

Location Planning Method of Urban Railway Logistics Park Based on Fuzzy Recognition

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Abstract: Railway transportation occupies an important position in the logistics transportation. In my country, more than two-thirds of the logistics transportation is completed by railway transportation. However, the development of the logistics industry today is relatively slow and lagging. Most of it is limited to bulk cargo transportation, and is out of touch with other logistics transportation modes such as roads, aviation, and sea transportation. Transportation services cannot be effectively implemented. The types of transportation are single and customer satisfaction is not high. The cost remains high. With the development of the market economy, the single operation mode of railway freight yards has been unable to meet the development of the logistics industry. It is imperative to build railway logistics parks relying on marshalling yards and freight yards. This paper uses fuzzy recognition algorithm to plan the location of the railway logistics park. First, determine the selection method of the railway logistics park candidate database: establish an index scoring system, use fuzzy recognition to calculate the index weight ratio, and use a fuzzy comprehensive evaluation method for site selection. Then use the mathematical model of railway logistics park site selection for modeling. Finally, the fuzzy recognition algorithm is used to solve the location problem of railway logistics park.

1. Introduction

The main goal of the overall layout of the railway logistics park is to make the logistics of the railway logistics park reasonable and unobstructed, and to minimize material handling. The various functions selected by the railway logistics park have formed several closely related functional areas due to the differences in the objects they serve. The connections between the functional areas in the railway logistics park include logistics, people flow, business flow, information flow and other activities[1]. Among them, logistics is the main part of these activities, and it is also the part that generates the largest cost consumption[2]. Therefore, in the overall layout planning of the railway logistics park, the logistics relationship between the functional areas should be mainly considered, and the influence of factors such as operational relevance should be considered[3]. Therefore, the layout of railway logistics parks has been further transformed to solve the problems of time and space distribution and optimal combination of logistics activities in the park[4]. The author integrates the indicators reflecting the logistics characteristics of each functional area selected by the railway logistics park, and uses the fuzzy recognition analysis method to cluster the functional areas with similar attributes and strong relevance to reduce the transportation cost between the functional areas and avoid the difference between the functional areas. The detour of the flow of people and goods in the railway logistics park provides a basis for the further planning of the overall layout of the railway logistics park[5].

The railway logistics park is based on railway resources such as railway freight yards and stations, integrating modern logistics management concepts and service concepts, and is established in areas where important transportation hubs and various transportation modes are assembled and converged on the whole road and where economic development is rapid. Provide a space for modern logistics services with railway transportation as the main body[6]. It is an important carrier for the assembly of railways to transform the flow of trains into the assembly of cargo flows, and it can provide logistics services for the railway itself. It can also be used as a public logistics base to attract city-related logistics companies to settle in. Jointly develop logistics services based on

railway transportation[7].

This paper uses fuzzy recognition methods to establish a classification index system considering dynamic factors, which is applied to the railway logistics park network to provide a theoretical basis for the logistics park network strategy[8]. In order to ensure the completeness of the examples, a brief analysis of the risks involved in the construction of the railway logistics park network, as well as the operation mode and profit model, is intended to attract more scholars and hope that more scholars will participate in the discussion of the logistics park network. , Provide methodology for the development of modern logistics to open up a new situation.

2. Fuzzy Recognition Analysis

2.1 Basic Principles of Fuzzy Recognition Analysis

Cluster analysis is a multivariate analysis method in mathematical statistics that studies “things are clustered together”, that is, using mathematics to quantitatively determine the closeness of the sample, so as to carry out objective classification[9]. Because things are vague in many cases, the introduction of fuzzy mathematics methods into cluster analysis can make the classification more realistic. The general steps of fuzzy recognition analysis are: selection of evaluation indicators, data standardization, establishment of fuzzy similarity matrix, establishment of fuzzy equivalence matrix, and fuzzy recognition[10]. The classification effect of the fuzzy cluster analysis method on samples mainly depends on whether the selection of evaluation indicators is reasonable. Under the principle framework of systematic, scientific, concise, independent, and qualitative and quantitative establishment of the indicator system, select indicators with clear meaning, strong distinguishing ability and representative indicators to obtain relatively accurate and scientific results. The clustering result is very critical.

2.2 Fuzzy Clustering Method for Hierarchical Division of Railway Logistics Park

In the hierarchical division of railway logistics parks, the transitive closure method has the characteristics of easy classification, clear calculation ideas, and easy value assignment. The transitive closure method can also be called the equivalent closure method. Fuzzy clustering methods require fuzzy similarity matrix R , but the fuzzy similarity matrix obtained is not necessarily the three characteristics of fuzzy clustering, namely symmetry, transitivity, and reflexivity, that is, fuzzy similarity matrix R is not necessarily a fuzzy equivalent matrix R^* when the above three characteristics are not satisfied. In order to facilitate subsequent clustering analysis, the fuzzy similarity matrix R needs to be transformed into a fuzzy equivalent matrix R^* . The transitive closure method is a method of transforming the fuzzy similarity matrix R into the fuzzy equivalent matrix R^* using formula calculation. The most commonly used method to obtain the fuzzy equivalent matrix by the transitive closure method is self-multiplication. The specific step is to square the fuzzy similarity matrix many times until the obtained matrix no longer changes[11].

The principle of the transitive closure method is that an ideal clustering result should satisfy the following three conditions:

One is reflexivity, that is, any object must be in the same category as itself;

The second is symmetry. If object a and object b are the same, then b and a should also be the same;

The third is transitivity. If the object a is the same as the object b , and b is the same as the object c , then a and c are the same. Only the relationship that meets the above three conditions can be called the equivalent relationship. Fuzzy cluster analysis is obtained by assigning the variable λ after obtaining the fuzzy equivalent matrix. For $\lambda \in [0,1]$, if $R \in \Phi(X \times Y)$, then the cut set is (1)

$$R_\lambda = \{(x, y) \in X \times Y | R(x, y) \geq \lambda\} X \times Y \quad (1)$$

In this way, R_λ is the relationship from X to Y , and R_λ is called the λ -cut set relationship. A set relationship of fuzzy equivalence R can perform cluster analysis on the research object U , and when the variable λ drops from 1 to 0, the number of classifications becomes smaller and smaller, so this is a dynamic aggregation affected by the value of λ . Class process[12].

2.3 Find the Fuzzy Equivalent Matrix

Generally speaking, the fuzzy similarity relationship matrix only satisfies the reflexivity and symmetry, but not the transitivity, but the clustering must be a fuzzy equivalence relationship, that is, in order to be transitive, the similarity matrix needs to be transformed into an equivalent matrix[13]. This article will use the transitive closure method in the fuzzy clustering method, because the complex operation of fuzzy mathematics used in the transitive closure method, the calculation process is simple and easy to understand, can realize the cluster analysis of multi-dimensional data, and achieve better cluster symmetry Reflexivity, reflexivity, and transitivity. It does not require manual clustering of the number of categories, which can better reflect the number of categories and internal connections of clustering objects. Let R and S be fuzzy similarity matrices, as shown in (2).

$$t_{ij} = \bigvee_{k=1}^n (r_{ik} \wedge r_{kj}) \quad (2)$$

According to the theorem, t(R) can be obtained by compound calculation at most $\lceil \log_2 n \rceil + 1$ times.

3. Hierarchy Division Model of Railway Logistics Park

3.1 Constructing a Fuzzy Clustering Hierarchical Division Model

In cluster analysis, similar attributes are usually divided into one category, and different attributes are used to divide into different categories, and then the classification is based on similar attributes. The closer the two samples are, the more similar they are[14]. What we are talking about are cluster samples, and the attribute values of these samples are called variables or indicators. In order to cluster, we need a mathematical description to describe the degree of similarity between each variable or between each sample. Clustering multiple samples and classifying them is called Q-type clustering. Cluster multiple variables and divide the samples into R-type clusters. In the Q-type clustering method, the similarity, common distance or similarity coefficient between samples is measured. In R-type clustering, the similarity between metrics is usually measured by correlation coefficient or correlation coefficient. Use the distance method directly, as shown in (3).

$$d_{ij} = \left(\sum_{k=1}^m |x_{ik} - x_{jk}|^p \right)^{\frac{1}{p}} \quad (p > 0) \quad (3)$$

Taking $p=2$, we get (4):

$$d_{ij} = \left(\sum_{k=1}^m |x_{ik} - x_{jk}|^2 \right)^{\frac{1}{2}} \quad (4)$$

The similarity coefficient is the opposite of distance. The larger the similarity coefficient, the greater the similarity between samples. The similarity coefficient of X_i, X_j has (5):

$$r_{ij} = \begin{cases} 1, i = j \\ \frac{1}{M} \sum_{k=1}^m x_{ik} \times x_{jk}, i \neq j \end{cases} \quad (5)$$

Among them, M is a parameter such that $0 \leq r_{ij} \leq 1$, there is (6):

$$r_{ij} = \begin{cases} 1, i = j \\ 1 - M |x_{ik} - x_{jk}|, i \neq j \end{cases} \quad (6)$$

Where M is the parameter.

This paper uses the transfer closure method in the fuzzy clustering method as the main research method to carry out hierarchical cluster analysis on the macro-layout of railway logistics parks. The elements r_{ij} in the fuzzy similarity matrix R connect the research objects r_i and r_j in descending order, without cross-interference in the process of connection, and finally connect all the elements

together to construct a “fuzzy tree” graph , Assign $\lambda(0 \leq \lambda \leq 1)$ from large to small, remove irrelevant elements, classify interconnected elements into one category, and finally find the same category. However, the process of selecting endpoints is difficult. If too many endpoints are selected, the “fuzzy tree” graph will be very complicated. Too many variables are not conducive to calculations. Therefore, the graph theory method is not suitable for calculations with too many elements; it is directly fuzzy The clustering method is a method of clustering directly through the fuzzy similarity matrix. The method is to directly assign the threshold λ from 1 to 0, and directly calculate the classification. If the deviation of the classification results obtained is large, and the direct fuzzy clustering method only Satisfy reflexivity and symmetry, poor transferability, will have an impact on subsequent classification analysis; C-means clustering method is called FCM), which optimizes the function to analyze the membership degree of each research object, and has better Classification effect, but this method can only be used to calculate the number of clusters already obtained, and it cannot discuss the number of clusters and the analysis of various clustering situations, and the effect is not good. The transitive closure method has a clear calculation idea, which satisfies the three principles of cluster analysis: reflexivity, symmetry and transitivity, and can clearly draw different conclusions for each classification number and different assignments.

3.2 Create Fuzzy Equivalence Matrix

Use transitive closure method to find fuzzy equivalent matrix. The fuzzy similarity matrix is not necessarily transitive, that is, R is not necessarily a fuzzy equivalent matrix. In order to perform fuzzy clustering, R should also be transformed into a fuzzy equivalent matrix R^* . The transitive closure of fuzzy similarity matrix R refers to the smallest fuzzy equivalent matrix containing R . The specific method is: starting from the fuzzy similarity matrix R^* , using the square method to sequentially calculate R^2, R^4, \dots, R^{2j} , when $R^k \times R^k = x R^k$ appears for the first time, $x R^k$ is the transitive closure $t(R)$.

Suppose the obtained transitive closure $t(R)=(r_{ij})$, then $\forall \lambda \in [0,1]$, the relation $t(R)$ on U can be obtained. $C U \times U$, that is, there is a Boolean matrix $t(R)$ as shown in (7).

$$r_{ij} = \begin{cases} 1, & r_{ij} > \lambda \\ 0, & r_{ij} \leq \lambda \end{cases} \quad (7)$$

For x_i and x_j , if $r_{ij}(\lambda)=1$, they are classified into one category at the level λ , so as to achieve the purpose of classifying the objects to be clustered. As the level λ changes in $[0,1]$, the corresponding clusters also change, forming a cluster pedigree map. This is more vivid and intuitive for a comprehensive understanding of the classification of samples.

If the fuzzy equivalence relation $r(R)$ is obtained, then $r(R)$ can be intercepted at an appropriate level threshold, so that the elements larger than the value λ in the fuzzy equivalence relation can be classified into one category. By using this theoretical method, the city's layout network classification in the railway logistics park can be divided into several categories and levels, and the corresponding conclusions are obtained to form a cluster map, which is a relatively visual and intuitive comprehensive understanding of the classification of the sample. However, many practical problems need to choose a threshold λ , which determines the specific classification of the sample. Generally, the value of λ is adjusted in the cluster graph to obtain a suitable classification according to actual needs, without the need to accurately estimate the number of sample classifications in advance. By combining the expertise of experienced experts with the λ threshold, an equivalent classification of the λ level can also be obtained. The clustering results can be analyzed by clustering pedigree diagram or λ value adjustment.

4. Conclusions

With the development of the modern logistics industry and the introduction of a series of measures to support the construction of urban railway logistics parks, this paper uses the transfer closure method in the fuzzy clustering method to construct a fuzzy clustering hierarchical division

model for railway urban railway logistics parks. Planning is a work that combines a large number of models with the actual situation. The lack of system and ability experience requires improvement in the following aspects:

(1) When selecting models in this paper, similar models were not compared and eliminated, and the deviations were determined. In this regard, we must strengthen and improve; the results obtained from the limitation of the collection of data have certain defects

(2) When selecting the model, this article did not include policy support policies, economic support policies, environmental protection policies and other factors into the parameters, and there are still certain deficiencies in the parameter settings.

(3) In the research process of this paper, only the layout of railway logistics park is studied from a macro perspective, and the site selection and internal layout planning of railway logistics park are not studied in more detail. The next step can continue to refine the research.

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