KYIV NATIONAL TARAS SHEVCHENKO UNIVERSITY
Department of Probability Theory and Mathematical Statistics

INTERNATIONAL CONFERENCE MODERN STOCHASTICS: THEORY AND APPLICATIONS

Dedicated to the 60th anniversary of the Department of Probability Theory and Mathematical Statistics and to the memory of Professor M.Y. Yadrenko (1932-2004)

CONFERENCE MATERIALS

Kyiv, Ukraine
June 19-23, 2006

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МІЖНАРОДНА КОНФЕРЕНЦІЯ СУЧАСНА СТОХАСТИКА: ТЕОРІЯ І ЗАСТОСУВАННЯ

Присвячена 60-річчю кафедри теорії ймовірностей і математичної статистики та пам'яті М.Й.Ядренка (1932-2004)

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Transport Combinatorial Stochastic Tasks and Their Solving

O.O. Yemets', T.O. Parfonova, Ukraine

Possible combinatorial conditions, which can be imposed on the permissible solving, and possible probable parameters of a task are not taken into account in classical transport tasks. More adequate modeling of transport optimization problems demands taking into consideration these aspects [1-9].

Let's consider Task: find volumes x_{ij} of conveyances from the supplier i to the consumer j for all $i \in J_m$, $j \in J_r$ (hereinafter $J_n = \{1, 2, ..., n\}$ - the set of the first n natural numbers) that provide minimal total cost of conveyances of a homogeneous product between the manufacturers m and the consumers n, if the cost c_{ij} of conveyances of the unit of output from the manufacturer i to the consumer j is known The maximum possible volumes of production in the point i equals a_i, where $i \in J_m$. The minimum possible volumes of consumption in the destination j are given and equals according to b_j, $\forall j \in J_n$. Magnitudes a_i will be considered as random numbers with known mathematical expectations $M(a_i)$.

It is considered that the transportation of the cargo is possible to be carried out in the certain capacities in the quantity k of volumes $g_1, g_2, ..., g_k$ accordingly.

The model of such Task can be submitted as: find

(1) $$F(x^*) = \min_{x \in R^k} \sum_{i=1}^{m} \sum_{j=1}^{n} c_{ij} \cdot x_{ij};$$

(2) $$x^* = \arg\min_{x \in R^k} \sum_{i=1}^{m} \sum_{j=1}^{n} c_{ij} x_{ij}$$

under conditions

(3) $$\sum_{i=1}^{m} x_{ij} \geq b_j, \forall j \in J_n;$$

(4) $$\sum_{j=1}^{n} x_{ij} \leq a_i, \forall i \in J_m;$$

(5) $$x_{ij} \geq 0, \forall i \in J_m, \forall j \in J_n;$$

(6) $$x = (x_{11}, ..., x_{1n}, ..., x_{i1}, ..., x_{in}, ..., x_{m1}, ..., x_{mn}) \in E_{k\nu}(G),$$

where m, n – are given constants, $k = mn$, a_i, b_j, c_{ij} are given (for all possible indexes) real positive numbers, $E_{k\nu}(G)$ is the set of permutations of k elements of the given multiset of possible volumes of conveyances $G = \{g_1, ..., g_k\}$, among which there is ν different real numbers.

Task (1) - (5) is classical transport Task. Task (1) - (6) will be entitled as transport combinatorial task on permutations with stochastic parameters.

As is well known, one of the approaches of the solving of tasks with stochastic parameters consists of these parameters replacement by their mathematical expectations. Then in model (1) - (6) the condition (4) will be transformed into

(7) $$\sum_{j=1}^{n} x_{ij} \leq M(a_i); \forall i \in J_m.$$

Task (1) - (3), (5) - (7) is the determined task of Euclidean combinatorial optimization with linear criterion function and linear restrictions on permutations.

It can be solved by a method of combinatorial cutting off, which was offered and proved in [2].

The solution of Task (1) - (3), (5) - (7) cannot satisfy the condition (4) at the certain realization of random magnitudes a_i. The risk of infringement of conditions of Task (1) - (6) can be taken into account in the following way. Let's designate x^M the solution of Task (1) - (3), (5) - (7), and consider function, which estimates risk of infringement of conditions of Task and increase of criterion function at transition from the solution x^M to the solution x of Task (1) - (6):

$$\sum_{i=1}^{m} \delta_i^A (a_i - \sum_{j=1}^{n} x_{ij}) + \sum_{j=1}^{n} \delta_j^B (b_j - \sum_{i=1}^{m} x_{ij}) + \delta^C \sum_{i=1}^{m} \sum_{j=1}^{n} c_{ij}(x_{ij} - x_{ij}^M) + \sum_{i=1}^{m} \Delta_i^A (M(a_i) - a_i).$$

In last formula variables δ_i^A, δ_j^B, δ^C, Δ_i^A express a payment for infringement of the appropriate conditions.

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Poltava University of Consumer Cooperatives in Ukraine,
P. B. 1671, Poltava, 36003, Ukraine
e-mail: slemets@e-mail.pl.ua