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KM-A Algorithm Based on Clustering Mixed Apriori for the Study of ZROM Model

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Abstract. Local path optimization of logistics distribution path line cannot break through the bottleneck of path optimization efficiency and realize the optimization of the whole logistics path network system. A global logistics path distribution route optimization model ZROM (Zoning-Routing Optimization Model) based on region partition is developed in this paper to solve the problem. The KM-A algorithm based on the K-Means clustering algorithm hybrid improved Apriori frequent sequence mining algorithm is designed in this paper to solve the ZROM model. The model can be implemented in the global scope to logistics path dividing area, at the regional internal implementation path optimization. The example analysis shows that the proposed ZROM model, under the condition of covering in the same purpose distribution cities, can effectively reduce the consumption of logistics distribution value, and the result is reasonable and with high reliability, which can offer scientific basis for related decisions.

Keywords: division of regional, KM-A hybrid algorithm, route optimization, ZROM model

1 Introduction

With the development of our economy and logistics technology, logistics industry has been developed rapidly. In the business of logistics distribution, the VRP (vehicle routing problem) is one of the most core need optimization decision problems. Vehicle routing problem is put forward for the first time in 1959 by Dantizg and Ramser. The main purpose of the VRP research is to send goods quickly and efficiently to the destination, reduce distribution costs, and improve the efficiency of distribution through the path planning and reasonable logistics distribution.

A study of distribution center location problem is proposed in [1-2]. In order to cover as much as possible target points, use the distance as the variable, considering the distribution of the actual distance between the objective cover point and the selected center address based on distance weighted minimum cost consumption. But these studies mainly aimed at the distribution center location problem based on target coverage, not involved in global logistics network of distribution path optimization research. An emergency relief supplies multimode transportation model is designed [3], using the genetic algorithm to solve the model of conditions such as increase the shortest, to provide disaster relief emergency events. This design of the emergency relief supplies multimode transportation model only for emergency vehicles transportation model, rather than general situation of global logistics network path planning as a whole, so there are some limitations during the path optimization of logistics. A distributed algorithm for mining frequent sequence path is designed to implement logistics distribution based on time property constraints [4], mining frequent sequential path and thus for the logistics distribution path optimization. This design of FMGSP algorithm does improve the efficiency of frequent sequence mining, but without considering the frequent pattern mining in logistics path optimization applications increase with the premise of the optimal path cost problem. An improved discrete particle swarm optimization and simulated annealing hybrid optimization approach is proposed to solve the production and distribution vehicle routing problem [5]. This approach aims to address the improvement of the performance of the local optimization, but does not take into account to ensure that the global optimal, cannot apply to solve the vehicle routing problem. An improved multi-agent coordinate VRPTW system is proposed to solve vehicle selection strategy in the process of transportation problem [6-7]. And an event-trigger mechanism has been proposed and used to decompose the DVRPTW into a series of system delay-snapshots in [8]. It is aimed at logistics path optimization of real-time transport research and mainly suitable for large-scale real-time transportation problem. A mathematical model multi– depot is set up, in addition an improved ant colony optimization IACO is proposed to solve the heterogeneous soft time Windows MDHVRPSTW vehicle routing problem [9-10]. It focused on increasing time window constraints in the path optimization problem. But only consider time constraints in the vehicle routing optimization and real-time is not able to allocate logistics based on the premise of the global solution of vehicle transportation route optimization problem. An approximate solution to the min–max MDVRP is presented for solving the problem the Single Depot Vehicle Routing Problem (SDVRP) and the multiple depots and min–max variants of the problem in [11-12]. But these studies aim at solving the problem of vehicle routing maximum distance. The sum of the distance of all paths for global consumption value is more exquisite.

These studies are all for logistics distribution route optimization problem, including site selection, emergency transportation planning, real-time transportation problem, frequent path mining, zoning, etc. The development of the electricity, the growing sophistication of logistics network and improving traffic conditions lead to the situation that logistics distribution coverage is more and more big. Just consider the location of the center issue, it will ignore the logistics distribution path optimization. Focusing on the optimization of distribution path, if not for the division of regional, is unable to adapt to the growing logistics network coverage, and this will achieve the optimized path bottleneck, as well as restricted logistics efficiency.

In this paper, "Zoning-Logistics distribution path Optimization" (Zoning-Routing Optimization Model) ZROM Model is researched combined with the division of regional logistics path Optimization, to the global logistics network structure optimization and it can be implemented on the path of the distribution to planning optimization, to achieve the purpose of improving the efficiency of logistics distribution.

2 ZROM Model

2.1 Problem Description

ZROM model is put forward for VRP-Vehicle Routing Problem, in order to solve the logistics division-distribution and route optimization problem, namely how to solve the problem of implement logistics distribution path integral planning reasonable and high efficiency and low cost. The planning of the path model is not only in order to achieve the shortest distance for a logistics way or the shortest time, but given the current rapid development of electrical business relative to the restriction of electricity line logistics distribution, to achieve the overall logistics model of the path planning in most regions of the country, and implement that path planning based on region partition is better than no zoning path of improving the efficiency of distribution.

ZROM model is worked for that under the premise of covering most of the country's purpose distribution cities, implements the path planning between goal points to achieve the least cost of the logistics. In this paper, considering the cost is the benefit of the net value after deducting expenses, because some cost under the condition of larger, income also bigger. ZROM model research is committed to under the same cover distribution scope of city logistics path, minimizing the sum of the distance to make all the paths of the global logistics network in the case of considering the global distribution of can achieve the highest efficiency.

2.2 ZROM Model

A global logistics path distribution route optimization model ZROM (Zoning-Routing Optimization Model) is proposed in this paper based on region partition for that logistics distribution path line local path optimization is not within the scope of the global path planning as a whole. It is to achieve the goal of overall planning of the global logistics network through reasonable zoning, further to regional internal path to realizing the reasonable optimization.

In ZROM model, the distance between the objective purpose-distribution cities expressed in L, L_k represents a complete path of the distance of the city k-1 to k. Place all the purpose distribution cities in a two-dimensional coordinate system, so the distance between the cities can use type (1) to represent:

$$L = \sum_{k=1}^{K} \sqrt{(X_{(k)} - X_{(k-1)})^2 + (Y_{(k)} - Y_{(k-1)})^2} \tag{1}$$

S represents the cost of transportation, represents a complete path of the costs of the city k-1 to k. The cost is across the path transportation costs including high speed costs $S_{high}{}^{(k)}$, fuel cost $S_{oil}{}^{(k)}$, artificial cost $S_{work}{}^{(k)}$, so the costs between the cities can use type (2) to represent:

$$S_k = \sum_{k=1}^{K} (S_{high}{}^{(k)} + S_{oil}{}^{(k)} + S_{work}{}^{(k)}) \tag{2}$$

T represents the time of the transportation, T_k represents the complete path of the time between the city k-1 to k; P represents the time of transportation, P_k represents a complete path of the income of the city k-1 to k; N represents the number of paths in the global logistics network, $2 \le N$; K represents the number of covered purpose distribution cities in each path, $K \in N^*$. D represents the maximum bearing capacity of one vehicle, presupposition the sum quantity of the goods on the each line is no more than a truck's maximum bearing capacity, namely $D: \sum_{n=1}^{n_k} d_k \le D, n_k \ne 0$.

The consumption of logistics path is the path of time T, L, P-S integrated computation cost consumption values. Make the consumption values of integrated represent as cost. Considering the efficiency of path is the efficiency value of the weighted average of the city based on the path distance and purpose of k distribution, so comprehensive consumption value, the smaller the cost shows that the model is more optimized, when function getting minimum value, the consumption value can achieve the minimum cost at the same time. Based on the above restriction factors and parameters, we can get the preliminary expression of the ZROM model, as type (3):

$$\text{cost}_{\min} = \min \sum_{n=1}^{N} (\frac{1}{k} \times \sum_{k=1}^{K} \frac{|P_{(k)} - S_{(k)}| \times L}{T_{(k)}}) \tag{3}$$

2.3 Constraint Factors of the ZROM Model

Express transportation industry in our country, the charge of high speed $S_{high}{}^{(i)}$ is determined according to the national policy, and volume of oil consumption per kilometer $S_{oil}{}^{(i)}$ is certain, which determines that the exception of the artificial factor $S_{work}{}^{(i)}$ cost and time has direct ratio relations, high-speed travel time between urban basic remain in a relatively stable state. In addition, to facilitate the transfer station between the management of transportation, in the province, the city place after the province, the province of transit between, the constraint conditions help province transportation between the management of provincial cities. These are the basic economic policies related with logistics company constant value, so these restrictive factors can be identified as stable constant value, namely $\frac{|P_{(k)} - S_{(k)}|}{T_{(k)}} = \theta$, so we can get type(4):

$$\sum_{k=1}^{K} (\frac{|P_{(k)} - S_{(k)}|}{T_{(k)}}) = K \cdot \theta \tag{4}$$

When considering the efficiency value of the model optimization, route choice between city become the main factor of restricting the efficiency, when bring (4) into (3), such ZROM model of target expression function can be simplified as type (5):

$$\text{cost}_{\min} = \min \sum_{n=1}^{n} (\theta \cdot \frac{\sum_{k=1}^{K} L_{(k)}}{k}) \tag{5}$$

3 KM-A Algorithm Based on ZROM Model

3.1 KM-A Algorithm for ZROM Model Process Design

Combining the logistics path optimization with the division of logistics area, forming the ZROM Model (Zoning-Routing Optimization Model) "a logistics distribution path optimization based on zoning", to a certain extent, the global logistics network structure optimization can realize the rezoning on the route of the distribution optimization.

At the beginning of the algorithm of the initial stage, preprocess the data set. E-commerce logistics data contains a flow between each city, each city has its own unique geographical coordinates (x, y), so use the mapping relationship between cities and coordinates, to each of the data records in the data set D according to certain regular expressions, coordinate mapping into the corresponding city. After the data preprocessing, the data set $D = \{(x_1 - x_2 - \ldots - x_q), (x_1 - x_2 - \ldots - x_m), \cdots, (x_1 - x_2 - \ldots - x_n)\}$ containing a complete logistics path, the two-dimensional data $x_i = (x, y)$ represent a destination point. After that, the solution of the model to need two stage processes:

(1) Determine the initial value of K according to the pattern of global logistics network, K value in clustering analysis algorithm for logistics city zoning distribution objective point, to get the optimal solution division;

(2) According to the division by step on the results, using the improved frequent sequence mining algorithm for frequent path based on the minimum path cost within the area, get the optimal solution path optimization.

3.2 Clustering Algorithm for ZROM Model

In the stage of the division of the model using the K Means clustering algorithm, present situation of logistics in China based on the geographical position is divided into Beijing, Shanghai, Chengdu, Guangzhou, Shenyang, namely, north and south, east and west in the center of the five large transfer site. K-Means algorithm is condensation of the dispersed data into K clusters based on K initial clustering center, so determine the 5 initial clustering centers μ, and take $K = 5$ cluster center from the data set D.

(1) Take the formula for definition described earlier $K = 5$ cluster center u_j $(j = 1, 2, \cdots, 5)$ from the data set D $D = \{(x_1 - x_2 - \ldots - x_q), (x_1 - x_2 - \ldots - x_m), \cdots, (x_1 - x_2 - \ldots - x_n)\}$, in which $x_i = (x, y)$.

(2) Calculation the distance $C^{(i)}$ of each purpose distribution cities $x^{(i)}$ to the center point u_j in data set D as the dissimilarity degree, when the data is two dimensional data, the distance $C^{(i)}$ of each purpose distribution cities $x^{(i)}$ to the center point u_j can be represented with the following type (6):

$$C^{(i)} = \sqrt{(X_{x^{(i)}} - X_{u_j})^2 + (Y_{x^{(i)}} - Y_{u_j})^2} \tag{6}$$

(3) After calculating the dissimilarity degree $C^{(i)}$, put every purpose distribution cities $x^{(i)}$ into the smallest class of dissimilarity degree, thus ensure the available $\min C^{(i)}$.

(4) Iterative process above, until all the purpose distribution cities $x^{(i)}$ has been classified into the center of the nearest itself transfer site.

(5) After the above process, the logistics division based on global logistics network has completed. And the minimum distance $\min C^{(i)}$ for every purpose distribution cities $x^{(i)}$ to the center point u_j has been gotten, so a complete path contains K purpose distribution cities, each distance to the center site can be

expressed as: $L=\sum_{i=1}^{I}\min C^{(i)}$ .After clustering analysis algorithm of zoning purpose distribution cities reach each goal logistics distribution path transfer center site, bring into type (6), we can get the expression of the minimum distance: $L_{\min}=\sum_{i=1}^{I}\min(\sqrt{(X_{x^{(i)}}-X_{u_j})^2+(Y_{x^{(i)}}-Y_{u_j})^2})$. The consumption of center site transfer between A and B, namely $\mathrm{cost}_{(A\to B)\min}$ can be represented with the type (7):

$$\mathrm{cost}_{(A\to B)\min}=\min\sum_{i=1}^{I}(\frac{\sqrt{(X_{u_j(A)}-X_{u_j(B)})^2+(Y_{u_j(A)}-Y_{u_j(B)})^2}}{K_{A\to B}}) \quad \textbf{(7)}$$

Minimizing L completes the clustering process, scilicet region partition. It's easy to see, as long as the target purpose distribution cities is classified into the center of its nearest transfer site, it can guaranteed that the comprehensive several regions of the sum of all the full path to the distance L can get the minimum value. The distribution of cross-regional logistics model, all get the service station first, and then transit to the destination of the region. Therefore, the consumption of cross-regional logistics path model expression can be divided into two parts between regional and area transfer. The type (7) is the minimum objective function of the distance across the area transfer. Reuse the above process to carry out the division on the data set D, five divided areas can be obtained and output as $D=\{D_1,D_2,D_3,D_4,D_5\}$.

3.3 Improved Frequent Sequence Mining Algorithm for ZROM Model

Five divided areas can be obtained and output as $D=\{D_1,D_2,D_3,D_4,D_5\}$, For each regional logistics path D_i , use the apriori algorithm for mining frequent sequential patterns improved depth pruning price for tolerance and pruning the candidate path sequence to obtain frequent path proposed in [8], to obtain frequent path from a large number of logistics distribution path information in the data for frequent.

In this algorithm, a collection of w purpose distribution cities called w item sets. The w item sets purpose distribution cities according to certain order to forming a complete sequence of path, which is called the w series. A path sequence in the frequency of dataset D_i is expressed in decimal form. Due to the premise of ZROM model $\sum_{n=1}^{n_k}d_k\le D$, $n_k\ne 0$, so under the premise of the enough truck capacity based on the maximum support degree to determine the basic support. The path not less than minimum support sequence, such as A, B, C three target purpose distribution city, the path from A to B to C as a sequence of path ABC. Traditional mining algorithm of frequent sequence only based on certain support for frequent sequences, however applied in solving ZROM minimization optimization path model should be first based on the comprehensive consumption path cost value of path for the candidate selection, to ensure that after processing the path of frequent sequence is to optimize the cost minimum comprehensive cost price. Therefore, use the apriori algorithm for mining frequent sequential patterns improved depth pruning price for tolerance and pruning the candidate path sequence to obtain frequent path proposed by Yang, Meng and Jiang [13].Therefore, prune the candidate frequent path at the expense of the consumption of the path. Its main idea is: if $least_{[i][j]}=0$, it means there is no path between node i and node j. Make the cost of c parameters as TD, connecting the two goals of Purpose distribution cities minimum path of the product $ultimate=least_{[i][j]}\times TD$, ultimate represent the maximum value of path cost between node i and node j. Compared C with ultimate, if $c>ultimate$, it suggests that the candidate path does not conform to the conditions, and it should be removed from the candidate path.

(1) Read the logistics data set and count, depending on each target Purpose distribution cities as 1-candidate paths and calculate the candidate path of minimum cost product ultimate record the result;

(2) By comparing with 1-candidate paths at the same time the ultimate compared with minimum cost of the path, produces 1-frequent path, acquire and record every 1-frequent path's support;

(3) Connecting the k-frequent path with its own, get a k-candidate paths and record the result;

(4) Repeat the (2) process, pruned k-candidate paths based on the support, and get a k-frequent path;

(5) Iterative process of the above four, until no more frequent path sequence is found, record and output result.

Through the above algorithm processing, each region has been output in accordance with frequent sequence style in turn within the path as the premise of the minimum cost of path. So the optimization path of internal region sequence can be got. Optimal utilization of regional internal path for frequent path sequence mining algorithm based on minimum cost path, the path of regional internal stop off in the distance L between urban comprehensive consumption values based on the destination number K can be got by type (5), weighted expressed as: $\sum_{k=1}^{K} L_{(k)} * \frac{1}{K}$, so each region internal logistics paths based on distance L and destination number K weighted consumption value can be represent by type (8):

$$\text{cost}_{(A\to A)\min} = \min \sum_{n=1}^{N} \{ \sum_{k=1}^{K} L_{(k)} * \frac{1}{K} \} \quad \textbf{(8)}$$

Regional internal transfer can be represent by type(8) based on the number of the destination of the weighted. Although consumption value of each path are not intuitive in numerical equal to each purpose distribution cities reached its hub in the sum of the value of the distance, the original path and model calculation of the optimized path is used to Purpose distribution cities to the sum of distance relay based on purpose distribution cities weighting methods to calculate the number. Two methods covered all the same Purpose distribution cities, only the path planning is different, and distribution area of the whole cover is the same, so the two paths are based on the calculation method of consumption values comparable.

3.4 KM-A Algorithm for ZROM Model Integration

After the above clustering algorithm for zoning type (7) can be got, regional logistics distribution of minimum consumption comprehensive value represented as $\text{cost}_{(A\to B)\min}$. Dealing with internal logistics path for data mining area based on the premise of minimum path cost for pruning algorithm of frequent sequential patterns, a path of minimum consumption cost of frequent sequences and the above type (8) minimum comprehensive cost of logistics distribution in the area of values $\text{cost}_{(A\to A)\min}$ can be got, after that the global logistics network model can be got by sorting the path according to the regional internal attribute to a whole network. Through the integration of the above, the regional $\text{cost}_{(A\to B)\min}$ and regional internal $\text{cost}_{(A\to A)\min}$ can be integrated into: $\text{cost}_{\min}=\text{cost}_{(A\to B)\min}+\text{cost}_{(A\to A)\min}$, improved KM-A algorithm for solving ZROM model can be got as the following type (9):

$$\text{cost}_{\min} = \min \sum_{n=1}^{N} \{ \frac{\sum_{k=1}^{K} L_{(k)}}{K} + \frac{\sqrt{(X_{u_j(A)} - X_{u_j(B)})^2 + (Y_{u_j(A)} - Y_{u_j(B)})^2}}{K_{A\to B}} \} \quad \textbf{(9)}$$

The growing sophistication of logistics network and improving traffic conditions lead to logistics distribution coverage is more and more widely. Just considering path optimization inside the area or considering the location of the center problem only from the global, already cannot adapt to the growing logistics network cover, which achieve the optimized path bottleneck and restricted logistics efficiency. By above knowable, cluster the city for the purpose of the national logistics network widely distributed into points area, after cross-regional transfer, further mining frequent path in the premise of the minimum path consumption cost in the region. According to this plan for logistics path distribution, under certain conditions, removing the influence of some constant factors, the efficiency of distribution is improved, and consumption values including time, cost, achieve a relatively low, so the ZROM path model is more scientific and effective.

4 Experimental Analysis

Implementation of the simulation analysis for hybrid KM-A algorithm based on K-Means and Apriori algorithm study for ZROM model, all validation are run on a commercial computer, PC i7-6700, 4G RAM, 3.4GHz, Validation of the environment is MATLAB7.0. The data used the large data set of logistics transportation company proposed [14]. Select 50 distribution cities as the experimental data in the data set, regard the logistics distribution path as the research sample, planning the path by using the model, to reduce the logistics distribution optimization of comprehensive consumption values. In this paper, the experimental data are shown in Table 1.

Table 1. The Experimental Data

target	1	2	3	4	5	6	7	8	9	10
abscissa	39.5	41.4	38.5	43.5	45.4	37.5	40	38	34.4	31.5
ordinate	116.2	123.2	121.3	125.1	126.3	112.3	113.1	114.3	113.4	117.1
target	11	12	13	14	15	16	17	18	19	20
abscissa	28.1	28.4	27.3	30.4	29.3	26.3	33	25.1	22.4	23
ordinate	112.5	115.5	109.5	104	105.5	106.4	107	110.1	108.1	113.1
target	21	22	23	24	25	26	27	28	29	30
abscissa	22.3	22.1	30.4	34.1	23	31.3	41.4	31.1	31.1	30
ordinate	114	113.3	120.4	108.5	118.4	120.4	125.5	121.2	120.3	120.1
target	31	32	33	34	35	36	37	38	39	40
abscissa	30.2	29.5	36.3	38.2	36.4	37.2	36	37.4	35.2	36
ordinate	120.1	121.3	101.4	106.1	117	116.1	120.1	120.4	119.3	103.5
target	41	42	43	44	45	46	47	48	49	50
abscissa	40.5	36	39.3	47.2	30.2	30.3	31.4	34.3	41.1	39
ordinate	117.5	114.2	118.1	123.5	115	114.1	119.5	119.1	123.4	117.1

The distribution in a two-dimensional coordinate system of sample purpose distribution cities placed in MATLAB7.0 as shown in Fig. 2.

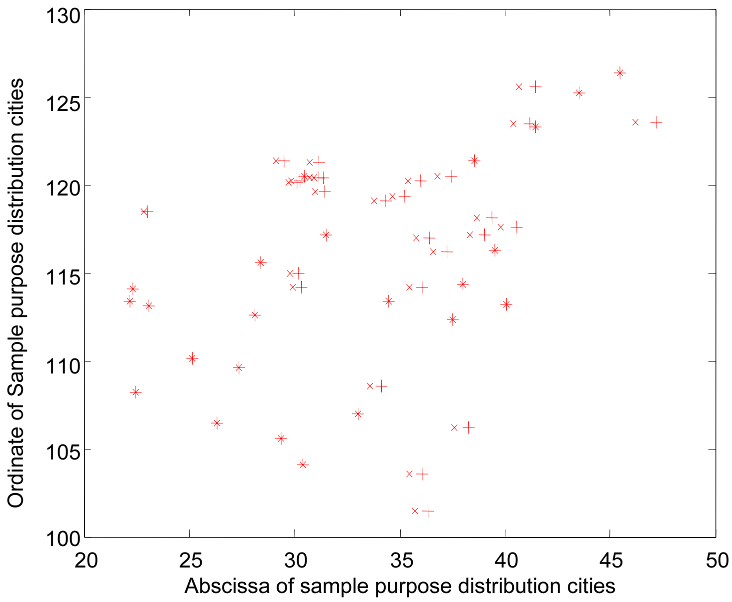

Fig. 1. Sample distribution simulation of purpose distribution cities

Studying the planning of logistics distribution model by using the KM-A algorithm, transfer center site determination of K have great influence on the distribution of points, and subsequent frequent subsequence form. Sample experimental data set is large enough to cover 80% purpose distribution provinces in our country, with sufficient representative, so use the algorithm to determine the center transfer station number K = 5.Using the K-Means clustering algorithm after division, the results are shown in the following Fig. 2.

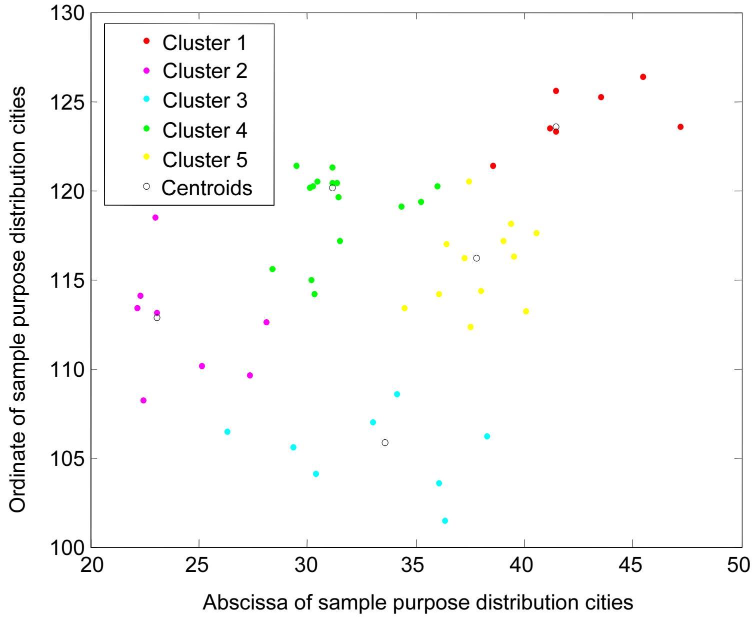

Fig. 2. Zoning effect

After solving zoning problem by K-Means algorithm, use the frequent sequential pattern mining algorithm based on minimum cost tolerance of regional internal logistics path optimization, and use the destination city Purpose distribution cities weighted distance covered size measure to determine the distribution path. After the division, the path planning in the region and final effect of global optimal path are shown in Fig. 3 below.

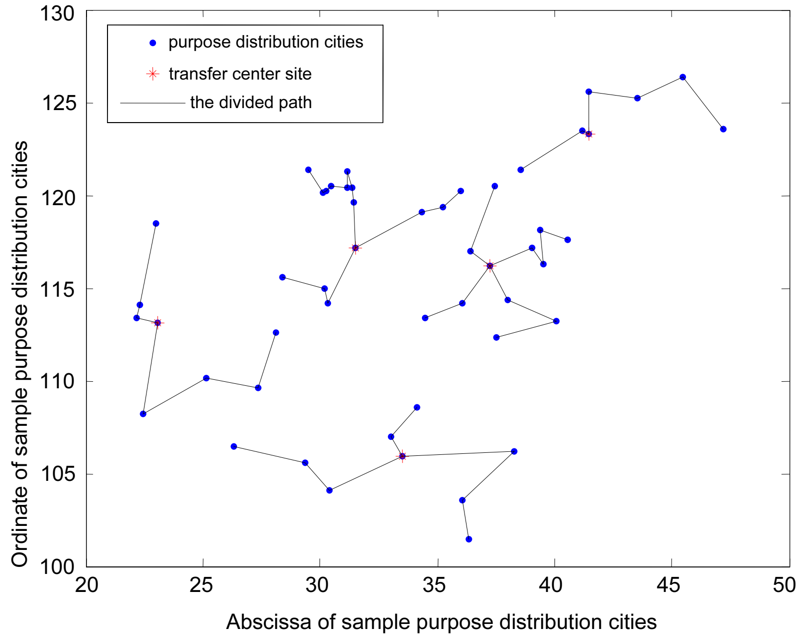

Fig. 3. Final path model rendering

From the ZROM model described above known that, the efficiency of the logistics distribution is determined by the comprehensive cost consumption. Using the ZROM model proposed in this paper, zone and optimize path based on frequent mining for global purpose distribution cities, to further improve on the effect of the optimal path distribution efficiency, reduce cost value.

Using the ZROM model proposed in this paper to solve the optimal path problem, compare its path with the initial path without division. Respectively for two series of comprehensive consumption value contrast experiment cost calculation, using the integrated method of calculating consumption values cost of the path above the ZROM model. The experimental results are shown in Fig. 4 below.

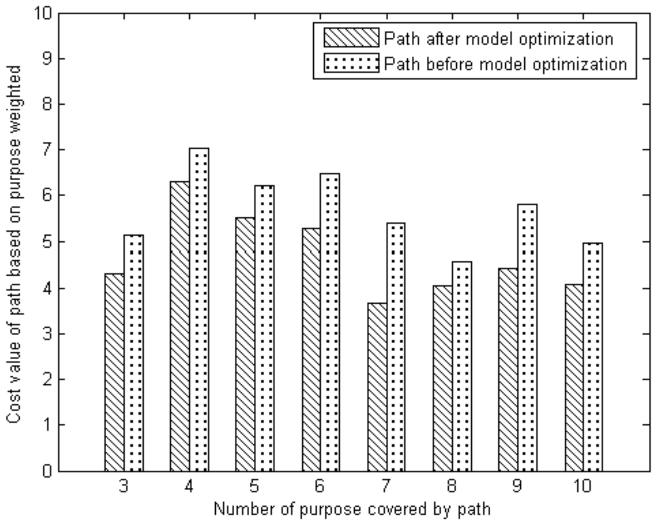

Fig. 4. Contrast consumption values before and after planning path by ZROM

It can be seen clearly from Fig. 4, the planning path cost consumption values in the case of coverage is 3~10, are less than that without zoning planning of the initial path. The results is intuitive, using cluster analysis to change the global purpose distribution cities' zoning and then optimize the path can improve the efficiency of logistics distribution clearly than logistics path sequence optimization without zoning.

Path distance based on covering city Purpose distribution cities for weight weighted average consumption values as shown in table 2. It can be seen clearly from table 2, the only path optimization based on the overall global logistics path consumption values and without division289.86>236.68, ZROM model optimization path of consumption values with division, average consumption based on purpose weighted with division 4.55<5.57 average consumption based on purpose weighted without division.

Table 2. Planning consumption value contrast before and after using the ZROM model

coverage	overall consumption based on purpose weighted	average consumption based on purpose weighted
Consumption without division	289.86	5.57
Consumption with division	236.68	4.55

Using KM-A hybrid algorithm for ZROM model based on region partition to optimize the logistics path, improves the efficiency of the overall distribution clearly, and the effect of logistics distribution path of global scope is relatively optimized, therefore the proposed model of logistics distribution based on zoning planning study is scientific rationality.

Through experiment of sample data cycle of 100 times, before and after the planning comprehensive consumption value's difference between the cost of the path error sum of squares has achieved 0.02, as shown in Fig. 5.Through the above Fig. 5 it can be seen that, the difference between the consumption values of error has leveled to the basic convergence, and the rendered results have representative and isn't able to affected the results by small errors.

5 Conclusion

A global logistics path distribution route optimization model ZROM (Zoning-Routing Optimization Model) based on region partition is developed in this paper to solve the problem that local path optimization of logistics distribution path line cannot break through the bottleneck of path optimization efficiency and realize the optimization of the whole logistics path network system. The KM-A algorithm based on the K-Means clustering algorithm hybrid improved Apriori frequent sequence mining algorithm is designed in this paper to solve the ZROM model.

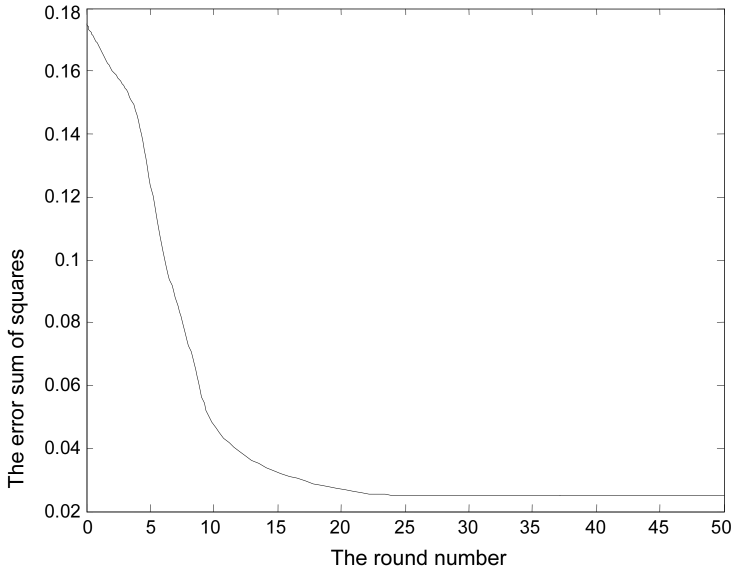

Fig. 5. Error sum of squares within the round number

According to the example analysis, the proposed ZROM model, under the condition of covering in the same purpose distribution cit, can effectively reduce the consumption of logistics distribution value, and the result is reasonable and with high reliability, which can offer scientific basis for related decisions. Through experiment of sample data cycle of 50 times, before and after the planning comprehensive consumption value's difference between the cost of the path error sum of squares has leveled to the basic convergence, and the rendered results have representative and isn't able to affected the results by small errors.

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