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Development of a mathematical model of transportation problem with limited time

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There are many interesting practical tasks that contain a number of optimization problems and can not be resolved within a reasonable time. This work is dedicated to the development of a mathematical model solution of the transport problem (TP) of a time limit. The setting of these tasks is more difficult. The problems of this type describe the actual process more fully, because arrival time to the customer and customer service play a significant role in many practical problems. Transport problem of the time limit refers to the class of problems routing. Each vehicle must pass route,

There are a number of restrictions, which imposed on the route of each vehicle:

- every route must start and end at the starting point;- every customer is served only by one vehicle $\sum_{k\in V}\sum_{j\in N} X_{ij}^{k} = 1, \quad \forall i \in C$. The variables X_{ij}^{k} taking values {0, 1} and characterize the traffic direction: X_{ij}^{k} = 1 means that the car moves from vertex and to vertex j, X_{ij}^{k} = 0 − is backwards. Superscript k designate the corresponding vehicle where k∈V; C -is the set of customers $|C| = n$; V − is the set vehicles;

- the total amount of goods required for delivery to customers on this route of the vehicle does not exceed its carrying capacity. $\sum_{i\in C} d_i \sum_{j\in N} X_{ij}^{k} \le q, \quad \forall k \in V$, where d_i − is the demand *i* -of client;

- every customer must be served in a certain period of time, this period is determined by two values: the first − determines the arrival time to the customer, the second − departure time $a_i \le S_i^k \le b_i, \forall i \in N, \forall k \in V$ is the time limit; he arrival of the vehicle to the customer must be within the time window where S_i^k − is arrival time corresponding to a customer's car; $[a_i, \quad b_i]$ is the time period, called time window.

There are formulated following objective functions by priority for this task:

1. to minimize overall transportation costs $\sum_{k\in V}\sum_{j\in N} c_{ij} X_{ij}^{k}$, where c_{ij} − is the cost of moving the car from client to client j;

2. to minimize the total time service of all customers $\sum_{k=0}^{V}\sum_{i=0}^{N} S_i^k$

3. to minimize the total distance, which crossed by all vehicles, where $\sum_{j\in N} X_{ij}^{k}\left(S_i^k + t_{ij} - S_j^k\right) \le 0, \quad \forall i \in C, \quad \forall k \in V$, is t_{ij} time of moving from the client $i \in C$, to the client j, $j \in C$. This time includes the time of service of customer i and c_{ij} − is the cost of way car from *i* to *j*.

KEY WORDS mathematical model, transport task

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