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Forecast of Passenger and Freight Traffic Volume Based on Elasticity Coefficient Method and Grey Model

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Abstract

The increase in passenger and freight traffic in a region reflects the development of railways, highways, waterways, aviation, and pipeline. With the growth of economy, China's transportation develops rapidly. However, the passenger and freight traffic present different growth features in different regions. Therefore, a reasonable forecast model for passenger and freight traffic and the analysis of relationship between regional transportation and economy are important for transportation planning. The elasticity coefficient between the passenger traffic volume, freight traffic volume and gross domestic product (GDP) is calculated based on the data from 2001 to 2010 in different regions in China. Then, the relationship between the change of regional traffic volume and regional economic development is obtained. With the analysis of the pros and cons for different forecast models, Elasticity Coefficient Method, GM (1, 1) model, and DGM model have been used to forecast passenger and freight traffic volumes from 2011 to 2015. In order to improve the accuracy of the forecast results, the combined models based on the variance reciprocal and the optimal weighting are applied to optimize the forecasting model. Among all the forecast models, the combined model with optimal weights outperforms other models with a relative error less than 0.006% for the freight traffic volume. The accuracy of forecast models on passenger and freight traffic volume has been improved, which provides a reasonable basis for the planning and development of the transportation system.

Key words：Coefficient of elasticity; passenger and freight traffic volume; GM (1, 1) model; DGM model; combination model

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1. Introduction

Forecasting on passenger and freight traffic volume is the basis of planning and construction of transport facilities. At the same time, it provides valuable policy-making information for the government departments which conducts market regulation and management. Forecasting traffic volume accurately plays an important role for the healthy development of transportation.

Volume depends on transportation demand, which is effected by regional population, structure of economy, industrial scale and layout, mechanization level, urbanization level and social culture etc. Therefore, how to forecast volume reasonably and improve accuracy is an import issue. In this context, researchers pay much attention to different forecast approaches including qualitative forecast or quantitative forecast methods. Quantitative forecast methods include exponential smoothing, grey forecasting model, and regression analysis.

In addition, China is a country with a vast territory. Regional economy development is unbalanced. Passenger and freight traffic volume and elasticity coefficient of gross domestic product (GPD) differ greatly. Therefore, the relationship between traffic volume and economic development is difficult to analyze. Analyzing elasticity coefficient is an effective approach to determine such relationship. Meantime, the future passenger and freight volume can be obtained by analyzing elasticity coefficient correctly. This paper forecast the passenger and freight volume according to static and dynamic elasticity coefficient models. In order to improve accuracy, a grey model and a combined model are also used to predict passenger and freight volume of different regions in China.

2. Passenger and freight traffic volume forecast based on elasticity coefficient method

This paper has applied the elasticity coefficient to forecast passenger and freight volume firstly. According to GPD data of different regions from 2001 to 2010 and the data of passenger and freight traffic volume, elasticity coefficient of passenger and freight volume in different regions can be calculated. Further, elasticity coefficient has been used to forecast passenger and freight traffic volume from 2011 to 2015 in different regions.

2.1. Elasticity coefficient

The transportation elasticity coefficient is defined as a numerical measure of the relative response of volume to changes in GDP, which can be expressed as follows:

Transportation elasticity coefficient = Rate of change of volume / Rate of change of GDP

In this research, passenger and freight traffic volume and GDP in different regions are used to calculate transportation elasticity coefficient.

Elasticity coefficient can be divided into static and dynamic elasticity coefficient, depending on different methods of calculation. The calculation for static elasticity coefficient is relatively simple and used more frequently.

2.1.1. Static elasticity coefficient

Currently, the method used to determine transportation static elasticity coefficient can be divided into two categories: one is to calculate the value of elasticity coefficient directly according to its definition, such as the geometric average method and arithmetic average method; the other is to use regression analysis to determine the value of elasticity coefficient. In this paper, a logarithmic linear regression method is used to determine static elasticity coefficient. Its equation can be expressed as:

$$\ln T = A + E \ln G \tag{1}$$

Where T is the traffic volume; A is coefficient; E is transportation elasticity coefficient; G is the GDP.