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Research on enterprise decision making based on integer programming model

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Abstract: This paper mainly studies the influence of suppliers and transporters on enterprises in the logistics chain composed of enterprises, suppliers and transporters, and how to choose the most appropriate ordering scheme and transport scheme when the enterprise has different objectives. The minimum number of suppliers needed can be regarded as the critical condition to meet the production requirements, for each supplier to judge whether to select, the 0-1 programming model in integer programming is constructed. In the part of ordering scheme, the difference between order quantity and supply quantity, price difference of different kinds of raw materials and contribution difference to production capacity are corrected by weighting when the objective function is obtained, and lingo is used to solve the model. In the part of transport scheme, 0-1 planning is carried out by Matlab to calculate the transport scheme.

1. Introduction

Supply chain management is an integrated management idea and method that performs the planning and control functions in the supply chain from the supplier to the transporter and eventually to the ordering company[1]. In this paper, on the premise that the raw material storage of enterprises is enough for two weeks of production capacity, the quantity of different suppliers should be supplied and the actual quantity of supply are analyzed and compared, and the ordering plan that needs the least number of suppliers and the ordering plan that needs the least cost in the next 24 weeks are selected[2]. On this basis, according to the characteristics of the transporter, the transport scheme with the least loss is formulated.

2. Model preparation

The enterprise should try its best to keep the raw material inventory not less than two weeks' production demand. According to the assumptions, the initial raw material inventory of the production enterprise is zero[3]. Therefore, the enterprise needs to reserve the raw materials of the first week and the second week for two weeks in total in the first week, and then only needs to reserve the raw materials of the next week, such as the materials of the third week in the second week and in the third week, in order to select at least the number of suppliers needed to meet the production demand, only the limiting case, that is, the situation in the first week, should be considered. When the first week is

satisfied, the remaining weeks must be satisfied.

This paper selects 0-1 programming[4] in integer programming, and uses decision variables 1 and 0 to represent the logical relations of yes or no. The establishment process of the model is as follows:

(1) Decision variables:

x_i(i = 1, 2, . . . , 50), indicates whether to select the ith supplier.

$$\begin{cases} x_i = 1, \text{indicates the i supplier is selected} \\ x_i = 0, \text{indicates the i supplier is not selected} \end{cases} \tag{1}$$

(2) Objective function:

$$\min z_i = \sum_{50}^{i=1} x_i \tag{2}$$

(3) Constraints:

In order to ensure that the company maintains the raw material inventory required for production for at least two weeks as far as possible, the constraint conditions are as follows:

$$\frac{\sum_{32}^{i=1} A_i x_i}{0.6} + \frac{\sum_{40}^{i=33} B_i x_i}{0.66} + \frac{\sum_{50}^{i=41} C_i x_i}{0.72} \geq 2.82 \times 10^4 \tag{3}$$

Lingo code is used to solve the problem: at least two suppliers should be selected to meet the production demand of the enterprise, namely supplier S115 and supplier S307. At this time, the raw materials provided are 21364. 8 cubic meters of Class A.

3. Model establishment

3.1 The most economical ordering scheme model

This program requires that the objective function be the most economical ordering scheme, which can be converted into the minimum cost. The enterprise always purchases all the raw materials provided by the supplier, so the cost depends on the quantity of supply.

(1) Decision variables:

x_i(i = 1, 2, . . . , 50), indicates whether to select the ith supplier.

$$\begin{cases} x_i = 1, \text{indicates the i supplier is selected} \\ x_i = 0, \text{indicates the i supplier is not selected} \end{cases} \tag{4}$$

(2) Objective function:

The corrected supply A_i, B_i and C_i are divided by the volume of raw materials required to produce per cubic meter respectively, and the values are taken as the corrected capacity A_i', $B_i'$and C_i'. That is:

$$A_i' = \frac{A_i}{0.6} \tag{5}$$

Since the unit purchase price of class A and B raw materials is 20% and 10% higher than that of Class C raw materials respectively, assuming that the unit purchase price of Class C raw materials is dimensionless unit 1, the unit purchase price of class A raw materials is 1.2 and that of class B raw materials is 1.1. To sum up, the objective function of the 0-1 model is:

$$\min Z = 0.72 * A_i' + 0.726 * B_i' + 0.72 * C_i' \tag{6}$$

(3) In order to meet production needs, enterprises should try to keep raw material inventory of no less than two weeks of production demand, and the constraint conditions are as follows:

$$A + B + C \geq 28200 \tag{7}$$

3.2 Transport scheme model with minimum loss

The number of suppliers selected for data processing is related to the supplier's supply, and there is a difference between the company's order quantity and the supplier's actual supply. Therefore, the effective value of the supplier's weekly supply and the maximum weekly supply are required The median value and non-zero weekly supply are assigned different weights according to the degree of impact, and the obtained value represents the supplier's revised supply.

(1) Decision variables

x_{ij} (i = 1, 2, ... , n; j = 1, 2, ... , 8), n represents the number of suppliers.

$$\begin{cases} x_{ij} = 1, \text{Indicates that the i supplier selects the J transporter for transport} \\ x_{ij} = 0, \text{Indicates that the i supplier does not selects the J transporter for transport} \end{cases} \tag{8}$$

(2) Objective function:

$$\min z = \sum_{n}^{i=1} \sum_{8}^{j=1} G_i * x_{ij} * \rho_j \tag{9}$$

(3) Constraints:

$$\begin{cases} \sum_{8}^{j=1} x_{ij} = 1, G_i <= 6000 \\ \sum_{n}^{i=1} G_i * x_{ij} <= 6000 \end{cases} \tag{10}$$

4. Analysis of model results

Visualized the raw material transfer plan of the enterprise in the next 24 weeks, and the results are shown in the figure.

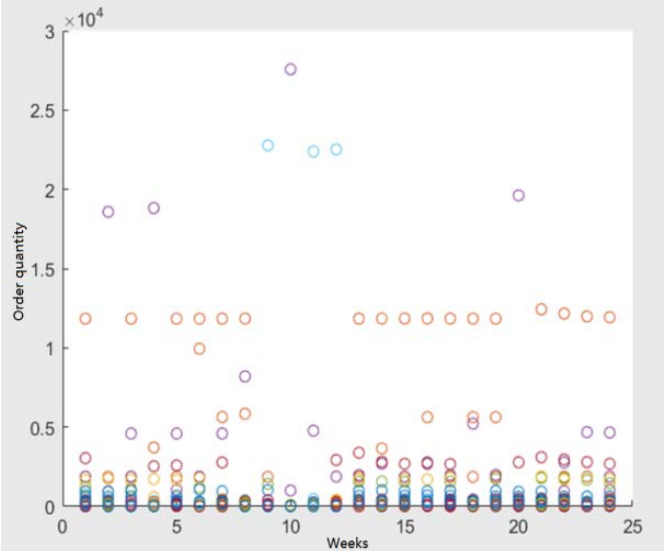

Figure 1: Order scheme scatter diagram

According to the scatter diagram can be found that the production cycle, in week output is less, the vast majority of suppliers of each production cycle, have several suppliers distribution is very big, supply ability of polarization of the supplier and this leads to meet production order plan formulated in this paper, mainly to supply ability of purchasing raw materials suppliers. From an economic perspective, the production cost of A is the lowest, and the order quantity of material A in this plan is also the largest, which has A good effect in saving production cost.

5. Conclusion

(1) Data extraction is comprehensive, taking into full account the difference between order quantity and supply quantity, the proportion of large orders placed by enterprises, order satisfaction rate, price difference of three raw materials, and production capacity difference of three raw materials and the difference between different transporters.

(2) The 0-1 programming model mainly used in this paper can modify the weight and objective function expression in the model to meet different requirements according to different requirements, and the solving algorithm is also very flexible.

(3) In data processing and model building, this paper not only considers the given data, but also considers the actual situation. For example, when there is a difference between supply quantity and order quantity, in order to ensure the production demand of the enterprise, it is better for supply quantity to be greater than order quantity.

(4) The amount of data is large, and the data required by the model needs to be processed by Lingo, Python and MATLAB for many times, which is complicated. Due to the limited types of data, there may be differences between the model and the actual situation.

References

[1] Huang Weilai, ZHANG Zigang, LIU Yunzhe. Systems Engineering, 1998,(1):44-50. (in Chinese)

[2] Wang Jue. Supplier and Distributor Joint Production Inventory Model with raw material Order [A]. Journal of Anhui Institute of Architecture and Technology [J]. Hefei: Department of Mathematics, PLA Electronic Engineering Institute, 2010:90-96.

[3] Pang Xue, Yang Jing, Yin Zhixiang, Tang Zhen, Yang Xinmu. A closed-loop double stranded DNA computational model for the 0-1 knapsack problem. Journal of Tangshan Normal University. 201, 43(03)

[4] Wang Yun. Research on the combination and layout method of low-impact development facilities based on 0-1 integer model and random sampling. Anhui University of Technology anhui Province.