Research on Express Demand Forecasting of Beijing

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Abstract. With the development of the national economy and the promotion of electronic commerce, as an important part of the logistics industry, express industry has become an important part of the national economy. This article gets Express traffic in Beijing through access to information and analyzes the influencing factors. Comparing characteristics of trend extrapolation, Marco forecasting method and gray model forecasting method, this article predicts the demand for express delivery business in Beijing by trend extrapolation and gray model forecasting method.

Introduction

In recent years, the demand of express service in our country was strong, and the express industry had broad prospects for development. At present, the express is the fastest and the greatest potential for development of new strategic services, marketing size ranked third in the world, and the express industry has become an important part of national economy of China in 21st century.

Express business volume increased in Beijing. During holidays, e-commerce platform introduced a variety of promotional activities, and the business volume surge [1]. "Warehouse explosion" is appeared frequently. The medium-and long-term forecast of express demand in Beijing is important for development and networks of express delivery companies.

Demand Analysis of Express

Demand Analysis of Express of Beijing. This article obtained 2001-2016 Beijing Express industry related data by looking over the Beijing Statistical Yearbook, annual reports[2] and statistical data released by the State Post Bureau, 2001-2016 express business and growth in the volume of cases has shown in Table 1.

Table 1   Beijing 2001-2016 express business volume and growth rate

Year	2001	2002	2003	2004	2005	2006	2007	2008
Express business volume (million pieces)	9.91	9.71	11.89	15.00	17.49	20.81	129.55	134.83
Rose	—	-1.98%	22.45%	26.16%	16.60%	18.98%	522.54%	4.08%
Year	2009	2010	2011	2012	2013	2014	2015	2016
Express business volume (million pieces)	149.86	180.03	336.63	480.74	818.18	1110.12	1414.47	1960.29
Rose	11.15%	20.13%	86.99%	42.81%	70.19%	35.68%	27.42%	38.59%

From the data shown in Table 1, 2001-2006, courier business has been below 30 million which growth rate is around the 20%, and courier business has also seen negative growth in 2002. In 2007, Beijing courier business volume surge, and courier business volume exceeded 120 million with growth rate as high as 522%. In 2016, Beijing Express business volume reached 1,960 million pieces, and Express business volume grew by 38.59%. Thus it can be seen, the Courier industry as a new industry is in a period of rapid growth, and full of energy [3].

Influence Factors of Express Service Demand. Express development can't be separated from the development of social economy, some policies and measures also have an impact on the courier industry. In addition, a number of related industries can also stimulate the development of express industry. Then analyze the factors affecting the demand for express delivery industry:

GDP and Residents 'Consumption Level. The regional economic development of Beijing is in good condition and the economic strength is further strengthened. With the development of economy, the disposable income of residents is increasing, the consumption ability is enhanced, and the people's material and cultural needs can be better met. The material needs of the residents is the root of express business requirements, and consumption levels provided the impetus for the development of express industry, and then the courier industry demand is also increasing.

Policy Support. To promote development of the logistics industry, the State Council and local governments introduced a number of policies. The State Council issued the "logistics industry development in the long-term planning (2014-2020)"[4], pointing out increasing land policy support and logistics costs. Implement the logistics industry-related tax incentives conscientiously. Policy support can accelerate the development of express delivery companies, improve the competitiveness of enterprises, making market full of vitality.

Electronic Commerce. In recent years, the number of Internet users in China grows fast, and basing on the network credit system implementation and gradual improvement, network transaction volume is increasing, and logistics as a link between the enterprise and the customer plays an indispensable role [5, 6]. With the development of e-commerce, e-commerce platforms carry price promotions during the holidays or special days. E-commerce transaction volume increases, and express traffic also increases, leading to a situation of blowing up.

Beijing Express Business Demand Forecasting

Express business demand forecast has a reference value to express development and network layout. This chapter uses the logistic curve model of trend extrapolation and GM (1, 1) model of grey model prediction method to make long-term prediction for Beijing express demand, and then select the appropriate results as the Beijing city courier business demand forecast value by comparing the predicted results.

Logistic Model. Logistic model is one of the most commonly used growth curve, describing some variables began to grow slowly, and then increased to a certain extent, after reaching a certain degree, the growth rate was low until smooth development[7]. It can be used in the prediction of product life cycle in the investment period, growth period and early maturity.

The curve model is:

$$\widehat{y}_t = \frac{1}{k + ab^t} \tag{1}$$

k, a, b are parameters, and t is time.

Due to a series of elements consisting of historical data which number should be a multiple of three, we chose 12 data in 2005-2016, and use logistic curve model to predict the next year's Express business volume.

Logistic curve model is:

$$\widehat{y}_t = \frac{10^5}{1.3145 + 125.1455 \times 0.5449^t} \tag{2}$$

Bring the *t* of each year into the forecast model, and then we can get the forecast values of each year. Beijing express business demand in the next few years which is predicted by the model is shown in Table 2.

Table 2 Forecasting result of Logistic curve model

Year	Order	Retrospective predictive value（10000 pieces）	Volume (10000 pieces)Yt
2005	0	2599.279309	1749
2006	1	4637.846324	2081
2007	2	8098.991199	12955
2008	3	13649.59002	13483
2009	4	21785.11481	14986
2010	5	32263.49619	18003
2011	6	43722.83177	33663
2012	7	54215.57025	48074
2013	8	62371.71793	81818.2
2014	9	67941.14777	111011.9
2015	10	71415.99177	141447.3
2016	11	73463.33123	196029
2017	12	74629.11904	—

Grey Prediction Model. Grey forecasting is the forecast of grey system. Grey system is the transition system between white and black box system [8]. The attributes section of this system is known, but people cannot establish objective physical models. Its principle is not clear, with internal factors difficult to identify or concealed relationship between each other. People can only get the model according to some deductive logical reasoning under certain assumptions. Grey prediction renders random irregular data into a regular series and then grey model is established to make quantitative prediction of the system. The calculation method of grey prediction is simple and needs less original data and applicable widely.

Prediction equation is:

$$\hat{x}^{(0)}(k+1) = \hat{x}^{(1)}(k+1) - \hat{x}^{(1)}(k) \tag{3}$$

This model should be tested in front of the forecast [9]. If testing within the permissible range, the model can be used to predict, otherwise it should be modified. Examination of residuals is inspection for the model value and the actual value of the residuals, which belong to the scope of the arithmetic test. Correlation test belongs to the geometric test range, according to the similarity of geometry and modeling curves. The more geometric similarity, the more reasonable. A posteriori error test is a statistical test, which test the statistical properties of residuals distribution, to determine the accuracy of model range.

In order to improve the accuracy of calculation, the MATLAB software is used to calculate and test [10]. MATLAB is a professional mathematical software for algorithm development, data visualization, data analysis and numerical calculation.

Predictive model is：

$$\hat{x}^{(0)}(k+1) = 2070.9962e^{0.39375k} - 2070.9962e^{0.39375(k-1)} \tag{4}$$

Correlation is：R=0.6489

Variance ratio of Posterior difference test is：C=6.1959%

Small error probability is：P=100%

The model is used to forecast the demand of express delivery service in Beijing，and the result is:

$$\hat{x}^{(0)}(16+1) = 2070.9962e^{0.39375 \times 16} - 2070.9962e^{0.39375 \times 15} = 247600.7 \tag{5}$$

$$\hat{x}^{(0)}(17+1) = 2070.9962e^{0.39375 \times 17} - 2070.9962e^{0.39375 \times 16} = 367075.4 \tag{6}$$

Beijing 2017-2018 express business forecasting demand are 2,476,007,000 and 3,670,754,000.

From the Logistic curve model prediction results we can see that retroactive prediction value far less than the actual courier business after 2013. The forecast result is different from the actual, and the reliability is low. Grey forecast model accuracy meets the requirements, which final results are more in line with reality, and credibility is large, so it is of great reference value. Finally, the results of this paper are based on the prediction results of the grey forecasting model.

Summary

This article made more accurate forecasting of demand for express delivery, to provide reference for government policies and the development of enterprises, having a certain significance. Among all kinds of forecasting methods, the grey forecasting model is of high precision, and the result is more in line with the change of express demand. Of course, in order to pursue higher calculation precision, we can use many kinds of prediction methods to make a more in-depth study.

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