

5. CONTROL PROBLEMS IN SOCIAL AND ECONOMICAL SYSTEMS

Abstracts

Abdrafikova S. A., Garnaev A. Yu. **On choosing of licensing type for innovative technology sale**

This paper deals with a problem of choosing of licensing type (royalty and a fixed fee) for sale of an innovative technology where production process is described by the Cournot model. Authors consider scenarios with complete as well as incomplete information about the preferences of firm-buyer of technology on licensing type. Also, plots with constant and decreasing unit costs are investigated. The condition of licensing type choosing is supplied.

Abramovskaya T. V. **On some differential games of pursuit**

The article focuses on the ε -search problem for connected graph for the first time formulated by P. A. Golovach. The properties of the Golovach function, which associates each nonnegative number ε with the ε -search number, are analyzed. Special attention is given to the jumps of the Golovach function for trees case. The research shows examples of trees that refute the hypothesis of that the Golovach function of any planar graph has only unit jumps. In these examples the number of arc is minimal. It is illustrated that the number of the Golovach function jumps is less than two.

Anisimov D. B., Orlov V. B., Petrova V. A. **Fuzzy theory in economics models**

The article deals with concepts of fuzzy theory and ways of its usage in the creation of mathematical models of economic. In the article, concepts and strict mathematical formulations of corresponding mathematical apparatus are considered. Its capabilities and examples of its application in economics modeling are described.

Afanasyev V. I., Kiryanen A. I. **Probabilistic model of the Russian Federation budget according to Markov's discrete chains**

The article deals with the problem of economic model building according to the scheme of Markov's discrete chains. The author also considers the problem of the most indicative model building, the Markov's chains periodicity, finding the vector of final probabilities and a possibility of control in conditions of statistical uncertainty. Further, based on 1994-2009 statistics, an attempt to build a similar model for the case of the Russian Federation budget is made.

Afanasyeva E. V. **Probabilistic chains. Resource distribution modeling**

The paper deals with the results of the probabilistic chains theory application to the processes of income allotment between different social strata and the processes of income and number of working people allotment between economic sectors in the Russian Federation. Mentioned processes are extrapolated on a time interval till 2017 inclusive, basic regularities are revealed, and connection between the income level in economics and the number of working people is analyzed.

Baskov O. V. **Algorithm for sequential accounting of information on the relative criteria importance in the multicriteria choice problem**

An approach to reduce the Pareto set in the multicriteria choice problem is considered. The reduction is based on the information on the relative criteria importance. The sequential algorithm of the Pareto set reducing, which is based on the relative importance information, is proposed.

Bogdanova O. K., Parilina E. M. **Empirical analysis of social networks**

The article deals with the dynamic model of social network. Each network user in each time period can be in one of the two states, namely, active or susceptible. It is supposed that the main property of the social network is a connectivity distribution. The condition of the network equilibrium (stationary state) is defined by using the main dynamics equation. The empirical study of two social networks is performed. Checking of statistical hypothesis about the type of a connectivity distribution is realized.

Bukholtseva A. A. **Modeling of macroeconomic relationships of a region based on the Input-Output equations**

In the article the model of macroeconomic relationships of a region based on the Input-Output equations is considered. Several algorithms for solving control problems of region economy are offered.

Garaev I. A. **New effective method of derivatives dynamics estimations**

Nowadays, it is not possible to predict the dynamics of derivatives by existing methods in the condition of strong turbulence (high volatility and abrupt change in assets) on-line. In this regard, the method of path integral is becoming more popular in mathematical finance as a successful language for description of derivatives including path dependent option. In this article, new method is proposed. Combined with cloud computing, it makes it possible to obtain an accurate estimations in real time.

Dorofeyeva T. B. **Probability-statistical analysis of financial expenditure in medical insurance system in Saint Petersburg**

In the article probability-statistical analysis of financial expenditure in medical insurance system in Saint Petersburg is given.

Zak M. M. **Algorithms of data classification based on decision trees**

This paper deals with the algorithms of data classification based on decision trees, namely, the C4.5, the CART, the CP-method, and its recently developed modifications. Besides, the author shows a new approach to the selection of partitioning attribute and describes a new algorithm, which is based on it.

Zakharov A. O. **Reduction of the Pareto set based on closed information on criteria groups**

The author considers the axiomatic approach to the Pareto set, that is proposed by V.D. Noghin. It includes a set of feasible vectors, a numerical vector criterion, and the Decision Makers strict preference relation. Closed information on the relative importance of criteria groups is used to reduce the Pareto set. In this paper, obtained theoretical results generalize the previous author's states on criteria groups. Besides, the Pareto set reduction is illustrated by the example.

Zemtsova V. N. **Generalization of the Sen and Schwartz theorems**

The aim of this article is to perform the conditions of a fuzzy choice representing by means of fuzzy binary preference relation. Well-known choice axioms are reformulated for the fuzzy case, and fuzzy variants of the Sen and Schwartz theorems are proposed.

Zubareva M. L., Gubar E. A. **Routes optimization in the ATM network**

The article deals with the capacitated vehicle routing problem for ATM service. It is considered two objects: the ATM network and the bank. The ATMs are serviced by the teams of money collectors that are based in the bank. The purpose is to minimize the delivery costs. The numerical example illustrating this problem for a certain ATM network is given.

Izbitskiy D. V., Pristavko V. T. **Application of information technology to the region's tax basis dynamics modeling**

Analysis and prognostication of the region's tax basis dynamics is an important task of governmental economics regulation. In the article, the problem of constructing of discrete and continuous matrix models of the region's tax basis dynamics and attendant problems are considered. Programmatically realized approaches for the identification of parameters of considered optimal models are suggested, and the simple examples of its work are given.

Izotov K. A. **Mathematical model of problem of employees administration**

In the paper, a model for automated distribution of teaching load of department's lecturers is offered. It allows to estimate a contribution of each lecturer and effectiveness of department work.

Ilyina A. V., Kozlovskaya N. V. **Time-consistency of PMS-vector in emission reduction model**

Coalitional solution of the differential game of emission reduction is considered. The coalitional partition of the players set is formed. Each player acts in the interests of coalition to which he belongs. The total cost of each coalition is divided among players according to the Shapley value. Time-consistency is proved. The irrational behavior proof condition is verified.

Karaseva V. V. **Some approaches to the oil price modeling**

The problem of the oil price forecasting is very pressing for the Russian Federation. In the article, the approach to the price modeling on the basis of the production function device is performed. The scenario of dollar devaluation and creation of a new multiple currency basket is considered.

Kozlovskaya N. V. **Characteristic function super-additivity in the game theoretic model of territorial environmental production**

The game-theoretic model of territorial environmental production is analyzed. The process is modeled as the cooperative differential game. The game characteristic function is computed. The computation of the characteristic function isn't standard; when the characteristic function for some coalition is computed, the left-out players stick to their perfect Nash strategies. The sufficient condition of super-additivity of characteristic function is formulated.

Konovalova M. V. **Variable selection in the linear regression model via the Bayes factor**

The definition of the Bayes Factor and description of the model to which the factor is applied is observed. In the article, the choice of the model parameters distributions is performed. Also, the aim is to provide numeric results and theoretical ground of the matter.

Koroleva A. F., Zenkevich N. A. **Differential game of advertising management on fashion market**

The differential game of oligopolistic competition by advertising on fashion market is considered. The companies (players) try to maximize their profit over an infinite time lag. They use advertising as a strategic instrument. The Nash equilibrium and expression for the optimal strategy are found. Also, the symmetric competition case is investigated.

Kostenko N. M. **Methodological fundamentals of development of interactive system of making decision on tax rates choice**

The article deals with the organization of dialog between a user and a program while entering initial data. The user must have a possibility to see all contingencies and choose all values inside it. Results help to simplify the problem of initial parameters choice without breaking of the optimality of calculated tax rate.

Kostyunin S. Yu. **Core in one class of the dynamic NTU games**

One class of cooperative dynamic games is considered. In the case of nontransferable utility the characteristic function is obtained. The focus is on one of the most important solutions for the NTU games, namely, the core. The sufficient condition is given for the core non-emptiness in general, and it is proved that the game always has nonempty core for the case of two players.

Kostyunin S. Yu., Shevkoplyas E. V. **One modified game-theoretical model of pollution management**

One game-theoretical model of environmental project is considered under condition of a random game duration. The game ends at random moment in time with the Weibull distribution. According to the Weibull distribution form parameter, the game can be in one of 3 stages such as "an infant" stage, "an adult" stage and "an aged" stage. The open-loop Nash equilibrium controls obtained with a help of the Pontryagin maximum principle are analyzed for each stage.

Kumacheva S. Sh. **Application of the search theory to the problem of tax evasions searching**

In the article, the search of tax evasions is analyzed in the network of the game theoretical attitude. It is assumed that tax authority knows due to indirect signs that some taxpayer evaded from taxation in the given period (he declared his income lower than his true income). It is also assumed that this taxpayer is quite a large company, having many branches. In practice, tax authority is an hierarchic structure, and it solves problems on different levels (federal, regional, district etc.). That's why, the usage of the theory of search of an immobile chain with the help of big search system is considered.

Legotina Yu. V. **Application of predator-prey model to problems of analysis and control of social-economic processes of a region**

In the article the problem of control of social-economic processes of a region is considered. The author suggests to use predator-prey model. The example of construction of programmed control is given.

Litvin A. Yu., Pristavko V. T. **Matrix filtration of random sequences in one economic problem**

In the article, the problem of the reduction of random market influences on a trading network is stated. The problem is considered in the network of the application of matrix filtration of the random processes theory. For the first time, it is offered to consider a filtration problem as a control problem of economic levers for the reduction of random factors that influences on a control system. Also, the proprietors and managers interests are simultaneously considered.

Mazalova A. V. **The equilibrium in Hotelling's model with the Manhattan distance**

In the article, the problem of two firms' placement in the city where customers move along the roads is considered. That is why, it is reasonable to use the Manhattan distance to define the prize of firms and find its best position.

Merzljakova Yu. D., Gubar E. A. **Cash flow forecast in the ATM network**

In the article, a cash flow in the ATMs network is considered. The authors estimate an average cash amount in each ATM using statistical methods and taking into account the ATMs locations, working time and date. Prediction of the ATMs refusal and necessity of each ATM servicing are defined. A numerical example based on a certain bank in Saint Petersburg is considered.

Minchenko S. V. **Matrix discrete filtration in trader problem**

In the paper matrix discrete filtration in trader problem is considered.

Mikhaltsova E. I. **Methods of treatment effect estimation**

In the article methods of treatment effect estimation are offered.

Petrov A. G., Slobozhanin N. M. **Analysis of potential function in the shortest-path problem**

The shortest-path problem with integer weight function and potential function is considered. Necessary and sufficient conditions of the potential function existing for graph with a set of vertices of any cardinality are obtained.

Pristavko V. T., Svischikova M. V. **Encoding and decoding of the Gaussian vector signals**

The algorithm for encoding and decoding of the Gaussian vector signals is proposed. Numerical simulation of the algorithm shows greater proximity of decoded signal to the original.

Svyatukhina M. A. **Program realization of the SEM algorithm and its application to archeological data classification**

In the article program realization of the SEM algorithm is offered. Its application to archeological data classification is described.

Sergeeva A. A. **Queueing model with good completeness rate**

In the article, the queueing model of delayed product differentiation is considered. Basic model characteristics such as a mean number of customers in the system, a mean customer order fulfillment delay, a mean number of units of semi-finished goods in the system, an expected number of unsuitable semi-finished items are calculated. The production cost can be counted using these parameters. Finally, the optimal values of manufacturer storage and good completeness rate are found.

Stinskaite L. V. **Optimal replacement policy for a system with obsolescence**

In the article, the problem of definition of optimal rule of replacement in case of two identical independent elements is considered. The theorem for the case of exponential distribution of time of trouble-free elements functioning is stated and proved. Results for a uniform distribution realized in the Maple software are received.

Sultanbekov A. A. **Dynamic models of portfolio problems**

The author considers the problem of stock market dynamic description. The model and classification of three group investors are offered. The strategy of all investors groups is presented. The author shows that the assumption about risk and risk diversification theory is truth only for one group of investors.

Tur A. V. **The Yeung condition for linear-quadratic discrete-time dynamic games with incomplete information**

In the article, the Yeung condition is concretize for case of linear-quadratic discrete-time dynamic games with incomplete information. The condition fulfillment ensures an independence of players on other players' irrational behavior. The example is given.