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Research on pricing and replenishment of vegetable products based on particle group algorithms

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Abstract: In the superiority of freshmen, formulating reasonable replenishment and pricing strategies is a necessary measure to achieve high -quality operations and refined management. Based on the background of the fresh market and the current status of fresh retailers, the current domestic large -scale fresh products retailer H is selected to analyze the retail status of various types of fresh products for three years of H retail dealers to obtain the decline and trend of the decline in order to formulate appropriate. The pricing strategy has obtained the optimal profit. At the same time, this article is based on the relationship between Pilson's relationship digital method to dig the correlation between core elements, and obtains the correlation between different categories of vegetables at different levels; uses wavelet analysis to capture the changes in different data under different data, and obtain sales in different periods of time periods. At the peak period of quantity; use heat maps to visualize the relationship between different categories; use rose maps to directly display different category sales distribution. Through the non -linear regression model as the constraints of the ARMA time sequence prediction model, the sales and pricing of each category in each category in the next week will be obtained to formulate the best daily replenishment decision.

1. Introduction

In the super -Chinese freshman, the appearance and freshness of the dishes will change over time. Therefore, most of the products of most of the varieties of Shang Chaoqin cannot be sold every other day. Commercial supermarkets are usually replenished every day according to the historical sales and demand of various products. Reasonable replenishment decisions are critical. This article aims to find the relationship between different categories or different products between vegetables and products, and then analyze the distribution laws and interrelationships of the sales volume of various categories and single products, and cost.

Lu Jing[1] uses the first -order linear partial micro -division equations about time and product freshness to depict the fresh agricultural product inventory dynamic system found that: dynamic pricing and transportation integration strategies have a substitution for the improvement of corporate profits, and the optimal price of the product is about the product's optimal price about the product. Its

attenuation coefficients and unit inventory costs have a non -monotonous change trend. OKELLO[2]and others use non -parameter methods to evaluate factors that affect consumers in the open -air market, roadside market, supermarkets, characteristic markets, and retail stores when purchasing fresh fresh products. Finally, income, education level, risks, the quality of perception, living environment, and fresh products is the main factor for consumers to choose retail stores.

Du Kangmin[3],Song Zhilan[4]pointed out: In offline sales channels, the price of the product is greatly related to freshness. Offline customers often sensitively affect the price of the product. It is a price -sensitive customer. Customers are more sensitive to freshness and delivery time, the greater the impact of retailers, and as the coefficient increases. In terms of customer needs, Zhou Yubing[5]obtained through multi-environmental simulation dynamic pricing model: When customers perceive the product inventory, the sense of urgency when the goods are about to be out of stock will increase their desire to buy, which will affect product demand. In terms of replenishment, Zhang Chi[6],Wang Jinbo[7]uses the theory of dynamic pricing theory to find that due to the characteristics of fresh agricultural products, short life cycles, etc., dynamic pricing strategies have also become an important way to manage ways in the sales process. Qiao Xue[8] proposed that when neither the new and old products were completely corrupted, the order point was determined by the inventory level of the new product and the inventory level of the old products. Li Huifang[9],Xin Ying[10] proposed that the larger the price sensitivity coefficient replacement rate, the larger the freshness sensitivity coefficient, the higher the optimal pricing of fresh fresh products; under certain conditions, compared with a binding strategy, adopting a discount strategy will make the first and second batches of the first and second batches Product sales are higher. (The data of this article comes from "China Statistical Yearbook", Wind Financial database, http://www.mcm.edu.cn/).

2. The establishment and solution of the model

2.1 Data pre -processing and summary process

Combined with the actual purchase of the shopping mall and the preferences of people's consumer choices, this article has done the following preprocessing work on each attachment data. First of all, the data matching is considered. Considering that the sale of vegetable products is strong, most of the day has not failed that day. The sale cannot be sold every other day. The sales date is equal to the wholesale date as the matching conditions to match the summary data; secondly, the data reduction and dimension and abnormal value are lost. The data of less than 1%, retain 60W+data for subsequent analysis. At the same time, the sales details and wholesale data of the items and categories are analyzed according to the year, month, and date. With the changes in the seasons and the cyclical changes of sales within 24 hours a day.

2.2 Analysis of sales relationship between different categories

The distribution rules and correlations of the relationship between different categories are split into two types of subjects. The sales volume distribution and correlation of various categories of vegetables, the distribution and correlation of the sales volume of each single product. For the distribution of sales volume, we use drawing display; for the correlation, we calculate through the number of Pilson phase relationships.

(1) Correlation between sales of different categories and sales between different categories

This article uses the month as a cluster unit to summarize the sales data of the same year in the same year. The Person correlation coefficient is calculated through SPSS and MATLAB. It is significantly positively correlated with flower leaf vegetables, eggplant vegetables and chili vegetables, edible fungus vegetables and aquatic root vegetables, and presence of 0.05 levels. There

is a significant positive correlation on the presence of level 0.01.

(1, 2, 3, 4, 5, 6 said in order: flower leaves, cauliflower, water -rooted stem eggplant, pepper, edible fungi, as shown in Fig 1)

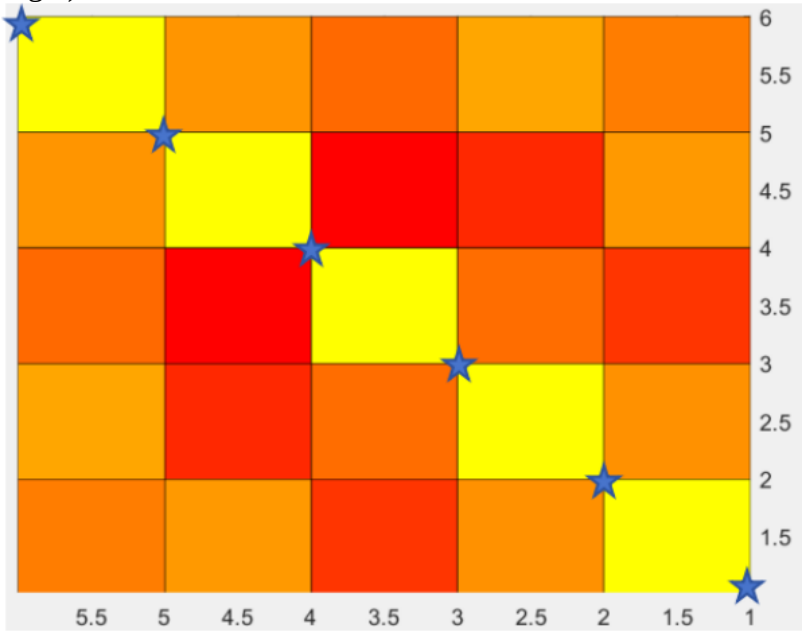

Figure 1: Person matrix heat map

(2) The relationship between sales distribution of different categories

By drawing the rose map of various categories of sales, this article obtains the overall distribution relationship of the sales volume of each category, as shown in Fig 2 below.

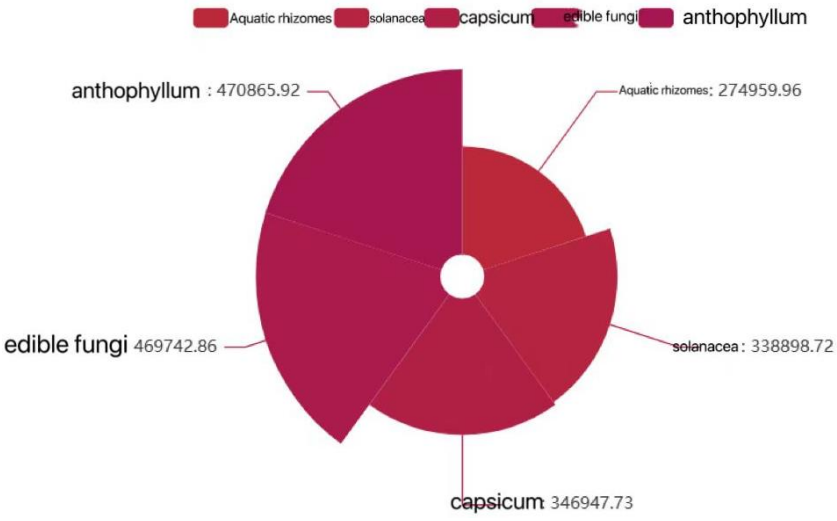

Figure 2: Sales of various categories distributed rose map

(3) The fluctuation relationship between single product sales and time

By drawing the wavelet analysis diagram, observe the changes in the 24 -hour image of each single product within a day, so as to obtain the change of sales over time. By observing the wavelet analysis image, this article can obtain the cyclicality of the sales volume of the day's single product over time changes over time.

By observing the concentration of the fluctuation time of the image and the distribution of fluctuation frequency, the image divides the sales time from 8:14 to 23:11 into 9 categories, with an

average interval between each node for about 1.5 hours. From the peak concentration in the Fig With the degree of color depth, we can get at 10:00 to 11:30, from 14:00 to 15:00 at noon, from 20 to 21:00 at night, the peak sales period. Combined with the actual consideration of social considerations, these three periods of time are a time interval with a large traffic.

At the same time, considering the high requirements of fresh preservation of fresh vegetables, the preservation period is short and the product will change over time. Most of the clocks are not sold on that day, and it is also difficult to sell again. Therefore, it is considered that the products and products that are about to miss the fresh -keeping period are placed in the peak of the high -crowded sales period for sales, thereby reducing the waste and waste of inventory. The wavelet analysis draws as shown in Fig 3 below:

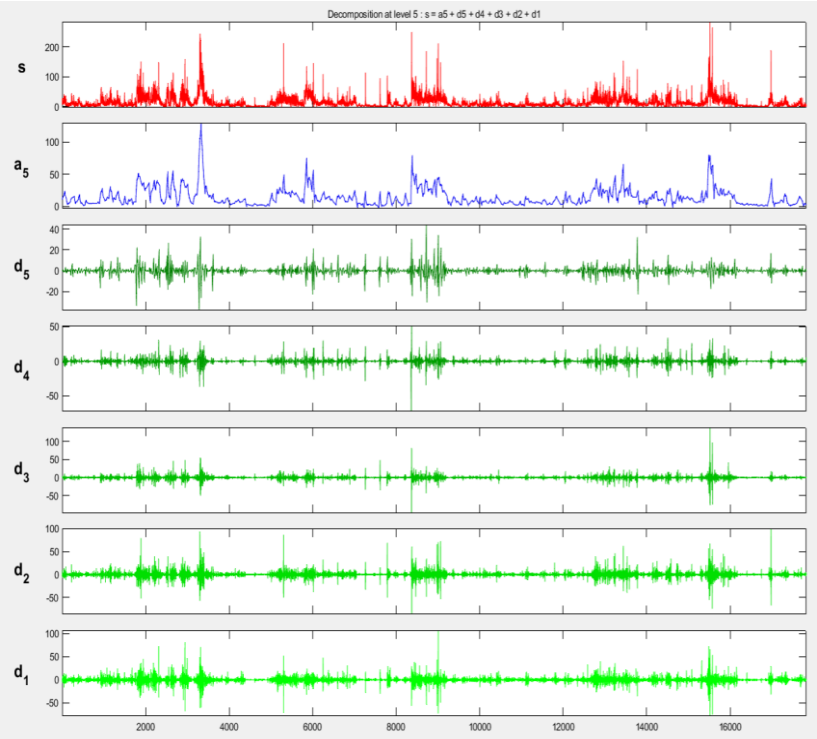

Figure 3: Wave analysis cycle changes diagram

3. In -depth analysis of model results

The relationship between the total sales and cost bonus pricing of vegetable products is transformed into the relationship between the total sales and pricing, and the fitting function obtained by returning is used as the constraint condition in the subsequent time prediction model, so that it can predict 2023 at 2023 While the sales volume and unit price in July, the maximization of merchant returns.

First of all, data pre-processing, matching the data through the STATA, and the outline of the data processing of the data. After screening the data in June 23 years, the division of the goods will be divided. That is, the return data of the return is separated and analyzed separately, and the data that has not occurred uniformly analyzed the data that did not occur. Secondly, regression analysis, through the results of calculating linear regression and non -linear regression, the results of linear regression are shown in Fig 4 and 5.

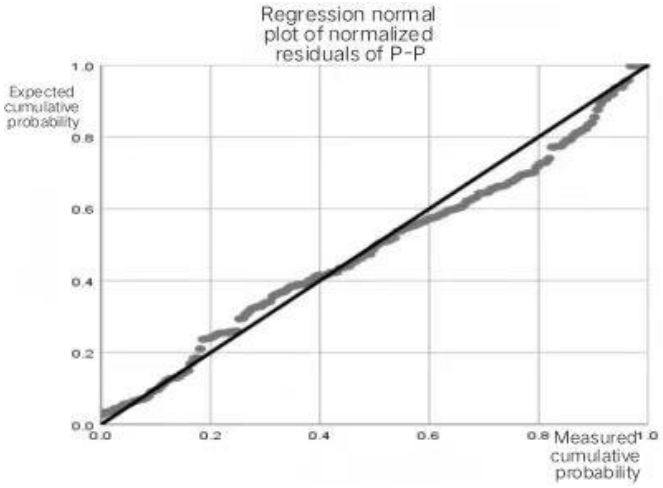

Figure 4: Return to standardized residual normal P-P

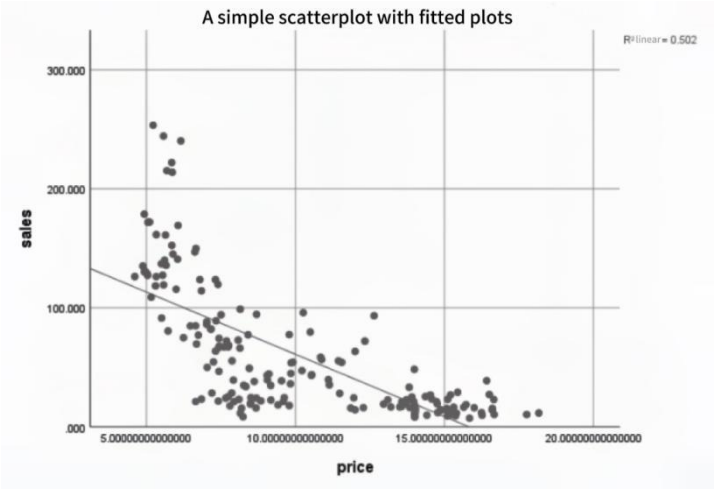

Figure 5: Linear Returning to the Sanda Sanda Point Fig

Get linear function:

$$Y = -10.457x - 0.708 \quad (1)$$

Non -linear regression results are shown in Fig 6:

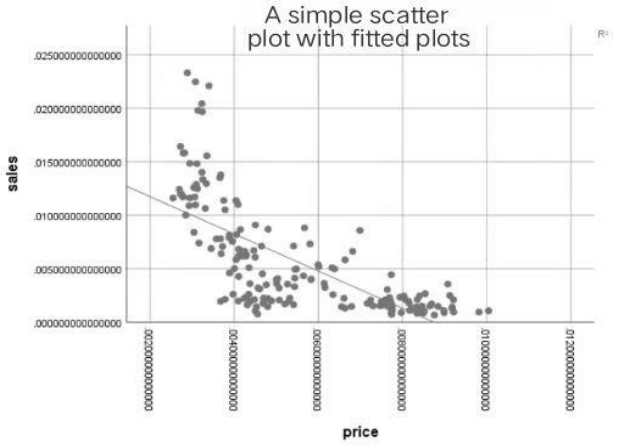

Figure 6: Nonlinear regression fitting scatter plot

Get non -linear function:

$$Y = b_1 + b_2 \times e^{-b_3 x} \quad (2)$$

$$b_1 = 0.023,\ b_2 = 0.0006 - b_1 = -0.0224,\ b_3 = -5.62628 \quad (3)$$

Table 1: Non -linear regression iterative historical record form

Iteration number	residual sum of squares	parameter		
		b1	b2	b3
0.2	0.59	.023	.000	-5.626
1.4	0.05	.023	-.018	-5.626
2.2	0.05	.006	.000	-5.626
3	0.05	.006	.000	-5.626

As shown in Table 1, and the number of guides will be determined by digital calculation. The main iteration code is displayed on the left side of the decimal point, and the secondary iteration number is displayed on the right side of the decimal point. After running 3 times, as shown in Table 2 the optimal solution was found, so the last third line is the parameter estimation value of the final model, that is:$Y = b_1 + b_2 \times e^{b_3 x}$.

Table 2: Non -linear regression parameter estimation value

parameter	estimation	standard error	95% confidence interval	
			lower limit	upper limit
b1	.006	.033	-.059	.070
b2	.000	.034	-.067	.067
b3	-5.626	.000	-5.626	-5.626

Table 3: linear regression residual statistical table

	minimum	maximum	average	standard deviation	number of cases
Forecast	-.00225247675553 0	.010792595334351	.005555555555556	.003585987076472	180
Residual	-.00687569519504 9	.013118313625455	.000000000000000	.0035737536 57515	180
Standard prediction value	-2.177	1.460	.000	1.000	180
Standard residual	-1.919	3.660	.000	.997	180

Table 4: Non -linear regression residue statistical diagram

	Source square	freedom	mean square
Return	.006	3	.002
Residual	.005	177	.000
Total before the revision	.010	180	
Total after revision	.005	179	

As shown in Table 3 and Table 4, after comparison, it was found that the error value obtained by linear regression was small, because the pre -processing part of the data before returning removed the sales volume to the negative value of return products and sales of 0, so the result of linear regression was finally adopted. Finally, the gray prediction model is used to predict the total daily replenishment and pricing strategies in the next week of 2023 to maximize the income, the results are shown in Table 5 and Table 6.

Table 5: Sales forecast form

	Flower vegetables	Mosaic	Chili -like	Eggplant	Edible bacteria	Aquatic root stems
2023/7/1	14.664	129.421	83.618	21.51	49.754	19.048
2023/7/2	14.461	127.668	83.107	21.219	49.316	19.166
2023/7/3	14.26	125.916	82.596	20.929	48.878	19.285
2023/7/4	14.058	124.166	82.085	20.639	48.44	19.403
2023/7/5	13.856	122.417	81.575	20.349	48.003	19.522
2023/7/6	13.654	120.671	81.065	20.059	47.566	19.64
2023/7/7	13.453	118.925	80.555	19.77	47.13	19.759

Table 6: Unit price prediction table

Date	Flower vegetables	Mosaic	Chili -like	Eggplant	Edible bacteria	Aquatic root stems
1	13.135	4.911	7.081	7.395	11.509	16.031
2	13.077	4.878	7.077	7.34	11.602	16.081
3	13.018	4.844	7.074	7.285	11.695	16.132
4	12.96	4.81	7.071	7.23	11.788	16.182
5	12.901	4.776	7.068	7.176	11.881	16.233
6	12.843	4.742	7.065	7.121	11.974	16.284
7	12.785	4.709	7.061	7.066	12.068	16.335

4. Conclusions

Advantages of the model: Create the LSTM time sequence predictive model predictive daily replenishment and pricing strategy. By analyzing the data of the attachment and combining the indicators of sales data, it can more appropriately and objectively describe the relationship between the total sales and costs, so that the forecast is more accurate; The three core variables are predicted, and the restriction conditions of the adjustment space for sales and pricing make the product portfolio more reasonable. In addition, the iterative model of the selection of particle group algorithms iterates its own best treatment, and selects the most ideal commodity portfolio. By the relationship between the total sales and cost bonus pricing, accurately calculate profits from different angles, which helps to help merchants understand and manage the cost of fresh vegetables, and formulate a scientific basis for providing science for different vegetable products or categories for the superiority Essence.

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