

Prediction and Analysis of Fresh Food Cold Chain Logistics Demand

Yin Hang

Engineering Training Center
Shenyang Aerospace University
Shenyang, China

Wang Mengyao

School of Economic and Management
Shenyang Aerospace University
Shenyang, China

Abstract—In the 21st century of economic globalization development, with the rapid increase in economic level and deepening of open-door to the outside world, China's cold chain logistics level is gradually geared to international standard and has undergone tremendous change. On the one hand, after our academic research in the development achievement of cold chain logistics in developed countries, we discuss and study based on actual situation in our country, the scientific research achievements have explosive development; our country offers strong support for the development of cold chain logistics, a lot of new policies helping the rapid development of cold chain logistics are introduced; on the other hand, with the further improvement of national living standard, Chinese residents' understanding for cold chain logistics this fresh thing are becoming mature and rational, they are no longer confined to frozen food as usual; at the same time, high-quality refrigerated trucks, refrigeration plants, refrigerated vehicles and other cold chain logistics transportation means are tending to perfect and diversified development, and thus, China's cold chain logistics has great development.

Keywords- Cold Chain Logistics; Fresh Food; Demand Prediction

I. INTRODUCTION

In recent years, China's economic development and people's living standard improve day by day, people's consumption on food gradually changes, that is, from the previous single quantitative concept now transformed into diverse quality idea. People not only require more food variety and timely delivery, they also pay more attention to the freshness and quality of the product. In order to ensure that consumers' needs are met and to ensure the quality, nutrition, safety and high freshness of consumer goods, it becomes more and more critical to establish thorough fresh food cold chain logistics system. According to relevant data report, in the cost structure of distribution process (including warehousing, sorting, transportation, etc.), transportation cost accounted for over 52%. However, according to relevant survey data, because the circulation process is not rigorous, existing preservation methods can not adapt to the fresh marketing way of fresh goods, every year in China, 30% of fruit and 40% to 50% of vegetables are in vain before they reach consumption terminal, fruit and vegetable consumption is up to a one hundred million tons.

II. DEVELOPMENT BOTTLENECKS OF FRESH FOOD COLD CHAIN LOGISTICS

A. Brand problem

Since the start of domestic fresh food cold chain logistics is too late, scale enterprises are too less, therefore, enterprises taking fresh food cold chain logistics as main business almost do not exist in China's top 500 enterprises. Well-known brands or well-known companies in this field are rare, enterprises with very high brand value are few. If our fresh food cold chain logistics wants to go further and develop to a great and good direction, to match development of international level cold chain logistics, we must have our own famous name.

B. Management problem

Although the development of fresh food cold chain logistics has successfully obtained necessary attention, due to lack of personnel training in early days, as what is called "Resisting foreign aggression Home Safe", facing the broad market, while domestic fresh food cold chain logistics related enterprises are constantly expanding business scope and scale, we must do internal talent management work, however, the current situation is, either domestic fresh food cold chain logistics enterprises lack management standard, or they hire with fat salary foreign experts in related fields for business management. Thus, another bottleneck of China's fresh food cold chain logistics development is the lack of management personnel.

C. Marketing problem

The so-called marketing problem does not mean simple buying and selling, in today's technologically advanced world, the development of all walks of life are inseparable from accurate, timely science and technology, the development of fresh food cold chain logistics industry is of course not an exception. If a real-time information platform from farm to table is established, market conditions such as residents buy vegetables at high prices and farmers have difficulty in buying vegetables will not appear, together with good marketing models and marketing team, that is the right development way of fresh food cold chain logistics industry.

D. Transformation problem

Domestic enterprises sensitive to market development established fresh food cold chain logistics related businesses earlier, however, the development opportunity at that time is immature, and the start is also too hasty.

Since these years, the development of fresh food cold chain logistics is more and more prosperous, with the help of policy, development of related enterprises is also more gratifying. However, in the era that modern fresh food cold chain logistics gradually becomes matured, the existing enterprise scale, product and traditional refrigeration house of fresh food cold chain logistics companies have to face the challenges of new standards of the new era.

E. Seize resources

As foreign fresh food cold chain logistics industry giants have been involved in Chinese market in succession, as well as strong-strong restructuring and mergers between companies in the country, in China, leading companies in fresh food cold chain logistics industry will gradually come out, while if other small and medium-sized enterprises want to survive and develop, they are bound to face a battle of seizing markets and resources.

III. PREDICTION METHOD OF FRESH FOOD COLD CHAIN LOGISTICS DEMAND

A. Comparison of prediction methods commonly used

Simple linear regression model, advantages: the involved variable is less, data collection and computer organizing works are relatively simple; disadvantage: only consider the impact of one certain factor on outcome, which is unrealistic in daily life.

Multiple linear regression model, advantages: combining effects of a variety of factors, prediction results are more complete and closer to the truth; disadvantage: data collection, organizing and computer process are complex.

Exponential smoothing, advantages: calculation steps are relatively simple, variable needed for prediction is not much; disadvantage: appropriate smoothing factor is hard to confirm.

Elastic coefficient method, advantages: economics principle is applied in prediction, prediction steps are simple, operation is easy; disadvantage: only applicable to analysis between two variables.

Gray prediction method, advantages: small amount of calculation, calculation method is more scientific and predictions are of high accuracy; disadvantages: demand for smoothness of each variable is high, system behavior is likely to cause missing of data sequence.

It can be concluded that the accuracy and validity of multiple linear regression model prediction results are obviously superior to other prediction methods.

B. Multiple linear regression model analysis

As independent variable to explain the change of dependent variable, Multiple linear regression is a major influencing factor, in everyday problems study, the change of dependent variable are often affected by several important factors, in which case you need to use two or more variable factors as independent variables to explain change in variables, which is known as multiple regression. When many independent variables and dependent variables is linearly dependent, the regression analysis

implemented is called multiple linear regression. The following is multiple linear regression model:

$$Y=b_0+b_1x_1+\dots+b_kx_k+e \quad (1)$$

Wherein, b_0 is a constant term, b_1, b_2, \dots, b_k are regression coefficients, when X_1, X_2, \dots, X_k are fixed, b_1 is the effect on y when each one unit is increased on x_1 , i.e., the partial regression coefficient of x_1 to y ; similarly when X_1, X_2, \dots, X_k are fixed, b_2 is the effect on y when each one unit is increased on x_2 , i.e., the partial regression coefficient of x_2 to y , the rest can be done in the same manner. If two independent variables x_1 and x_2 is linearly dependent with one dependent variable y , then binary linear regression model is used to describe as:

$$y=b_0+b_1x_1+b_2x_2+e \quad (2)$$

C. Application of multiple linear regression in

McDonald's fresh food cold chain logistics prediction

Case background: In 1990 in Shenzhen, McDonald's established the first restaurant in China, that is, from that time, when most people in China have no concept of the term "logistics", McDonald's took the first step to introduce its advanced logistics model to China. As time goes, the food quality provided by McDonald's obtained the national recognition, which is mainly attributed to the success of McDonald's pushing its own cold chain logistics to ensure food quality. The operation of McDonald's internal food cold chain logistics is not self-run mode, but outsourcing to HAVI company for operation. According to report, McDonald's cold chain logistics standards include the temperature recording and tracking, commodity acceptance inspection, temperature equipment control, establishment of operational system SOP, temperature monitoring point setting and other fields. McDonald's supervises HAVI company's cold chain logistics process, thus achieving the mastery of food quality sold by its own restaurant. In most cases, McDonald's supervises through inventory and distribution management and order management.

Now, let us see how multiple linear regression prediction method is applied in the above-mentioned case of McDonald's cold chain logistics: take McDonald's branch in Port Arthur for example, from 2004 to 2013, the sales volume of McDonald's branch in Port Arthur mainly consists of hamburger and meat, the remaining species are supplemented, and these two items of goods are respectively transported by A and B two kinds of cold chain logistics professional transport carts, as profit of each year mainly depends on sales volume of bread and meat, so what kind of transport carts will the company focuses on developing appears to be particularly important because in order to know which kind of transport cart will create a greater profit, we must compare profits obtained of finished products made from the goods shipped by refrigerated trucks, then we see in 10-year period of the company, the sales volume and annual profit of finished products made from the goods shipped by A and B two kind of cold chain logistics professional transport carts as shown in the table below:

Table 1 Sales volume and annual profit of A and B Two kinds of finished products

TABLE I. SALES VOLUME AND ANNUAL PROFIT OF A AND B TWO KINDS OF FINISHED PRODUCTS

Year	Profit (Y _i) (Ten thousand)	Sales volume of A product (X _{1i}) (Ton)	Sales volume of B product (X _{2i}) (Ton)
2004	29	45	16
2005	24	42	14
2006	27	44	15
2007	25	45	13
2008	26	43	13
2009	28	46	14
2010	30	44	16
2011	28	45	16
2012	28	44	15
2013	27	43	15
Total	272	441	147

How after analysis, we obtain sensitivity factor, under the circumstance of limited fund, to make the company choose more optimized development strategy, to put forward more scientific guidance basis for the development of McDonald's next operational phase of cold chain logistics and transport?

Analysis procedure: obtain sensitivity factor from the known factor

$$x_{1i} = X_{1i} + X \quad x_{2i} = X_{2i} + X$$

$$Y_i = Y_i - Y$$

$$\sum x_{1i}y_i = 9.8 \quad \sum x_{2i}y_i = 14.6 \quad \sum x_{1i}x_{2i} = 2.3$$

$$\sum x_{1i}^2 = 12.9$$

$$\sum x_{2i}^2 = 12.1$$

Provided sample regression line equation is:

$$Y_i = \beta_0 + \beta_1 X_{1i} + \beta_2 X_{2i}$$

$$\beta_1 = \frac{\sum y_i x_{1i} \cdot \sum x_{2i}^2 - \sum y_i x_{2i} \cdot \sum x_{1i} x_{2i}}{\sum x_{1i}^2 \cdot \sum x_{2i}^2 - (\sum x_{1i} x_{2i})^2}$$

According to the formula, we get parameter estimation

$$\text{is: } \beta_1 = \frac{\sum y_i x_{1i} \cdot \sum x_{2i}^2 - \sum y_i x_{2i} \cdot \sum x_{1i} x_{2i}}{\sum x_{1i}^2 \cdot \sum x_{2i}^2 - (\sum x_{1i} x_{2i})^2}$$

$$= \frac{9.8 \times 12.1 - 14.6 \times 2.3}{12.9 \times 12.1 - (2.3)^2}$$

$$= 85/150.8$$

$$= 0.564$$

$$\beta_2 = \frac{\sum y_i x_{2i} \cdot \sum x_{1i}^2 - \sum y_i x_{1i} \cdot \sum x_{1i} x_{2i}}{\sum x_{1i}^2 \cdot \sum x_{2i}^2 - (\sum x_{1i} x_{2i})^2}$$

$$= \frac{14.6 \times 12.9 - 9.8 \times 2.3}{12.9 \times 12.1 - (2.3)^2}$$

$$= 165.8/150.8$$

$$= 1.099$$

$$\beta_0 = Y - \beta_1 X_1 - \beta_2 X_2$$

$$= 272/10 - 0.564 \times 441/10 - 1.099 \times 147/10 = 27.2 -$$

$$0.564 \times 441 - 1.099 \times 147$$

$$= 27.2 - 24.87 - 16.16 = -13.83$$

$$Y_i = -13.83 + 0.564 X_{1i} + 1.099 X_{2i}$$

From the above, sample regression line equation is:

$$Y_i = -13.83 + 0.564 X_{1i} + 1.099 X_{2i}$$

The economic implication of parameter estimation is:

$\beta_0 = -13.83$ —Indicates if the sales of A and B two kinds of finished products is 0, then the average loss of this company is 138,300 Yuan a year;

$\beta_1 = 0.564$ — Indicates that under the condition that other conditions remain unchanged, each additional ton is increased to A finished product sales, the company's profit increases by an average of 5,640 Yuan;

$\beta_2 = 1.099$ — Indicates that under the condition that other conditions remain unchanged, each additional ton is increased to B finished product sales, the company's profit increases by an average of 10,990 Yuan;

So we can see, under the condition of limited existing fund, if the company increases maintenance and investment of B class cold chain logistics professional transport truck, the finished product it produces can obtain greater profit.

Summary: The use of multiple regression analysis can do comparative analysis for factors influencing profit of fresh food cold chain logistics enterprises from more channels, and better fulfill its estimation function.

However, this prediction method also has some deficiencies, firstly, there may be autocorrelation, multicollinearity, heteroscedasticity and other problems; secondly, if experience regression formula obtained applying regression analysis is used to predict, the accuracy is not enough, it can only be used as macroscopic reference on policy-making, but with more comprehensive collection of information, the accuracy will improve more obviously, which can absolutely meet the requirements of logistics cost prediction accuracy; thirdly, analysis method is only used for regression analysis, application range is lacking. Only these are perfected increasingly, multiple regression method can be better used in fresh food cold chain logistics prediction process.

IV. STRATEGY OF PROMOTING INCREASED DEMAND FOR FRESH FOOD COLD CHAIN LOGISTICS

To promote increased demand for fresh food cold chain logistics, this paper puts forward the following strategies:

First, establish cold chain scale of integration of manufacturing and marketing of fresh food. From great perspective, the development of existing domestic fresh food cold chain logistics industry has problems like lagged mechanization, low scale and other problems. Therefore, in order to accelerate the growth of fresh food cold chain logistics demand, China should strengthen training from professional fresh food cold chain logistics and transport companies, hoping to establish a complete industrial chain from before production to transport, storage and processing in production until sales after production.

Second, increase investment in infrastructure of fresh food cold chain logistics. The main drawbacks of existing domestic fresh food cold chain logistics is that the infrastructure is too lagged and obsolete, therefore, China should increase investment in transport infrastructure of fresh food cold chain, remould and update the existing refrigeration equipment with big action, on the other hand, China should introduce a number of refrigerated transport equipment at the same time. Meanwhile, construction of fresh food dedicated cold storage should be taken as the key point of investment, we should invest in constructing all kinds of fresh storage and low temperature storage, so that we can effectively reduce the loss of fresh food because of cold chain so as to further improve fresh food transport efficiency.

Third, raise market specialization of fresh food cold chain logistics. In China, many shortcomings appear in our fresh food cold chain logistics such as the service of third party cold chain logistics is not in place, market size is small, starting is late, etc. But only in terms of logistics, the development of third party companies logistics is important decision at present and for a long time in the future, therefore, third party companies cold chain logistics is the conclusive way of improving marketization professional level and getting rapid development, so be sure to make third party cold chain logistics companies develop to the direction of specialization, systematism and large-scale in order to promote our fresh food cold chain logistics to meet the needs of professional services, so our demand for fresh food cold chain logistics will increase.

Fourth, strengthen the cultivation of fresh food cold chain logistics services and management talents. At this stage, a serious shortcoming in China's development of fresh food cold chain logistics is the lack of cold chain logistics-related personnel. Some day in the future, China should spend more manpower, material resources and financial resources to train professional staff, to make up for shortcomings in this regard.

Fifth, develop a complete set of fresh food cold chain logistics standard planning. From the extent of the standard, fresh food cold chain logistics is a perfect system with no interruption, so, irregularities are not allowed in any link. Thus, starting from the perspective of the supply chain, to build an operating specification standard in line with relative standard and linking up with the entire circulation before and after has become a thing need to be paid attention. Moreover, this operating procedure standard will

play a pivotal role to provide a legal basis for the relevant law enforcement personnel and areas like ensuring the safety of fresh food.

V. CONCLUSION

In the historical background that fresh food cold chain logistics needs continue to increase and the value it creates obtains more and more recognition and importance of governments all over the world, conducting fresh food cold chain logistics research is the general trend and interest point.

At present, China's fresh food cold chain logistics has entered an era of vigorous development, it has obtained attention from ordinary people to governments, enterprises and researchers, after years of development, although our fresh food cold chain logistics had some success, but there are still many shortcomings such as lack of industry standard, third party cold chain logistics service is not in place, infrastructure is too old, related professionals are missing, which we need to work together with the government. In future, we will see the expansion period of domestic fresh food cold chain logistics development, although related research work now seems a long way, but we believe that due to further strengthening of our economic strength and further enhancement of the international status, which will certainly encourage our fresh food cold chain logistics develop sound and rapidly.

REFERENCES

- [1] Li Xuegong. Agricultural products cold chain logistics status and development trend in China [J]. Integrated Transport, 2010 (4): 45-49.
- [2] Chen Hongli, Li Jinying, Liu Yongsheng. Fresh food cold chain logistics service quality research summary [J]. Logistics Technology, 2011, 30 (10): 32-34.
- [3] Xu Hongfeng, Zhang Yancai, Zheng Yanmin. Cold chain logistics research status and future development trend [J]. Ecological Economy, 2012, 5: 027.
- [4] Zhan Shuai, Huo Hong. Domestic and foreign status analysis of agricultural products cold chain[J]. Logistics Technology, 2013, 32 (4): 54-56.
- [5] Wu Wenshu, Chen Jiumei. Status and countermeasure study of China third party cold chain logistics development [J]. Logistics Technology, 2013, 32 (1): 19-21.
- [6] Joshia R, Ban wet D K, Shankar R. Consumer Link in Cold Chain: Indian Scenario[J]. Food Control, 2010, 21(8): 1137-1142.
- [7] H A Myung-shin. A comparison of service quality at major container ports: implications for Korean ports [J]. Journal of Transport Geography, 2013, 11: 131-137.
- [8] Zhou Haixia, Han Limin. China's aquatic products cold chain logistics demand analysis and policy advice [J]. Chinese Fisheries Economics, 2012, 30 (4): 19-23.
- [9] Hao Shibo, Zhu Lilong, Ma Deyu. Cold chain logistics network model analysis based on IT [J]. Logistics Technology, 2013, 36 (2): 7-10.
- [10] Zhang Jian, Liu Lixin, Li Jianrong, etc. Suitability research on China's vegetable cold chain logistics model [J]. Food Science, 2011, 30 (5): 287-290.
- [11] Lan Hongjie, Han Zhanfei, Li Ruxian. 2008 Beijing Olympic food cold chain logistics system planning study [J]. Chinese Food Industry, 2012, 5: 044 ..
- [12] Joshia R,Ban wet D K,Shankar R.A Delphi-AHP-TOPSIS based Benchmarking Framework for Performance Improvement of a Cold Chain[J]. Expert Systems with Applications,2011,38(8):10170-10182.