S. MUSTĂŢEA

L. CURTA

An Application of the Transportation Problem in Optimizing the Activities of Repair Shops

The paper describes a mathematical model useful for economic units owning a number of repair shops spread over a large area.

It is a well known fact that the mathematical model of a transportation problem [1], in which the quantities x_{ij} are requested, is the following:

$$min\ C = \sum_{i=1}^{m} \sum_{j=1}^{r} c_{ij} x_{ij} \text{ with the conditions}$$

$$\sum_{j=1}^{r} x_{ij} = d_i, \quad i = 1, 2, ..., m$$

$$\sum_{i=1}^{m} x_{ij} = n_j, \quad j = 1, 2, ..., r,$$

$$x_{ij} \geqslant 0, \qquad i = 1, 2, ..., m,$$

$$j = 1, 2, ..., r.$$

In the above expression, the way of distributing product P from the producers P_i to the consumers C_j, is to be computed, in view of obtaining a minimum total cost C without exceeding the quantities d_i and n_j. This problem has an infinity of solutions. The best among them is called the optimum solution, or the optimum transportation plan.

Product P may be any object needing repairs. Obviously, the bigger the objects of type P to be repaired, the higher their transportation costs

The trucks coming from Brăila (P_2) will be distributed to the Buzău repair shop ($x_{22} = 28$); those from Bucharest (P_3) will be distributed to the Ploiești repair shop $C_4(x_{34} = 24)$, while those from Turda (P_4) will be distributed to the repair shops at:

— Blaj	(C_1)	15 pieces (x_{41})
— Cîmpina	(C_3)	24 pieces (x_{43})
	Total =	39 pieces

Supposing that the transportation costs are not taken into account, it obviously doesn't matter how this distribution is performed.

The distribution obtained by solving the transportation problem of the selected illustration is, however, the best possible one. The mathematic model of this example is as follows:

Determine

$$(min)\ C = \sum_{i=1}^{4}\sum_{j=1}^{5} c_{ij}x_{ij}$$

under the conditions:

$$\sum_{j=1}^{5} x_{ij} = d_i \qquad (i = 1,\ 2,\ 3,\ 4)$$

$$\sum_{i=1}^{4} x_{ij} = n_j \qquad (j = 1,\ 2,\ 3,\ 4,\ 5)$$

$$x_{ij} \geqslant 0.$$

There is, in the economic activity of a state, a great number of distribution problems that can be optimially solved by using the mathematical model of a transportation problem. Such problems arise particularly at central authorities level (ministries, general departments, industrial central offices, etc.) entrusted with the task of carrying out several allocations, including the distribution of equipment to subordinate units.

If the problem has a small matrix (a limited number of producers and consumers), it can also be solved manually, by one of the well known methods.

However, the transportation problems encountered in actual practice are usually large-size problems (m and r are great numbers) and their manual solution is very difficult. This is not a reason for giving up the scientific method of solving the problem by favouring instead an empirical one.

By using the NEAC 1240 computer, problems governed by the relationships

$$\begin{aligned} m + n &\leqslant 270 \\ m \times n + 2(m + n) &\leqslant 10{,}000 \end{aligned} \qquad (1)$$

can be solved.

The "ICT 1905" computer can solve problems having a larger size. The upper size limit of a transportation problem which can be solved by using this type of computer, by applying the best program variant, is $m = r = 2{,}200$.

Confronted with such a problem, the economist who wishes to make use of an electronic computer has only to develop the necessary matrix for the problem to be solved.

REFERENCES

1. MIHOC, GH. and IONESCU, H., *Bazele matematice ale programării liniare*, Editura Ştiinţifică, Bucureşti, 1965.
2. ALTĂR, M., MEASNICOV, I., RĂDULESCU, M. and RĂDULESCU, D. TH., *Aplicaţii ale metodelor matematice în problemele de repartiţie*, Editura Ştiinţifică, Bucureşti, 1967.

APPLICATION D'UN PROBLEME CONCERNANT LES TRANSPORTS A L'OPTIMISATION DE L'ACTIVITE DES ATELIERS DE REPARATIONS

Cet ouvrage présente un modèle mathématique utile aux entreprises qui possèdent plusieurs ateliers de réparations dispersés.

La constitution de ce modèle mathématique a eu pour but d'optimiser l'activité de l'entreprise en question, compte tenu de la répartition par ateliers des objets à réparer.

L'ouvrage indique en même temps les possibilités concrètes de solution du modèle présenté avec des ordinateurs ICT 1905 et NEAC 1240.

ПРИМЕНЕНИЕ ЗАДАЧИ ТРАНСПОРТА К ОПТИМИЗАЦИИ ДЕЯТЕЛЬНОСТИ РЕМОНТНЫХ МАСТЕРСКИХ

Работа представляет математическую модель, полезную экономическим предприятиям, имеющим много разбросанных ремонтных мастерских.

При составлении математической модели имелась в виду оптимизация деятельности такого предприятия, с учетом распределения ремонтных объектов на каждую мастерскую.

Одновременно работа показывает и практические возможности решения представленной модели на электронных вычислительных машинах I.C.T. 1905 и NEAC 1240.