

Forecast research on air cargo demand

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Abstract: With the continuous development of economic integration and the rapid development of market economy in our country, the air freight transportation is as a kind of efficient circulation modernization. The position of the air freight transportation in the national economy has become increasingly prominent, and as a new growth point of the civil aviation transportation development, contains a huge economic benefits and market potential. As the "east gate" of China, Shanghai has a favorable geographical environment and abundant source of import and export trade, which is a must for all major air cargo companies at home and abroad. As one of the three state-owned aviation groups, China Eastern airlines started early in the development of air cargo. In order to be in the fierce competition in the market both at home and abroad, and relatively stable market share, China Eastern airlines freight companies need to fully understand the characteristics of the air cargo market demand, and need to predict the air cargo market demand changes, to combine their own actual situation to formulate scientific and effective space flight control, planning, fleet arrangement, and to improve operational efficiency, optimize cargo sales process. Then it can realize the air cargo logistics system of digital, intelligent, and to increase their operating revenue. Therefore, it is necessary to study the method of freight volume forecasting. China Cargo Airlines is as the research background of this topic of air cargo. The history of air cargo booking data using a variety of research methods and model were analyzed and built. Then to solve the established model, it need to select the best parameters, and then select the optimal prediction model, for the air cargo to provide more effective guidance and planning.

Keywords: Demand forecasting, Air freight, China Cargo Airlines.

1. BACKGROUND AND SIGNIFICANCE OF THE TOPIC SELECTION

1.1 Background of the topic

With China's sustained economic growth is also actively promote the development of the air freight, in order to adapt to the development trend of air freight to the aviation logistics, the revitalization of China's logistics industry, in the air cargo will be the future development orientation in the modern logistics service provider, is committed to build internationally competitive national logistics brand. Despite the good development trend of China cargo shipping market, there are still many challenges and problems:

Air cargo in air cargo information system construction is not perfect, has always been leased SITA freight system, the system can't completely fit the localization of operation, in addition, the use of the system is not perfect, unable to provide the perfect goods tracking and query, affect the service quality. In addition, there is a lack of reasonable planning and layout of data support, such as the route arrangement, hub construction, airport security and settlement system.

1.2 Significance of the topic selection

(1) It is of great significance to the development of domestic aviation logistics and the formation of international air freight brands. China cargo airlines should adapt to the development trend of air cargo to aviation logistics, build up its own aviation logistics information system, and provide reference for other domestic air cargo companies. To build a national logistics brand with international competitiveness. It is of great significance to establish the corresponding integration measures to maintain domestic advantages of China cargo airlines and to form international branding and compete with foreign air cargo companies.

(2) The company's own development needs. Cargo traffic in the existing business model most of the processing done by manual, inefficient and not automatic, especially lack of demand forecasting management of shipping, aviation average data such as support and control human decision-making, subjectivity is too strong, to some extent this great limits the scientific development. Therefore, the study of this subject has positive significance to the improvement of the control system and the formation of revenue management system.

2. RESEARCH CONTENTS

(1) How to deal with the historical booking data and establish the prediction object, and study the macro characteristics of the data (the volatility analysis is carried out in the "week").

(2) To apply several kinds of prediction methods of air cargo in the history of the freight volume data of case analysis, the data is divided into training set and prediction set accuracy test, and according to the accuracy of indicators for the prediction model, comparison, to find out a more accurate prediction model.

3. AIR CARGO VOLUME FORECAST

3.1 Wave analysis of data

Analysis of air cargo in the actual operation of the general characteristics of aviation freight volume, through the data trend characteristics and the characteristics of various prediction methods, a combination of applicable environment analysis, and then select apply to goods in air freight volume forecasting model method.

1 Seasonal analysis of air cargo volume of Shanghai international airport (PVG) to Hong Kong international airport (HKG). The selected air cargo volume period is from January 2015 to July 2017.

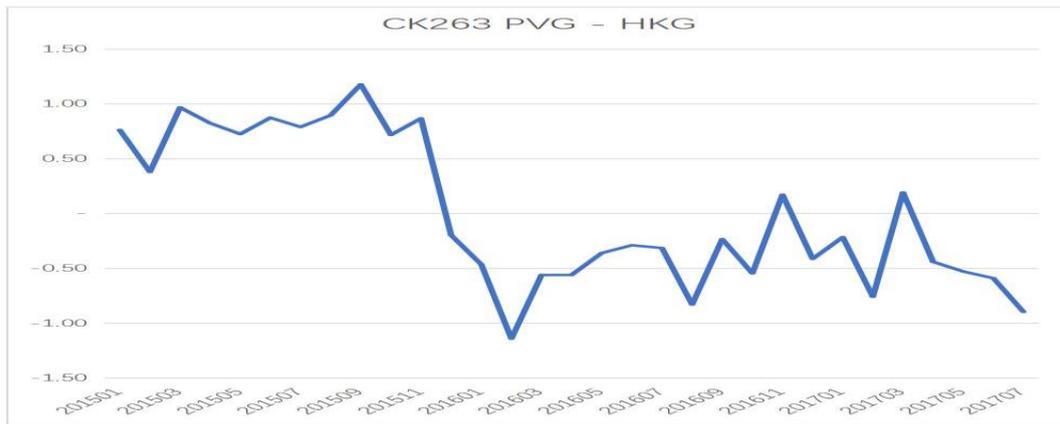


Fig 3.1-1 the fluctuation of freight volume in Shanghai to Hong Kong

2 Seasonal analysis of the historical air cargo volume of Shanghai international Airport (PVG) to Los Angeles international Airport (Airport Schiphol). The selected air cargo volume period is from January 2015 to July 2017.

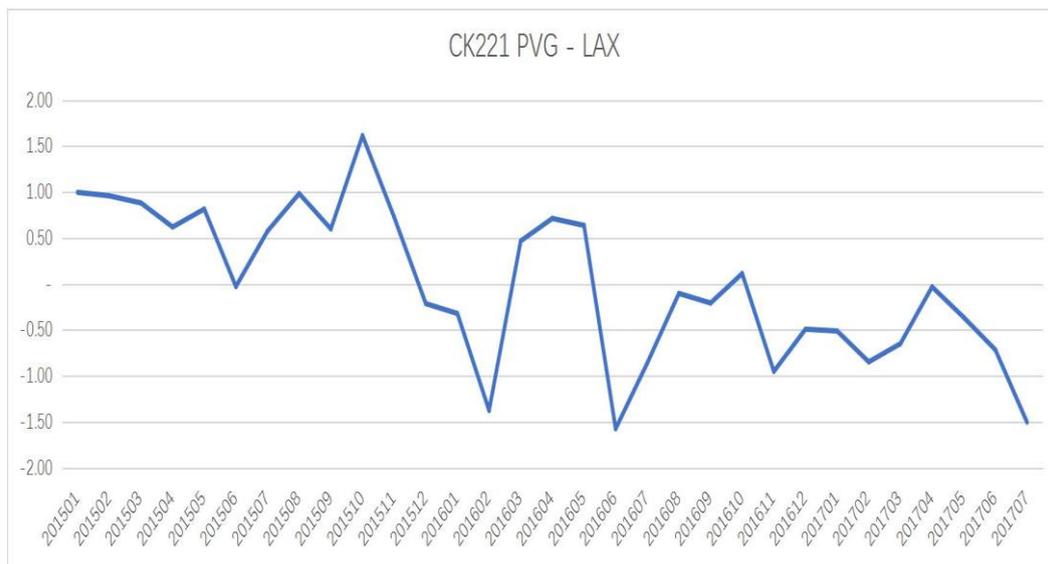


Fig 3.1-2 Shanghai to Los Angeles freight volume fluctuation graph

3.2 Exponential smoothing prediction method

When the historical data is large and varied, the above regression analysis can be used to solve the problem of load forecasting. However, when the historical data is relatively small, the accuracy of regression analysis can be reduced, and the exponential smoothing method can be used to predict.

The analysis of the causes of using the exponential smoothing method, exponential smoothing only a small amount of data can be predicted by the result of the need, is based on moving average method developed a kind of time series analysis method, is compatible with the whole period, director of the average and moving average and does not forsake the past data, but only give the influence degree of the waning, namely as the data from, gradually converge to zero weight, exponential smoothing values by calculation, with a certain amount of time series forecasting model to forecast the phenomenon of the future.

When carrying out the demand forecast of aviation load, only certain historical load data are required, and they are processed as time series. The exponential smoothing method is divided into an

exponential smoothing method, a quadratic exponential smoothing method and a cubic exponential smoothing method. Which method to choose depends on the type of data . When the historical load data shows a linear trend, it is possible to choose one or two smoothness index method (see figure 2).When the change of time series shows the trend of the quadratic curve, or the load data shows a certain periodicity, the three exponential smoothing method can be used to predict.

Aircraft loads in different every year, there are the peak season and off-season, so in a year, loads of fluctuation is bigger, but from years of data, the loads are the obvious cyclical, generally in the peak season loads of every year is larger, default rate is relatively low, because the customer default cost is higher; In the off-season, the load is generally smaller and the default rate is higher, because the cost of default is lower.

Example: acquisition on January 1, 2012 to February 29 CK205 cargo data, respectively, using an exponential smoothing, the secondary exponential smoothing and three exponential smoothing to forecast , the average relative error are respectively 0.07125, 0.17363 and 0.26698.The results show that an exponential smoothing effect is better, and the smoothing coefficient is 0.4 (see table below).

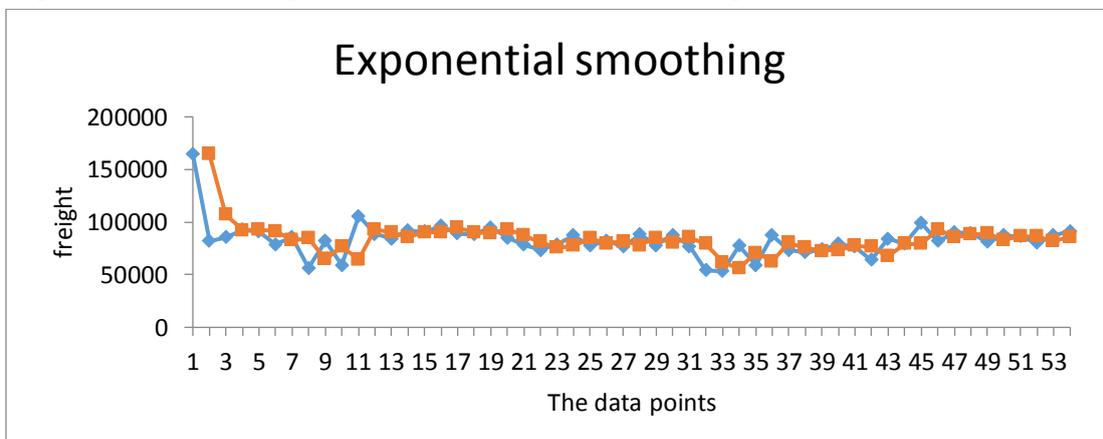


Fig 3.2-1 Exponential smoothing

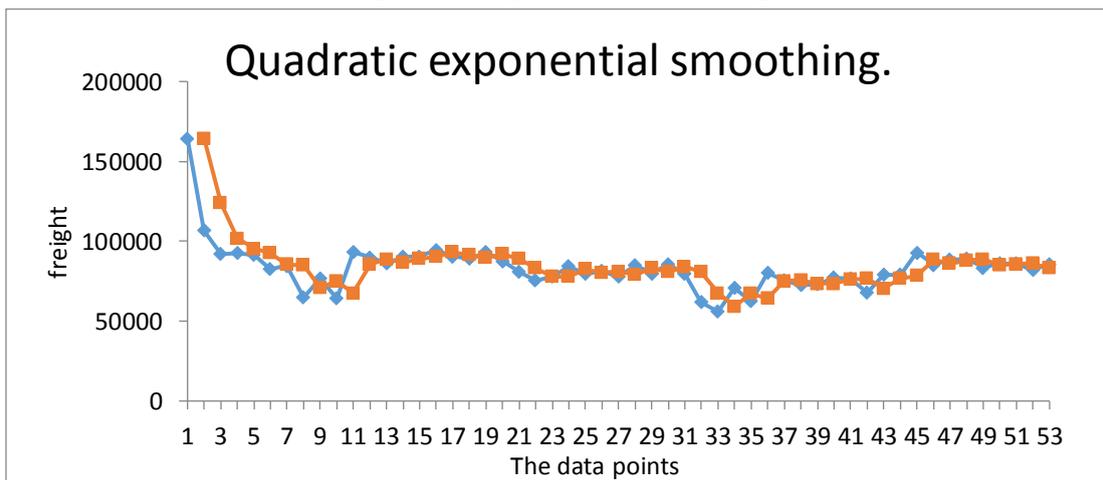


Fig 3.2-2 Exponential smoothing

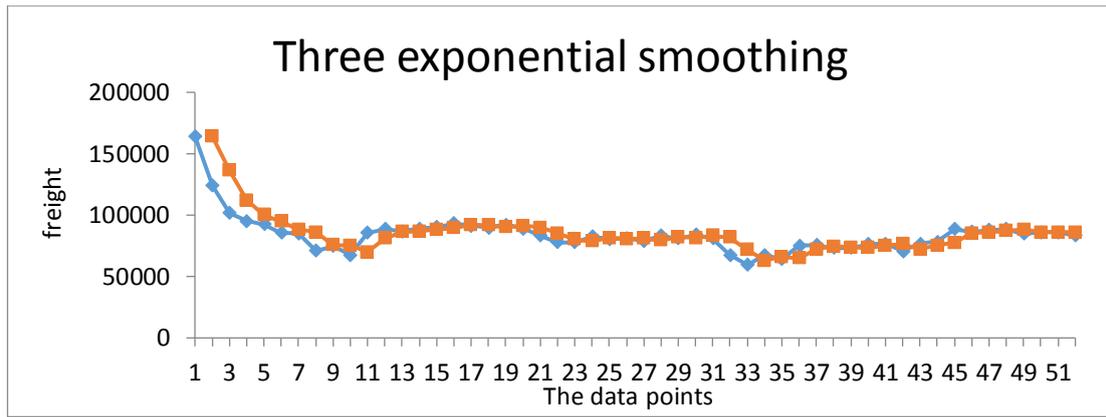


Fig 3.2-3 Three exponential smoothing

3.3 Deep learning prediction method

Deep learning is a forward direction in the big data environment. It is a kind of training data directly from the training data, which is trained by deep neural network model and directly outputs the final result. Each layer in deep learning can adjust itself for the final task, and improve the accuracy of the prediction through the cooperation between layers. Deep learning can use massive data to automatically learn abstract knowledge expression and obtain the required knowledge model from raw data. Therefore, it is possible to use the historical data of Air China, China southern and eastern airlines to predict the future load of China Eastern airlines through the use of deep learning methods. Both short-term and long-term Memory network (Long Short Term Memory, LSTM) Neural network is a special kind of cycle (Recurrent Neural Networks, RNN) type, can learn to depend on the information for a Long time, and in the RNN network behind time node for the previous time perception. The repeating module in the standard RNN network contains a single layer, while the repeating module in LSTM contains four interactive layers, as shown in figure 12 below, which can make an effective prediction of time series data.

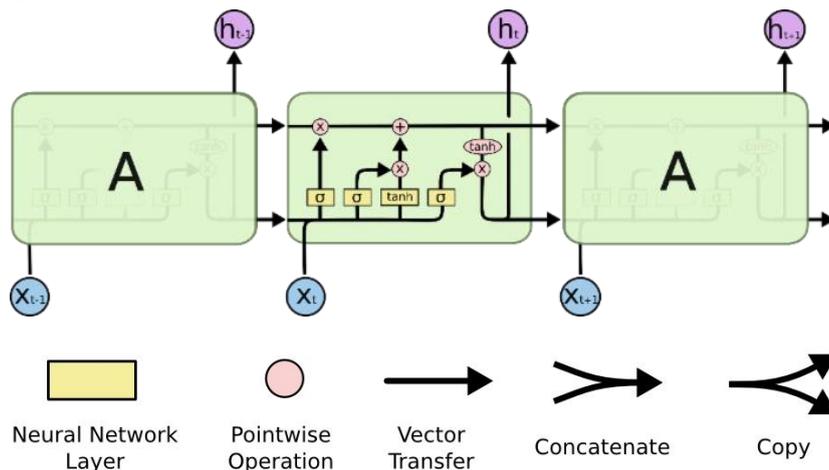


Fig 3.3-1 Deep learning LSTM network flow chart

Therefore, the data of cabin demand is predicted by using LSTM network.

Parameters	seed	miniBatchSize	numHiddenNodes	learningRate	momentum	nEpochs
Value	140	32	10	0.0015	0.9	300

Fig 3.3-2 LSTM parameter setting

Through the LSTM deep learning network, the output result (see figure above), $MSE = 7.34E-03$, $RMSE = 7.51E-02$, the prediction effect is obvious.



Fig 3.3-3 depth learning effect diagram

4. CONCLUSION

Comprehensive, for China Eastern loads can be predicted using the above model respectively, we can find that the best, the goodness of fit the best prediction model is exponential smoothing model, can be used to the air cargo freight volume forecast.

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