Forecast of Demand in China Courier Industry

Jiawei Yang

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Supervisor: Muhammad Abid
Examiner: Ming Zhao
Abstract

Since entering 21st century, the courier industry in China has been developing rapidly. In 2016, the revenue of China courier industry accounted for more than 5% of China’s GDP. As an emerging industry injected with dynamism and potentials, the courier industry should be integrated into China’s mainstream economy and sustain its growth momentum. The purpose of this thesis is to identify the development trend and demands of the courier industry in China, and provide some suggestions on its future development.

The grey model and the regression model were employed as the mathematic techniques in this thesis. First of all, through examining prior literature and availability of related data of China’s courier industry, seven explanatory variables and one explained variable (courier production value) were picked up as the original data.

Then, through the use of the grey model, correlations of those seven variables with courier production value are worked out respectively.

Third, based on China’s 13th Five-year Plan, three possible GDP growths of 2016 to 2020 (optimistic scenario, negative scenario and normal scenario) were set in this thesis. After that, the future development of seven explanatory variables was reckoned by linear regression model and the assumed GDP growth to predict.

Finally, the law of development of explained variable and seven explanatory variables were reckoned by the grey model. Through those result, this thesis drew the conclusions.

The result shows that, under three different scenarios, courier industry in China will maintain a tremendous development in the next 5 years. Moreover, all the three main industries (primary industry, secondary industry and tertiary industry) will play important roles in courier industry, among which the tertiary comes first. Also in the coming five years, the development of courier industry, rendering more service to residents, will rely more on the Residents’ consumption and the total retail of goods. And its development will be largely affected by the government’s investment. Another observation concerns total investment in fixed asset which will have a strong impact on the courier industry. That is to say, the government could improve the China courier industry by increasing total investment in fixed asset. Last but not least, the correlation between export-import and courier industry shows that the courier companies should focus more on domestic market.
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1 Introduction

The study reported in this thesis aims to show whether the courier industry in China, one of the fastest growing sectors in the country, will maintain its present momentum for growth in next few years. In this introductory chapter, the background and the purpose of the study are introduced and its limitations are explained.

1.1 Background

Four years after the Express Mail Service (EMS, one of the mail-service companies in China) started international service in 1980s, it established its domestic express mail service. Later on, the DHL (the world largest logistic company) entered into the Chinese market by cooperating with the Sinotrans (a courier company in China); followed by UPS, FedEx, TNT as well as other less known logistic companies established their presence in China. Led by economic booming in the Pearl River Delta and Yangtze River Delta in the 1990s, domestic courier companies like Shunfeng, Yuantong and Zhongtong made their appearances one after another. In the 21st century, supported by the Chinese government, courier industry has been developing rapidly in China, especially after 2006. The prosperity of e-commerce, facilitating the courier service, speeded up development of the courier industry.

With Chinese economy undergoing a rapid transformation, the courier industry plays an increasingly important role in Chinese economic development by bringing much convenience to residents and other businesses, In the future, despite the probable slowdown trend of Chinese economy, improvement of resident consumption and expansion of overseas trades will create a much more flexible environment for Chinese courier industry. The aim of this thesis is to explore the future development trend of Chinese courier industry. And suggestions will be provided for its future development.

1.2 Purpose

This thesis aims to propose some guidance for the future development of Chinese courier industry by predicting the demand trend of Chinese courier industry in the future.

Courier industry is one of the foundations that ensure the normal operation of national economy, as the development scale of courier industry goes along with the development of economy. Therefore, taking Chinese future economic development as foundation to predict the demand trend of courier industry has guiding significance.

Predicting the demand trend of Chinese courier industry is beneficial for the all-round development of courier industry, which will, in turn, benefit China's national economy.
1.3 Limitations

This study has several limitations. First of all, limited data were used to analyze and predict the overall development trend of Chinese courier industry. Lack of uniform statistical indicator system of courier industry in China has made it harder to acquire related data of e-commerce and courier industry in recent years. Second, empirical studies involving demand forecast of the courier industry has been rather limited, for most of them have focused on logistic instead of courier industry. Third, due to adopting data processing and model application, many parameters needed to be tested and debugged many times to obtain more reliable results. How to find appropriate parameters has been another difficult part of this study. Finally, counting methods have been used in China are different from those used in Europe, which may lead to different units of some statistics.
2 Methodologies

In order to predict the future demand of courier industry in China, several methods are employed. This chapter gives an overall view of the methods used in this thesis.
First, through reading literature on previous studies, several factors (explanatory variables) that may have effects on courier production value (explained variable) were identified.
Second, the correlation between those factors and courier production value would be reckoned by adopting grey relational model.
Third, three possible GDP growths of China’s 13th Five-year Plan from 2016 to 2020 (optimistic scenario, negative scenario and normal scenario) were set in this thesis, followed by the linear regression model reckoning future development of seven explanatory variables and predict the assumed GDP growth.
Meanwhile the correlations between those factors and courier production value in the future are calculated.

2.1 Data collection

Walliman (2005) noted that information and statistics are kinds of facts that can be called data, used by researchers to analyze the problems that they intend to investigate. He (2005) also pointed out that there are two different types of methods to collect data: secondary research and primary research. The data used in this thesis is secondary. Remenyi et al (2003) noted that a secondary source would be information already published or available indirectly. Similarly, Walliman (2005) reminded that the source of secondary information would include published articles, books, websites, government departments and commercial bodies.
In this thesis all the data is drawn from China Statistical Yearbook, published by Chinese government.
Following literature review and availability of related data of China’s courier industry, seven explanatory variables and one explained variable (courier production value) as the original data were selected.

2.2 Quantitative Research

The use of mathematical and statistical tools to carry out the analysis of numerical data has long been associated with a more positivistic approach to research (Simon, 2009). Bryman (1988) described quantitative research as being generally underpinned by natural science model. Statistics is the most widely used branch of mathematics in quantitative research.
Quantitative research is utilized in this thesis. Large amounts of numerical data were used, and the regression analysis and the grey model were adopted to reach the
conclusion.

2.2.1 The grey model

The grey model is often used to calculate fuzzy or incomplete data. The main function is to conduct a fuzzy prediction and reveal the possible changing process. The grey model serves well for short-term prediction, for it could work with limited sample but high accuracy.

Courier industry, an emerging industry in China, lacks a good statistical indicator system due to data accessibility difficulty. Moreover, courier industry is currently related to a number of other industries (such as railways, navigation etc.), for they all have varying degree of effects on courier industry. Hence, the grey model can work well in this research.

In this thesis, the grey model is used to reckon the correlation between several explanatory variables and one explained variable, seeking to find the law of seven explanatory variables and that of explained variable.

2.2.2 The linear regression model

The linear regression is an approach for modeling the relationship between a scalar dependent variable Y and one or more explanatory variables (or independent variables) denoted X (David, 2009). Based on original data, it can be an easy task to find the relationship between two variables.

The linear regression model and the assumed GDP growth were applied to predict the future development of seven explanatory variables.
3 Literature review

3.1 Definition of supply chain management

Supply chain is a system of organizations, people, activities, information, and resources moving a product or service from suppliers to customers. Introduced in 1980’s, supply chain management (SCM) has been drawing increasing attention in last three decades. Definitions about SCM vary by different researches. In Nigel et al (2006)’s book Operation Management, supply chain management is defined as “the management of the interconnection of organizations that relate to each other through upstream and downstream linkages between the processes that produce value to the ultimate consumer in the form of products and services”. They mentioned that all the supply chains share one common and central objective: to satisfy the end customer. Different stages of supply chain should take “end-customer satisfaction” into consideration. It does not matter how far they are from the end-customers. Nigel also listed five objectives that influence the performance of supply chain:

1. Quality. It refers to the quality of products and service that reaches customers. In order to offer end-customers a high quality service, errors need to be avoided in every stage since a small error could invoke a huge loss to end-customers.

2. Speed. Speed is understood from two angles. The first is how fast customers can be served and the second means how quick customers’ demand could be met. In order to have a better performance, supply chain managers should keep both “speed”s run fast.

3. Dependability. Dependability refers to certainty, time in particular. Keeping each process “on-time” is of extreme importance in supply chain, for a small delay during the process could waste more time for end-customers to get their products or services.

4. Flexibility. Supply chain should be flexible enough to cope with changes that may occur during the delivery.

5. Cost. Cost is incurred in each operation. Developments in supply chain management, such as partnership agreements and reduction in the number of suppliers, are all attempts to minimize transaction costs. Nigel et al (2006)’s accounts suggest that the central aim of SCM is to provide a better service to end-customers. And every single unit in the whole supplier chain may exert a huge influence.

3.2 Logistic management

Effective logistic management could bring up opportunity for improved profitability and competitive performance (Ballou, 2007). Based on Ballou (2007)’s argument, how to implement an effective logistic management is the main target for those companies intending to improve their logistics. The Council of Supply Chain Management Professionals (2013) defined logistics management as “The procedure of planning, implementing and controlling the
effective, cost-efficient flow of goods, storage, work-in-process inventory, finished goods and flow of information from point of origin to point of consumption in order to meet the customer requirements”. With the main objective of adding values, logistics should not only deliver and store goods in the warehouse but also provide more services. Lambert et al (1998) noted that logistics is to ensure the customer service with the lowest logistics costs.

3.2.1 Third party logistic (TPL) industry

For different reasons and considerations, companies outsource their logistic process to third party logistic (TPL) companies. TPL is defined extensively in previous articles. Lieb (1992) defined it as “the use of external companies to perform logistics functions that have traditionally been performed within an organization. The functions performed by the third party can encompass the entire logistics process or selected activities within this process”. The definition given by Berglund et al (1999) explained what the logistic process meant for TPL. They said that TPL referred to activities carried out by a logistics service provider on behalf of a shipper and consisting of at least management and execution of transportation and warehousing. In the statement of Bolumole (2003), TPL performs all or part of other companies’ logistic operations. Empirical studies noted that third party logistic is necessary for different business areas at present. Razzaque and Sheng (1998) pointed out that outsourcing of logistics is a business function filled with growing dynamics all over the world. Liu and Lyons (2011) mentioned lacking in logistic abilities in transportation or storage explains why some companies need TPL. However, it is not the only reason why companies choose outsourcing. Armistead (1993) noted another motivation that drives TPL is that companies could focus more on their core competence. On the other hand, certain disadvantages of TPL may come along since companies choose to use TPL service may take the risk of alienating customers (Lonsdale and Cox 2000).

The question of improving core competence of TPL remains to be solved for management in most TPL companies. Armistead (1993) advocates that a TPL provider should attach great importance to their quality, speed, dependability and flexibility.

3.3 The evaluation of logistic industry development

Research has been conducted to explore the ways of evaluating the logistic industry. Wang (2011) proposed Data Envelopment Analysis (DEA) to evaluate the level of logistic development in some parts of China, finding inadequate investment and inefficiency of human resource in some regions of China. He also worried that an unscientific planning of highway route can be seen in many regions. By adopting grey correlation analysis, Liu and Xie (2011) analyzed the factors that may have influences on logistic industry in Sichuan Province. They found that primary industry
produced the strongest influence on logistic industry, followed by tertiary industry, while the secondary industry has the slightest among the three. Zhang and Bao (2005) evaluated locations of logistic centers by building a fuzzy comprehensive evaluation model with the entropy method.

### 3.4 Logistic and Regional economy development

Investigations have been carried out in looking for the relation between logistics, transportation and regional economy. Bolton (1995) indicated a strong relationship between transportation and economy. A prosperous economy must receive substantive support from highly developed traffic, or vice versa. By applying time series analysis and vector auto-regression model on India railways, Mudit (2001) aimed to prove interplay between transportation and economy. Joseph (2003) conducted similar work with Rome as the sample.

As for the relationship between logistics and regional economy, researchers vary in their explanations. In Donald (1999)’s research, logistics and regional economy is mutually facilitating and restricting. Basarab (2001) concluded that economy and logistic had a strong relevance after analyzing 42 explanatory factors of logistics performance of a country. Keith (1999) explained the remarkable relationship between regional economies with air transportation in his study.

### 3.5 Logistics demand forecast

Most of logistics demand forecast is based on quantitative method. By using RBF network, Zhou and Wang (2009) built a multivariate nonlinear prediction model, which proves its accuracy despite sample limits, to predict future demand of logistics in Sichuan province. Yan et al (2009), combining Markov model and GM (1, 1) model, predicted the future logistics demand in Shaanxi Province and found that markov model could be a good option on this topic.

Chu and Liu (2007) said that at present in China, statistic system of logistic industry needs improvement, and added that GM (1, 1) model is well-suited for data quantizing. Liu (2013) employed generalized regression neural network (GRNN) to predict the logistic demand of Guangdong Province from 2012 to 2015. Compared with other models, GRNN is more suitable for limited and instable sample data. But what is worth mentioning is that most of researchers neglected the current situation of regional economy.

Research in other countries is focused more on cargo quantity.
4 The current situation of China courier industry

4.1 The Basic Conditions of Development in Chinese courier Industry

4.1.1 Economic gross

The last decade has witnessed high speed growth in Chinese Gross Domestic Product (GDP). As can be seen from figure 4-1, in 2015, China’s GDP totaled 6.7 trillion Yuan. It stands at the second place at that time. It increased by 2.6 times compared with that of 2005. Foreseeing the possible slowdown, China’s economy remains its momentum and grows faster than other countries and regions.

![GDP Growth from 2005 to 2015](image)

**Figure 4-1** Gross Domestic Product from 2005 - 2015 (Unit: hundred million Yuan) (Source: China Statistical Yearbook)

The added value of the secondary industry in China stood at the top among three industries before 2012. But the output of tertiary industry in 2012 reached 2.448 trillion Yuan (Figure 4-2), exceeding the secondary industry. The fast growth of tertiary industry shows that service industry becomes increasingly important in China. As a main content of tertiary industry, courier industry will usher in a rosy prospect.
4.1.2 The Total retail sales of consumer goods

Consumer market in China is experiencing healthy development. In 2015, the retail sales of consumer goods totaled 30.1 trillion Yuan, up by 10.7% than that of last year (Figure 4-3). And 3.87 trillion Yuan were created from e-commerce, up by 33.3% than that of last year. The growth of the total retail sales of consumer goods slowed down after 2010, but still remained 10% or over per year, a remarkable rise compared with other regions and countries. What’s more, the ever-increasing retail sales online demonstrates that consumers turn to online purchase which stimulates the development of courier industry.
Figure 4-3 Chinese the Total retail sales of consumer goods and growth (unit: hundred million Yuan) (Source: China Statistical Yearbook)

4.1.3 Import and export trade

The import and export trade in China developed fast in recent years. The export-import volume in 2014 totaled 4.3 trillion dollar with export of 2.3 trillion and import of 1.9 trillion. Supported by Chinese government, foreign trade volume kept a steady growth since 2005 (Figure 4-4).
4.1.4 Residents consumption

The fast economic growth in China also stimulated rise in resident disposable income. In 2015, the resident consumption averaged 14699 Yuan, with rural consumption at 4941 Yuan and urban, 17104 Yuan. Compared with 2005, the resident consumption increased by almost 3 times. Residents were able to spend more money on purchasing at their disposal. As one of the main channels for resident consumption, online shopping and courier services took this opportunity and experienced fast growth.
### Table 4-1 The China resident consumption (unit: Yuan) (Source: China Statistical Yearbook)

<table>
<thead>
<tr>
<th>Year</th>
<th>resident consumption</th>
<th>rural resident consumption</th>
<th>urban resident consumption</th>
</tr>
</thead>
<tbody>
<tr>
<td>2005</td>
<td>5771</td>
<td>2784</td>
<td>9832</td>
</tr>
<tr>
<td>2006</td>
<td>6416</td>
<td>3066</td>
<td>10739</td>
</tr>
<tr>
<td>2007</td>
<td>7572</td>
<td>3538</td>
<td>12480</td>
</tr>
<tr>
<td>2008</td>
<td>8707</td>
<td>4065</td>
<td>14061</td>
</tr>
<tr>
<td>2009</td>
<td>9514</td>
<td>4402</td>
<td>15127</td>
</tr>
<tr>
<td>2010</td>
<td>10919</td>
<td>4941</td>
<td>17104</td>
</tr>
<tr>
<td>2011</td>
<td>13134</td>
<td>6187</td>
<td>19912</td>
</tr>
<tr>
<td>2012</td>
<td>14699</td>
<td>6964</td>
<td>21861</td>
</tr>
<tr>
<td>2013</td>
<td>16190</td>
<td>7773</td>
<td>23609</td>
</tr>
<tr>
<td>2014</td>
<td>17778</td>
<td>8711</td>
<td>25424</td>
</tr>
</tbody>
</table>

### 4.2 Current situation of China courier industry

#### 4.2.1 The expansion of China courier industry

From 2008 to 2015, the average growth rate of China courier revenue is 31.39%, up from 40.8 billion Yuan in 2008 to 276 billion Yuan in 2015. The volume of China courier industry increased from 1.5 billion in 2008 to 20.6 billion in 2015. Three types of courier companies in China market can be found:

1. state – owned courier company, such as Express mail service;
2. private courier company, such as Shunfeng, Shentong, Yuantong;
3. foreign courier company, such as Fedex and DHL.

Private courier companies have been proportionally large in Chinese market in recent years they, accounting for 86% of total market shares.
Figure 4-5 The Production value of China courier industry and growth (Source: China Statistical Yearbook)
5 The variable selection in Chinese courier demand forecast and situation setting

5.1 Correlation analysis of Chinese economy and courier industry

5.1.1 The selection of dependent variables

Drawing on the convention of selecting dependent variable by previous work and available data of current Chinese courier industry, the output value of courier industry was selected as explained variables and seven variables were regarded as explanatory variables. They are:

1. The output of primary industry;
2. The output of secondary industry;
3. The output of tertiary industry;
4. The total investment in fixed assets;
5. The total retail sales of consumer goods;
6. The total export-import volume;
7. The residents’ consumption.

5.1.1.1 The output value of courier industry

Output value of courier industry is one of the most convincing standards used to measure the development of courier industry. It shows the total value of the products and services provided by China courier industry.

5.1.1.2 The output of three main industries

All the three important industries in a country would have effects on courier industry in many aspects. Farm products, industrial products and import-export products are all from different industries of national economy. And different industrial structure would create different scale of production, which finally influences the demand of courier industry. It is easy, then, to see that the three main industries would have essential effects on courier industry.

5.1.1.3 The total investment in fixed assets

The total investment in fixed assets would influence the courier industry in the
following aspects:
First, the total investment in fixed assets, improving and remodeling public transportation, such as railway and airport, would enhance the deliver capacity.
Second, the total investment in fixed assets expands the public transportation. For instance, building a new airport could help courier industry expand the local market.

5.1.1.4 The total retail sales of consumer goods

The total retail sales of consumer goods, as one of the most direct and objective standard, reflect fully the consumer demands. As its name suggests, it shows the total value of consumers’ goods bought by Chinese companies. Consumer goods enter into the market facilitated by courier industry. So it could reflect the demand of courier indirectly. As a service industry, courier would influence the market demand by its cost. In other words, an active demand of market could promote the development of courier industry.

5.1.1.5 The total export-import volume

The total export-import volume reflects the commercialization of different regions. Transfer of goods and services ask for strong support from courier industry. A better total export-import volume would enable courier industry to develop fast. In a sense, the total export-import volume and production value of courier industry complement each other.

5.1.1.6 The Residents’ consumption

The resident’s consumption reflects the purchasing power of residents. A strong purchasing power would stimulate the related industries and commerce. Just like three main industries, a sound residents’ consumption would promote the development and progress of courier industry.

5.1.2 Research on the correlation of explanatory variables

5.1.2.1 The grey correlation model building

As mentioned above, correlation is used to explore the relationship between two or more factors with the change of time. Grey correlation model is often used to describe the correlation among multiple variables. It could find out the degree of synchronization among those variables and then help to reach the conclusions.
Here is the derivation of grey correlation model utilized in this thesis:

Assuming there are \( N \) factors, \( X_1, X_2, \ldots, X_n \), in a period of time, they would form the sequence \( \{X_1(t), X_2(t), \ldots, X_n(t)\} \). The correlation formulation of \( X_i \) and \( X_j \) is:

\[
\{X_1(t), X_2(t), \ldots, X_n(t)\}, \text{ and } t = 1, 2, \ldots, m
\]

Hence, at \( t \) time, the correlation between \( X_i \) and \( X_j \) is:

\[
ζ_{ij}(t) = \frac{Δ_{min} + σ Δ_{max}}{Δ_{ij}(t) + σ Δ_{max}} \text{ and } t = 1, 2, \ldots, m
\]

Among them, \( ζ_{ij}(t) \) is the correlation coefficient of \( X_i \) and \( X_j \) at \( t \) time, \( Δ_{ij}(t) \) is the absolute value of difference of \( X_i \) and \( X_j \) at \( t \) time (i.e. \( Δ_{ij}(t) = |X_i(t) - X_j(t)| \)). \( Δ_{min} \) and \( Δ_{max} \) refer to \( Δ_{ij}(t) \) when both \( X_i \) and \( X_j \) are in maximum or minimum at \( t \) time (i.e. \( Δ_{min} = \min_i \min_j Δ_{ij}(t) \)). \( σ \) is gray resolution coefficient and \( σ \in [0,1] \).

So it can be seen that at period of time, the definition of correlation between \( X_i \) and \( X_j \) is:

\[
Y_{ij} = \frac{1}{m} \sum_{t=1}^{m} ζ_{ij}(t)
\]

At most of time, \( σ \) equals 0.5. But in this thesis, a more flexible way was used to get gray resolution coefficient. Here is the derivation process:

Set

\[
Δ_{ij} = \frac{1}{m} \sum_{t=1}^{m} Δ_{ij}(t), \text{ and } t = 1, 2, \ldots, m.
\]

So we can get:

\[
σ_{ij} = \frac{Δ_{ij}}{\max |Δ_{ij}(t)|}
\]

Set:

\[
σ = \{σ(1), σ(2), \ldots, σ(n)\}
\]

Due to \( σ \) is among \([0,1]\), so the value of \( σ(n) \) is:

1. when \( \frac{1}{ζ_{ij}} > 3 \), \( σ(n) = [ζ_{ij}, 1.5ζ_{ij}] \), under normal circumstance, \( σ = 1.5ζ_{ij} \);
2. when \( 0 < \frac{1}{ζ_{ij}} \leq 3 \), there will be three different situations:
   1. when \( 2 < \frac{1}{ζ_{ij}} \leq 3 \), \( σ(n) = [1.5ζ_{ij}, 2ζ_{ij}] \) most of time, \( σ(n) = 2ζ_{ij} \);
   2. when \( 0 < \frac{1}{ζ_{ij}} < 2 \), so \( σ(n) \) could equals any value among \([0.8,1]\).
   3. when \( ζ_{ij} = 0 \), \( σ(n) \) could equals to any value among \([0,1]\).
To summarize, after improving the possible value of $\sigma(n)$, the correlation coefficient of $X_i$ and $X_j$ is:

$$
\zeta_{ij}(t) = \frac{\Delta_{\text{min}} + \sigma(n) \Delta_{\text{max}}}{\Delta t(t) + \sigma(n) \Delta_{\text{max}}}, \text{ and } t = 1, 2, \ldots, m
$$

### 5.1.2.2 Calculation of correlation

$Y$ as courier production value, $X_1$ is the output of primary industry, $X_2$ is the output of secondary value, $X_3$ is the output of tertiary industry, $X_4$ is total investment of fixed asset, $X_5$ is total retails sales of consumer goods, $X_6$ is the Total export-import volume, and $X_7$ is the Residents’ consumption.

**Table 5-1** China economic data (source: China Statistical Yearbook)

<table>
<thead>
<tr>
<th>Year</th>
<th>Courier production value (unit: billion Yuan)</th>
<th>The output of primary industry (unit: billion Yuan)</th>
<th>The output of secondary value (unit: billion Yuan)</th>
<th>The output of tertiary industry (unit: billion Yuan)</th>
<th>total investment of fixed asset (unit: billion Yuan)</th>
<th>total retails sales of consumer goods (unit: billion Yuan)</th>
<th>The Total export-import volume (unit: billion dollar)</th>
<th>The residents’ consumption (unit: Yuan)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2008</td>
<td>40.84</td>
<td>3275.32</td>
<td>14995.6</td>
<td>13680.58</td>
<td>17282.8</td>
<td>11483.0</td>
<td>17992.147</td>
<td>8707</td>
</tr>
<tr>
<td>2009</td>
<td>47.9</td>
<td>3416.18</td>
<td>16017.1</td>
<td>15474.79</td>
<td>22459.87</td>
<td>13304.8</td>
<td>15064.806</td>
<td>9514</td>
</tr>
<tr>
<td>2010</td>
<td>57.46</td>
<td>3936.26</td>
<td>19162.9</td>
<td>18203.8</td>
<td>25168.37</td>
<td>15800.8</td>
<td>20172.215</td>
<td>10919</td>
</tr>
<tr>
<td>2011</td>
<td>75.8</td>
<td>4616.31</td>
<td>22703.8</td>
<td>21609.8</td>
<td>31148.51</td>
<td>18720.5</td>
<td>23640.199</td>
<td>13134</td>
</tr>
<tr>
<td>2012</td>
<td>105.5</td>
<td>5090.23</td>
<td>24464.3</td>
<td>24482.19</td>
<td>37469.47</td>
<td>21443.2</td>
<td>24416.021</td>
<td>14699</td>
</tr>
<tr>
<td>2013</td>
<td>151.5</td>
<td>5532.91</td>
<td>26195.6</td>
<td>27795.93</td>
<td>44629.40</td>
<td>24284.2</td>
<td>25816.889</td>
<td>16190</td>
</tr>
<tr>
<td>2014</td>
<td>204.5</td>
<td>5834.35</td>
<td>27757.1</td>
<td>30805.8</td>
<td>51202.06</td>
<td>27189.6</td>
<td>26424.177</td>
<td>17778</td>
</tr>
<tr>
<td>2015</td>
<td>276.0</td>
<td>6086.3</td>
<td>27427.8</td>
<td>34156.7</td>
<td>56200.0</td>
<td>30093.1</td>
<td>24574.1</td>
<td>19555.8</td>
</tr>
</tbody>
</table>

Calculation by the grey model reached the correlation of those 7 factors with courier production value (Table 5-2):
### Table 5-2 The grey correlation of those factors and courier production value

<table>
<thead>
<tr>
<th>Correlation</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Correlation between primary industry and courier industry</td>
<td>0.866160824</td>
</tr>
<tr>
<td>Correlation between secondary industry and courier industry</td>
<td>0.857787789</td>
</tr>
<tr>
<td>Correlation between tertiary industry and courier industry</td>
<td>0.82178833</td>
</tr>
<tr>
<td>Correlation between total investment of fixed asset and courier industry</td>
<td>0.764481519</td>
</tr>
<tr>
<td>Correlation between retail sales of consumer goods and courier industry</td>
<td>0.809499651</td>
</tr>
<tr>
<td>Correlation between the Total export-import volume and courier industry</td>
<td>0.876854324</td>
</tr>
<tr>
<td>Correlation between the residents’ consumption and courier industry</td>
<td>0.804763712</td>
</tr>
</tbody>
</table>

As can be seen, the total export-import volume, primary industry and secondary industry have a better correlation than other factors. Meanwhile, total investment of fixed asset has the lowest correlation among those related factors.

### 5.2 Scenario setting and related data calculation

#### 5.2.1 Scenario setting

In this thesis, three possible GDP growths were set, based on the “The 13th Five-year Plan”, initiated by the Chinese government,

Scenario one: normal scenario, based on “The 13th Five-year Plan”, and the GDP growth in the next 5 years in China is expected at 6.5% per year.

Scenario two: Due to a variety of reasons, in the next 5 years, national economy may not grow as fast as expected. Under this circumstance, the growth of GDP was
Scenario three: Contrary to scenario two, Chinese economy developed faster than expected. The growth of GDP, thus, is set as 7% per year.

5.2.2 Related data calculation

From 2016 to 2020, based on three different predictions of economic growth in China, three different GDP and be figured out:

<table>
<thead>
<tr>
<th>Scenario</th>
<th>2016</th>
<th>2017</th>
<th>2018</th>
<th>2019</th>
<th>2020</th>
</tr>
</thead>
<tbody>
<tr>
<td>optimistic scenario</td>
<td>72.40775</td>
<td>82.126687</td>
<td>87.4649217</td>
<td>93.1501416</td>
<td>92.7148605</td>
</tr>
<tr>
<td>negative scenario</td>
<td>71.73104</td>
<td>81.3591479</td>
<td>86.6474925</td>
<td>92.2795795</td>
<td>92.7148605</td>
</tr>
<tr>
<td>normal scenario</td>
<td>72.06940</td>
<td>81.7429174</td>
<td>87.0562071</td>
<td>92.7148605</td>
<td>92.7148605</td>
</tr>
</tbody>
</table>

Based on this prediction, the linear regression model was adopted to calculate the total output of primary industry, secondary industry, tertiary industry, the total investment in fixed assets, the total retail sales of consumer goods, the total export-import volume, and the residents’ consumption under three situations.

As mentioned in methodology section, the linear regression model is presented below.

\[ Y_i = \beta_0 + \beta_1 X_i + u_i \]

\( Y_i \) is called independent variable, \( X_i \)'s dependent variable, and \( \beta_0 \) is constant; \( \beta_1 \) refers to slope. What is worth mentioning is that \( u_i \) is called error term. Different from mathematical model, \( u_i \) appeared in economic model which helps to explain the error during measurement or calculation.

5.2.3 Total value of primary industry

The data from Table 5-4 was adopted and GDP was set as independent variable and the output of primary industry was set as dependent variable to build a regression model. This model was then used to predict the output of primary industry under three different situations.
Table 5-4 China GDP and The output of primary industry from 2008 to 2015 (unit: trillion Yuan) (Source: Statistical yearbook of China)

<table>
<thead>
<tr>
<th>Year</th>
<th>GDP</th>
<th>The output of primary industry</th>
</tr>
</thead>
<tbody>
<tr>
<td>2008</td>
<td>31.95155</td>
<td>32.7532</td>
</tr>
<tr>
<td>2009</td>
<td>34.90814</td>
<td>34.1618</td>
</tr>
<tr>
<td>2010</td>
<td>41.30303</td>
<td>39.3626</td>
</tr>
<tr>
<td>2011</td>
<td>48.93006</td>
<td>46.1631</td>
</tr>
<tr>
<td>2012</td>
<td>54.03674</td>
<td>50.9023</td>
</tr>
<tr>
<td>2013</td>
<td>59.52444</td>
<td>55.3291</td>
</tr>
<tr>
<td>2014</td>
<td>64.3974</td>
<td>58.3435</td>
</tr>
<tr>
<td>2015</td>
<td>67.6708</td>
<td>60.863</td>
</tr>
</tbody>
</table>

Calculated by Eviews, the result as follow:

Figure 5-1 The result and test of one variable linear regression of the output of primary industry and GDP

T test was given on this regression model at 95 confidences, indicating validity of this one variable linear regression. The goodness of this model ($R^2$) is 0.997. It can be interpreted that fewer than 95% of confidence, China’s GDP could explain 99.7% of changes of the output of primary industry. The expression of this model is:
Combining Table 5-3, this model seeks to calculate the result in three situations (Table 5-5).

Table 5-5 The output of primary industry under three different situations from 2016 to 2020 (unit: trillion Yuan)

<table>
<thead>
<tr>
<th>Year</th>
<th>2016</th>
<th>2017</th>
<th>2018</th>
<th>2019</th>
<th>2020</th>
</tr>
</thead>
<tbody>
<tr>
<td>optimistic scenario</td>
<td>65.17362</td>
<td>68.99954</td>
<td>73.07414</td>
<td>77.41359</td>
<td>82.03511</td>
</tr>
<tr>
<td>negative scenario</td>
<td>64.62353</td>
<td>68.41369</td>
<td>72.45021</td>
<td>76.74910</td>
<td>81.32743</td>
</tr>
<tr>
<td>normal scenario</td>
<td>64.89857</td>
<td>68.70661</td>
<td>72.76217</td>
<td>77.08135</td>
<td>81.68127</td>
</tr>
</tbody>
</table>

5.2.4 The output of secondary industry

A regression model was made by the data from Table 5-6 and GDP as independent variable and the output of secondary industry as dependent variable. This model was used to predict the output of secondary industry under three different situations.

Table 5-6 China GDP and The output of secondary industry from 2008 to 2015 (unit: trillion Yuan) (Source: Statistical yearbook of China)

<table>
<thead>
<tr>
<th>Year</th>
<th>GDP</th>
<th>The output of secondary industry</th>
</tr>
</thead>
<tbody>
<tr>
<td>2008</td>
<td>31.95155</td>
<td>14.99566</td>
</tr>
<tr>
<td>2009</td>
<td>34.90814</td>
<td>16.01717</td>
</tr>
<tr>
<td>2010</td>
<td>41.30303</td>
<td>19.16298</td>
</tr>
<tr>
<td>2011</td>
<td>48.93006</td>
<td>22.70388</td>
</tr>
<tr>
<td>2012</td>
<td>54.03674</td>
<td>24.46433</td>
</tr>
<tr>
<td>2013</td>
<td>59.52444</td>
<td>26.19561</td>
</tr>
<tr>
<td>2014</td>
<td>64.3974</td>
<td>27.75718</td>
</tr>
<tr>
<td>2015</td>
<td>67.6708</td>
<td>27.4278</td>
</tr>
</tbody>
</table>

Calculated by Eviews, the result is as follows:
Figure 5-2 The result and test of one variable linear regression of the output of secondary industry and GDP

T test was given on this regression model at 95 confidence levels, indicating validity of this one variable linear regression. The goodness of this model ($R^2$) is 0.977. It can be interpreted that fewer than 95% of confidence, China’s GDP could explain 99.7% of changes of the output of primary industry.

$$X_2 = 0.372965Z + 35654.34$$

Combining Table 5-3 this model was used to calculate the result in three situations (Table 5-7).

Table 5-7 The output of secondary industry under three different situations from 2016 to 2020 (unit: trillion Yuan)

<table>
<thead>
<tr>
<th>Year</th>
<th>2016</th>
<th>2017</th>
<th>2018</th>
<th>2019</th>
<th>2020</th>
</tr>
</thead>
<tbody>
<tr>
<td>optimistic scenario</td>
<td>30.570993</td>
<td>32.326354</td>
<td>34.195814</td>
<td>36.186789</td>
<td>38.307177</td>
</tr>
<tr>
<td>negative scenario</td>
<td>30.318604</td>
<td>32.057560</td>
<td>33.909549</td>
<td>35.881916</td>
<td>37.982487</td>
</tr>
<tr>
<td>normal scenario</td>
<td>30.444799</td>
<td>32.191957</td>
<td>34.052681</td>
<td>36.034352</td>
<td>38.144832</td>
</tr>
</tbody>
</table>
5.2.5 The output of tertiary industry

A regression model was made with the data from Table 5-8, GDP set as independent variable and the output of tertiary industry set as dependent variable. This model was then used to predict the output of tertiary industry under three different situations.

<table>
<thead>
<tr>
<th>Year</th>
<th>GDP</th>
<th>The output of tertiary industry</th>
</tr>
</thead>
<tbody>
<tr>
<td>2008</td>
<td>31.95155</td>
<td>13.68058</td>
</tr>
<tr>
<td>2009</td>
<td>34.90814</td>
<td>15.47479</td>
</tr>
<tr>
<td>2010</td>
<td>41.30303</td>
<td>18.2038</td>
</tr>
<tr>
<td>2011</td>
<td>48.93006</td>
<td>21.60986</td>
</tr>
<tr>
<td>2012</td>
<td>54.03674</td>
<td>24.48219</td>
</tr>
<tr>
<td>2013</td>
<td>59.52444</td>
<td>27.79593</td>
</tr>
<tr>
<td>2014</td>
<td>64.3974</td>
<td>30.80586</td>
</tr>
<tr>
<td>2015</td>
<td>67.6708</td>
<td>34.1567</td>
</tr>
</tbody>
</table>

Calculated by Eviews, the result as follow:

```
Dependent Variable: X3
Method: Least Squares
Date: 11/26/16 Time: 09:40
Sample: 2008 2015
Included observations: 8

<table>
<thead>
<tr>
<th>Variable</th>
<th>Coefficient</th>
<th>Std. Error</th>
<th>t-Statistic</th>
<th>Prob.</th>
</tr>
</thead>
<tbody>
<tr>
<td>C</td>
<td>-41967.56</td>
<td>12459.41</td>
<td>-3.368343</td>
<td>0.0151</td>
</tr>
<tr>
<td>Z</td>
<td>0.545745</td>
<td>0.024018</td>
<td>22.72272</td>
<td>0.0000</td>
</tr>
</tbody>
</table>

R-squared | 0.988513  | Mean dependent var | 232762.1
Adjusted R-squared | 0.986598 | S.D. dependent var | 73524.27
S.E. of regression | 8511.589 | Akaike info criterion | 21.14856
Sum squared resid 4.35E+08 | Schwarz criterion | 21.16842
Log likelihood | -82.59425 | Hannan-Quinn criter. | 21.01461
F-statistic | 516.3219 | Durbin-Watson stat | 0.888685
Prob(F-statistic) 0.000000 |
```

Figure 5-3 The result and test of one variable linear regression of the output of tertiary industry and GDP

T test was given in this regression model at 95 confidences, proving the validity of
this one variable. The goodness of this model ($R^2$) is 0.988. So it can be interpreted that fewer than 95% of confidence, China’s GDP could explain 98.8% of changes of the Total export-import volume. The expression of this model:

$$X_3 = 0.545745Z - 41967.56$$

Combining Table 5-3 this model seeks to calculate the result in three situations (Table 5-9)

**Table 5-9** The output of tertiary industry under three different situations from 2016 to 2020 (unit: trillion Yuan)

<table>
<thead>
<tr>
<th>Year</th>
<th>2016</th>
<th>2017</th>
<th>2018</th>
<th>2019</th>
<th>2020</th>
</tr>
</thead>
<tbody>
<tr>
<td>optimistic scenario</td>
<td>35.319415</td>
<td>37.887966</td>
<td>40.623473</td>
<td>43.536788</td>
<td>46.639468</td>
</tr>
<tr>
<td>negative scenario</td>
<td>34.950105</td>
<td>37.494651</td>
<td>40.204592</td>
<td>43.090680</td>
<td>46.164363</td>
</tr>
<tr>
<td>normal scenario</td>
<td>35.134760</td>
<td>37.691308</td>
<td>40.414033</td>
<td>43.313734</td>
<td>46.401916</td>
</tr>
</tbody>
</table>

**5.2.6 The total investment in fixed assets**

A regression model was made with the data from Table 5-10, GDP set as independent variable and the total investment in fixed assets set as dependent variable to build a regression model. After that, this model was used to predict the total investment in fixed assets under three different situations.

**Table 5-10** China GDP and the total investment in fixed assets from 2008 to 2015 (unit: trillion Yuan) (Source: Statistical yearbook of China)

<table>
<thead>
<tr>
<th>Year</th>
<th>GDP</th>
<th>The total investment in fixed assets</th>
</tr>
</thead>
<tbody>
<tr>
<td>2008</td>
<td>31.95155</td>
<td>17.28284</td>
</tr>
<tr>
<td>2009</td>
<td>34.90814</td>
<td>22.459877</td>
</tr>
<tr>
<td>2010</td>
<td>41.30303</td>
<td>25.168377</td>
</tr>
<tr>
<td>2011</td>
<td>48.93006</td>
<td>31.148513</td>
</tr>
<tr>
<td>2012</td>
<td>54.03674</td>
<td>37.469474</td>
</tr>
<tr>
<td>2013</td>
<td>59.52444</td>
<td>44.629409</td>
</tr>
<tr>
<td>2014</td>
<td>64.3974</td>
<td>51.202065</td>
</tr>
<tr>
<td>2015</td>
<td>67.6708</td>
<td>56.2000</td>
</tr>
</tbody>
</table>
Figure 5-4 The result and test of one variable linear regression of the total investment in fixed assets and GDP

T test was given in this model at 95% confidence, proving the validity of this one variable. The goodness of this model ($R^2$) is 0.977. It can be interpreted that fewer than 95% of confidence, China’s GDP could explain 97.7% of changes of the total investment in fixed assets. The expression of this model:

$$X_4 = 1.040136Z - 166656.7$$

So we can combine Table 5-3 and this model to calculate the result in three situations (Table 5-11).

Table 5-11 the total investment in fixed assets under three different situations from 2016 to 2020 (unit: trillion Yuan)

<table>
<thead>
<tr>
<th>Year</th>
<th>2016</th>
<th>2017</th>
<th>2018</th>
<th>2019</th>
<th>2020</th>
</tr>
</thead>
<tbody>
<tr>
<td>optimistic scenario</td>
<td>58.648244</td>
<td>63.543648</td>
<td>68.757254</td>
<td>74.309744</td>
<td>80.223146</td>
</tr>
<tr>
<td>negative scenario</td>
<td>57.944375</td>
<td>62.794028</td>
<td>67.958909</td>
<td>73.459506</td>
<td>79.317643</td>
</tr>
<tr>
<td>normal scenario</td>
<td>58.296310</td>
<td>63.168838</td>
<td>68.358081</td>
<td>73.884625</td>
<td>79.770394</td>
</tr>
</tbody>
</table>
5.2.7 The Total retail sales of consumer goods

A regression model was made with the data from Table 5-12, GDP set as independent variable and the total retail sales of consumer goods set as dependent variable. This model was used to predict the total retail sales of consumer goods under three different situations.

Table 5-12 China GDP and the Total retail sales of consumer goods from 2008 to 2015

(Unit: trillion Yuan) (Source: Statistical yearbook of China)

<table>
<thead>
<tr>
<th>Year</th>
<th>GDP</th>
<th>The Total retail sales of consumer goods</th>
</tr>
</thead>
<tbody>
<tr>
<td>2008</td>
<td>31.95155</td>
<td>11.48301</td>
</tr>
<tr>
<td>2009</td>
<td>34.90814</td>
<td>13.30482</td>
</tr>
<tr>
<td>2010</td>
<td>41.30303</td>
<td>15.8008</td>
</tr>
<tr>
<td>2011</td>
<td>48.93006</td>
<td>18.72058</td>
</tr>
<tr>
<td>2012</td>
<td>54.03674</td>
<td>21.44327</td>
</tr>
<tr>
<td>2013</td>
<td>59.52444</td>
<td>24.28428</td>
</tr>
<tr>
<td>2014</td>
<td>64.3974</td>
<td>27.18961</td>
</tr>
<tr>
<td>2015</td>
<td>67.6708</td>
<td>30.0931</td>
</tr>
</tbody>
</table>

Calculated by Eviews, the result is as follows:

![Regression Results](Figure 5-5)

*Figure 5-5* the result and test of one variable linear regression of the Total retail sales of consumer goods and GDP
T test was given in this model at 95 confidences, proving the validity of this one variable. The goodness of this model \((R^2)\) is 0.988. It can be interpreted that fewer than 95% of confidence, China’s GDP could explain 98.8% of changes of the total retail sales of consumer goods. The expression of this model:

\[ X_5 = 0.493947Z + 11240.27 \]

Combining Table 5-3 this model seeks to calculate the result in three situations (Table 5-13).

**Table 5-13** The Total retail sales of consumer goods under three different situations from 2016 to 2020 (unit: trillion Yuan)

<table>
<thead>
<tr>
<th>Year</th>
<th>2016</th>
<th>2017</th>
<th>2018</th>
<th>2019</th>
<th>2020</th>
</tr>
</thead>
<tbody>
<tr>
<td>optimistic scenario</td>
<td>36.89621</td>
<td>39.214384</td>
<td>41.690258</td>
<td>44.327063</td>
<td>47.135260</td>
</tr>
<tr>
<td>negative scenario</td>
<td>36.555363</td>
<td>38.858400</td>
<td>41.311134</td>
<td>43.923296</td>
<td>46.705248</td>
</tr>
<tr>
<td>normal scenario</td>
<td>36.722492</td>
<td>39.036392</td>
<td>41.500696</td>
<td>44.125179</td>
<td>46.920254</td>
</tr>
</tbody>
</table>

**5.2.8 The Total export-import volume**

A regression model was made with the data from Table 5-14, GDP set as independent variable and the total export-import volume set as dependent variable. This model was used to predict the total retail sales of consumer goods under three different situations.

**Table 5-14** Chinese GDP and the Total export-import volume from 2008 to 2015(Source: Statistical yearbook of China)

<table>
<thead>
<tr>
<th>Year</th>
<th>GDP(trillion Yuan)</th>
<th>The Total export-import volume(trillion Dollar)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2008</td>
<td>31.95155</td>
<td>17.992147</td>
</tr>
<tr>
<td>2009</td>
<td>34.90814</td>
<td>15.064806</td>
</tr>
<tr>
<td>2010</td>
<td>41.30303</td>
<td>20.172215</td>
</tr>
<tr>
<td>2011</td>
<td>48.93006</td>
<td>23.640199</td>
</tr>
<tr>
<td>2012</td>
<td>54.03674</td>
<td>24.416021</td>
</tr>
<tr>
<td>2013</td>
<td>59.52444</td>
<td>25.816889</td>
</tr>
<tr>
<td>2014</td>
<td>64.3974</td>
<td>26.424177</td>
</tr>
<tr>
<td>2015</td>
<td>67.6708</td>
<td>24.5741</td>
</tr>
</tbody>
</table>
Calculated by Eviews, the result is as follows:

**Figure 5-6** the result and test of one variable linear regression of the Total export-import volume and GDP

T test was given in this model at 95 confidences, proving the validity of this one variable. The goodness of this model ($R^2$) is 0.819. It can be interpreted that fewer than 95% of confidence, China’s GDP of could explain 81.9% of changes of the total export-import volume. The expression of this model:

$$X_6 = 0.275270Z + 84054.11$$

Combing Table 5-3, this model seeks to calculate the result in three situations (Table 5-15).

**Table 5-15** The Total export-import volume under three different situations from 2016 to 2020 (unit: trillion Dollars)

<table>
<thead>
<tr>
<th>Year</th>
<th>2016</th>
<th>2017</th>
<th>2018</th>
<th>2019</th>
<th>2020</th>
</tr>
</thead>
<tbody>
<tr>
<td>optimistic scenario</td>
<td>28.337094</td>
<td>29.632653</td>
<td>31.012424</td>
<td>32.481880</td>
<td>34.046850</td>
</tr>
<tr>
<td>negative scenario</td>
<td>28.150817</td>
<td>29.434268</td>
<td>30.801144</td>
<td>32.256866</td>
<td>33.807211</td>
</tr>
<tr>
<td>normal scenario</td>
<td>28.243955</td>
<td>29.533461</td>
<td>30.906784</td>
<td>32.369373</td>
<td>33.927031</td>
</tr>
</tbody>
</table>
5.2.9 The Residents’ consumption

A regression model was made with the data from Table 5-16, GDP set as independent variable and the residents’ consumption set as dependent variable. This model was used to predict the residents’ consumption under three different situations.

Table 5-16 China’s GDP and the Residents’ consumption from 2008 to 2015 (Source: Statistical yearbook of China)

<table>
<thead>
<tr>
<th>Year</th>
<th>GDP (trillion Yuan)</th>
<th>The Residents’ consumption (Yuan/person)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2008</td>
<td>31.95155</td>
<td>8707</td>
</tr>
<tr>
<td>2009</td>
<td>34.90814</td>
<td>9514</td>
</tr>
<tr>
<td>2010</td>
<td>41.30303</td>
<td>10919</td>
</tr>
<tr>
<td>2011</td>
<td>48.93006</td>
<td>13134</td>
</tr>
<tr>
<td>2012</td>
<td>54.03674</td>
<td>14699</td>
</tr>
<tr>
<td>2013</td>
<td>59.52444</td>
<td>16190</td>
</tr>
<tr>
<td>2014</td>
<td>64.39743</td>
<td>17778</td>
</tr>
<tr>
<td>2015</td>
<td>676708</td>
<td>19555.8</td>
</tr>
</tbody>
</table>

Calculated by Eviews, the result as follow:

![Figure 5-7](attachment:image.png)

Figure 5-7 the result and test of one variable linear regression of resident’s consumption and GDP
T test was given in this model at 95 confidences, proving the validity of this one variable. The goodness of this model ($R^2$) is 0.992. It can be interpreted that fewer than 95% of confidence, China’s GDP could explain 99.2% of changes of resident’s consumption. The expression of this model:

$$X_7 = 0.029279Z - 926.8038$$

Combining Table 5-3, this model seeks to calculate the result in three situations (Table 5-17).

<table>
<thead>
<tr>
<th>Year</th>
<th>2016</th>
<th>2017</th>
<th>2018</th>
<th>2019</th>
<th>2020</th>
</tr>
</thead>
<tbody>
<tr>
<td>optimistic scenario</td>
<td>20273.46</td>
<td>21651.48</td>
<td>23119.07</td>
<td>24682.05</td>
<td>26346.63</td>
</tr>
<tr>
<td>negative scenario</td>
<td>20075.33</td>
<td>21440.47</td>
<td>22894.34</td>
<td>24442.72</td>
<td>26091.73</td>
</tr>
<tr>
<td>normal scenario</td>
<td>20174.40</td>
<td>21545.97</td>
<td>23006.71</td>
<td>24562.38</td>
<td>26219.18</td>
</tr>
</tbody>
</table>

**5.2.10 Summary**

All the results achieved above would help to calculate the output of primary industry, secondary industry, tertiary industry, the total investment in fixed assets, the Total retail sales of consumer goods, the Total export-import volume, and the Residents’ consumption under three different situations.
### Table 5-18 China economic data under normal scenario

<table>
<thead>
<tr>
<th>Year</th>
<th>2016</th>
<th>2017</th>
<th>2018</th>
<th>2019</th>
<th>2020</th>
</tr>
</thead>
<tbody>
<tr>
<td>The output of primary industry</td>
<td>64898.57</td>
<td>68706.61</td>
<td>72762.17</td>
<td>77081.35</td>
<td>81681.27</td>
</tr>
<tr>
<td>The output of secondary industry</td>
<td>304447.99</td>
<td>321919.57</td>
<td>340526.81</td>
<td>360343.52</td>
<td>381448.32</td>
</tr>
<tr>
<td>The output of tertiary industry</td>
<td>351347.60</td>
<td>376913.08</td>
<td>404140.33</td>
<td>433137.34</td>
<td>464019.16</td>
</tr>
<tr>
<td>The total investment in fixed assets</td>
<td>582963.10</td>
<td>631688.38</td>
<td>683580.81</td>
<td>738846.25</td>
<td>797703.94</td>
</tr>
<tr>
<td>The Total retail sales of consumer goods</td>
<td>367224.92</td>
<td>390363.92</td>
<td>415006.96</td>
<td>441251.79</td>
<td>469202.54</td>
</tr>
<tr>
<td>The Total export-import volume</td>
<td>282439.55</td>
<td>295334.61</td>
<td>309067.84</td>
<td>323693.73</td>
<td>339270.31</td>
</tr>
<tr>
<td>The Residents’ consumption</td>
<td>20174.40</td>
<td>21545.97</td>
<td>23006.71</td>
<td>24562.38</td>
<td>26219.18</td>
</tr>
</tbody>
</table>

### Table 5-19 China economic data under negative scenario

<table>
<thead>
<tr>
<th>Year</th>
<th>2016</th>
<th>2017</th>
<th>2018</th>
<th>2019</th>
<th>2020</th>
</tr>
</thead>
<tbody>
<tr>
<td>The output of primary industry</td>
<td>64623.53</td>
<td>68413.69</td>
<td>72450.21</td>
<td>76749.10</td>
<td>81327.43</td>
</tr>
<tr>
<td>The output of secondary industry</td>
<td>303186.04</td>
<td>320575.60</td>
<td>339095.49</td>
<td>358819.16</td>
<td>379824.87</td>
</tr>
<tr>
<td>The output of tertiary industry</td>
<td>349501.05</td>
<td>374946.51</td>
<td>402045.92</td>
<td>430906.80</td>
<td>461643.63</td>
</tr>
<tr>
<td>The total investment in fixed assets</td>
<td>579443.75</td>
<td>627940.28</td>
<td>679589.09</td>
<td>734595.06</td>
<td>793176.43</td>
</tr>
<tr>
<td>The Total retail sales of consumer goods</td>
<td>365553.63</td>
<td>388584.00</td>
<td>413111.34</td>
<td>439232.96</td>
<td>467052.48</td>
</tr>
<tr>
<td>The Total export-import volume</td>
<td>281508.17</td>
<td>294342.68</td>
<td>308011.44</td>
<td>322568.66</td>
<td>338072.11</td>
</tr>
<tr>
<td>The Residents’ consumption</td>
<td>20075.33</td>
<td>21440.47</td>
<td>22894.34</td>
<td>24442.72</td>
<td>26091.73</td>
</tr>
</tbody>
</table>
**Table 5-20** China economic data under optimistic scenario

<table>
<thead>
<tr>
<th>Year</th>
<th>2016</th>
<th>2017</th>
<th>2018</th>
<th>2019</th>
<th>2020</th>
</tr>
</thead>
<tbody>
<tr>
<td>The output of primary industry</td>
<td>65173.62</td>
<td>68999.54</td>
<td>73074.14</td>
<td>77413.59</td>
<td>82035.11</td>
</tr>
<tr>
<td>The output of secondary industry</td>
<td>305709.93</td>
<td>323263.54</td>
<td>341958.14</td>
<td>361867.89</td>
<td>383071.77</td>
</tr>
<tr>
<td>The output of tertiary industry</td>
<td>353194.15</td>
<td>378879.66</td>
<td>406234.73</td>
<td>435367.88</td>
<td>466394.68</td>
</tr>
<tr>
<td>The total investment in fixed assets</td>
<td>586482.44</td>
<td>635436.48</td>
<td>687572.54</td>
<td>743097.44</td>
<td>802231.46</td>
</tr>
<tr>
<td>The Total retail sales of consumer goods</td>
<td>368896.21</td>
<td>392143.84</td>
<td>416902.58</td>
<td>443270.63</td>
<td>471352.60</td>
</tr>
<tr>
<td>The Total export-import volume</td>
<td>283370.94</td>
<td>296326.53</td>
<td>310124.24</td>
<td>324818.80</td>
<td>340468.50</td>
</tr>
<tr>
<td>The Residents’ consumption</td>
<td>20273.46</td>
<td>21651.48</td>
<td>23119.07</td>
<td>24682.05</td>
<td>26346.63</td>
</tr>
</tbody>
</table>
6 The demand forecast of China courier industry

6.1 The analysis of demand in China courier industry

6.1.1 Building the grey model

In general, there are two ways to calculate the GM model, and they are accumulated generating operation and accumulated reduction operation. As their name suggest, accumulated generating operation would make sequences plus together to obtain new sequence and data:

\[ X^{(1)} = \{X^{(1)}(t_1), X^{(1)}(t_2), \ldots, X^{(1)}(t_n)\} = \left\{X^{(0)}(t_1), \sum_{i=1}^{2} X^{(0)}(t_i), \ldots, \sum_{i=1}^{n} X^{(0)}(t_i)\right\} \]

On the contrary, accumulated reduction operation would make sequences minus together to obtain new sequence and data:

\[ X^{(0)}(t_i) = X^{(1)}(t_i) - X^{(1)}(t_{i-1}), \quad (i = 1, 2, 3, \ldots) \]

In this thesis, accumulated generating operation to calculate and process data were used.

6.1.1.1 GM (1, 8)

In this thesis, 8 factors were mentioned. A GM (1, 8) was built to find the relationship between them; the differential equation is as follows:

\[ \frac{dY^{(1)}}{dt} + \alpha Y^{(1)} = \beta_1 X_1^{(1)} + \beta_2 X_2^{(1)} + \beta_3 X_3^{(1)} + \beta_4 X_4^{(1)} + \beta_5 X_5^{(1)} + \beta_6 X_6^{(1)} + \beta_7 X_7^{(1)} \]

And

\[ A_1 = [\alpha, \beta_1, \beta_2, \beta_3, \beta_4, \beta_5, \beta_6, \beta_7]^T = (B^TB)^{-1}B^TY \]

\[ Y = \left[ X_1^{(0)}(2), X_1^{(0)}(3), \ldots, X_1^{(0)}(n) \right]^T \]

\[ B = \left[ \begin{array}{cccc}
-\frac{1}{2} \times (X_1^{(1)}(2) + X_1^{(1)}(1)) & X_2^{(1)}(2) & \cdots & X_7^{(1)}(2) \\
\vdots & \ddots & \ddots & \vdots \\
-\frac{1}{2} \times (X_1^{(1)}(n) + X_1^{(1)}(n - 1)) & X_2^{(1)}(n) & \cdots & X_7^{(1)}(n) 
\end{array} \right] \]

After calculating the equation:

\[ X_1^{(1)}(n + 1) = \left[ X_1^{(0)}(1) - \frac{1}{\alpha} \sum_{i=1}^{7} \beta_i X_i^{(1)}(n + 1) \right] \times e^{-\alpha n} + \frac{1}{\alpha} \sum_{i=1}^{7} \beta_i X_i^{(1)}(n + 1) \]
\[ X_1^{(0)}(n + 1) = X_1^{(2)}(n + 1) - X_1^{(1)}(n), \quad (n = 0, 1, 2, \ldots) \]

### 6.1.1.2 GM (1, 1)

Also, GM (1, 1) is used to test the precision of those factors. In other words, the purpose of GM (1, 1) is to test whether those predicted data is reasonable. The differential equation is as follows:

\[
\frac{dX^{(1)}}{dt} + aX^{(1)} = \beta
\]

And

\[
A = [a, \beta]^T = (B^T B)^{-1} B^T Y
\]

\[
Y = [X^{(0)}(2), X^{(0)}(3), \ldots, X^{(0)}(n)]^T
\]

\[
B = \begin{bmatrix}
-\frac{1}{2} \times (X^{(1)}(2) + X^{(1)}(1)) & 1 \\
\vdots & \vdots \\
-\frac{1}{2} \times (X^{(1)}(n) + X^{(1)}(n - 1)) & 1
\end{bmatrix}
\]

After calculating the equation:

\[
X^{(1)}(n + 1) = \left( X^{(0)}(1) - \frac{\beta}{a} \right) \times e^{-\alpha m} + \frac{\beta}{a}, \quad (n = 0, 1, 2, \ldots)
\]

Posterior error is used to test the precision of model in this thesis (table 6-1), and the following table demonstrates the accuracy standard of posterior error of the grey model (Ning et al, 2009):

<table>
<thead>
<tr>
<th>Table 6-1 The standard of Posterior error</th>
</tr>
</thead>
<tbody>
<tr>
<td>Good</td>
</tr>
<tr>
<td>------</td>
</tr>
<tr>
<td>P (minimum error probability)</td>
</tr>
<tr>
<td>C (variance ration)</td>
</tr>
</tbody>
</table>

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6.1.2 Building China courier demand model

Based on the variables set on chapter 4, \( Y \) equals the output value of courier industry, \( X_1 \) is the output of primary industry, \( X_2 \) for secondary industry, \( X_3 \) for tertiary industry, \( X_4 \) for the total investment in fixed assets, \( X_5 \) for the total retail sales of consumer goods, \( X_6 \) equals to the total export-import volume and \( X_7 \) means the Residents’ consumption. And the related data from 2008 to 2015 was used as well (Table 6-2).

<table>
<thead>
<tr>
<th>Year</th>
<th>The output value of courier industry (billion Yuan)</th>
<th>The output of primary industry (trillion Yuan)</th>
<th>The output of secondary industry (trillion Yuan)</th>
<th>The output of tertiary industry (trillion Yuan)</th>
<th>The total investment in fixed assets (trillion Yuan)</th>
<th>The Total retail sales of consumer goods (trillion Yuan)</th>
<th>The Total export-import volume (trillion dollar)</th>
<th>The Residents’ consumption (Yuan/peop le)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2008</td>
<td>40.84</td>
<td>32.7532</td>
<td>14.9956</td>
<td>13.6805</td>
<td>17.28</td>
<td>11.48301</td>
<td>17.992147</td>
<td>8707</td>
</tr>
<tr>
<td>2009</td>
<td>47.9</td>
<td>34.1618</td>
<td>16.0171</td>
<td>15.4747</td>
<td>22.45</td>
<td>13.30482</td>
<td>15.064806</td>
<td>9514</td>
</tr>
<tr>
<td>2010</td>
<td>57.46</td>
<td>39.3626</td>
<td>19.1629</td>
<td>18.2038</td>
<td>25.16</td>
<td>15.8008</td>
<td>20.172215</td>
<td>10919</td>
</tr>
<tr>
<td>2011</td>
<td>75.8</td>
<td>46.1631</td>
<td>22.7038</td>
<td>21.6098</td>
<td>31.14</td>
<td>18.72058</td>
<td>23.640199</td>
<td>13134</td>
</tr>
<tr>
<td>2013</td>
<td>151.51</td>
<td>55.3291</td>
<td>26.1956</td>
<td>27.7959</td>
<td>44.62</td>
<td>24.28428</td>
<td>25.816889</td>
<td>16190</td>
</tr>
<tr>
<td>2014</td>
<td>204.54</td>
<td>58.3435</td>
<td>27.7571</td>
<td>30.8058</td>
<td>51.20</td>
<td>27.18961</td>
<td>26.424177</td>
<td>17778</td>
</tr>
<tr>
<td>2015</td>
<td>276</td>
<td>60.863</td>
<td>27.4278</td>
<td>34.1567</td>
<td>56.20</td>
<td>30.0931</td>
<td>24.5741</td>
<td>19555.8</td>
</tr>
</tbody>
</table>

Original sequences as follow:
\[ Y^{(0)} = \{408.4, 479, 574.6, 758, 1055.3, 1515.1, 2045.4, 2760\} \]
\[ X_1^{(0)} = \{32753.2, 34161.8, 39362.6, 46163.1, 50902.3, 55329.1, 58343.5, 60863\} \]
\begin{align*}
X_2^{(0)} &= \{149956.6, 160171.7, 191629.8, 227038.8, 244643.3, 261956.1, 277571.8, 274278\} \\
X_3^{(0)} &= \{136805.8, 154747.9, 182038, 216098.6, 244821.9, 277959.3, 308058.6, 341567\} \\
X_4^{(0)} &= \{172828.4, 224598.77, 251683.77, 311485.13, 374694.74, 446294.09, 512020.65, 562000\} \\
X_5^{(0)} &= \{114830.1, 133048.2, 158008, 187205.8, 214432.7, 242842.8, 271896.1, 300931\} \\
X_6^{(0)} &= \{179921.47, 150648.06, 201722.15, 236401.99, 244160.21, 258168.89, 264241.77, 245741\} \\
X_7^{(0)} &= \{8707, 9514, 10919, 13134, 14699, 16190, 17778, 19555.8\} \\
\text{Sequence after once accumulated:} \\
Y^{(1)} &= \{408.4, 887.4, 1462, 2220, 3275.3, 4790.4, 6835.8, 9595.8\} \\
X_1^{(1)} &= \{32753.266915.00, 106277.60, 152440.70, 203343.00, 258672.10, 317015.60, 377878.60\} \\
X_2^{(1)} &= \{149956.6, 310128.30, 501758.10, 728796.90, 973440.20, 1235396.30, 1512968.10, 1787246.10\} \\
X_3^{(1)} &= \{136805.8, 291553.70, 473591.70, 689690.30, 934512.20, 1212471.50, 1520530.10, 1862097.10\} \\
X_4^{(1)} &= \{172828.4, 397427.17, 649110.94, 960596.07, 1335290.81, 1781584.90, 2293605.55, 2855605.55\} \\
X_5^{(1)} &= \{114830.1, 247878.30, 405886.30, 593092.10, 807524.80, 1050367.60, 1322263.70, 1623194.70\} \\
X_6^{(1)} &= \{179921.47, 330569.53, 532291.68, 768693.67, 1012853.88, 1271022.77, 1535264.54, 1781005.54\} \\
X_7^{(1)} &= \{8707, 18221.00, 29140.00, 42274.00, 56973.00, 73163.00, 90941.00, 110496.80\}
\end{align*}
6.1.3 Building GM (1, 1) model

Because the output of primary industry, secondary industry, tertiary industry, the total investment in fixed assets, the total retail sales of consumer goods, and the total export-import volume and means the Residents’ consumption are all independent variables, 7 GM (1, 1) models were built to test the precision of the model.

6.1.3.1 GM (1, 1) of the output of primary industry

The B and Y matrix of total value of primary industry in GM (1, 1):

\[ B = \begin{bmatrix}
-49834.1 & 1 \\
-86596.3 & 1 \\
-129359.15 & 1 \\
-177891.85 & 1 \\
-231007.55 & 1 \\
-287853.85 & 1 \\
-347447.1 & 1
\end{bmatrix}, \quad Y = \begin{bmatrix}
34161.8 \\
39362.6 \\
46163.1 \\
50902.3 \\
55329.1 \\
58343.5 \\
60863
\end{bmatrix} \]

Matlab led to A

\[ A = (B^T B)^{-1} B^T Y = [\alpha, \beta]^T = [-0.089422, 32569.1756]^T \]

So GM (1, 1) model of total value of primary industry is:

\[ X_1^{(1)} (n + 1) = 396972.023 e^{0.089422n} - 364218.8231, \quad (n = 0, 1, 2, ...) \]

The posterior error of this model:

\[ c = \frac{S_2}{S_1} = 0.417578 < 0.5, P = \left[ \left| \Delta^{(0)} (1) - \overline{\Delta}^{(0)} \right| < 0.6745 \times S_1 \right] = 0.875 > 0.8 \]

The result shows the suitability of the model in that the posterior error was more than 0.8.

6.1.3.2 GM (1, 1) of the output of secondary industry

The B and Y matrix of total value of secondary industry in GM (1, 1):
\[
\begin{bmatrix}
-230042.45 & 1 \\
-405943.20 & 1 \\
-615277.50 & 1 \\
-851118.55 & 1 \\
-1104418.25 & 1 \\
-1374182.20 & 1 \\
-1650107.10 & 1
\end{bmatrix}
\begin{bmatrix}
\begin{array}{c}
160171.7 \\
191629.8 \\
227038.8 \\
244643.3 \\
261956.1 \\
277571.8 \\
274278
\end{array}
\end{bmatrix}
\]

The Matlab led to A.
\[
A = (B^T B)^{-1} B^T Y = [\alpha, \beta]^T = [-0.08002345, 162665.17167]^T
\]

So GM (1, 1) model of total value of secondary industry is:

\[
X_2^{(1)}(n + 1) = 2182675.4e^{0.08002345n} - 2032718.8052, \quad (n = 0, 1, 2, ...)
\]

The posterior error of this model:

\[
c = \frac{S_2}{S_1} = 0.424776 < 0.5, \quad P = \left\{ \left| \Delta^{(0)}(i) - \overline{\Delta}^{(0)} \right| < 0.6745 \times S_1 \right\} = 0.875 > 0.8
\]

The result shows the suitability of the model in that the posterior error was more than 0.8.

### 6.1.3.3 GM (1, 1) of total value of tertiary industry

The B and Y matrix of total value of tertiary industry in GM (1, 1):

\[
\begin{bmatrix}
-214179.75, & 1 \\
-382572.70, & 1 \\
-581641.00, & 1 \\
-812101.25, & 1 \\
-1073491.85, & 1 \\
-1366500.80, & 1 \\
-1691313.60, & 1
\end{bmatrix}
\begin{bmatrix}
154747.9 \\
182038 \\
216098.6 \\
244821.9 \\
277959.3 \\
308058.6 \\
341567
\end{bmatrix}
\]

The Matlab led to A.
\[
A = (B^T B)^{-1} B^T Y = [\alpha, \beta]^T = [-0.12554657, 136674.31826]^T
\]

So GM (1, 1) model of total value of tertiary industry is:

\[
X_3^{(1)}(n + 1) = 1225439.97e^{0.12554657n} - 1088634.17, \quad (n = 0, 1, 2, ...)
\]

The posterior error of this model:

\[
c = \frac{S_2}{S_1} = 0.448878 < 0.5, \quad P = \left\{ \left| \Delta^{(0)}(i) - \overline{\Delta}^{(0)} \right| < 0.6745 \times S_1 \right\} = 1 > 0.95
\]
The result shows the suitability of the model in that the posterior error was more than 0.95.

6.1.3.4 GM (1, 1) of the total investment in fixed assets

The B and Y matrix of total investment in fixed asset in GM (1, 1):

\[
B = \begin{bmatrix}
-265127.79, & 1; \\
-523269.06, & 1; \\
-804853.51, & 1; \\
-1147943.44, & 1; \\
-1558437.86, & 1; \\
-2037595.23, & 1; \\
-2574605.55, & 1 \\
\end{bmatrix}, \quad Y = \begin{bmatrix}
224598.77 \\
251683.77 \\
311485.13 \\
374694.74 \\
446294.09 \\
512020.65 \\
562000 \\
\end{bmatrix}
\]

The Matlab led to A. So GM (1, 1) model of total investment in fixed asset is:

\[
A = (B^T B)^{-1} B^T Y = [\alpha, \beta]^T = [-0.1546455, 185929.9469]^T
\]

So GM (1, 1) model of total investment in fixed asset is:

\[
X_{t+1}^{(1)} = 1375126.22 e^{0.1546455n} - 1202297.82, \quad (n = 0,1,2,...)
\]

The posterior error of this model:

\[
c = \frac{S_2}{S_1} = 0.433290 < 0.5, P = \left[ |\Delta^{(0)}(i) - \bar{\Delta}^{(0)}| < 0.6745 \times S_1 \right] = 0.875 > 0.8
\]

The result shows the suitability of the model in that the posterior error was more than 0.8.

6.1.3.5 GM (1, 1) of the Total retail sales of consumer goods

The B and Y matrix of the Total retail sales of consumer goods in GM (1, 1):

\[
B = \begin{bmatrix}
-181354.20, & 1; \\
-326882.30, & 1; \\
-499489.20, & 1; \\
-700308.43, & 1; \\
-928964.20, & 1; \\
-1186315.65, & 1; \\
-1472729.20, & 1 \\
\end{bmatrix}, \quad Y = \begin{bmatrix}
133048.2 \\
158008 \\
187205.8 \\
214432.7 \\
242842.8 \\
271896.1 \\
300931 \\
\end{bmatrix}
\]

The Matlab led to A. So GM (1, 1) model of the Total retail sales of consumer goods is:

\[
A = (B^T B)^{-1} B^T Y = [\alpha, \beta]^T = [-0.179921, 83675.6384]^T
\]
\[ X^{(1)}_3(n + 1) = 579897.37e^{0.179921n} - 465067.27, \quad (n = 0, 1, 2, \ldots) \]

The posterior error of this model:

\[ e = \frac{S_2}{S_1} = 0.448444 < 0.5, \quad P = \left\{ \left| \Delta^{(0)}(i) - \bar{\Delta}^{(0)} \right| < 0.6745 \times S_1 \right\} = 1 > 0.95 \]

The result shows the suitability of the model in that the posterior error was more than 0.95.

### 6.1.3.6 GM (1, 1) of the Total export-import volume

The B and Y matrix of the Total export-import volume in GM (1, 1):

\[
B = \begin{bmatrix}
-255245.50, & 1; \\
-431430.61, & 1; \\
-650492.68, & 1; \\
-890773.78, & 1; \\
-1141938.33, & 1; \\
-1403143.66, & 1; \\
-1658135.04, & 1;
\end{bmatrix}, \quad Y = \begin{bmatrix}
150648.06 \\
201722.15 \\
236401.99 \\
244160.21 \\
258268.89 \\
264241.77 \\
245741 \\
\end{bmatrix}
\]

The Matlab led to A.

\[ A = (B^TB)^{-1}B^TY = [\alpha, \beta]^T = [-0.0624867, 171317.44362]^T \]

So GM (1, 1) model of total value of import-export is:

\[ X^{(1)}_6(n + 1) = 2921583.99e^{0.0624867n} - 2741662.52, \quad (n = 0, 1, 2, \ldots) \]

The posterior error of this model:

\[ e = \frac{S_2}{S_1} = 0.427924 < 0.5, \quad P = \left\{ \left| \Delta^{(0)}(i) - \bar{\Delta}^{(0)} \right| < 0.6745 \times S_1 \right\} = 0.875 > 0.8 \]

The result shows the suitability of the model in that the posterior error was more than 0.8.

### 6.1.3.7 GM (1, 1) of resident consumption

The B and Y matrix of resident consumption in GM (1, 1):
The Matlab led to \( A \).

\[
A = (B^T B)^{-1}B^T Y = [a, \beta]^T = [-0.1136666, 8528.2162]^T
\]

So GM (1, 1) model of resident consumption is:

\[
X_2^{(1)}(n + 1) = 83735.34 e^{0.1136666n} - 75028.34, \quad (n = 0, 1, 2, \ldots)
\]

The posterior error of this model:

\[
c = \frac{S_2}{S_1} = 0.443155 < 0.5, P = \left\{ |\Delta^{(0)}(i) - \bar{\Delta}^{(0)}| < 0.6745 \times S_2 \right\} = 1 > 0.95
\]

The result shows the suitability of the model in that the posterior error was more than 0.95.

### 6.1.3.8 Forecasting Model of Regional Courier Demand System

Before building the forecasting model of regional courier demand system, GM (1, 8) of regional courier demand was built.

\[
Y^{(1)} = \{408.4, 887.4, 1462, 2220, 3275.3, 4790.4, 6835.8, 9595.8\}
\]

\[
Y^{(0)} = \{408.4, 479, 574.6, 758, 1055.3, 1515.1, 2045.4, 2760\}
\]

The B and Y matrix of GM (1, 1) of region courier demand:

\[
B = \begin{bmatrix}
-13464.00, & 1; \\
-23680.50, & 1; \\
-35707.00, & 1; \\
-49623.50, & 1; \\
-65068.00, & 1; \\
-82052.00, & 1; \\
-100718.90, & 1
\end{bmatrix}, \quad Y = \begin{bmatrix}
9514 \\
10919 \\
131314 \\
14699 \\
16190 \\
17778 \\
19555.8
\end{bmatrix}
\]

\[
\text{The B and Y matrix of GM (1, 1) of region courier demand:}
\]

\[
B = \begin{bmatrix}
-647.90 & 66915.00 & 310128.30 & 291553.70 & 397427.17 & 247678.30 & 330539.53 & 18221.00 \\
-1174.70 & 106227.60 & 501758.10 & 473591.70 & 649110.94 & 405886.30 & 532291.68 & 29140.00 \\
-1841.00 & 152440.70 & 728796.90 & 699690.30 & 960596.07 & 593092.10 & 768693.67 & 42274.00 \\
-2747.65 & 203343.00 & 973440.20 & 934512.20 & 1335290.81 & 807524.80 & 1012853.88 & 56973.00 \\
-4032.85 & 258672.10 & 1235396.30 & 1212471.50 & 1781584.90 & 1050347.60 & 1271022.77 & 73163.00 \\
-5813.10 & 317015.60 & 1512968.10 & 1520530.10 & 2293605.55 & 1322263.70 & 1535264.54 & 90941.00 \\
-8215.80 & 377878.60 & 1787246.10 & 1862097.10 & 2855605.55 & 1623194.70 & 1781005.54 & 110496.00
\end{bmatrix}
\]
The Matlab led to A.

\[ A = (B^T B)^{-1} B^T Y = [\alpha, \beta_1, \beta_2, \beta_3, \beta_4, \beta_5, \beta_6, \beta_7]^T \]

\[ = \begin{bmatrix} 1.290019, 0.017783, -0.000065, -0.000148, -0.005298, 0.021246, -0.025633, 0.294585 \end{bmatrix}^T \]

So the forecasting GM (1, 8) of China courier demands:

\[ Y^{(1)}(n + 1) = \left[ 408.4 - 0.013785X_4^{(1)}(n + 1) - 0.000050X_2^{(1)}(n + 1) \right. \]
\[ + 0.000115X_3^{(1)}(n + 1) + 0.004107(n + 1) - 0.016470X_5^{(1)}(n + 1) \]
\[ + 0.019870X_6^{(1)}(n + 1) - 0.228357X_7^{(1)}(n + 1) \]
\[ + 0.013785X_1^{(1)}(n + 1) + 0.000050X_2^{(1)}(n + 1) - 0.000115X_3^{(1)}(n + 1) \]
\[ - 0.004107X_4^{(1)}(n + 1) + 0.016470X_5^{(1)}(n + 1) - 0.019870X_6^{(1)}(n + 1) \]
\[ + 0.228357X_7^{(1)}(n + 1), \quad (n = 0, 1, 2, ...) \]

The posterior error of this model:

\[ c = \frac{S_2}{S_1} = 0.476282 < 0.5 \]

\[ P = \left\{ |\Delta^{(0)}(i) - \Delta^{(0)}| < 0.6745 \times S_1 \right\} = 1 > 0.95 \]

The result shows the suitability of the model in that the posterior error was more than 0.95.
6.1.3.9 Comprehensive prediction model of China courier production value

Based on the above analysis and calculation, the GM (1, 1) of total value of primary industry, secondary industry, tertiary industry, total investment in fixed asset, the total retail sales of consumer goods, the total export-import volume and the Residents’ consumption and GM (1, 8) of forecast of China courier production value were obtained.

A comprehensive model of China courier production value was established, which is used to predict the China courier production value in the next few years. The model is as follows:

\[
\begin{align*}
X_1^{(1)}(n + 1) &= 396972.023e^{0.069422n} - 364218.8231, \\
X_2^{(1)}(n + 1) &= 2182675.4e^{0.08002345n} - 2032718.8052, \\
X_3^{(1)}(n + 1) &= 1225439.97e^{0.12554657n} - 1086634.17, \\
X_4^{(1)}(n + 1) &= 1375126.22e^{0.1546455n} - 1202297.82, \\
X_5^{(1)}(n + 1) &= 579897.37e^{0.179921n} - 465067.27, \\
X_6^{(1)}(n + 1) &= 2921583.99e^{0.0624867n} - 2741662.52, \\
Y^{(1)}(n + 1) &= 408.4 - 0.13785X_1^{(1)}(n + 1) - 0.000050X_2^{(1)}(n + 1) \\
&+ 0.000115X_3^{(1)}(n + 1) + 0.004107Y^{(1)}(n + 1) - 0.016470X_5^{(1)}(n + 1) \\
&+ 0.019870X_6^{(1)}(n + 1) - 0.228357X_7^{(1)}(n + 1) \\
&+ 0.1290019n + 0.013785X_1^{(1)}(n + 1) + 0.000050X_2^{(1)}(n + 1) - 0.000115X_3^{(1)}(n + 1) \\
&- 0.004107X_4^{(1)}(n + 1) + 0.016470X_5^{(1)}(n + 1) - 0.019870X_6^{(1)}(n + 1) \\
&+ 0.228357X_7^{(1)}(n + 1) \\
Y^{(0)}(n + 1) &= Y^{(1)}(n + 1) - Y^{(1)}(n)
\end{align*}
\]

Moreover, as proved above, the precision of those 8 models has a high accuracy. This comprehensive model is suitable for prediction and analysis.

6.2 Situation Analysis of demand forecast in China courier industry

The model displayed the courier demand in different situations in the next 5 years.
6.2.1 Development trend of China courier industry under normal scenario

Under normal scenario, from 2016 to 2020, economic growth in China will stay at a speed of 6.5% per year (Table 6-2).

<table>
<thead>
<tr>
<th>Year</th>
<th>2016</th>
<th>2017</th>
<th>2018</th>
<th>2019</th>
<th>2020</th>
</tr>
</thead>
<tbody>
<tr>
<td>China courier production value</td>
<td>351.827</td>
<td>380.669</td>
<td>411.384</td>
<td>444.095</td>
<td>478.931</td>
</tr>
</tbody>
</table>

Data based on the courier demand shows that when economy grows at 6.5% per year, the courier revenue would rise up in the next 5 years. As Table 6-2 shows, the growth rate is 27.47%、8.19%、8.07%、7.95%、7.84% respectively.

Combing the other economic data under normal scenario, the correlation coefficient matrix and grey correlation between courier production value and other economic data were reckoned (Table 6-4):

| Correlation between courier production and primary industry | 0.931087 |
| Correlation between courier production and secondary industry | 0.931332 |
| Correlation between courier production and tertiary industry | 0.916074 |
| Correlation between courier production and total investment in fixed asset | 0.906057 |
| Correlation between courier production and the Total retail sales of consumer goods | 0.925579 |
| Correlation between courier production and the Total export-import volume | 0.943860 |
| Correlation between courier production and The Residents’ consumption | 0.923409 |

Comparison with Table 5-2 led to some findings. Table 5-2 indicated that the primary industry and the total export-import volume has the best synchronization to courier production value among those explanatory variables (relevancy is higher than 86%). In Table 6-3, the relevancy of those 7 variables exceeds 90%.
Moreover, it can be seen that the correlation of primary industry, total investment in fixed asset, the total retail sales of consumer goods and the Residents’ consumption had more tremendous correlation than before. Tertiary industry and the Residents’ consumption keep a steady correlation with courier industry.

6.2.2 Development trend of China courier industry under negative scenario

Under normal scenario, from 2016 to 2020, economy in China will grow at a speed of 6% per year (Table 6-5).

<table>
<thead>
<tr>
<th>Year</th>
<th>2016</th>
<th>2017</th>
<th>2018</th>
<th>2019</th>
<th>2020</th>
</tr>
</thead>
<tbody>
<tr>
<td>China courier production value</td>
<td>349.744</td>
<td>378.450</td>
<td>409.021</td>
<td>441.578</td>
<td>476.252</td>
</tr>
</tbody>
</table>

Data based on the courier demand shows that when economy grows at 6.5% per year, the courier revenue would rise up in the next 5 years. As Table 6-4 shows, the growth rate is 28.23%、8.19%、8.06%、7.94%、7.84% respectively. Combing the other economic data under normal scenario, the correlation coefficient matrix and grey correlation between courier production value and other economic data were reckoned (Table 6-6):
Table 6-6 Grey correlation between courier production value and other economic data

<table>
<thead>
<tr>
<th>Correlation between courier production and primary industry</th>
<th>0.931119</th>
</tr>
</thead>
<tbody>
<tr>
<td>Correlation between courier production and secondary industry</td>
<td>0.931366</td>
</tr>
<tr>
<td>Correlation between courier production and tertiary industry</td>
<td>0.916035</td>
</tr>
<tr>
<td>Correlation between courier production and total investment in fixed asset</td>
<td>0.905956</td>
</tr>
<tr>
<td>Correlation between courier production and the Total retail sales of consumer goods</td>
<td>0.925589</td>
</tr>
<tr>
<td>Correlation between courier production and the Total export-import volume</td>
<td>0.943931</td>
</tr>
<tr>
<td>Correlation between courier production and The Residents’ consumption</td>
<td>0.923409</td>
</tr>
</tbody>
</table>

Comparison with Table 5-2 led to some findings. Table 5-2 indicated that the primary industry and the total export-import volume has the best synchronization to courier production value among those explanatory variables (relevancy is higher than 86%). In Table 6-5, the relevancy of those 7 variables exceeds 90%.

Moreover, it can be seen that the correlation of primary industry, total investment in fixed asset, the total retail sales of consumer goods and the Residents’ consumption had more tremendous correlation than before. Tertiary industry and the Residents’ consumption keep a steady correlation with courier industry.

6.2.3 Development trend of China courier industry under optimistic scenario

Under normal scenario, from 2016 to 2020, economy in China will grow at a speed of 7% per year (Table 6-7).
Data based on the courier demand shows that when economy grows at 7% per year, the courier revenue would rise up in the next 5 years. As Table 6-6 shows, the growth rate is 26.72%、8.21%、8.08%、7.96%、7.86% respectively.
Combining the other economic data under normal scenario, the correlation coefficient matrix and grey correlation between courier production value and other economic data were reckoned (Table 6-8):

### Table 6-7 China courier production value from 2016 to 2020 under optimistic scenario (unit: billion Yuan)

<table>
<thead>
<tr>
<th>Year</th>
<th>2016</th>
<th>2017</th>
<th>2018</th>
<th>2019</th>
<th>2020</th>
</tr>
</thead>
<tbody>
<tr>
<td>China courier production value</td>
<td>353.910</td>
<td>382.887</td>
<td>413.746</td>
<td>446.611</td>
<td>481.611</td>
</tr>
</tbody>
</table>

Comparison with Table 5-2 led to some findings. Table 5-2 indicated that the primary industry and the total export-import volume has the best synchronization to courier production value among those explanatory variables (relevancy is higher than 86%). In Table 6-7, the relevancy of those 7 variables exceeds 90%.

Moreover, it can be seen that the correlation of primary industry, total investment in fixed asset, the total retail sales of consumer goods and the Residents’ consumption had more tremendous correlation than before. Tertiary industry and the Residents’ consumption keep a steady correlation with courier industry.

### Table 6-8 Grey correlation between courier production value and other economic data

<table>
<thead>
<tr>
<th>Correlation</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Correlation between courier production and primary industry</td>
<td>0.931055</td>
</tr>
<tr>
<td>Correlation between courier production and secondary industry</td>
<td>0.931299</td>
</tr>
<tr>
<td>Correlation between courier production and tertiary industry</td>
<td>0.916111</td>
</tr>
<tr>
<td>Correlation between courier production and total investment in fixed asset</td>
<td>0.906157</td>
</tr>
<tr>
<td>Correlation between courier production and the total retail sales of consumer goods</td>
<td>0.925569</td>
</tr>
<tr>
<td>Correlation between courier production and the Total export-import volume</td>
<td>0.943790</td>
</tr>
<tr>
<td>Correlation between courier production and the Residents’ consumption</td>
<td>0.923409</td>
</tr>
</tbody>
</table>
7 Conclusions

7.1 Result

By analyzing the courier production value from 2016 to 2020 under three different situations (Table 7-1), results were presented below:

<table>
<thead>
<tr>
<th>Year</th>
<th>2016</th>
<th>2017</th>
<th>2018</th>
<th>2019</th>
<th>2020</th>
</tr>
</thead>
<tbody>
<tr>
<td>Normal scenario</td>
<td>351.827</td>
<td>380.669</td>
<td>411.384</td>
<td>444.095</td>
<td>478.931</td>
</tr>
<tr>
<td>Negative scenario</td>
<td>349.744</td>
<td>378.450</td>
<td>409.021</td>
<td>441.578</td>
<td>476.252</td>
</tr>
<tr>
<td>Optimistic scenario</td>
<td>353.910</td>
<td>382.887</td>
<td>413.746</td>
<td>446.611</td>
<td>481.611</td>
</tr>
</tbody>
</table>

1. The courier production value is proportionally low, but shows an upward trend. One of the findings is that the proportion of GDP accoutered by courier industry is increasing. Take negative scenario as an example. the revenue of China courier industry in 2016 accounted for 4.9‰ of China’s GDP whereas in 2016 it accounted for 5.2‰ of China’s GDP for that year. That is to say, even under the worst situation (negative scenario); the courier industry would have a rosy prospect for future growth.

2. Under three different situations, the correlation of secondary industry, tertiary industry, the Residents ‘consumption and the total retail sales of consumer goods with courier production value have a rapid increase. It is expected that the future courier industry would deliver more service in facilitating residents’ life in China. Meanwhile, the correlation between primary industry and courier production value sustains a steady rise.

3. Under three different situations, the correlation between total investments in fixed asset and courier production value will foresee a rapid growth. The growth of total investments in fixed asset would have a substantial influence on the courier industry. Moreover, the investment on fixed assets is not saturated since the rate of increased correlation does not show any sign of slowing down in the near future.

4. The correlation between the total export-import volume and courier production value has a relatively low growth, despite the rise from 87% to 94%. It recommends that the courier industry should pay more attention to domestic market than overseas
market.

### 7.2 Suggestion

Several suggestions are proposed in this thesis based on a comprehensive analysis of the correlations in the previous chapters.

1. It is reasonable to hold out the possibility that courier services, playing an increasingly important role in national economy, would penetrate into people’s daily life to a fuller extent. The future development of courier industry will depend on the total investment in fixed assets, increase of which from the Chinese government will contribute to the future growth of the courier industry.

2. The correlation of courier productions and three main industries exceeds 90% in 2020. Courier services will not only enter into people’s life but also give itself a full play in agriculture and industry. Courier service network should be improved by the Chinese government in both industrial and agricultural districts instead of exclusive focus on urban areas.

3. Cooperation between courier industry and retail trade shall be strengthened. As one of the main supports of courier industry, retail trade is expected to cooperate with courier companies. Despite the prominent role played by courier industry to three main industries and the over 90% correlation of courier productions and primary and secondary industries, the relationship between the Residents ‘consumption cannot be neglected. In other words, developing residents ‘consumptions means more than developing industrial districts and agricultural districts

4. Courier resources should be integrated. The courier industry, as the research has shown, will not remain as a small industry anymore. It is undergoing rapid development and has close relationship with other industries. The courier industry should develop in a down-to-earth manner and evolve from traditional courier industry to a diversified one.
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Journal


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Zhang Gf and Bao Fb (2005). Application of entropy weight fuzzy comprehensive evaluation in logistics location. *Journal of Wuhan University of Technology* 7(1):91-93


**Book:**


**Website:**