaluation of textual information was created on the combined method and the method of logistic regression, which combines support vector machine method (SVM), key words method and logistic regression method. Following steps are used: dictionary creation (we use finite automaton, which performs preliminary processing of the text. We obtain a set of tables - chapters, sentences, and tokens - as a result. This allows us to define signs of dictionary – it is a selection of words and phrases in the text, occurring more than 3 times.); convenience method creation; usage of support vector machine method SVM (we calculate and store the global weight, which determines the significance of each value for task solution. As a next hop – we create a vector text pattern for further training of the SVM-classifier); SVM-classifier training; usage of logistic regression method; merging of these two methods. Thus, usage of combined method and logistic regression method will allow to get more accurate and precise estimation of text tone evaluation.

References

1. Yi J. Nasukawa T., Niblack W., Bunescu R. Sentiment analyzer: Extracting sentiments about a given topic using natural language processing techniques // Proc. of the 3rd IEEE international conference on data mining (ICDM 2003) Florida. USA. PP. 427–434.
2. Prabowo R., Thelwall M. Sentiment analysis: A combined approach // Journal of Informatics. 2009.

THE SIMULATION OF THE FRACTIONAL BROWNIAN MOTION

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This paper analyzes the statistical simulation algorithms of fractional Brownian motion. Fractional Brownian motion with Hurst index $\alpha \in (0,1)$ is the Gaussian random process $W_\alpha(t), t \in [0, T]$ with correlation function

$$R_\alpha(t, s) = \frac{1}{2} \left(|t|^{2\alpha} + |s|^{2\alpha} - |t - s|^{2\alpha} \right), \text{ and } W_\alpha(0) = 0, \quad EW_\alpha(t) = 0.$$

Fractional Brownian motion $W_\alpha(t)$ it's the process with stationary increments. Therefore, random process $w(t) = W_\alpha(t + \Delta) - W_\alpha(t)$ is stationary Gaussian random process with correlation function [1]

$$Ew(t + \tau)w(t) = \frac{1}{2} \left(|\tau + \Delta|^{2\alpha} + |\tau - \Delta|^{2\alpha} - 2|\tau|^{2\alpha} \right) \quad \text{and} \quad \text{spectral density}$$

$$f(\lambda) = \frac{A^2}{\pi} \left(\frac{1 - \cos(\lambda\Delta)}{|\lambda|^{2\alpha+1}} \right), \quad \text{where } A^2 = \left(\frac{2}{\pi} \int_0^\infty \frac{1 - \cos(\lambda)}{\lambda^{2\alpha+1}} d\lambda \right)^{-1}.$$

Whereas, $W_\alpha(0) = 0$, then for all Δ the model of fractional Brownian motion we constructed as $W_\alpha(t + \Delta) = W_\alpha(t) + w(t)$.

And for the partition $D_\Lambda: 0 = \lambda_0 < \lambda_1 < \dots < \lambda_n = \Lambda$, the model of random process $w(t)$ can be obtained as $w_n(t, \Lambda) = \sum_{k=0}^{n-1} \left(\sin(\lambda_k t) X_k + \cos(\lambda_k t) Y_k \right)$,

where $\{X_k, Y_k\}$ - uncorrelated strictly sub-Gaussian random variables with

$$EX_k = EY_k = 0 \quad \text{and} \quad E(X_k)^2 = E(Y_k)^2 = \int_{\lambda_k}^{\lambda_{k+1}} f(\lambda) d\lambda.$$

Simulation of fractional Brownian motion is reduced to simulation of stationary Gaussian random process. Methods simulation of stationary Gaussian processes studied in [2].

References

1. Prigarin S. Numerical Modelling of Random Processes and Fields Novosibirsk, 2005.
2. Kozachenko Yu.V., Pashko A.A. Accuracy of Simulation of the Gaussian random processes with continuous spectrum. Computer Modelling and New Technologies. 2014. Vol.18, №3, PP. 7–12.

COMPUTATIONAL EXPERIMENT FOR SOLVING STOCHASTIC DIFFERENCE EQUATIONS

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We developed a statistical algorithm for simulation of solutions in the form of a computational experiment for solving linear stochastic equations with random coefficients. The developed algorithm of modeling uses the difference scheme of finding the solution and the spectral representation of the Wiener process. The difference equation is

$$X_{n+1} = X_n + [hA(t_n, \xi_{n+1}, \xi_n) + \sum_{j=1}^r B_j(t_n, \xi_{n+1}, \xi_n) \Delta W(t_n)] X_n, \quad X(0) = \zeta. \quad (1)$$

We need to simulate the Wiener random process $W(t)$, Markov chain $\xi_n = \xi(t_n)$, with its initial state $\xi_0 = \xi(0)$, initial distribution $P\{\xi(0) = \theta_k\}$ and a given matrix of transitions $P_t(x, y)$, initial conditions $X(0) = \zeta$ for obtaining process realizations $X(t)$ of the difference equation (1).

For simulatin the initial conditions, it is sufficient to know the density or distribution function. Methods of modeling random variables with given distribution laws are considered in [1].

The algorithm for solving any stochastic difference equation is

1. For given accuracy δ and reliability α , we find the number of terms M , needed to construct a Wiener random process model [2].
2. We model the initial conditions, realization of the Wiener process and a value X_n , $n \geq 1$ by the formula (1).
3. We get realization of the solution.
4. We perform computational experiment K times, as a rule, $K = 10^3$ or $K = 10^6$.
5. We get average of the obtained K realization. And this is the solution of the stochastic difference equation.

With obtained realisations it is possible to find other characteristics of the process $X(t)$.

1. Prigarin S. Numerical Modelling of Random Processes and Fields Novosibirsk, 2005.
2. Pashko A.A. Statistical simulation of the generalized Wiener process. Bulletin of Taras Shevchenko National University of Kyiv. Series Physics & Mathematics. 2014. 2, PP. 180-183.

THE DECISION MAKING AND LEADER'S MORAL MATURITY

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The nature of contemporary threats changed the character of warfare. Contemporary armed conflicts as "low intensity" conflicts have forced enemies act in various ways using different methods and tactics[1]. The commanders face thoughtful, creative and adaptive enemy so they never can predict how enemies will act and react and how the military operation will be developed in the process. The civilians are involved in the armed conflicts what leads to more unpredictable human behavior during military operations.

The philosophy of mission command as the foundation of contemporary military operations emphasizes that military command is essentially a human endeavor what means that contemporary military leadership directs the development of teams and helps to establish mutual trust and shared understanding with the subordinators [2].

The results of decision making process includes the commander's ability to provide clear intent of the task as well as his ability to encourage subordinates to take action, accept the risks and to seize the initiative. These aims demand to transform the system of military education from a rules-based to a judgement-based methodology [3].

New model of military education is based on universal human values as a guarantee of his personal moral maturity. This model must include both critical thinking and creativity of future leader as well as his ability for critical assessment of himself and his decision.

References

1. Crevelde M.V. Technology and War II: Postmodern War? /Ch. Townshend.// The Oxford History of Modern War. – New York, USA: Oxford University Press. – PP. 349.
2. Mission Command / Army Doctrine Reference Publication No. 6-0. - Headquarters Department of the Army Washington, DC, 17 May 2012. – PP. 1- 4.
3. Bolgiano D.G., Paterson J.M. fighting today's wars: how America's leaders have failed our warriors /D.G. Bolgiano, J.M. Paterson. – Pensilvania, 2012. – PP. 148.
4. Dooley M., Kearney R. Questioning Ethics - Contemporary Debates in Continental Philosophy /M. Dooley, R. Kearney. – London, New York, 2002. – PP. 66.

CALCULATING CONSEQUENCES: STATE POLICY DECISIONS IN THE CONTEXT OF INDIVIDUAL ASSESSMENT

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The goals of the national security policy cover protection of political, economic, and other interests of the state as well as defense of the sovereignty of the country [1]. With this aim, the government of every state attempts to estimate the consequences of every political decision from a number of perspectives- political, economic, social, and alike. In other words, every decision of the governmental institutions is judged on the basis of the state's needs, financial, economic and human resources.

The consequences of the state policy decisions could be mathematically calculated when the state is considered as a unified system [2]. However, the consequences of any political decision are unpredictable and uncountable in terms of ethics due to the unique nature of society. The society is heterogeneous with individuals holding different perceptions of prosperity and happiness, interests, and worldviews. In this vein, it is neither possible to make the decision that would be righteous for everyone, nor calculate the moral consequences of every decision for every person.

Every decision must be based on knowledge, information, and infinitive analysis. Still, as Jacques Derrida notes, “at some point, however, for a decision to be made, you have to go beyond knowledge, to do something that you don't know“ [3]. Hence, despite positive or negative outcomes of the decision, its moral consequences will be ambiguous in the context of individual assessment. The state in the decision-making process should thereby understand the inevitability of the negative ethical aspects of any decision and be ready to take the responsibility for every decision made.

References

1. Barry B. People, States & Fear. / Buzan B. - ECPR Press, 2009. – P. 65-104.
2. Rawls J. A Theory of Justice. / J. Rawls. - Cambridge, 1999. – P. 22-27.
3. Dooley M., Kearney R. Questioning Ethics - Contemporary Debates in Continental Philosophy /M. Dooley, R. Kearney. – London, New York, 2002. – 66 p.

ON MULTICRITERIAL OPTIMIZATION OF RETRIAL QUEUEING SYSTEMS

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This paper deals with the problem of optimal control of retrial queueing systems. Such systems form a very important class of models from a practical point of view, because they take into account retrial calls phenomenon and allow to model the service process more precisely. Existence of the second flow of incoming calls makes the steady state analysis of retrial queues a complicated problem that has no general solution so far. However, when dealing with real world systems, the more important problems that arise are the problem of optimal control and optimization of total income from the system. In this paper, we will state these problems in general form and describe the approaches of the solution, so it can be applied to a wide range of retrial queueing systems.

The general approach on optimization of queueing system is to adaptively change operation mode depending on the current state of the system according to control policy and to find such a policy, that gives an optimal solution to the defined optimization problem. The most widely used types of control policies for retrial queues are: threshold and hysteresis policy (more details can be found in [1]).

Consider the following functionals that will be used as criteria of the multicriterial optimization problem:

$f_i(H)$ – the number of calls that were served by the system while working in the i -th mode, $i=1, \dots, m$, $f_{m+1}(H)$ – the number of calls that were rejected by the system and became the sources of retrial calls, $f_{m+2}(H)$ – the number of service rate switches.

The above functionals depend on the control policy H and can be expressed in terms of stationary probabilities of the system. Taking into account the objective characteristics of the system such as income from serving a call, penalty for call rejection and so on, we can state and solve a multicriterial optimization problem of total income optimization.

References

1. Lebedev E.A., Ponomarov V.D. Retrial queues with variable service rate // *Cybern. and Syst. Anal.* – 2011. – Vol. 3. – P.118-126.

ON A MULTI-CHANNEL RETRIAL QUEUES WITH TWO REPEATED ATTEMPTS

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Retrial queues are characterized by that a primary customer who finds busy the service facility upon arrival moment immediately leaves the servers area, but some time later he repeats his demand. Between retrials he is said to be in 'orbit' [1]. Retrial queues have been widely used to model the many practical situations arising from telephone systems, telecommunication network, wireless networks and call center model.

In this work, we consider retrial queues of the $M/M/c$ - type in which the number of retrials of each customer is limited by two attempts. That is, each customer is allowed to attempt the service request at most three times including primary attempt by an external arrival and if a customer fails to enter the service facility at third attempt, then the customer leaves the system without service.

Such systems are given by next parameters: λ is the arrival rate, μ is the service rate and ν_k is the rate of k -th repeated attempt, $k=1,2$.

The system state at time t can be described by means of a process $Q(t)=(Q_0(t), Q_1(t), Q_2(t))$, $t \geq 0$, where $Q_0(t)$ is the number of busy servers at time t , $Q_k(t)$ is the number of calls which was blocked after k -th attempt at time t , $k=1,2$. The process $Q(t)$ is a continuous time Markov chain with the state set $S = \{0,1,\dots,c\} \times Z_+^2$.

We use truncated system $M/M/c/N$ to approximate base model. It is described by means of a process $Q^N(t)=(Q_0^N(t), Q_1^N(t), Q_2^N(t))$, $t \geq 0$ with finite state space $S^N = \{0,1,\dots,c\} \times \{0,1,\dots,N\} \times \{0,1,\dots,N\}$. $Q^N(t)$ is a continuous-time quasi-birth-and-death process. Stationary probabilities for this system are calculated using recurrent computational algorithm that is used for quasi-processes of birth and death [2].

1. Artalejo J.R., Gómez-Corral A. Retrial Queueing Systems. A Computational Approach. – Springer, 2008. – 317 p.

2. Bright L. Calculating the equilibrium distribution in level dependent quasi-birth-and-death processes / L. Bright and P. G. Taylor // Stochastic Models. –1995. – №11. – PP. 497–525.

COMPENSATION OPERATOR FLUCTUATIONS DIFFUSION PROCESS IN SEMI-MARKOV ENVIRONMENT

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Consider the diffusion process in semi-Markov environment defined by stochastic differential equation[1,2]

$$du^\varepsilon(t) = C(u^\varepsilon(t); x(t/\varepsilon^2)) + \sigma(u^\varepsilon(t); x(t/\varepsilon^2))dw(t), \quad (1)$$

where $u^\varepsilon(t)$ - random evolution in the form of a diffusion process [2], $x(t), t \geq 0$, is a semi-Markov process in the standart phase space of states (X, X) with stationary distribution $\pi(B), B \in X$, ε - small parameter[2].

The average equation has form $d\hat{u}(t) = C(\hat{u}(t))dt$, where $C(u) = \int_x C(u; x)\pi(dx)$.

Lemma. Compensation operator L^ε [2] in the test-function $\phi(v, u, x) \in C^{3,3}(R^2)$, $x \in X$ [2], for the fluctuations $v^\varepsilon(t) = \varepsilon^{-1}[u^\varepsilon(t) - \hat{u}(t)]$ has by form

$$L^\varepsilon \phi(v, u, x) = [\varepsilon^{-2}Q + Q_1(x)P + Q_2(x)P + \theta^\varepsilon(x)]\phi(v, u, x),$$

where

$$Q_1(x)\phi(v, u, x) = C(u, x)\phi'(v, u, x) + (1/2)B(u, x)\phi''_{vv}(v, u, x),$$

$$Q_2(x)\phi(v, u, x) = [vC_1(u, x) - C(u)]\phi'_v(v, u, x) +$$

$$+(\mu_2(x)/2)C^2(u, x)\phi''_{vv}(v, u, x) + (1/2)B(u, x)\phi''_{vv}(v, u, x),$$

$$C_1(u, x) = C'(u, x), \quad B(u, x) = 2\sigma^2(u, x), \quad \mu_2(x) = g_2(x)/g(x),$$

$$g_2(x) = \int_0^\infty t^2 G_x(dt), \quad g(x) = \int_0^\infty (1 - G_x(t))dt, \quad G_x(t) - \text{distribution}$$

function of the semi-Markov process [2].

References

1. Khimka U.T., Chabanyuk Ya.M. *A difference stochastic optimization procedure with impulse perturbation*. Cybernetics and Systems Analysis. Springer US. November 2013, – Vol. 49, 5, – PP. 768-773.
2. Koroliuk V. and Limnios N. *Stochastic Systems in Merging Phase Space*. World Scientific Publishing, 2005.

SOME STATISTICAL PROPERTIES OF THE ESTIMATORS FOR IMPULSE RESPONSE FUNCTION

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A time-invariant casual continuous linear system with impulse response function $H(\tau)$ on finite domain $[0, \Lambda]$ is considered. It means that the response of the system to an input $X(t)$, $t \in [-\Lambda, \Lambda]$ is

$$Y(t) = \int_0^{\Lambda} H(\tau) X(t-\tau) d\tau. \quad (1)$$

One of the problems arising in the theory of such systems is to estimate or identify the function H by observations of the responses of the system. Here we use a method of cross-correlograms for the estimation of the response function H .

Assume that $X_N(t)$, $t \in [-\Lambda, \Lambda]$, is a measurable real-valued stationary zero-mean Gaussian process that has such representation

$$X_N(u) = \sum_{j=1}^N \xi_j g_j(-u), \text{ for } t \in [-\Lambda, \Lambda],$$

where ξ_j are supposed to be jointly independent random variables with $E\xi_j = 0$, $E\xi_j^2 = 1$ and $g_j(z)$, $j \geq 1$ is an orthonormal basis in $L_2[0, \Lambda]$.

Definition. As an estimator for H we will use the function

$$\hat{H}_{N,\Lambda}(\tau) = Y_N(0) X_N(-\tau), \quad \tau \in [0, \Lambda].$$

Applying the theory of Square-Gaussian Processes the estimation of large deviation probability $P \left\{ \sup_{\tau \in [0, \Lambda]} |\hat{H}_{N,n}(\tau) - H(\tau)| > \varepsilon \right\}$ can be founded that allows to construct the criterion on the shape of the impulse response function.

References

1. Kozachenko Yu. V., Rozora I.V. Cross-correlogram estimators of impulse response functions, Theor. Probability and Math. Statist. 2016. – №. 93, PP. 79–91.
2. Kozachenko Yu. V., Rozora I.V. A Criterion For Testing Hypothesis About Impulse Response Function, Stat., Optim. Inf. Comput., September 2016. – Vol. 4 – PP. 214–232.

3. Rozora I.V. (2017) Statistical hypothesis testing for the shape of impulse response function, Communications in Statistics - Theory and Methods, <http://dx.doi.org/10.1080/03610926.2017.1321125>.

AUTOMATED BENCHMARKING SYSTEM IN ASSESSING FINANCIAL HEALTH OF A BUSINESS

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Since the early part of the 20th century, the DuPont analysis, which could be also called the DuPont model, remains the best method of company's performance measurement. Nowadays, there are many ways to make this analysis automatic. But what if we need to automate not only the calculation process, but also to establish a system of an automatic replanning?

$$ROE = \frac{Net\ Income}{Sales} * \frac{Sales}{Assets} * \frac{Assets}{Equity} - \text{main DuPont formula.}$$

The main idea of benchmarking is that cognition comes through comparison. Overall, benchmarking is a strategy tool that is used to compare the performance of the business processes and products that lead to the company's best results, considering the results of other companies inside and outside the industry [1].

Let's say DuPont had shown that company has a great profitability; but will it be the most sufficient inside its industry? Benchmarking is a search for industries actions that lead to superior performance [2]. The establishment of the unified automatic system will provide the ability to regulate business development plan based on the DuPont analysis. For example, 2.3 ROE ratio might look great for your business, even when compared to your industry's average. However, it should also be considered that some other companies within the same industry can easily achieve 3.8 rate. In this situation, the 2.3 ROE rate does not look as good as it used to. Using automated benchmarking system will allow to easily recalculate strategy possibilities. Based on these assumptions, a template of automated benchmarking system that uses 3 main ratios was developed using Python language and Anaconda platform.

References

1. Spendolini M.J. The Benchmarking Book. – New York, NY: AMACOM. American Management Association, 1992. – 207 p.
2. Bogan C.E., Bogan M.J. Benchmarking for Best Practices: Winning Through Innovative Adaptation. – Charlottesville: McGraw-Hill, 1994. – 312 p.

IMPROVEMENT OF VIRTUAL COMMUNICATION USING A HIERARCHICAL DECISION TREE APPROACH

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Nowadays virtual communication is one of the most important aspects in order to establish and maintain relationship with prospective and existing partners and customers. The problem is determined as selection of virtual communication elements for effective completion process of online customer tasks. The aim of the article is to classify virtual communication elements using a hierarchical decision tree approach in order to identify most important ones for completion of browsing and searching tasks. Literature analysis of customer behavior and virtual communication elements is provided. Experiment of virtual communication process was carried using eye tracking technologies.

For our data analysis, the Chi-square Automatic Interaction Detector (CHAID) growing method of Decision Trees (DT) was used. As for the technical conditions, specified in the model execution, there were kept default measures of the 0.05 minimum p-value required for splitting nodes and merging categories. For model estimation maximum number of iterations was 100 and minimum change in expected cell frequencies was chosen 0,001. The significance values were adjusted by Bonferroni method with a minimum number of records in parent node of 25, and a minimum in a child node of 10. Additionally, it should be noted that, since the tree growth algorithm follows all type variables as either categorical or ordinal, no standardizations were required for this step.

The retrieved data reduction and variable screening helped to select useful subset predictors from a large set of variables for using in building a formal parametric model. Moreover, the interaction identification helped to identify relationships that pertain only to specific subgroups and specify these in a formal parametric model. As a result of these investigations the hierarchical decision tree model was formed.

DECOMPOSITION METHOD FOR SOLVING MIXED DISCRETE BILINEAR OPTIMIZATION PROBLEMS

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Many applications of bilinear programming have been reported in the literature and several techniques have been developed for solving these continuous and mixed integer problems [1,2].

Investigated mixed discrete bilinear programming problems with related variables: $\min \{ f(x, y) \mid Ax + G(y) \geq b, x \geq 0, y \in S \subset R^q \}$, where

$$f(x, y) = \langle c, x \rangle + \langle x, Qy \rangle + \langle d, y \rangle, c, x \in R^n, d, y \in R^q, b \in R^m, Q \in R^{n \times q},$$

$A \in R^{m \times n}$, $G(y) = (g_1(y), \dots, g_m(y))$, S – discrete space.

These problems have two sources of nonconvexity: discrete variables and bilinear functions. As is generally known, nonconvex problems have plenty of local solutions, distant at a global optimum, and classic methods of convex optimization in similar problems directly inapplicable or ineffective. These problems are NP-hard.

Researched the properties and structure of the problems. Constructed and justified decomposition method for finding exact and approximate solutions. Resulting method based on a combination of Benders' method [3] and ideas of relaxation [4]. This method uses the properties of feasible set of problem' structure. It allows to replace the solving original problem to the solving sequence of simpler associate subproblems. Promising direction develops on the basis of the offered method of decomposition. These are new and original algorithms for the decision of bilinear problems, using parallel computing.

Referens

1. Semenova N.V. Solving mixed integer bilinear optimization problems using decomposition method / N.V. Semenova, S.V. Oliynyk // Journal of Computational & Applied Mathematics. – 2015. – № 3 (120). – PP. 69–76.
2. Adams W.P. Mixed integer bilinear programming problems / W.P Adams, H.D. Sherali // Mathematical Programming. – 59, 1993. – PP. 279-305.
3. Benders J.F. Partitioning procedures for solving mixed-variables programming problems / J.F. Benders // Numerische Mathematik.– 1962. – № 4, 3.– PP. 238–252.
4. Semenova N.V. Vector problems of discrete optimization on combinatorial sets: methods of research and decision / N.V. Semenova, L.M. Kolechkina – Kyiv: Sciences idea, 2009. – 266 p. (in ukrainian).

CONVERGENCE ANALYSIS OF NEWTON-SECANT METHOD FOR NONLINEAR LEAST SQUARES PROBLEM

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Consider the nonlinear least squares problem [1, 2]

$$\min_{x \in R^p} \frac{1}{2} (F(x) + G(x))^T (F(x) + G(x)), \quad (1)$$

where residual function $F + G: R^p \rightarrow R^m$ ($m \geq p$) is nonlinear by x , F is continuously differentiable function, G is continuous function, differentiability which, in general, is not required.

For finding the solution of the problem (1) we propose the modification of Gauss-Newton method, which uses the sum of derivative of differentiable parts of operator and divided difference of nondifferentiable parts instead full Jacobian,

$$x_{n+1} = x_n - (A_n^T A_n)^{-1} A_n^T (F(x_n) + G(x_n)), \quad n = 0, 1, \dots \quad (2)$$

where $A_n = F'(x_n) + G(x_n, x_{n-1})$, $F'(x_n)$ is Fréchet derivative of function $F(x)$; $G(x_n, x_{n-1})$ is divided difference of the first order of $G(x)$ [2] by points x_n, x_{n-1} ; x_0, x_{-1} are given. This combined method for solving (1) on the Gauss-Newton method and Secant method [2] is based. We have proved theorems under weak conditions where convergence of the proposed method are justified and rate of convergence are established. On test problems we show its high performance compared with secant method [2] and Gauss-Newton type's method which uses only the derivative of differentiable part of operator.

References

1. Dennis J.E. Numerical methods for unconstrained optimization and nonlinear equations / J.E. Dennis, Jr., Robert B. Schnabel, – Philadelphia: SIAM, 1996. – 378 p.
2. Shakhno S.M. On an iterative algorithm of order 1.839... for solving the nonlinear least squares problems / S.M. Shakhno, O.P. Gnatyshyn // AMC (Appl. Math. Comp.). – 2005. – Vol. 161. PP. 253 – 264.

SELECTION AND FITTING OF PEARSON DISTRIBUTIONS

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Since statisticians become acquainted with Pearson distribution functions family ([1]), one can find many attempts to use it for practical distributions ([2]). It seems to be rather easy because all we need to do is, first, identify the type of the Pearson curve by first four statistical moments in a form of Pearson's kappa coefficient and, second, obtain parameters of the chosen curve. Though parameters are the functions of mentioned statistical moment, their estimations should not be the functions of the moments estimations. I.e. method of moments can largely depend on which moments to take. Moreover, sometimes it is better to consider quantiles instead of moments.

Another interesting question is a verification model development process. Every time we can generate a sample of a pre-selected distribution and compare its type and parameters with estimated ones. If Pearson's kappa gives us another type of distribution or rather different parameters we may doubt the quality of our generator as well as a parameters assessment way.

Some articles [3] and internet links on this subject lead to Russian Programs Registry [4] and to Rospatent [5] but without specific information.

References

1. Maurice G., Kendall M.A., The advanced theory of statistics, vol. 1, 1945, 137 p.
2. Andriy Andreev, Antti Kanto, Pekka Malo, Simple approach for distribution selection in the Pearson system. Swedish School of Economics, Helsinki School of Economics, Quantitative Methods in Economics and Management Science, Working Papers, September 2005.
3. P. V. Zaikin, M. A. Pogorelovsky, V. S. Mikshina, Approximation of experimental data functions by high order polynomial. Surgut State University, Proceedings in Cybernetics, 2015, vol.4, 123-134.
4. <https://reestr.minsvyaz.ru/>
5. http://www.rupto.ru/activities/function/reg_evm

**ON THE METHOD OF CONSTRUCTING ALGORITHMS FOR
THE EFFECTIVE CALCULATION OF OPTIMAL ESTIMATES IN
EXTRAPOLATION (FORECAST), FILTERING AND
INTERPOLATION TASKS FOR FUNCTIONALS OF RANDOM
PROCESSES WITH VALUES IN THE HILBERT SPACES.**

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The paper deals with the general formulas for the effective calculation of optimal estimates for functionals of the form $h(.)$ from random processes with values from the Hilbert space H under observation of some other functionals of the form $g(.)$ from the same process, where $h(.)$ and $g(.)$ are some functions defined on H .

In the particular case, when the process being studied is a solution of some nonlinear evolutionary differential equation in H , with a small nonlinearity, the obtained optimal general estimates are expanded in powers of a small parameter, and the coefficients of the expansion itself are given in the form of algorithms and are calculated explicitly through the known values of the most differential equation, herewith, these general estimates, as a special case, contain simultaneously optimal estimates for tasks and extrapolation (forecasting), as well as filtering and interpolation at specific values of the functionals $h(.)$ and $g(.)$.

For instance, let's suppose that the random process $x(t) \in H$ is regarded as a vector from a finite-dimensional Hilbert space H and only a certain part of its coordinates is observable, naturally, the task is to find optimal estimates, as well as to forecast, to filtrate and to interpolate those coordinates $X(t)$ that were not observed, or those functions and functionals from them at specific values of the functionals $h(.)$ and $g(.)$.

Such problems are the most important tasks in the theory of optimal estimates of random processes and their applications in various problems of science and technology. Precisely they represent the subject of research for our paper.

SENSITIVITY ANALYSIS FOR SEMILINEAR PARTIAL DIFFERENTIAL EQUATIONS

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The optimal control problem in term of reduced functionals can be written as follows: find vector of optimization parameters (control function) u_* such that

$$u_* \in U_{\partial}, \quad \psi_0(u_*) = \min_{u \in U_{\partial}} \psi_0(u), \quad \psi_0(u) \equiv \tilde{\psi}_0(y, u),$$

$$U_{\partial} = \{u : u \in U, \quad \psi_j(u) \equiv \tilde{\psi}_j(y, u) \leq 0, \quad j = 1, \dots, m\},$$

$$c(y, u) = 0 \text{ - model of the system, } y \text{ - state function..}$$

Sensitivity analysis (SA) consists of calculation of total derivatives $d\psi_j/du$, $j = 0, 1, \dots, m$ of the system characteristic ψ_j with respect to optimization parameters u . Several methods are available for sensitivity computation, including the finite difference method (FDM), the direct differentiation method (DDM) and the adjoint method (AM). These methods can be derived in continuous and discrete formulation. SA is an essential tool for gradient-based optimization method for solving optimal control problems.

In this paper we consider optimal control problems for systems, governed by semilinear partial differential equations (PDEs) of elliptic and parabolic types. Coefficients of equations, right hand side of equations, boundary conditions are selected as optimization parameters. After discretization of control function optimal control problem leads to nonlinear programming problem. One-dimension optimal control problems are used to illustrate the ideas.

Computational efficiency of different methods of SA, difficulties during obtaining relationships of sensitivity and during software implementations is analysed. FDM method is very easy to use in software implementation but often is not accurate enough. Also, computational efficiency may be quite different, depending on the number of system characteristic m and the number of optimization parameters. DDM is attractive when there are relatively few optimization parameters and large number of system characteristic. AM is more efficient for problems involving large number of optimization parameters and few system characteristics.

ABOUT TIME-VARYING PARAMETER ESTIMATION FOR LINEAR DYNAMIC SYSTEMS UNDER UNCERTAINTIES BY LEAST SQUARES METHOD WITH LEAST DEVIATIONS FROM 'ATTRACTION' POINTS

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The estimation problem of slowly time-varying matrix A is considered for linear dynamic system

$$x(k+1) = Ax(k) + \xi(k), \quad k \in \mathbb{N}.$$

The recurrent algorithm is proposed for least squares estimate $\hat{A}(N)$ with variable forgetting factor $\lambda(k)$ and least deviation from known 'attraction' point $A_*(k)$ at any moment k in non-classical case when this estimate may be not unique:

if $\delta(N+1) > 0$, then

$$\left\{ \begin{aligned} \hat{A}(N+1) &= \hat{A}(N) + \delta^{-1}(N+1)[x(N+2) - \hat{A}(N)x(N+1)] \times \\ &\quad \times x^T(N+1)P(N) + [A_*(N+1) - A_*(N)] \times \\ &\quad \times [P(N) - \delta^{-1}(N+1)P(N)x(N+1)x^T(N+1)P(N)], \\ R(N+1) &= \lambda^{-1}(N) \left\{ R(N) - \delta^{-1}(N+1) \left[R(N)x(N+1)x^T(N+1)P(N) + \right. \right. \\ &\quad \left. \left. + P(N)x(N+1)x^T(N+1)R(N) \right] + \right. \\ &\quad \left. + \gamma(N+1)\delta^{-2}(N+1)P(N)x(N+1)x^T(N+1)P(N) \right\}, \\ P(N+1) &= P(N) - \delta^{-1}(N+1)P(N)x(N+1)x^T(N+1)P(N), \end{aligned} \right.$$

otherwise

$$\left\{ \begin{aligned} \hat{A}(N+1) &= \hat{A}(N) + \gamma^{-1}(N+1)[x(N+2) - \hat{A}(N)x(N+1)] \times \\ &\quad \times x^T(N+1)R(N) + [A_*(N+1) - A_*(N)]P(N), \\ R(N+1) &= \lambda^{-1}(N) \left\{ R(N) - \gamma^{-1}(N+1)R(N)x(N+1)x^T(N+1)R(N) \right\}, \\ P(N+1) &= P(N), \end{aligned} \right.$$

with initial conditions $\hat{A}(0) = A_*(0)$, $R(0) = \Theta_n$, $P(0) = E_n$, where

$$\gamma(N+1) = \lambda(N) + x^T(N+1)R(N)x(N+1), \delta(N+1) = x^T(N+1)P(N)x(N+1).$$

MATHEMATICAL MODEL OF STATIONARY PROPELLANT COMBUSTION

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Stationary combustion of propellant is described of equations [1, 2]

$$D \frac{d^2 T}{dx^2} - V \frac{dT}{dx} = -f, \quad x \in (0, L), \quad (1)$$

$$\frac{dy}{dx} = \Phi(T), \quad (2)$$

here T – temperature, D – coefficient of thermal conductivity, $V = u \cdot c \cdot \rho$, u – the speed of the front of combustion, c – heat capacity, ρ – density, $f = Q \cdot \Phi(T)$, Q – the heat of reaction, $\Phi(T) = k_0 \exp(-\frac{E}{RT})$, k_0 – pre-exponential factor, E – activation energy, R – the universal gas constant, y – mass concentration of propellant.

The appropriate boundary conditions set for the equation (1) and initial condition set for equation (2).

Difference scheme was used for solving the boundary problem for the equation (1) basing on parabolic spline [3]. To use difference scheme necessary to make the digitization of interval $(0, L)$. For this purpose, two splitting (Δ_x and Δ_τ) are defined:

$$\Delta_x : 0 = x_0 < x_1 < \dots < x_N = L, \quad (3)$$

$$\Delta_\tau : 0 = \tau_0 < \tau_1 < \dots < \tau_{N-1} = L, \quad (4)$$

here $x_i < \tau_i < x_{i+1}$, $i = \overline{1, N-2}$.

Then the difference scheme is written as

$$\phi_{\tau_{i-1}} \left(\frac{D}{h^2} + \frac{V}{h^2} \mu \right) - \phi_{\tau_i} \left(\frac{2D}{h^2} - \frac{V}{h} \left(1 - \frac{2\mu}{h} \right) \right) +$$

$$+\phi_{\tau_{i+1}}(\frac{D}{h^2}-\frac{V}{h}(1-\frac{\mu}{h}))=-(f_{x_{i+1}}+f_{x_i})/2, \quad i=\overline{1, N-2}. \quad (5)$$

here ϕ_{τ_i} – the lattice function that approximates the solution of equation (5) in the grid.

Difference scheme is monotonous and there it is the only solution. This follows from the following theorem [3].

Theorem. Following conditions was performed for the split (3)–(4):

$$\tau_{i+1} = \tau_i + h, \quad i = \overline{0, N-2}, \quad h > 0, \quad N = L/h + 1,$$

$$x_1 = x_0 + h - \mu, \quad x_{i+1} = x_i + h, \quad i = \overline{1, N-2},$$

$$x_N = x_{N-1} + \mu, \quad 0 < \mu < h.$$

Then, if $\mu > h - \frac{D}{|V|}$ and $V > 0$ or if $\mu < \frac{D}{|V|}$ and $V < 0$ for (5) maximum

difference principle is performed.

Because the right side of the equation (1) contains the desired solution, the system of difference equations will be nonlinear. The combined Newton's method and successive upper relaxation method is used for solution of the system. The Kutt-Merson method is used for solving the Cauchy problem for the equation (2).

References

1. Knyazeva AG, Dyukarev A.E. About modes of solid-phase decomposition of single crystals of initiating explosives. // Physical mesomechanics – 2000. – No 3. – PP. 97–106.
2. Merzhanov A. G., Dubovitsky F. I. To the theory of steady burning of propellant. // Reports of the USSR Academy of Sciences – 1959. – Vol. 120. – No 1. – PP. 153–156.
3. Stelia O. B. About existence of the one parabolic spline //Journal of computational and applied mathematics – 1997. – No 1(81). – PP. 124–129.

PACKING OF POLYHEDRA WITHIN A CONVEX CONTAINER

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Polyhedra packing problems have a wide spectrum of applications, for example in modern biology, mineralogy, medicine, materials science, nanotechnology, robotics, pattern recognition systems, control systems, in power engineering, mechanical engineering, shipbuilding, aircraft construction. At present, the interest in finding effective solutions for packing problems is growing rapidly.

The study focuses on the problem of packing a given set of convex polyhedra allowing continuous rotations into a convex container (an arbitrary convex region bounded by cylindrical, spherical surfaces and planes) of a minimal sizes, in particular, a sphere of a minimal radius, a cylinder of a minimal coefficient of homothety or cuboid of minimal volume. In addition minimal allowable distances between objects are given. Non-overlapping, containment and distance constraints are described by means of radical-free ϕ -functions, quasi- ϕ -functions, adjusted ϕ -functions and adjusted $-\phi$ -functions [1], [2]. The ϕ -function technique allows us to construct a mathematical model in the form of a nonlinear programming problem. A feasible region is described by a system of inequalities with smooth functions. The proposed solution strategy includes a fast algorithm for generating feasible starting points and the COMPOLY-S optimization procedure that reduces the nonlinear programming problem with a large number of variables and a large number of inequalities to a sequence of smaller size problems and smaller number of nonlinear inequalities. The COMPOLY-S procedure significantly reduces the computational cost (time and memory) and allows an efficient use of modern NLP-solvers for solving nonlinear programming problems.

References

- 1 Chernov, N., Stoian, Y., Romanova, T. (2010). Mathematical model and efficient algorithms for object packing problem. *Comput. Geom.: Theory and Appl.*, **43**(9), PP.535–553.
- 2 Stoian, Y., Pankratov, A., Romanova, T.: Quasi- ϕ -functions and optimal packing of ellipses. (2016) *Journal of Global Optimization*. 65(2): PP.283–307.

THE TASKS OF THE CONSTRUCTION OF THE CONTROL SYSTEM FOR THE TEAM OF THE SUBDIVISIONS

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The activity of the flexible manufacturing shop and computer system must be synchronized. These two subdivisions must function as a team. Also manufacturing shop should have the opportunity to operate in optimal mode.

For the purpose to solve the indicated problem we use some groups of the tasks:

- construction of the artificial environment with the help of the intelligent procedure. The result is the number of the corteges of the quntums of time;
- construction of the missing structure blocks for computer system, for the mathematical calculation of the optimal model etc. On this stage another intelligent procedures are used.
- calculation of the parameters of the branch markers from one system to another. On this stage mathematical models may be used.
- auxiliary calculations

The result of the construction of the environment is new knowledge receiving. Environment is not only the sum of the parameters. First of all environment is a structure – time structure of the interaction of the elements of the system.

Intelligent procedures based on the concepts of symmetry, balance, oscillation ets. We refer intelligent procedurce to the class of the harmony rules.

FUZZY PETRI NETS AND DECISION SUPPORT SYSTEMS ²

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The aim of the work is to present an overview of selected classes of fuzzy Petri nets (FP-nets) and to provide illustrating examples showing an application of FP-nets in the design of decision support systems.

FP-nets are one of the most popular and applicable Petri net classes in the domain of Artificial Intelligence (AI). The concept of a FP-net has been introduced by C.G. Looney in 1988. FP-nets allow to model fuzzy rule-based reasoning by propositional logic. Several authors, from Petri net and AI communities, have proposed different kinds of FP-nets. Despite almost the same name, these models are based on different approaches combining Petri nets and fuzzy sets.

Recently, several new classes of FP-nets have been proposed. They extend the existing FP-nets by introducing new input/output operators, which are supposed to function as substitute for the min, * (algebraic product), and max operators used in classical ones. These net models are not only more comfortable in terms of knowledge representation but, most of all, they are more effective in the modelling process of approximate reasoning as in these classes of FP-nets the user has the chance to define the input/output operators and/or suitable parameters. The choice of suitable operators for a given reasoning process and the speed of reasoning process are very important, especially in real-time decision support systems described by incomplete, imprecise and/or vague information.

References

1. Cardoso J., Camargo H. (eds.). Fuzziness in Petri Nets, Studies in Fuzziness and Soft Computing, Vol. 22, Physica-Verlag, Berlin 1999.
2. Suraj Z. A new class of fuzzy Petri nets for knowledge representation and reasoning. *Fundamenta Informaticae* 128(1-2), 2013, PP.193-207.
3. Suraj Z., Grochowalski P., Bandyopadhyay, S. Flexible Generalized Fuzzy Petri Nets for Rule-based Systems. *Lecture Notes in Computer Science* 10071, Springer, 2016, PP. 196-207.

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ABOUT OF SELF-ORGANIZATION IN NATURE

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Under the self-organization understand the processes nascence of complex structures in the absence imposed by external influence of order. During its development, arbitrary system is evolutionary and the revolutionary stage. The result is a qualitative leap and the system creates a new structure. That is, the emergence of order from disorder and the formation of fractal structures takes place spontaneously. Many authors believe that the role of random processes of self-organization of natural systems is much smaller than it seems. They are defined and predictable. Quite a challenge of self-organization is an attempt to explain how the system spontaneously passes from chaos (disorder) in a state of order, how and why takes place this self-organization. Some authors, such as [1] believe that this self-organization achieved at the level of heuristics. In control theory it is considered as a normal process with feedback, which is the same operation is performed again and again.

During the self-organization of nature occur search of options. And it says here that there are laws combinatorics. When generating combinatorial configurations are seeing similar phenomena. Combinatorial set can be arranged as randomly and by strict laws for one and the same recurrent rules. Since the formation and organization of combinatorial configurations performed recursively, then there are feedbacks. As a self-organization and organization of combinatorial sets is inherent frequency and in both cases generated fractal structure. Therefore made an attempt to is modeled self-organization in nature using combinatorial analysis.

References

1. Ивахненко А.Г. Системы эвристической самоорганизации в технической кибернетике / А.Г.Ивахненко. – К.: “Техніка”, 1971. – 392 с.

THE METHOD OF MAKING A DECISION ABOUT TO CHOOSE OF TEACHING TASKS

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Each process learning before becoming a reality is first seen as a system of links and content of the learning process. Based on the system characteristics polysystemic content on the micro didactic level, during the educational process of professional computer training persons with visual impairments teacher make a decision to choose of simultaneous implementation of two teaching tasks are given: to achieve didactic aim of a certain training level under a given applied field and provide the development of compensatory adaptations as a mandatory factor of success of training individual with visual deprivation and mastery of the list of identified competencies.

The effective of the educational process on the didactic micro level can be expressed in the functional model R of learning activities of individuals with visual deprivation that reveal the influence of the training content parameters on the formation of mental image of the object.

$$R = f(P, Q, S), \quad (1)$$

where $P (P_1, P_2, \dots, P_n)$ is a set of educational content elements that reveals the professional competency requirements for the application of computer technologies;

$Q (Q_1, Q_2, \dots, Q_m)$ is a set of structure variations of learning objectives;

$S (S_1, S_2, \dots, S_k)$ is a set of characteristic signs of a mental image of the object which labor learning object (LO) consists of.

Training activities R on didactic micro level we offer to define as the process of mastering individual with visual deprivation totality of elements of educational content P_i that reflect the demands of professional competence for the application of computer technologies. Each content element P_i contains learning objectives Q_j that consist of combinations of characteristic features S_i of labor object mental image, and reveal the conditions, tools and techniques for working individuals with visual impaired person with computer technologies through the knowledge and skills that is needed to be learned. Determination of the characteristic features S_i that form the lowest structural hierarchical level of the educational process requires the analysis of elementary sensory-perceptual

and psychomotor activities that are available to individual with visual deprivation in the process of usage the computers which he can master using mnemonic memory mechanisms (grouping the characteristics, determining relationships, establishing structure).

The basic condition for the formation of the content of practical work is that the number of the units shall not exceed the cortege dimension. To form the structure combinations of LO in each learning objectives we apply the polynomial generatrix function:

$$\sum_{k=1}^n \binom{n}{k} x^k = (1+x)^n. \quad (2)$$

On the basis of the proposed approaches for determining the educational content of professional computer training people with visual impairments it can be concluded that the existing traditional system content in regulatory training documentation could be adapted easily enough, using the principle of correspondence to individuals with visual deprivation.

We believe that the proposed formal approach to learning content formation as the polysystemic system is more efficient because it does not require additional complex mathematical apparatus that allows to realize simple algorithms of content structure for training people with visual impairments. This creates an opportunity for the application in teaching technology principles of individual and differentiated approaches that is based on special educational administration of educational and developmental process of professional computer training people with visual impairments.

MODELS OF DECISION MAKING IN EDUCATION: THE MODERN NOTION OF LEGAL PREPARATION OF CADETS

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National security and defence is the first and foremost priority of any state. Therefore the Republic of Lithuania as well as any other state follows its National Security Strategy which establishes the interests of national security, directions of its evolution, the security and defence policy in general, means and types of risk factors and threats to the national security. The topical issues directly related to the national defence and security which arise in the run of the training course for the military, especially junior leaders at the institution of higher education in the sphere of

providing them with the basic legal knowledge, are presented and examined in the article. In the process of education and training of a junior leader more attention is paid to their professional skills and competencies, and a leader's and subordinate's personality, therefore, a system of legal preparation and training provided for students of this kind of educational institutions, its role and degree of influence on personal qualities of a future leader have not yet been studied and described in scientific publications.

As a result in this research has been concluded, that a leader who is politically correct and competent in the legal sphere can ensure that the decisions made are well-reasoned, consistent and adequate, and they are aimed at the elimination of possible disagreements which might emerge in the sphere of human resource management, management of military units in the run of resolving their daily tasks, holding negotiations at any levels, as well as enhancement of the army's defensive power in general.

ONE METHOD OF DATA EXTRAPOLATION

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Prediction of physical, economic, environmental or social processes [1] is crucial for their study. Today are known a series of quantitative and qualitative approaches of forecasting [2]. The most common methods of short time-series forecasting are the extrapolation methods . There are a number of problems dealing with the study of small time series. For example, in the absence of additional information is often impossible to conclude that process is determinate or indeterminate, which significantly effects on the model construction. In determinate case is obvious that for any set of points there are many curves that pass through them or something to bring, and it is difficult to argue that one curve (model) is precisely the law that comprehensively describes the phenomenon and will effectively predict its behavior in the future.

The hypothesis, which corresponds to the observation point, is effective if it is appropriate to predict with reasonable accuracy the process starting from any step of observations. In practice, the finding an effective hypothesis is impossible.

In this paper we present a new method which is based on the property of the rows of modified finite differences that provide the best

cubic approximation is in the range of convexity. Numerical results show significant advantages of the proposed method in comparison with approaches to extrapolate, based on the using of polynomials, including Newton's extrapolation.

References

1. Lyashenko I.M., Korobova M.V., Stolyar A.M. Basics of mathematical modelling of economic, environmental and social processes. – Ternopil, 2006. – 300 p.
2. Kostinsky A.S. On the principles of a spline extrapolation concerning geophysical data// Reports of the National Academy of Sciences of Ukraine. – 2014. – Vol. 2.– P.111-117.

COMPONENTS OF AN HIL TEST SYSTEM

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HIL simulation is a powerful test method you can use to test embedded control systems more efficiently. When testing embedded control systems, safety, availability, or cost considerations can make it impractical to perform all of the necessary testing using the complete system. You can use HIL simulation to simulate the parts of the system that pose these challenges, which gives you the power to thoroughly test the embedded control device in a virtual environment before proceeding to real-world tests of the complete system. With this capability, you can maintain reliability and time-to-market requirements in a cost-effective manner even as the systems you are testing become more complex.

An HIL test system consists of three primary components: a real-time processor, I/O interfaces, and an operator interface. The real-time processor is the core of the HIL test system. It provides deterministic execution of most of the HIL test system components such as hardware I/O communication, data logging, stimulus generation, and model execution. A real-time system is typically necessary to provide an accurate simulation of the parts of the system that are not physically present as part of the test. The I/O interfaces are analog, digital, and bus signals that interact with the unit under test. You can use them to produce stimulus signals, acquire data for logging and analysis, and provide the sensor/actuator interactions between the electronic control unit (ECU) being tested and the virtual environment being simulated by the model. The operator interface communicates with

the real-time processor to provide test commands and visualization. Often, this component also provides configuration management, test automation, analysis, and reporting tasks.

ANALYSIS OF STOCHASTIC SYSTEMS WITH QUEUE AND REPEATED CALLS

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A significant part of the queueing theory is the theory of systems with repeated calls (retrial queues). The detailed overviews of the related references with retrial queues can be found in [1],[2]. Queues with repeated attempts are widely used in teletraffic theory and computer and communication networks. We deal with a retrial queues of the type $M / M / m + n / N$ in which a rate of primary call flow λ_j depends on the number j - of customers in the orbit. The rates of repeated calls ν and of the service process μ are supposed to be constant. Queues with repeated attempts, m servers, and n waiting positions are characterized by the following feature: when the m servers are busy, an arriving customer occupies a waiting position and, when one server becomes free, one of the waiting customers immediately starts being served; an arriving customer is blocked when the service facility and the m waiting positions are occupied. Unlike in the main queue with repeated attempts, the state of the system at time t is described by the process $\{X(t), t \geq 0\} = \{C(t), Q(t), t \geq 0\}$, where $C(t)$ is the total number of servers and waiting positions occupied, and $Q(t)$ denotes the number of orbiting customers. Notice, that the process $\{X(t), t \geq 0\}$ is a random walk in space $\{0, \dots, m+n\} \times \{0, 1, \dots, N\}$ so its stationary analysis is similar to the analysis of the corresponding bivariate Markov process associated with the queue with repeated attempts and $m+n$ servers.

The effective approach to find a steady state distribution of the service process is proposed. The only explicit formulae for the state stationary distribution have been derived for the Markovian single server queue with repeated attempts and one waiting position.

References

1. Falin G.I., Templeton J.G.C. Retrial queues. – London Chapman & Hall, 1997. – 331 p.
2. Artalejo J.R., Gomez-Corral A. Retrial Queueing Systems. – Springer, 2008. – 317 p.

CHEMICAL SYNTHESIS FORECASTING ALGORITHM

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For input to the proposed algorithm is given structural formula of compound to be synthesized. The goal of the algorithm is to generate all possible reactions, which products must include input compound. Thus, the algorithm automates the process of finding suitable ways of synthesis substances acting as an electronic reference book [1]. Unlike existing solutions, the algorithm uses for its work not limited number of heuristics but the fundamental properties of materials for prediction and modeling of chemical reactions, such as the potential energy of the molecule and the principle of minimum energy. [2]

The main idea of the algorithm is retrosynthetic analysis, that is "backward" synthesis: having the structural formula of the substance, the algorithm predicts in what way it can be obtained. For this purpose structural formula converts into molecular graph, which is representing an entered compound. For the next step the algorithm breaks the graph for subgraphs, obtaining molecular radicals – paramagnetic particles (atoms or molecules) with one or more unpaired electrons on the outer atomic or molecular orbitals. It may be neutral or carry a positive or negative charge. So long as free radicals are rarely found in nature, obtained charged particles are completed to full molecules which are ready for reaction. Formula of potential reactions involving completed molecules is constructed. The last step of the algorithm is detection of formula coefficients using the principle of minimum energy. If such coefficients exist and are integer, then obtained formula is considered to be valid and described with the algorithm.

References

1. Barone R. and Chanon M. Computer-Assisted Synthesis Design (CASD). In "Chemoinformatics. From data to knowledge", J. Gasteiger, T. Engel Eds, J. Wiley, 2003
2. Phoetner M. and Sitzmann M. Computer-Assisted Synthesis Design by WODCA (CASD). In "Chemoinformatics. From data to knowledge", J. Gasteiger, T. Engel Eds, J. Wiley, 2003.
3. Zefirov N.S., Baskin I.I., Palyulin V.A. SYMBEQ Program and Its Application. in Computer-Assisted Reaction Design. J. Cheiri. Inf. Comput. Sci. 1994, 34 (4).

THE PROBLEM OF MASS TRANSFER WITH PARTIALLY UNKNOWN BOUNDARY CONDITIONS

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Usually getting solution of the problem of determination the distribution of the Cs¹³⁷ radionuclide in the area of soil aeration in the system of hydro technical shafts-terraces provides for known values on the limits of area. In practice, exact values of the limit values concentration are impossible to get accurately. In addition, the initial values are measured only in limited number of points. Therefore, we can calculate the distribution of the radionuclide concentration only approximately.

Having in mind the construction of surfaces shafts-terraces we investigated two-dimensional model of mass transfer:

$$Zu \equiv \frac{\partial u}{\partial t} + Lu \equiv \frac{\partial u}{\partial t} - \sum_{i=1}^2 \frac{\partial}{\partial x_i} \left(D(x) \frac{\partial u}{\partial x_i} \right) + \sum_{i=1}^2 V \frac{\partial u}{\partial x_i} = f(x, t) \equiv -\lambda u_0 \phi(x) \delta(t-0)$$

$$\left(-\sum_{i=1}^2 D(x) \frac{\partial u}{\partial x_i} + Vu \right) \Big|_{x \in \Gamma} = k(\Gamma) c_0 q_0(x), \quad t \in [0, T]$$

$$\left(-\sum_{i=1}^2 D(x) \frac{\partial u}{\partial x_i} + Vu \right) \Big|_{x \in \partial \Omega \setminus \Gamma} = 0, \quad t \in [0, T].$$

$$u(x, 0) = 0, \quad x \in \Omega,$$

in the bounded area $Q = \Omega \times (0 \leq t \leq T)$, $\Omega \subset R^2$ with piecewise smooth surface $\partial\Omega$, λ – half-decomposition factor, $\phi(x_1, x_2)$ – the function describing the surface of the shaft-terrace Γ , $\phi(x_1, x_2) \in L_2(\Omega)$, u_0 – surface contamination, $u(x, t)$ – the concentration of the substance in the point $x = (x_1, x_2)$ at the moment t , $u(x, t)$ is twice continuously differentiated by x on Ω and continuously differentiated by t on $[0, T]$. The operator

$$Au = - \sum_{i=1}^2 \frac{\partial}{\partial x_i} \left(D(x) \frac{\partial u}{\partial x_i} \right)$$

is elliptical in closed area $x \in \Omega + \partial\Omega$, $D(x)$ – continuously differentiable in the closed area $\bar{Q}$, an integral and limited in the relevant area, V – positive constant, $k(\Gamma) = k \cdot \cos(\alpha(\Gamma))$, k – the coefficient of conductivity (absorption) for surface, $\alpha(\Gamma)$ – the slope of the segment of terraces, q_0 – the flow of water coming from atmospheric precipitation with a concentration of the substance c_0 .

In [1] shows the existence of a unique generalized solution of this problem.

Consider the case where the values of concentration for certain boundary points measured with an error or missing.

Let it is known that $\|Z_h u - f_\delta\| \leq \delta$ and in grid region $\Omega_h^\tau = \{(x_{1i}, x_{2j}, \tau^k) : h_1 = x_{1i+1} - x_{1i}, h_2 = x_{2j+1} - x_{2j}, \Delta\tau = \tau^{k+1} - \tau^k, i = \overline{0, N}, j = \overline{0, M}, k = \overline{0, K}\}$ constructed difference scheme for determining u_{ij}^k .

Has been introduced the functional

$$\Phi^\alpha[u] = \|Z_h u - f_\delta\|^2 + \alpha \|u\|^2, \alpha > 0$$

and made the transition to the problem

$$\inf_{u \in Q} \Phi^\alpha[u],$$

where α – regularization parameter, elected in accordance with the principle of generalized discrepancy [2]. The solution of abovementioned task exists and unique. All of this allows us the use of methods of regularization, i.e. we can numerically construct such function α that satisfies the equation

$$\rho(\alpha) = \|Z_h u_h^\alpha - f_\delta\|^2 - (\delta + h \|u^\alpha\|)^2 = 0$$

and look for such u^α , which converge to the exact value $\bar{u}$ when tending to zero the input data error.

References

1. Vergunov V.A. Study of the transfer process of Cs137 in the system of hydrotechnical ramparts / V.A. Vergunov, I.N. Vergunova, O.V. Hajduk // Scientific journal of Tessedik Samuel college. – Hungary, 2001. – T. 1. – PP. 311-316.
2. Tikhonov A.N. Numerical methods for solving ill-posed problems / A.N. Tikhonov, A.V. Goncharsky, V.V. Stepanov, A.G. Jagola. - Moscow: Nauka, 1990. – 232 p. (in russian).

OBTAINING THE WEIGHTS OF INDICATORS TO EVALUATE SPECIAL TRANSPORTATION SERVICES ACCORDING TO F-AHP METHODOLOGY

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Multicriteria decision making methods are widely used in different decision making situations where the indicators of diverse fields should be evaluated. The problem of integration of special transportation services to people with movement disorders into existing public transport system is analyzed in this paper. The evaluation of possible alternatives is based on indicators that can be used for decision making. According to the requirements of sustainable public transport development, the set of indicators was carried out. Whereas the public transport environment is claimed to be a fuzzy environment, the fuzzy analytic hierarchy process (f-AHP) can be applied to obtain the fuzzy weight of each indicator. This system of indicators is a tool for decision makers in further evaluation of the alternatives. A case study is provided to verify this approach.

OPTIMIZATION OF OPERATION OF DRAINAGE SYSTEM FOR DRAINING SOIL MASS WITH MATHEMATICAL MODELING OF SALTS AND MOISTURE TRANSFER

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Mathematical and computer modeling was carried out for the optimal operation of horizontal drainage system for draining soil mass.

The mathematical model of this problem in generally adopted specifications may be described by the following boundary problem under corresponding boundary conditions at margins of filtration and moisture transfer field and also under conjugation conditions at a free margin.

$$\frac{\partial \left(D_1(c_1) \frac{\partial c_1}{\partial x} \right)}{\partial x} + \frac{\partial \left(D_1(c_1) \frac{\partial c_1}{\partial y} \right)}{\partial y} - v'_x(c_1) \frac{\partial c_1}{\partial x} - v'_y(c_1) \frac{\partial c_1}{\partial y} - \gamma_1(c_1 - C^*) = \sigma_1 \frac{\partial c_1}{\partial t}, \quad (1)$$

$$\frac{\partial}{\partial x} \left(k_1(c_1, h_1) \frac{\partial h_1}{\partial x} \right) + \frac{\partial}{\partial y} \left(k_1(c_1, h_1) \frac{\partial h_1}{\partial y} \right) - \frac{\partial}{\partial x} \left(v(c_1, h_1) \frac{\partial c_1}{\partial x} \right) - \frac{\partial}{\partial y} \left(v(c_1, h_1) \frac{\partial c_1}{\partial y} \right) = 0, \quad (2)$$

$$v'_x(c_1) = -k(c_1, h_1) \frac{\partial h_1}{\partial x} + v(c_1) \frac{\partial c_1}{\partial x}, \quad v'_y(c_1) = -k(c_1, h_1) \frac{\partial h_1}{\partial y} + v(c_1) \frac{\partial c_1}{\partial y}, \quad (3)$$

$$\frac{\partial \left(D_2(c_2) \frac{\partial c_2}{\partial x} \right)}{\partial x} + \frac{\partial \left(D_2(c_2) \frac{\partial c_2}{\partial y} \right)}{\partial y} - v_x(c_2) \frac{\partial c_2}{\partial x} - v_y(c_2) \frac{\partial c_2}{\partial y} - \gamma_2(c_2 - C^*) = \sigma_2 \frac{\partial c_2}{\partial t}, \quad (4)$$

$$\mu(h_2) \frac{\partial h_2}{\partial t} = \frac{\partial}{\partial x} \left(k(c_2, h_2) \frac{\partial h_2}{\partial x} \right) + \frac{\partial}{\partial y} \left(k(c_2, h_2) \frac{\partial h_2}{\partial y} \right) - \frac{\partial}{\partial x} \left(v(c_1) \frac{\partial c_1}{\partial x} \right) - \frac{\partial}{\partial y} \left(v(c_1) \frac{\partial c_1}{\partial y} \right), \quad (5)$$

$$v_x(c_2) = -k(c_2, h_2) \frac{\partial h_2}{\partial x}, \quad v_y(c_2) = -k(c_2, h_2) \frac{\partial h_2}{\partial y}. \quad (6)$$

For a boundary problem (1)-(6), using the method of numeric conforming reflections there had been constructed a monotonous differential scheme of the problem in the complex area, its numeric solution had been obtained. As a result of which the optimal distribution was established of the concentration of salt solutions in case of draining soil mass between drains of deep and shallow layout.

OPTIMIZATION OF COMPUTER METHODS FOR MATHEMATICAL MODELING OF RADIONUCLIDES VERTICAL MIGRATION IN CATALYTIC POROUS MEDIA

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There has been a rapid development of computer technology for a long time. In this regard, the need for optimal use of all of the computing power of modern technology is increasing. In recent years, producers have preferred multi-processor architectures instead of increasing clock speed, ensuring parallelism at the level of instructions. Thus, to obtain the maximum effect from the increased productivity, the code should be adapted for multi-use. This is achieved through parallel computing.

We consider the problem of vertical migration of contaminants (e.g., radionuclides) in a layer of soil. To find the numerical solution of the corresponding boundary-value problem, we use the finite difference method. Finite difference analogs of mathematical model equations and their solutions are described in detail in [1].

A software implementation of a numerical solution of the mathematical model is a nontrivial task. This follows from the relationships between the desired concentrations $c_1(x,t)$, $c_2(x,t)$, $c_3(x,t)$, $q(x,r,t)$ and filtration velocity v . That is why each mathematical model should be considered according to the relationships between groups of equations. The universal solution for parallel computing does not exist. Taking this into account, our calculations can be divided into smaller ones for the initialization of boundary and initial conditions of the first order and calculation of the sweep methods compared with those used to consistently find filtration velocity v and concentration $q(x,r,t)$, $c_3(x,t)$, $c_2(x,t)$ and $c_1(x,t)$. Additionally, each calculation of concentration may use parallelism on a low level of the sweep method (Thomas algorithm).

Our previous papers derived coefficients of the sweep method, which is usually performed in a single threaded mode. To work on two streams on systems with shared memory, we should use a combination of left and right sweep methods. This type of sweep method is called the counter sweep method.

We used the following computer configuration for the calculation experiments made using OpenMP technology in our NanoSurface tool:

- CPU: Intel(R) Core(TM) i7-3630QM CPU @ 2.40GHz (8 CPUs)
- RAM: 8192MB RAM
- VideoCard: NVIDIA GeForce GT 650M x2
- Operation System: Windows 10 Pro 64-bit
- Compiler: MinGW 32/64bits (gcc 5.3.0)

Figure 1 show a comparison of execution time on 8 threads for a different version of the algorithm: parallel loop for initialization according to boundary conditions; parallel calculation of the matrix coefficients a_i , b_i , $\bar{c}_i$, f_i of all equations; parallel calculation of filtration velocity; and parallel calculation for concentration $q(x,r,t)$. As we see, parallel computing allows us to minimize execution time. For example, for 120,000 steps in x , the variable parallel computing algorithm is 3.5 times faster than the single mode algorithm.

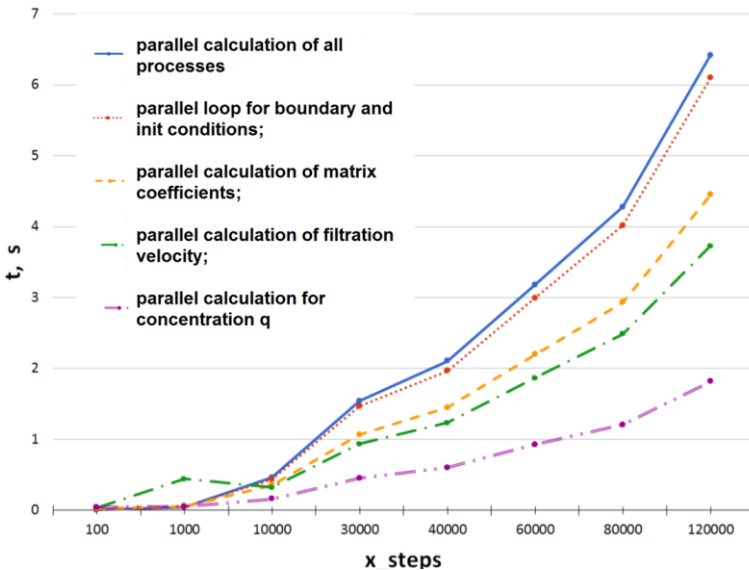


Fig. 1. Time execution of parallel computing using 8 threads

References

1. Vlasjuk A.P. Mathematical modeling of vertical migration of radionuclides in catalytic porous medium in the nonlinear case / A.P. Vlasjuk, V.V. Zhukovskyy// Mathematical and computer modeling. – 2015. – T.12. – PP.161–172. (in ukrainian)

BELIEFS, PREFERENCES AND CONSTRAINTS MODEL: ADVANTAGES AND CHALLENGES INHERENT IN BIOLOGICAL EXPLANATIONS OF HUMAN CHOICE

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In the recent decade Beliefs, preferences and constraints (BPC) model has offered hope of unifying disparate methodologies of various social sciences concerned with explaining human behavior. While the main insight of the model -- that biologically and culturally determined cognitive tools explain patterns of decision-making -- remains appealing, the more recent propositions from scholars studying evolutionary origins of human morality might cast doubt on the concept of human rationality inherent in the BPC model. The presentation will review the aforementioned literature and its implications for future research.

DISCRETE MODELING OF OPTION PRICE ON THE BASE OF BLACK-SCHOLES EQUATION

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One of the most famous models of the dynamics of option pricing is Black-Scholes model [1] on an infinite time interval and an infinite period of basic financial asset prices. We consider the case of Black-Scholes model with discrete initial and boundary conditions:

$$\frac{\partial w(x,t)}{\partial t} + \frac{1}{2} \sigma^2 x^2 \frac{\partial^2 w(x,t)}{\partial x^2} + r x \frac{\partial w(x,t)}{\partial x} - r w(x,t) = 0, x \in [X_1, X_2], t \in [0, t^*];$$

$$w(x_i, t) \Big|_{t=t^*} = \varphi_i, x_i \in [X_1, X_2], i = \overline{1, n}; w(x, t_j) \Big|_{x=X_1} = 0, t_j \in [0, t^*], j = \overline{1, m},$$

where x^* – the price of the basic asset, σ – volatility, r – risk-free interest rate, $w(x, t)$ – the price of the option. By replacing the variables, the model is simplified to a homogeneous parabolic models:

$$\frac{\partial y(z, \tau)}{\partial \tau} - \frac{1}{2} \sigma^2 \frac{\partial^2 y(z, \tau)}{\partial z^2} = 0, z \in S, \tau \in [0, t^*];$$

$$y(\hat{z}_i, \tau) \Big|_{\tau=0} = \varphi_i e^{-r\tau^*}, \hat{z}_i = \ln(x_i) + Ct^*, x_i \in [X_1, X_2], i = \overline{1, n};$$

$$y(\tilde{z}_j, \tau_j) = 0, \tilde{z}_j = \ln(X_1) + C(t^* - \tau_j), \tau_j = t^* - \tau_j, j = \overline{1, m}.$$

This is a well known fundamental solution of the parabolic equation. Therefore, the function $y(z, \tau)$ is written in the integral form [2] and substituted in the initial and boundary conditions of the problem. Then we discretize these expressions to variables of integration. Thus, the system of algebraic equations $Au = B$ is obtained, where A – rectangular matrix coefficients in terms of discretizing, B – column of right parts, and u – unknown. Solution of the system is determined by the formula $u = A^+ B + (I - A^+ A)\eta$, where I – the identity matrix, and η – random vector. The value of the function $y(z, \tau)$ at points of discretizing can be obtained by moving its integral sums of Darboux. Clearly, initial and boundary conditions are satisfied by mean-square criterion.

References

1. Voloschuk S.D. Modelyuvannya vartosti optionu na osnovi rivnyannya Bleka-Shoulsa [Online] / S.D. Voloschuk // *Efektivna ekonomika*. – 2015. – №4. – Available at: <http://www.economy.nayka.com.ua/?op=1&z=4001>
2. Stoyan V.A. Matematichne modelyuvannya linijnyh, kvazilijnij i nelinejnyh dinamichnih sistem: monografija / V.A. Stoyan. – K.: Vydavnicho-poligrafichniy tsentr «Kiyivskiy universitet», 2011. – 320 p.

FRAUD DETECTION SYSTEM

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The work describes the system for recognizing fraudulent transactions. The architecture of the fraud tracing recognition system is presented.

The datasets contains transactions made by credit cards by european cardholders. This dataset presents transactions that occurred in two days, where we have 492 frauds out of 284,807 transactions.

The algorithm of negative clonal selection was modified, in particular, the Hamming distance was applied, and for increasing the speed of the algorithm, the input sample for "close" data was consolidated.

Using machine learning algorithms models have been built that can detect fraudulent transactions with a high degree of reliability.

A comparative analysis of models of artificial immune systems and decision trees has shown that the best model is negative clonal selection.

References

1. John Hunt – Jisys: The Envelopment of an Artificial Immune System for Real World Applications / John Hunt, John Timmis, Denise Cooke, Mark Neale, Clive King; пер. с англ. под ред. А. А. Романюхи. – М.: ФИЗМАТЛИТ, 2006. – 344 с.
2. Lu Q., Ju C. Research on credit card fraud detection model based on class weighted support vector machine. – 2011. – Access mode: [dx.doi.org/10.4156/jcit.vol6.issue1.8](https://doi.org/10.4156/jcit.vol6.issue1.8)
3. Brause R., Langsdorf T., Hepp M. Neural data mining for credit card fraud detection. – 1999. – Access mode: ieeexplore.ieee.org/document/809773

ON METHODS FOR SOLVING NONLINEAR EQUATIONS WITH NONDIFFERENTIABLE OPERATOR

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Many problems in applied mathematics can be brought in the form of an equation

$$H(x) = 0, \quad (1)$$

where H is a nonlinear operator defined on a convex subset D of a Banach space X with values in a Banach space Y . The well-known method for solving equation (1) is Newton's method. This method converge with second order, but it needs the existence of the first Fréchet derivative of the operator H . As H is a nondifferentiable operator, the methods with divided difference can be applied [1]. Another approach is to divide operator H into two parts: one is differentiable, say F ; another is Lipschitz continuous, say G . Thus, (1) becomes

$$H(x) \equiv F(x) + G(x) = 0. \quad (2)$$

Effective method for finding an approximate solution x^* for a nonlinear equation (2) consists in combination the Fréchet derivative of F with the divided difference of first order of G [2, 3].

We provide a convergence analysis of the combined methods and its modification for solving nonlinear equation (2). Also we carry out the numerical experiments on test problems with nondifferentiable operator to show that combined methods are faster than basic methods.

References

1. Dennis J.E., Schnabel Jr. and R.B. Numerical Methods for Unconstrained Optimization and Nonlinear Equations. – Prentice Hall. – 1983. – 378 p.
2. Iakymchuk R., Shakhno S., Yarmola H. Combined Newton-Kurchatov method for solving nonlinear operator equations // PAMM – Proc. Appl. Math.Mech.–2016.–16(1).–PP. 719-720. / DOI: 10.1002/pamm.201610348.
3. Shakhno S., Babjak A.-V., Yarmola H. Combined Newton-Potra method for solving nonlinear operator equations // Journal of Computational & Applied Mathematics. – 2015. – № 3 (120). – PP. 170-178.

NONLINEAR APPROXIMATION FOR MARKOV EVOLUTIONS

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Consider the family of normalized Markov processes with independent increments $\eta_\varepsilon^\delta(\cdot)$ and Markov random evolution $\xi_\varepsilon^\delta(\cdot)$ with trajectories in $D[0; \infty)$. In the scheme of Poisson approximation there are two normalizing functions: the function $g_1(\varepsilon)$ normalizes time and value of jumps and the function $f_1(\delta)$ normalizes intensity of jumps.

$$\xi_\varepsilon^\delta(t) = \xi_\varepsilon^\delta(0) + \int_0^t \eta_\varepsilon^\delta(ds; x \left(\frac{s}{(g_1(\varepsilon))^2} \right), \quad t \geq 0,$$

$$\eta_\varepsilon^\delta(t) = g_1(\varepsilon) \eta^\delta \left(\frac{t}{(g_1(\varepsilon))^2} \right), \quad t \geq 0.$$

These processes are defined by the generator

$$\Gamma_\varepsilon^\delta(x)\varphi(u) = (g_2(\varepsilon))^{-1} \int_R (\varphi(u + g_1(\varepsilon)v) - \varphi(u)) \Gamma^\delta(dv; x), \quad x \in E, \quad \text{where}$$

$\varphi(u)$ is a twice differentiable function in R , which tends to 0 at infinity

and with sup-norm, $\varphi(u) \in C_0^2(R)$. The kernel of intensity Γ^δ belongs to the class $C^3(R)$, $\Gamma^\delta(0) = 0$. Here $g_2(\varepsilon) = 0(g_1(\varepsilon))$.

References

1. Koroliuk V.S. Stochastic systems in merging phase space / V.S. Koroliuk, N. Limnios. – Singapore: World Scientific Publishing Company, 2005. – 348 p.
2. Feng J. Large deviation for stochastic processes / J. Feng, T.G. Kurtz. – Mathematical Surveys and Monographs, 131. Providence, RI, American Mathematical Society, 2006. – 410 p.

THE IMPACT OF SITUATIONAL LEADERSHIP ON SOLDIERS' SATISFACTION WITH MILITARY SERVICE

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The purpose of this study was to examine the impact of situational leadership theory practical application on soldiers' duty satisfaction and evaluate the possibilities to raise the level of duty satisfaction by providing the recommendations. As the supplementary goal the intrinsic and extrinsic duty satisfaction levels were determined. The research was performed in the NATO force integration unit Lithuania. This military organization is multicultural, comparatively young as organization, consisting of matured, educated, experienced personnel. The hypothesis – application of the situational leadership theory positively effects duty satisfaction in the armed forces.

The level of application of the situational leadership in the organization was investigated using the LEAD (self) questionnaire. This tool was chosen because it was intentionally created to conduct researches of particularly this theory of leadership. The level of duty satisfaction was determined using Minnesota Satisfaction Questionnaire (MSQ) as the one of the most reliable tool, widely used in the scientific researches. Finally the statistical analysis with SPSS was made to find the links between the level of situational leadership and duty satisfaction.

The results of empirical research showed, that application level of situational leadership theory in the organization is lower than average, but the duty satisfaction level was 3.87 in 5 points scale, more than average. The social factors and liberty to use own methods were evaluated as most

positively affecting the duty satisfaction. The level of application of situational leadership indicates the intense use of social communication between leaders and subordinates.

The results didn't show any positive correlation between the level of situational leadership and duty satisfaction. According the results the full application of this leadership theory would possibly negatively affect the duty satisfaction. The possible descent is 20 %.The recommendations for improvement of duty satisfaction were provided.

ENHANCING STATE 'S GOVERNANCE CAPACITY THROUGH ADAPTIVE LEADERSHIP AND EFFECTIVE DECISION MAKING PROCESS

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The state's resilient governance capacity is essential in ensuring the prosperous development and welfare of any nation. In a case of so called, wicked problems'', the state could become more vulnerable and susceptible to internal and external threats and risks. In the contemporary academic debates, good governance'' doctrine is mainly used as an exemplary and antagonistic framework against „bad governance'' which neglects the rule of law, and human rights and legal aspects of at the state level and beyond. However, even having legislation in place it provides no guarantee that the nation will be secure, stable and prosperous in the long term, particularly, if it lives under constant political, economic and military pressure, Emerging security challenges and events require sound leadership and an ability to effectively address uncertainty.

I argue that the decision making could serve as an indicator of adaptive capacity and resilience in governance. Applying effective and timely decision-making requires leaders at all levels to consider and balance their thinking. Adaptive leadership looks both forward and back to evaluate the effectiveness of applied solutions and searches for new ones as the crisis unfolds. It recognizes a complex crisis and leads through mobilisation of people using combinations of conventional and innovative solutions, if deemed necessary. The lack of the adaptive governance capacity could be well exemplified during Crimean crisis in the beginning of 2014.

FILTRATION OF THE MATRIX SINGULAR DECOMPOSITION FOR THE CORTEGE OPERATORS

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In the Euclidean spaces of numerical vectors the singular decomposition (SVD) and the theories of pseudo-inversion (PdI) are realized as theories, which describe properties of the matrices. The concept of cortege operators (CorO) with matrix corteges [1,2] gives the opportunity to transfer the possibilities of SVD– and PdI–analyse to the matrix Euclidean spaces $R^{m \times n}$, which allows to consider matrices as representatives instead of vectors: vectors of characteristics. In the case of matrices, the SVD–development of cortege operator is constructed according to the sequence of matrices of the training sample, which consists of a set of vectors: vectors of characteristics. This training sample can represent, for example, one class–cluster, as in the spectrogram of an audio signal or in image processing. The same as in the case R^n , transformation – filtration of a set of matrices, which represent the training sample is proposed to be implemented through rejection in SVD–decomposition the corresponding cortege operator of the senior members with the next return to the cortege, which corresponds to the received cortege operator

$$\|A_c\|_{sp}^2 = \left(\|a_{ij}^{(re)} + ja_{ij}^{(im)}\|^2 \right) = \left((a_{ij}^{(re)})^2 + (a_{ij}^{(im)})^2 \right),$$

where $A_c = A_{re} + ja_{im} = (a_{ij}^{(re)} + ja_{ij}^{(im)})$.

The procedure is described on the example of vectors, although the technique CorO allows it to be moved in the same form to the matrix representatives.

Reference

1. Донченко В.С., Зинько Т.П. Концепция кортежности и ее реализация для матричных кортежей. // Международный научно-технический журнал “Проблемы управления и информатики”, 2016, №4. – С. 87–99.
2. Donchenko V., Zinko T., Skotarenko F. Feature vectors in grouping information problem in applied mathematics: vectors and matrixes. // Problems of computer Intellectualization. ITHEA, Kiyv, Ukraine–Sofia, Bulgaria, 2012. – P. 111–124.

TENSOR MODELING OF FRACTAL DYNAMICS OF FINANCIAL AND ECONOMIC SYSTEMS

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In the context of the transformation of economic relations in Ukraine, the task of assessing the stability, stability of trends, the nature of changes

in economic dynamics is relevant. For many complex systems, the values of such characteristics form a fractal set. These systems are self-similar or self-contained. Their behavior is characterized by chance in the local and definite in the global. For such systems, the synthesis of an ordered structure from a combination of cases is characteristic. In this paper, the fractal dynamics of financial and economic systems is proposed to describe the distance between its elements by the formula:

$$Y^2 = YU_t X \quad \text{or} \quad Y^2 = \varphi. \quad (1)$$

Where $\varphi = YU_t X$ - isotropic scalar function of a tensor U_t . Since the right-hand side of equality (1) is the distance that retains the numerical value when the coordinates are replaced, but retains the form, then it depends only on the invariants [1].

Statement 1. The scalar function over a symmetric tensor represents a scalar invariant if and only if it can be represented as a function of the invariants of this tensor.

Statement 2. An invariant scalar, which is a polynomial of the components of a symmetric tensor, is a polynomial of its invariants $I_k(U_t)$:

$$\varphi(U_t) = \varphi(I_1(U_t), I_2(U_t), I_3(U_t)), \quad (2)$$

where I_1, I_2, I_3 - the first, second and third invariants of the corresponding tensor U_t . Consequently, it is proposed to fractal dynamics of financial and economic systems to model the scalar function of a tensor argument, in particular, if the tensor is a symmetric polynomial of its invariants.

References

1. Lurie A.I. Nonlinear theory of elasticity. - Moscow: Science. The main edition of physics and mathematical literature, 1980. - 512 p.

RATIONAL CHOICE ACTOR MODEL ANALYSIS OF RUSSIAN FOREIGN AND NATIONAL SECURITY POLICY: LONG-RUN AND SHORT-RUN STRATEGIES OF RULING ELITES

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There are different assessments of the Kremlin foreign and national security policy. One extreme see it as the efficient long term strategic plan, other – as the mess of *ad hoc* tactical moves. The dominant approach here is realism (neorealism), but other approaches are also often used.

Rational choice actor model could also provide important insights for understanding Kremlin decision making. In this presentation selectorate model (B. Bueno de Mesquita, A. Smith) is complemented with the elites (selectorate members) strategy longevity analysis.

In case of Russia (and many other similar countries, such as Ukraine, Nigeria etc), strategies of action could be divided in to:

Long term. Future of Russia as an developmental project is seen positively. Elite members threat the country as the future place for a safe and prosperous living for them and their children. Russia is also seen as profitable and safe place for investments.

Short term. Russia is not seen as perspective project. It is much better and safer to live and consume abroad (usually, in the Western countries – official adversaries).

This dimension, despite being almost ignored in the Western academic literature, is very popular in the Russian domestic discourse. Kremlin is using it in the propaganda measures (portraying itself as the nationally oriented elite, which is fighting against globalists and their representatives in the Russian elites). Opposition (for example, A. Navalny) is also using this topic to portray Russian elite members as corrupt and non – patriotic at the same time.

What indicators could be used to measure LTS and STS? First at all, goals of the investments (acquisitions, capital flight etc). Minor factors, such as second citizenship, place of living of elite members (Lavrov and Peskov daughters) and their relatives are also quite illustrative.

It is clear, that STS strategy is more beneficial to Russia – West relations, but in normal conditions (democratic government) LTS would be even more beneficial.

Factors influencing STS vs LTS choice:

1. Conditions for legal and illegal investments from Russia in the West. For example, fight against “Tax heavens”, money laundering etc.
2. Economic sanctions against Russia.
3. Enforcement at home (personnel policy, laws etc.).
4. Relations between power and property in Russia.

Taking into consideration STS and LTS dimension of selectorate theory, the Kremlin decision making (including aggression in Ukraine) and Russia – West relations have additional set of explanations.

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