

The forecast study on freight volume of multimodal transport in Jinan

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Abstract. As an advanced form of transport organization, multimodal transport is an inevitable trend which production enterprises cope with the increasingly fierce global competition and the inevitable direction which social and economic development causes the development of transportation industry. As a kind of advanced transportation organization mode, multimodal transport has important strategic value and practical significance for the transformation and development of domestic multimodal transport. Firstly, the significance of multimodal transport is analyzed; And then we built the prediction model; The prediction results are calculated. Finally, the prediction results are analyzed.

1. The significance of developing multimodal transport in Jinan city

The development of multimodal transport is conducive to the formation of transportation network and the development of integrated transportation system. Through careful organization, a single linear mode of transportation has gradually formed a transportation network of multiple modes of transportation, which further promotes the development of integrated transportation system.

The development of multimodal transport is beneficial to reduce transportation cost and improve economic and social benefits. The inland region is vast, and it is convenient for aviation, railway, water and road transportation to give full play to its optimal distance. The development of multi-modal transport reduces transportation cost, improves economic efficiency and reduces waste of social resources.

The development of multi-modal transport is conducive to improving transport organization and speeding up the reform of transportation management system. multimodal transportation are coordinated and operated in an orderly and efficient manner, which requires very advanced management philosophy and transportation organization level. The concept and operation of "big transportation" will also be gradually formed to promote the improvement of management system and mechanism.

2. The establishment of the three exponential smoothing model

Based on the data of highway freight volume in Jinan city in recent years, it is found that it has been increasing recently. The demand for multimodal transport will also continue to grow, so the three exponential smoothing will be used to forecast the freight volume of the road.

The detailed modeling process of applying the three exponential smoothing model is as follows:

Set time series $\{x_t, t=1,2,\dots,n\}$, Where n is the sample size. The model of three exponential smoothing is calculated as follows:



$$S_t^{(1)} = \alpha X_t + (1 - \alpha) S_{t-1}^{(1)} \quad (1)$$

$$S_t^{(2)} = \alpha S_t^{(1)} + (1 - \alpha) S_{t-1}^{(2)} \quad (2)$$

$$S_t^{(3)} = \alpha S_t^{(2)} + (1 - \alpha) S_{t-1}^{(3)} \quad (3)$$

in the formula:

$S_t^{(1)}$ Denotes an exponential smoothing value of phase t,

$S_t^{(2)}$ Denotes the smooth value of the quadratic exponential in phase t,

$S_t^{(3)}$ Denotes the three exponential smoothing values of phase t;

The prediction model is:

$$\hat{x}_{t+T} = \hat{a}_t + \hat{b}_t T + \hat{c}_t T^2 \quad (4)$$

in the formula:

$$\hat{a}_t = 3S_t^{(1)} - 3S_t^{(2)} + S_t^{(3)} \quad (5)$$

$$\hat{b}_t = \frac{\alpha}{2(1-\alpha)} [(6-5\alpha)S_t^{(1)} - 2(5-4\alpha)S_t^{(2)} + (4-3\alpha)S_t^{(3)}] \quad (6)$$

$$\hat{c}_t = \frac{\alpha^2}{2(1-\alpha)^2} (S_t^{(1)} - 2S_t^{(2)} + S_t^{(3)}) \quad (7)$$

The evaluation of α is the key to the exponential smoothing method; α is the weighted coefficient, moreover $0 < \alpha < 1$, The larger the evaluation of α , the greater the weight of the new data in the calculation result. In general, if the data fluctuates significantly, to increase the impact of recent data on the prediction results, α should be a little bit bigger; If the data fluctuates smoothly, smaller evaluation of α should be taken.

The evaluation of α is based on the actual sequence. By the empirical judgment method, then the evaluation of α is calculated in turn. By comparing the prediction standard error, the minimum error of the prediction standard is determined. In addition, When the exponential smoothing method is

used to predict the calculation, The initial evaluation on $S_0^{(1)}$, $S_0^{(2)}$, $S_0^{(3)}$ must first be specified.

When the original data sample of time series is more (greater than 20), the initial value has less influence on the prediction result, and the first observation value can be selected as the initial value. However, when the original data sample of time series is less (less than 20), the initial evaluation has a great influence on the prediction result. In order to eliminate the influence of the initial evaluation, according to the experience, it is generally taken as follows:

$$S_0^{(1)} = S_0^{(2)} = S_0^{(3)} = \frac{x_1 + x_2 + x_3}{3}$$

3. Forecast on freight volume of multi-modal transportation in Jinan

There are few waterways in Jinan. The mode of transportation should be mainly by rail and road. Some conclusions were drawn from the analysis of road and rail freight volume from 2005 to 2015 in Jinan. The conclusions are shown in table 1.

Table 1. Freight volume on highway and railway in Jinan

year	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Highway freight volume (ten thousand tons)	8484	8784	9398	13588	11827	13029	14574	15922	17570	19359	20419
Railway freight volume (ten thousand tons)	7211	7413	7211	8344	9028	9913	10053	10104	19043	16792	15794

Source: Jinan statistical yearbook.

Take them separately in the Excel table: $\alpha = 0.2$ 、 0.5 、 0.8 , can get to know, $\alpha = 0.2$, the predicted value is smaller than the actual value. The conclusions are shown in table 2.

Table 2. Prediction and analysis of Highway freight volume by Cubic Exponential Smoothing

year	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
actual value (ten thousand tons)	8484	8784	9398	13588	11827	13029	14574	15922	17570	19359	20419
$S_t^{(1)}$	8889	8484	8724	9263	12723	12006	12824	14224	15582	17172	18922
$S_t^{(2)}$	8699	8889	8565	8692	9149	12008	12007	12661	13911	15248	16788
$S_t^{(3)}$	8718	8699	8851	8622	8678	9055	11418	11889	12506	13630	14925

Therefore, this model is used to obtain the forecast data of road freight volume in Jinan city in the next three years, as shown in table 3.

Table 3. Forecast data on highway freight volume in Jinan in the next three years

year	2018	2019	2020
predicted value (ten thousand tons)	23325	23935	25324

As with road freight volume, the forecast analysis of railway freight volume is shown in table 4.

Table 4. Prediction and analysis of railway freight volume by Cubic exponential smoothing

year	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
actual value (ten thousand tons)	7211	7413	7211	8344	9028	9913	10053	10104	19043	16792	15794
$S_t^{(1)}$	7281	7211	7372	7243	8124	8847	9700	9982	10080	17250	16884
$S_t^{(2)}$	7289	7282	7225	7343	7263	7952	8668	9493	9885	10041	15808
$S_t^{(3)}$	7265	7289	7283	7237	7322	7275	7816	8498	9294	9767	9986

Therefore, this model is used to obtain the forecast data of railway freight volume in Jinan city in the next three years, as shown in table 5.

Table 5. Forecast data on railway freight volume in Jinan in the next three years

year	2018	2019	2020
predicted value(ten thousand tons)	16661	15594	20109

The forecast results show that the road cargo volume of Jinan city will reach 253.24 million tons in 2020. In 2020, railway freight volume will reach 2010.09 million tons. Overall, in the next three years, road freight volume is increasing year by year. And rail freight volume is decreasing progressively from 2018 to 2019, and then more than 20 million tons in 2020. It shows that the demand for multimodal transport in the future will increase and the development trend will be good. Thus it can be seen that the development of multi-modal transport in Jinan is fully necessary.

4. Conclusion

According to the above data, united transportation of railways and highways has more advantages. To give full play to the advantages of railway backbone transportation, the road is flexible and fast, providing customers with a ticket door to door transportation service. As a separate transportation process, united transportation of railways and highways is arranged and coordinated to reduce the loss of time in operation and the risk of loss, damage and pilferage. This saves the freight cost and reduces the transportation cost. It can also improve the organization level of transportation, realize the continuous transportation of goods, and realize the transportation of door to door so as to make reasonable transportation become a reality. Jinan is a vast territory with the potential to develop the railway.

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