ELABORATION OF COST EFFICIENT PLAN FOR GOODS DELIVERY FROM SUPPLIERS TO CONSUMERS

Tishyn I.A.
National aviation university, Kyiv
Scientific director- Volkovska G.G., senior lecturer

Key words: mathematical model, cost-efficient, transportation, supplier, consumer.

Transport logistics becomes more prevalent in business, because the delivery of products from warehouses to the customers, in the most efficient, timely and cost effective manner is one of the most common conditions in world trade.

In this paper we consider how to create the most cost-efficient plan for delivery of products from different points of supplier to different points of consumer, by using mathematical models.

Such mathematical model is called "Transportation problem" and supposes several suppliers, who offer the same type of product, consumers who are characterized by cargo orders and transportation cost which means tariff for transportation of a single cargo unit from the $Supplier_{\,i}$ to the $Consumer_{\,j}$.

Now we consider step by step solution of transportation problem.

Step 1. We establish primary plan and chose the type of problem – closed or opened.

If $\sum Supply \neq \sum Demand$ – Problem is opened

If $\sum Supply = \sum Demand$ – Problem is closed

Table 1. Primary plan of transportation

	$Consumer_{\,1}$		$Consumer_{\,2}$		$Consumer_{\,3}$		$Consumer_{\,4}$		Supply
$Supplier_{\,1}$	1	100	2		2	35	4		135
$Supplier_{\,2}$	3		1	170	5		3	40	210
$Supplier_{\,3}$	5		3		6		2	145	145
$Supplier_{\,4}$	1		7		5	195	4	5	200
Demand	100		170		230		190		$\sum 690$

1 2 3 4

Where,

1- tariff for transportation of a single cargo unit from $Supplier_{\,i}$ to $Consumer_{\,j}$

2 - demand for cargo units of 4 consumers

3- quantity of cargo units which can be delivered from 4 suppliers.

Conclusion:

4 - $\sum Supply = \sum Demand$, so the problem is closed.

$$Cost\ of\ primary\ plan = 100 * 1 + 35 * 2 + 170 * 1 + 40 * 3 + 145 * 2 + 195 * 5 + 5 * 4 = 1745\ (monetary\ units)$$

Step 3. Application of “method of potentials” for checking the optimality of the plan. If plan is not optimal we procced next step, if plan – optimal, so the problem is solved For obtaining optimal results there are used “Hungarian method” or “Method of potentials”.
Step 4. Construct the cycle of transportation.
Step 5. Again check the optimality of plan using “method of potentials”.

$V_i + U_j$ (calculated potentials for filled cells)
$V_i + U_j - Tariff\ for\ empty\ cells$ (calculated potentials for empty cells).

Table 2. Final plan of transportation

	$Consumer_1$			$Consumer_2$			$Consumer_3$			$Consumer_4$			Supply	U
$Supplier_1$	1		-1	2		-3	2	135		4		-3	135	0
$Supplier_2$	3		-3	1	170		5		-1	3	40		210	0
$Supplier_3$	5		-6	3		-3	6		-1	2	145		145	-1
$Supplier_4$	1	100		7		-5	5	95		4	5		200	1
Demand	100			170			230			190			$\sum 690$	
V	0			1			4			3				

Conclusion:

If we need get optimal plan we must know the capacity requirements of the sources and the destinations and an estimation of the costs of transport between the sources and destinations.

In this example we have determined the shipping schedule that minimizes the total shipping cost while satisfying supply and demand constraints. Because the total cost of final plan is $=135 * 2 + 170 * 1 + 40 * 3 + 145 * 2 + 100 * 1 + 95 * 5 + 5 * 4 = 1445\ (monetary\ units)$, is more less than 1745 m.u.– total cost of primary plan.

Reference:

1) M. E. Ben-Akiva, A. de Palma, and I. Kaysi. Dynamic network models and driver information systems. Transportation Research A, 25 (5): 251–266, 1992.

2) Hillier, F.S. & Lieberman, G.J. (2014). Introduction to Operations Research. McGraw Hill Higher Education, pp: 1050.