

Research on the Model of Agricultural Products Distribution Optimization under Electronic Commerce

Li Xiuli¹, Liu Zhaohui² and Xu Zhikun³

¹College of Finance, Hebei Normal University of Science & Technology
Qinhuangdao, Hebei, P.R.China,066004

²pupillary workroom, Hebei Normal University of Science & Technology
Qinhuangdao, Hebei, P.R. China , 066004

³College of Finance, Hebei Normal University of Science & Technology
Qinhuangdao, Hebei, P.R. China, 066004

¹32590984@qq.com, ²liying7688@126.com, ³xuvikp@126.com

Abstract

Recently, people pay more and more attention to the healthy lifestyles. And there is an increasing demand for the green agricultural products in real life. With the rapid development of the computer network technology and the electronic commerce, the emergence of e-business provides a new idea to promote the service of agricultural products. A huge supply chain network is established by the new idea and the technology. More and more agricultural products firms establish the electronic sale channel and get great profits. Firstly, we analyze the status of the agricultural products logistics distribution in both traditional sale channel and electronic sale channel in this paper. Then, we summarize the problems appeared in e-commerce channel. To solve these problems, we build an optimization model of the agricultural products distribution in e-commerce channel.

Keywords: Logistics distribution, SC network, E-commerce

1. Introduction

In the age of the e-commerce, the electronic sale channel has become an important retail channel. With the popularization of the Internet in people's lives, the process of network is continually going deep. The new business philosophy changes the economic structure of society a lot. With the improvement of life quality, people pay more and more attention to the food safety issues. The markets of the high-quality green agricultural products have a great economic potential. The socialization trend of the agricultural products consumption also offers many opportunities, especially for the development of the agricultural products logistics industry based on the electronic commerce.

The study on agricultural products supply chain abroad focuses on the optimization and the convenient of the supply chain network. Robson and Rawnsley researched the cooperation problems in UK supply chain. This paper utilized an interpretive methodology to examine the buyer-supplier relationships in the food industry from the perspectives of manufacturing managers and food regulators [1]. Hsu C I, Hung S F and Li H C studied the vehicle routing problem with time-windows for perishable food delivery. Their study has extended a vehicle routing problem with time-windows (VRPTW) to construct a SVRPTW model for obtaining optimal delivery routes by considering the randomness of the perishable food delivery process [2]. Montanari R discussed the cold chain. They proposed the structured frameworks to identify the most appropriate managerial solution in order to minimize the logistics cost [3].

Rediers H, Claes M, Peeters L and Willems K A assessed the cold chain of the fresh agricultural products. Their experiments indicated that the cold chain is generally maintained properly. [4]. Ovca A and Jevnik M investigated the maintenance and the understanding of the cold chain among consumers in the framework of the food safety [5]. Dabbene F, Gay P and Sacco N presented a novel approach for the optimization of the fresh-food supply chains. This supply chain managed a trade-off between logistic costs and some indices measuring the quality of the food itself as perceived by the consumer [6]. Osvald and Stirn made a distribution research programs in agricultural products supply chain. They established a distribution model of the fresh agricultural products supply chain with time constraints. The model reduced the cost of distribution network effectively in supply chain [7].

At present, the research and the practice of agricultural products supply chain are at the initial stage in our country. Researches are limited to the whole or the part of the supply chain analysis [8]. The researches of Liu Zhaoyun and Dan Bin lacked the quantitative analysis methods and models [9-10]. Jiao Lin studied Chinese network marketing of agricultural products. She thought that the network marketing appeared late in our country. But the development of the agricultural products network marketing is very fast [11]. Xia Wenhui studied on the operation mode of agricultural products logistics under e-commerce platform [12]. Yu Hongxin thought that the traditional agricultural products logistics system of information flow, logistics and capital flow can't lapped smoothly. But he believed that the advantages of the e-commerce can solve this problem [13].

Researches on the logistics of the agricultural products have made a lot of achievements. But in the business environment, the fresh agricultural products logistics and the distribution problems still need further research and improvement. The agricultural products have the characteristic of easy perishable. This characteristic requires that the agricultural e-commerce enterprises must ensure a high level of service in the distribution. And they also need reduce the logistics costs and improve the distribution efficiency. We build an optimization model of the agricultural products distribution in e-commerce channel to solve the above problems. The results show that this model is effective. The first part of this paper is the introduction of the related problems. The second part is the situation analysis. In the third part, we build a distribution optimization model in e-commerce channel and the final part is the experiment.

2 The Agricultural Products Distribution Situation Analysis

2.1. The Network Structure Analysis of the Agricultural Products Distribution under the Electronic Commerce

There is a huge commercial potential in the field of the agricultural e-commerce products. Now, many enterprises expand the electronic commerce channel. These enterprises cooperate with the agricultural production bases. These bases are around the city. When they collect the agricultural products, these enterprises sent vehicles to produce the base loading directly. Then, the vehicles transport the vegetables to the logistics distribution center in the middle of the city. The vegetables are processed in logistics distribution center. Then the vegetables are distributed in this city according to the customers' orders. The customers can pay on the Internet or pay cash on delivery after receiving the goods. At present, the traditional agricultural products distribution network structure is shown as Figure 1. And the agricultural products distribution network in e-commerce environment is shown as Figure 2.



Figure 1. Agricultural Products Distribution Network in Traditional SC Chain

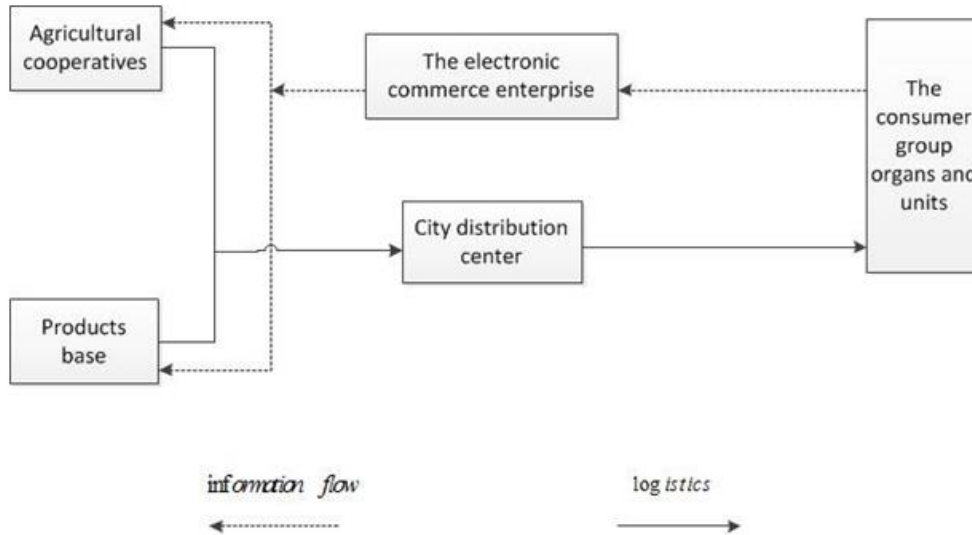


Figure 2. Agricultural Products Distribution Network in E-commerce Environment

From Figure 2, we can see that the intermediate links of the agricultural products distribution network in electronic commerce is less than those in the traditional mode. The distribution network in electronic commerce includes three parts. They are the agricultural production base, the logistics distribution center and the consumers. The agricultural products distribution network in the e-commerce channel can improve the efficiency of the distribution greatly and save the logistics costs. This mode can also ensure the quality of the agricultural products and a high level of service at the same time.

Compared with the traditional agricultural products distribution network, the agricultural products distribution network based on the electronic commerce has the following advantages.

(1) Less circulation links

Circulation links of the traditional agricultural products distribution network are more relative. The products are usually delivered from the producer, the wholesale market in original area, wholesale markets and farmers market (supermarket) to the consumers. However, circulation links of the agricultural products distribution network are only three parts under the electronic commerce platform. Namely, they are the producer, the logistics distribution center and the customers. This model reduces the number of intermediate links in circulation, the logistics cost and the distribution.

(2) Lower inventory

The main form of the agricultural products logistics node is the logistics distribution center in e-commerce channel. It replaces the original distribution warehouse and the storage warehouse. This mode will integrate the scattered inventory, the storage, the processing and the distribution into a whole. The mode reduces the operation process and accelerates the inventory turnover rate. In addition, the bullwhip effect reduces greatly due to the decrease of the intermediate links in circulation. The inventory can be maintained at a reasonable level.

(3)The information flow is more smoothly

Due to the development of the agricultural in e-commerce environment, many unnecessary links are reduced. It makes the direct communications among the agricultural products possible. The agricultural growers can understand the demands of the consumers better. The terminal consumers can understand clearly that the safe agricultural products can be easily obtained. At the same time, the electronic commerce also reduces the gap and makes the communications between the enterprise and 4customers more smoothly. The enterprises can face the terminal consumers directly and grasp more accurate market information. Therefore, the adaptability of the enterprises enhance greatly.

The emergence of the electronic commerce can reduce the distribution circulation of the agricultural products fundamentally. The consumers get the agricultural products from the producers more quickly. The agricultural products distribution network in electronic commerce reduces the logistics cost greatly. And it improves the logistics efficiency and the distribution.

The agricultural products distribution under the electronic commerce has been improved a lot compared with traditional distribution. However, many problems need to be solved. For example, (1) Enterprises could not deliver the goods according to the customers' requirements. (2) The delivery time is long. (3)The transportation cost is high. (4) Dispatched is inequality.

The VRP model will be built with the time window constraints in order to solve the above problems. In addition, we add the discussion of customers' satisfaction. We quantify the satisfaction degree of the customers to achieve our goals.

2.2. Discussion on Customer Satisfaction

The customer satisfaction reflects the service quality level of the agricultural products directly. For the electronic business enterprise, the problem of the time window is linked to the customer satisfaction closely. If we sent the goods to the customer in a period time, the customers will have a high satisfaction. If the goods can't be delivered within the required time, the customer's satisfaction will drop and they even return the goods.

In real life, the request of receipt for the customers is often divided into two time periods. The one time period is the expected time window. That is, the customers want to accept the delivery services in a certain period of time. If the vehicle arrives at that time and starts to deliver the goods, the customers' satisfaction is 100%. The other time period is the acceptable time window and it includes two small time windows. This time window is the expected time window period. If the vehicle arrives at the two small time window and starts to deliver the goods, the customers' satisfaction will be reduced. The started service time of the customer expectation is a range of time interval $[E_i^d, L_i^d]$. That is the fuzzy appointment time. However, the range of the max service time that the customer can accept is interval $[E_i, L_i]$.

When we optimize the distribution route, this scheme may damage the long-term interests of enterprises if we only consider the minimum delivery cost as the optimization objective. Therefore, we need to consider the customer satisfaction. In the short term, this way saves the

distribution costs and it will bring more benefits. However, it increases the level of the logistics services. Therefore, the customers' satisfaction will reduce. The possibility of customers to buy the products again on the Internet reduces greatly. In this way, this manner will cause a lot of invisible loss. For example, this way will make the agricultural e-commerce enterprises lose a lot of potential consumers.

From the definition of the fuzzy appointment time, we can see that the customers' satisfaction can be expressed with the function of the fuzzy appointment time. For the customer i , if the started service time is t_i , the function of the customers' satisfaction can be expressed as:

$$f_i(t_i) = \begin{cases} 0 & t_i < ET_i \\ 0.7 \times \frac{(t_i - ET_i)}{(ET_i^d - ET_i)} + 0.3 & ET_i \leq t_i \leq ET_i^d \\ 1 & ET_i^d < t_i < LT_i^d \\ 0.7 \times \frac{(LT_i - t_i)}{(LT_i - LT_i^d)} + 0.3 & LT_i^d \leq t_i \leq LT_i \\ 0 & t_i > LT_i \end{cases} \quad (1)$$

We complete the task i and start the task j . If the arrived time t_j of the vehicle pq is earlier than the earliest started service time, the vehicles pq must wait in j .

The waiting time of the vehicle pq in j can be expressed as:

$$\omega_j(t_j) = \max\{0, ET_j - t_j\} \quad (2)$$

In the formula, t_{ij} is the travel time of the delivery vehicles from customer i to customer j . μt_i is the unloading time of the delivery vehicles in customer i . If the started time of the customer j is t_j , the waiting time of the delivery vehicles in the customer j is $\omega_j(t_j)$.

3. The Route Optimization Model of the Agricultural Products under the Electronic Commerce

We suppose that the electronic commerce enterprises receive the online-orders yesterday. Then they arrange the delivery center to send the agricultural products to each customer on the same day in this city.

We know the distance between the logistics distribution center and each customer. We also know the distance among the various customers. The distribution costs include the vehicle expenses, the pilot costs, the waiting cost and the delayed cost. The vehicle costs are accounted according to the actual operation. It mainly includes the depreciation charges, the fuel costs and the variable costs. In order to guarantee the freshness of the agricultural product, we require the shortest delivery time. We have analyzed that the driver salary is calculated according to the delivery time. Therefore, this constraint conditions can be represented by the constraint of the lowest salary of the drivers. Now, we discuss the drivers' salaries. If the drivers' working time is within 8 hours, the wage will be paid according to the distribution working time. If the drivers' working time is more than 8 hours, the drivers will get the overtime expenses according to the overtime. The customers require that they can get the goods in the required time window. Otherwise, the enterprises shall pay a penalty fee. If the

goods are arrived early, the enterprises will pay the waiting cost; if the goods are delayed, the enterprises will pay the delayed cost. So, we establish that a single logistics distribution center delivers goods to l customers. The freight volume of the i customer is g_i . The time window is $[ET_i, LT_i]$. The unloading time is μt_i . The delay cost per hour is r_i . The average speed and the shortest distance are v_{ij} and d_{ij} respectively ($i, j = 0, 1, \dots, l, 0$ is logistics distribution center). We use m vehicles to deliver goods. The number of p vehicles are n_p , and the loading capacity is v_p ($p = 0, 1, \dots, m$). Per kilometer travel cost of one vehicle is f_p ($p = 0, 1, \dots, m$). The waiting costs of per hour is r . The overtime grants and the travel grants per hour are e_s and s . The vehicle must return to the original logistics distribution center on the same day. We use n_{pq} to express the demand point of the q vehicle from the p kind vehicle ($n_{pq} = 0$ expresses that we do not use the q vehicle from the p kind vehicle). We determine the vehicle scheduling scheme according to the above assumptions.

We establish the route optimization model of the agricultural products under the electronic commerce.

In order to construct the model, we establish the following variables.

$$\begin{aligned}
 x_{ipq} &= \begin{cases} 1 & \text{vehicle } p \text{ visit } i, j \\ 0 & \text{vehicle } p \text{ do not visit } i, j \end{cases} \\
 y_{ipq} &= \begin{cases} 1 & \text{vehicle } p \text{ services for customer } i \\ 0 & \text{vehicle } p \text{ do not service for customer } i \end{cases}
 \end{aligned} \tag{3}$$

Then we establish the following model.

$$\text{Min } Z = \sum_{i=0}^l \sum_{j=0}^l \sum_{p=1}^m \sum_{q=1}^{n_p} d_{ij} f_p x_{ipq} + \sum_{p=1}^m \sum_{q=1}^{n_p} (c_{p,q} \times s + \text{ect}_{p,q} \times e_s) \tag{4}$$

$$\begin{aligned}
 &+ r_i \times \sum_{i=1}^l \max(t_i - t_i^0, 0) + v \times \sum_{i=1}^l \max(t_i - t_i^0, 0) \\
 &\frac{1}{l} \sum_{i=1}^l f_i(t_i) \geq 80\% \tag{5}
 \end{aligned}$$

$$\sum_{i=1}^l g_i y_{ipq} \leq v_p \tag{6}$$

$$\sum_{p=1}^m \sum_{q=1}^{n_p} y_{ipq} = 1 \tag{7}$$

$$\sum_{i=1}^l x_{i01} = y_{i01} \quad j=0, 1, \dots, l \tag{8}$$

$$\sum_{j=1}^l x_{j01} = y_{j01} \quad i=0, 1, \dots, l \tag{9}$$

The formula (4) is the objective function. It expresses that the distribution cost is the minimum.

The formula (5) is the customer satisfaction constraints. The average value of the customer satisfaction which has been implemented must be more than 80%.

The formula (6) is the vehicle loading capacity.

The formula (7) is used to ensure that the customer i delivers by the q car of the p kind vehicle.

The formula (8) and (9) express that the uniqueness constraint to a customer's vehicle. That is, each customer has only one car for its service.

Among this:

t_0 is the departure time.

$$t_0 = e t_i - d_{\alpha} / v_{\alpha};$$

t_0' is the off-running time;

ωt_{pq} is the running time of the q car of the p kind vehicle.

$$\omega t_{pq} = \tau_{pq} - t_0' S;$$

$e \omega t_{pq}$ is the overtime of the q car of the p kind vehicle.

$$\omega t_{pq} = \tau_{pq} - t_0' S.$$

4. The Experimental Analysis

This paper selects a logistics distribution center as the research object to test the rationality of the algorithm. We verify the scientificity and the applicability of this model through the example analysis. The customers of this distribution are mainly individual consumers. We receive the orders at the first day and deliver the goods at the next day. Here we select one day delivery customers as sample. One day, we must carry on the agricultural product distribution to the 16 customers. The 17 points are the logistics node which include food logistics distribution center. The food logistics distribution center, the housekeeper name, code, the location coordinates and other information are shown in Table 1.

Table 1. Distribution Points Information

Code	Name	Location (X, Y)
0	Food butler logistics distribution center	60,140
1	Customer1	30,14
2	Custome2	40,36
3	Custome3	48,96
4	Custome4	52,120
5	Custome5	92,154
6	Custome6	92,66
7	Custome7	94,100
8	Custome8	108,100
9	Custome9	44,160
10	Custome10	20,54
11	Custome11	108,32
12	Custome12	130,88
13	Custome13	120,37
14	Custome14	73.64.
15	Custome15	82,57
16	Custome16	102,38

There are some differences between the actual distance and the space coordinate distance. Therefore, the shortest distance between nodes can be calculated approximately by formula (10).

$$d_{ij} = \sqrt{(x_i - x_j)^2 + (y_i - y_j)^2} \quad (10)$$

For the business requirements of the 16 customers in logistics distribution center, we can see that the time window and the demand are in Table 2.

Table 2. Time Window and Quantity Demand

Customer number	Demand (Kg)	Business hours(minute)	Time window		fuzzy due time	
			$E t_i$	$L t_i$	$E t_i^d$	$L t_i^d$
1	2.5	15	8:00	17:00	9:00	11:30
2	3	20	8:00	10:30	8:30	10:30
3	3	20	8:00	17:00	9:00	15:00
4	6	30	8:00	12:00	8:30	11:30
5	3	20	8:00	8:30	8:00	8:30
6	2.5	15	8:00	17:00	10:00	15:00
7	5	25	8:00	17:00	8:30	11:30
8	5	25	8:00	10:45	9:00	10:30
9	6	30	8:00	8:30	8:00	8:30
10	4	25	8:00	13:00	8:00	12:00
11	5	25	8:00	13:00	10:30	12:00
12	5	25	8:00	17:00	9:00	15:00
13	3	20	8:00	17:00	9:00	15:00
14	2.5	15	8:00	13:00	8:00	12:00
15	3	20	8:00	13:00	8:00	12:00
16	4	25	8:00	13:00	8:00	12:00
Total	62.5	355	—	—	—	—

The related data of the distribution business that the calculation need are as follows.

- ①The models of cars: single small electric vehicles equipped with a fresh-keeping box.
- ②Maximum loading: 15kg.
- ③The transportation costs of per vehicle and per kilometer: 0.4 yuan.
- ④The average vehicle speed: 30km/h.
- ⑤The normal working wage for drivers is 10 yuan per hour. The overtime wage is 20 yuan per hour.
- ⑥The vehicle waiting cost is 10 yuan per hour. The customer delay cost is 100 yuan per hour.
- ⑦The earliest departure time is 6:30 in the morning.

The distribution route optimization model of the agricultural products based on the electronic commerce changes to the following formula according to the above data.

$$\begin{aligned}
 \text{Min } Z = & \sum_{i=0}^{16} \sum_{p=1}^{16} \sum_{q=1}^{16} c_{ij} x_{ijpq} + \sum_{p=1}^{16} \sum_{q=1}^{16} c_{pq} x_{0pq} + \sum_{i=1}^{16} c_i x_{i0} \\
 & + 10 \times \sum_{i=1}^l n_i(t_i - t_i^0) + 10 \times \sum_{i=1}^l n_i(t_i - t_i^0) \\
 & \frac{1}{l} \sum_{i=1}^l f_i(t_i) \geq 80\% \\
 & \sum_{i=1}^{16} g_i y_{ipq} \leq 15 \\
 & \sum_{p=1}^l \sum_{q=1}^{n_p} y_{ipq} = 1 \\
 & \sum_{i=1}^{16} x_{jipq} = y_{jpq} \quad j=2, 3, \dots, 16 \\
 & \sum_{j=1}^{16} x_{ijpq} = y_{ipq} \quad i=2, 3, \dots, 16
 \end{aligned}$$

4.1 The Genetic Algorithm Ideals

(1) The code and the generating of initial population

The problems of VRP are usually out of order with binary code. In order to compensate for this shortcoming, we use the ordinal code. 0 is on behalf of the logistics distribution center. The natural numbers represent the customer point numbers. We suppose that there are 8 customers and generating a sequence 5 1 2 7 3 4 6 randomly. Then we decode the sequence. The decoding method is:

① We accumulate the customer demands from the left to the right. Once the total demand is greater than the capacity of the vehicle, we record the cumulative number of the record i . The record breakpoint 1 is $i-1$. The accumulation resets.

② We accumulate the customer demand again from the number i in the sequences. When the total demand is greater than the vehicle capacity, we record the cumulative number j . The record breakpoint 2 is $i+j-1$. The accumulation resets.

③ We repeat the above procedures until to the last breakpoint sequence and generate the matrix.

④ Through the breakpoint matrix, we add "0" to the corresponding position in the sequence.

⑤ We add "0" at the beginning and at the end of the sequence to generate the chromosome.

Now, we use a sequence 5 2 1 8 7 3 4 6 as an example to illustrate the process of decoding. We set the breakpoints matrix is (2, 4, 6). Firstly, we add "0" behind the second number, the fourth number and the sixth number in the sequence. The sequence changes to 5 2 0 1 8 0 7 3 0 4 6. Then we add "0" at the beginning and at the end of the new sequence. Therefore, the chromosome changes to 0520180730460. It represents that the distribution scheme is composed of 4 lines. Among them, the route of the first vehicle is the logistics distribution

center---the customer 5---the customer 2--- the logistics distribution center. The route of the second vehicle is the logistics distribution center---the customer 1---the customer 8--- the logistics distribution center. The route of the third vehicle is the logistics distribution center---the customer 7---the customer 3--- the logistics distribution center. And the route of the fourth vehicle is the logistics distribution center---the customer 4---the customer 6--- the logistics distribution center. We repeat the above process of the generated chromosomes until the population forming the scale. Then, we generate the initial population of the algorithm.

(2) The Fitness Calculation

The fitness function is transformed by the objective function of the model.

$$f_k = d \times \frac{Z_{\min}}{Z_k} \quad (11)$$

In the formula, f_i is the fitness value of the chromosome k . Z_{\min} represents the costs of the best chromosome in the same generation. Z_i is the cost of the chromosome k . The largest fitness chromosome corresponds to the distribution route of the minimum cost.

(3) The selection operator

①Sorting for n chromosomes;

②Computing the fitness of each chromosome: f_i ;

③Computing the selection probability of each chromosome:

$$p_i ; p_k = \frac{f_k}{\sum_{i=1}^n f_i}$$

④Computing the cumulative probability of each chromosome:

$$d_i ; d_k = \sum_{i=1}^k p_i ;$$

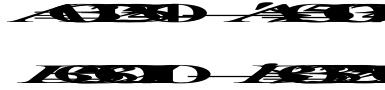
⑤Then we generate a uniform random number r ($0 \leq r \leq 1$). If $r \leq d_1$, we select the first chromosome. If $d_{k-1} \leq r \leq d_k$ ($k=2,3, \dots, n$), we select the k chromosome. Repeating the above procedures until the selected chromosomes to the population size n .

Due to the random selection, the best chromosome in the group may lose their ability of reproducing after selecting the chromosome. In order to improve the performance of the algorithm, we use the individual of the highest fitness one to replace the individual of the lowest fitness which is selected by the choice of operation.

(4) The Crossover Operator

The chromosome of a serial number coding genetic algorithm cannot cross with free positions. The chromosome of the random cross may not represent the solution of the original problem. Now we use a simple example to illustrate.

A and B are cross parents. They can generate the progenies A' and B' through the single point.



We can see that A' and B' are not the solution of the original problem. Therefore, we adopt the gene conversion operators of pareto genetic algorithm to achieve the cross of the chromosome in this paper. The process is as following:

① We select a chromosome and it generates three chromosomes randomly which are not “0”. Then we put them back which are arranged randomly. They will generate a new chromosome and the offspring of the chromosomes.

② Then we repeat the above procedures until the population form the scale.

(5) The mutation operator

We chose two points of a chromosome randomly and then reverse the non-zero sub-string. The operation procedure is as following:



(6) The end of the genetic algorithm

The search path of the genetic algorithm is random. This paper gives the appropriate parameters ϵ, λ, ψ of termination according to the termination condition of the heuristic algorithm. If the genetic algorithm meets one of the following conditions, we consider that the algorithm is convergence.

① We calculate the fitness variance of the chromosome per generation. If the variance is less than ϵ , we consider the algorithm is convergence.

② We compute the mean of the fitness in each population. When the average between the mean and the best chromosome is larger than λ , we consider that the algorithm is convergence.

③ Because the computational time is finite and the computational algebra is not infinite, we need to stop the calculation when the number of the iterations requires ψ .

4.2 The Results

The vehicle scheduling scheme and vehicle distribution information are showed in Table 3 and Table 4.

Table 3. Vehicle Scheduling Scheme

Car number	Loading(kg)	Vehicle routing and time of arrival	The journey(hour)
1	14	0-9-14-12-1-0	4.3
		7:30-8:09-9:21-9:58-10:43-11:57	
2	12	0-5-10-15-6-0	4.0
		7:30-8:13-9:17-10:11-10:53-11:32	
3	13.5	0-7-2-13-8-0	6.1
		6:30-7:47-8:36-10:27-11:13-12:36	
4	15	0-3-11-14-4-0	5.4
		6:30-7:20-8:43-9:32-10:57-12:11	

Table 4. Vehicle Distribution Information

Car number	The mileage (yuan)	Vehicle expenses (yuan)	Driving cost (yuan)	Delay cost e (yuan)	Total cost (yuan)	The average satisfaction
1	207.94	104.7	54	0	158.7	100%
2	187.78	93.2	47	0	140.2	82%
3	343.62	147.6	73	0	220.6	100%
4	274.73	123.9	62	0	185.9	93%

After the operation, the total cost of the distribution is 705.4 yuan, and the average satisfaction of all customers is 93.75%. The customer satisfaction is relatively high. And we can see that each vehicle loading rate is ideal and the running time is also very average. There is no excessive use of vehicles and each vehicle delivery time is not long. So this distribution model guarantees the agricultural products fresh. In general, the optimization results are satisfactory.

5. Conclusion

In real life, the computer network technology has integrated into people's lives. It also changes the life we live and brings us convenience. The electronic commerce is an important example. Today, the computer technology has applied in daily trade. The sum of business transactions of the electronic commerce increases in geometrically speed. The electronic commerce model decreases the links of the commodity circulation and shortens the logistics time. Due to the characteristic of easy perishable, the logistics time of the agricultural products should be reduced as much as possible. Therefore, the agricultural products can combine the electronic commerce model well.

In this paper, we establish a distribution model based on the electronic market. We discuss the problems appeared in electronic commerce model. Aiming at the characteristics of the agricultural products, we build a vehicle routing optimization model. At last, we verify the validity of the model through a numerical example. From the results, we can see that this model saves the logistics cost, reduces the delivery time and improves the comprehensive efficiency of delivery. All of these advantages ensure the customers' satisfaction.

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