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Forecast of China's Power Generation Demand Trend Based on Scenario Prediction Method

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Abstract. This paper mainly studies the application of scenario prediction method in the forecasting of China's generating capacity, and conducts an empirical analysis with data of China's generating capacity from 1994 to 2017. Firstly, use the regression analysis method to fit sequence data. Taking the relationship between generating capacity and GDP into account, a China's prediction model of generating capacity can be established. Then, consider in two different scenarios and get the predicted value of GDP model in different scenarios. At last, apply the regression model to the predicted trend of China's generating capacity in 2018. Finally, a comparison with the real value of generating capacity in 2018 shows that the prediction error is within a controllable range, and it indicates that the scenario prediction method is of certain practical significance in predicting this macroeconomic phenomenon.

1. Introduction

Forty years since the reform and opening, China is mainly in the middle stage of industrial development, and coal plays a principal role in the energy structure. The present situation determines that our country has a high external dependence on the energy, especially on oil and gas, which however leads to more and more serious problems, such as global warming, the dried up of traditional energy sources, destruction of the ecological environment, etc.. Therefore, people are forced to look for sources both of energy saving and environmental protection. Along with the higher and higher country urbanization rate, the city has an increasing energy demand. Especially at present, the policy measures for reducing exhaust pollution in our country, such as applying electric vehicles, will increase the demand for electricity in city. With the development and popularization of network technology in our country, we need more and more electricity. Therefore, in order to provide theoretical basis for relevant policy adjustment. It is necessary to make a scientific forecast for the demand of electricity in our country.

Scenario prediction method is a kind of forecasting technology which is emerged in 1970s. It is first published in "2000 Years". The authors Kane and Villas define scenario analysis as: A series of hypothetical events that focus on contingencies and decision points. Scenario prediction method is a way to forecast future scenarios. It divides the research objects into theme and environment. With the study of the environment, it identifies the external factors which affect the development of the theme, and the various possible prospects of the development of the theme can be predicted by simulating a variety of overlapping scenarios that may occur in the external factors. It first constructs a "non-mutation" scenario that means, study the future scenario of the subject under the assumption that the current environment does not change significantly; then, analyze the environmental factors of scenario A. The different values of each factor have different impacts on A, therefore and scenario B and scenario C are generated. Then the six scenarios of A, B, C, AB, AC and BC are occurred. At the same time, it can also be assumed



that there is an emergency D, which has different influences on scenario A, B and C, thus get 6 scenarios: AD, BD, CD, ABD, ACD and BCD. Due to different values of environmental factors, a variety of other scenarios can be obtained, but the scope of the scenario is determined, which is $B \cup C \cup D$. For the situation prediction method has its characteristics: it is widely used, it is not restricted by any assumptions, it can be used for any future analysis, it can discover the future problems that may occur in time, so can we take action to eliminate or reduce their influence etc., so this paper tries to consider using scenarios prediction method to speculate the relationship between China's total generating capacity and the GDP, as well as the change trend of total generating capacity in China with economic development of our country in the future.

With the advent of the era of big data, scenario prediction method has been more and more ignored in recent years, but many scholars still find that it is particularly unique in analyzing macroeconomic or natural phenomena. For example, Chen Ping (2016) used scenario prediction method to predict the content of heavy metal elements in the surrounding soil of an enterprise related to heavy metals in the optimistic scenario and the non-mutation scenario in 2030. By statistical analysis, we found that the pollution was still relatively serious in the two scenarios, and the average element content in the non-mutation scenario is 2~2.5 times of that in the optimistic scenario. Through spatial interpolation, it is found that the pollution area is increasing in the no mutation scenario, and the pollution is more serious than that in the case of now, while the pollution in the optimism scenario is less serious than that of now. Bo Dong (2003) mainly studied its application in the statistical prediction and in the decision about the management of hospital, as well as other applications.

2. Sample Data Description

According to the research of this paper, and after sorting out the annual data of China's power installation capacity and generation capacity over the years, which are released by "Statistical Yearbook of China", the results are shown in table 1 below:

Table 1. China's total electricity generation and GDP from 1994 to 2017 (1×10^8 KWH)

t (Year)	X (Total electricity generation)	Y (GDP) (100 million)
1994	9281	48198
1995	10100	60794
1996	10800	71177
1997	11300	78973
1998	11700	84402
1999	12400	89677
2000	13600	99215
2001	14700	109655
2002	16400	120333
2003	19100	135823
2004	22000	159878
2005	25000	183085
2006	28283	211924
2007	32473	249531
2008	34510	300670
2009	36812	340507
2010	42278	397980
2011	47217	471564
2012	49863	519322
2013	53724	568845
2014	55549	636463
2015	56937	677000
2016	59897	744127
2017	64180	827122

Remarks: The year is expressed by time variable t, and the national total electricity generation is expressed by variable x.

3. Theoretical Model

3.1. Establishment of Regression Model

While predicting China's power generation, China's GDP is selected in this paper as the explanatory variable to do the regression of China's total power generation. China's GDP growth must be accompanied by the energy consumption. The power generation is a significant index which reflects the consumption of energy and also has important effects on gross domestic product (GDP). In turn, the situation of power generation in our country can be inferred by the gross domestic product (GDP). At the same time, considering a series of problems of the multivariate factors model such as the multicollinearity, only one explained variable, GDP, is selected.

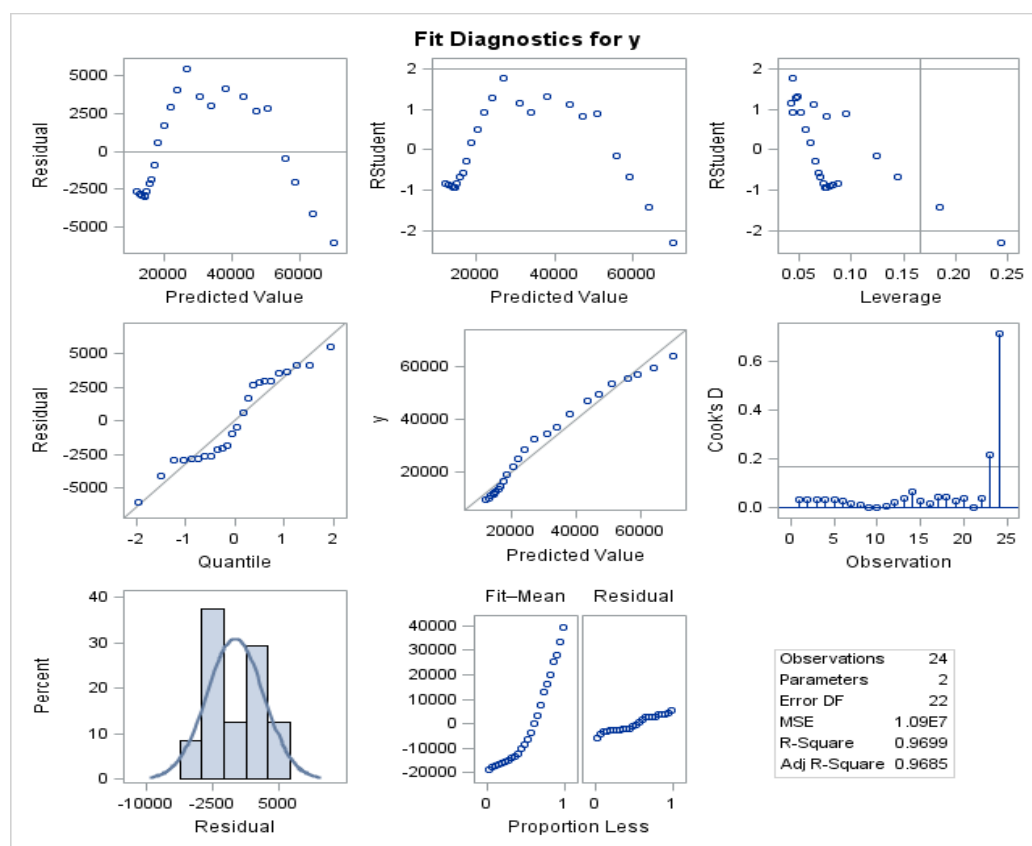
Considering the effects of the transition stage of China's market economy on various aspects of China's economic development, a dummy variable is added here. The dummy variable is set as 1 during the transition stage, and the dummy variable is set as 2 during the development stage, then the prediction model of China's power generation is here as follow:

$$T\text{-test value of the coefficient: } Y=8342.51+0.07X+26888.90Z$$

Table 2. Analysis of Variance

Analysis of Variance					
Source	DF	SumofSquares	MeanSquare	F Value	Pr >F
Model	1	7750477706	7750477706	708.22	<.0001
Error	22	240757763	10943535		
Corrected Total	23	7991235469			

According to Table 2, we can see that the F value of the equation is 708.22, and the P-test value is less than 0.05, which indicates that the equation is significant. The fitting degree of the equation R-Square is 0.9699.

**Figure 1.** Diagnostic of power generation fitting effect in China from 1994 to 2017

As can be seen from Figure 1, even though there is a certain linear relationship between dependent variables and independent variables, the data informations between them has not been fully extracted by this model. If the quantitative relationship between them needs a further study, the model needs to be adjusted.

3.2. Analysis Results of the Model

Here are two scenarios for the future:

(1) Assuming that China's economy continues to develop at the current growth rate, and China's total power generation still increases at the original rate. Compared with the GDP in 2016, the GDP in 2017 increased by 6.5%. Take this as scenario 1 to operate, the predicted value of total power generation in 2018 can be obtained. Use this pattern in the following years.

(2) GDP growth has its own law, here the GDP is regarded as a time series. Since it has a steady growth trend, so using exponential smoothing method to forecast GDP, we find that in 2017 GDP grew by 6.0%. Take this as scenario 1 to operate, the predicted value of total power generation in 2018 can be obtained. Use this pattern in the following years.

Put the GDP value of 2017 calculated from the above two scenarios into the prediction model of this paper, the predicted value of China's total power generation in 2018 can be obtained. The predicted results of the two scenarios are shown as that in table 3.

Table 3. Comparison of scenario forecast results of China's total electricity generation in 2018

Scenario	Scenario 1	Scenario 2
Object	d=6.5%	d=6.0%
Generating Capacity	70352 (1×10^8 KWH)	69510 (1×10^8 KWH)

According to the data released by ASKCI Consulting Co., Ltd, the generating capacity of China in 2018 is 6791.42 billion KWH. Comparing with the predicted results in table 3, the results of scenario 2 are much closer to the real data. It also shows that the scenario prediction method has the applicable and practical significance for China's macroeconomic phenomenon prediction.

4. Conclusion

In this paper, the regression analysis method is used for the model fitting of sequential data. Because of the relationship between power generation and GDP, a prediction model of China's power generation is established. We assume two scenarios, scenario 1 is that China's economy continues to develop at the current rate, and China's total power generation is increasing at the original rate. Scenario 2 is that the growth of GDP has its own law. Here, we take GDP as a time series. Because it has a relatively stable growth trend, the exponential smoothing method is used to predict GDP. The predicted values of different dependent variables are obtained from different scenarios. Finally, the dependent variable, or the trend of China's power generation in 2018 is predicted by using the regression model. At last, the comparison with the real power generation in 2018, which shows that the prediction error is within the controllable range, indicates that the scenario prediction method has certain practical significance in predicting this kind of macroeconomic phenomenon.

5. Expectation

In the regression analysis of the dependent variable, it is simply assumes that the power generation is only impacted by one variable, but a serie of problems such as the multicollinearity in the multivariable factor model are not taken into consideration, which need the further discussion in the following studies.

References

- [1] NAMEROFF T J, GARANT R J, and ALBERT M B. Adoption of greenchemistry: an analysis based on US patents [J]. Research Policy, 2004, 33 (6/7): 959-974.
- [2] Shuguang Liang. Empirical study on the regulatory effect of power generation industry in China [D]. Liaoning University, 2012.
- [3] Lingxiao Wang, Xi Lu, Shuyan Liu, Jintai Lin. Annual variation in China's potential wind power generation [J]. Acta Scientiarum Naturalium Universitatis Pekinensis, 2016, 52 (05): 837-847.
- [4] Xiaohong Zhan. Economy low carbon, green growth and enlightenment of South Korea [J]. Leadership Digest, 2012 (15): 7-22.
- [5] Haibo Ren, Jie Zhong, Liang Peng, Hao Lai. History and development of hydropower in China [J]. China Southern Agricultural Machinery, 2019, 50 (02): 225.
- [6] What are feedback forecasting technique, intuitive forecasting technique and all can scenario writing? [J]. Future and Development, 1981 (03): 78.
- [7] Shenjun Zhang, Chengwei Yuan. Model for GM (1.1) Combination forecast of energy

- consumption based on BP neural network and modified GM (1, 1) model [J]. Statistics & Decision, 2016, (5).
- [8] Bo Dong, Huici Wang. Statistical prediction, statistical decision making, hospital management (1) [J]. Chinese Journal of Hospital Statistics, and 2003 (02): 104-106.
- [9] Lingxiong Tu. Construction of Time Series Model and Empirical Analysis of Power Generation [J]. Economic Research Guide, 2011 (21): 322-323.