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Market Demand Forecast of Refined Oil Products in Qamdo Region of Tibet

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Abstract: As a strategic material and important commodity related to the national economy and people's livelihood, refined oil products analyze its industry trend under the background of existing national policies, which is also of great signifi-cance to energy security. Based on the development trend and characteristics of the refined oil products industry, this paper analyzes the current situation of the development of the refined oil products industry in Tibet's Qamdo region under the new price policy, combs through the influencing factors affecting the growth of the demand for refined oil products in Tibet's Qamdo region, carries out the qualitative and quantitative decomposition and measurement of the main driving variables, establishes a forecast model of Qamdo's refined oil products demand, and applies the neural network model to forecast the 2023-2027 The demand of refined oil products, which provides theoretical support for the development of refined oil products market in Qamdo region of Tibet, and provides certain reference and inspira-tion for the future development of the market.

Keywords: Refined oil products, demand forecasting, BP neural network, new price policy,

1. INTRODUCTION

Since February 14,2022, according to the "Notice on Adjusting the Price Zone Spread and Inter-provincial Price Difference of Refined Oil Products in Qamdo and Ali" (Zangfa Gaijia Ge [2022] No. 96)[1] spirit, the price zone spread and inter-provincial price difference of refined oil products have been reduced, that is, the maximum retail price limit of the second and third price zones has been adjusted, and the retail benchmark price of refined oil products in Qamdo and Ali price zones has been officially lowered[1,2]. As a strategic material and an important commodity related to the national economy and people's livelihood, analyzing the industry trend of refined oil under the current national policy background is not only of great significance to the operation and development of the refined oil industry, but also to China's energy security[3,4].

According to the different theories of model construction, the demand forecasting models are mainly divided into two categories. One is the traditional statistical model based on statistical theory, such as the traditional time series model, Markov model, etc[5,6].; the other is the innovative model based on machine learning and deep learning, such as the forecasting model based on support vector machine, the innovative model based on decision tree, the innovative model based on neural network, etc[7,8,9,10]. Many scholars and experts have done systematic research on demand forecasting. In the traditional sales forecasting methods, most of them have adopted statistical methods such as linear models and exponential smoothing[11,12]. And the traditional statistical forecasting methods usually find it difficult to utilize the features that have a significant impact on demand for forecasting. Therefore, new methods of artificial intelligence, including machine learning and deep neural networks, have attracted attention due to their ability to enhance forecasting performance and model nonlinear patterns[13,14,15,16,17], people began to apply them to demand forecasting.

In summary, based on the development trend and characteristics of China's refined oil products industry, this paper analyzes the current situation of the development of refined oil products industry in Tibet's Qamdo region under the new price policy, combs through the influencing factors,

disaggregates and measures the main driving variables qualitatively and quantitatively, and establishes a demand prediction neural network model, which predicts the demand for refined oil products in the Qamdo region of Tibet in the period of 2023-2027, and provides a theoretical support for the development of the market of refined oil products in this region. It provides theoretical support for the development of the refined oil market in the region.

2. Analysis of the Factors Affecting the Demand for Refined Oil Products in Qamdo Region, Tibet under the New Price Policy.

2.1 Selection of Influencing Factor Indicators

The main factors affecting the demand for refined oil products can be attributed to five aspects: price factors, economic growth, population size, industrial structure, and technological progress [18,19].

The price of refined oil products should be the primary factor affecting the demand for refined oil products. However, in China's refined oil market, the impact of price changes on the demand for refined oil products is relatively small compared to the impact of other factors[1,20]; the development of the economy requires oil as a driving force, and the demand for refined oil products is greatly affected by the level of economic development, so economic growth is a very important factor affecting the demand for refined oil products[21,5]; the population size directly affects the total consumption of refined oil products, so the population size is an indispensable factor affecting the demand for refined oil products[22]; in China, the petroleum consumption of various industries varies greatly, and the second industry has a greater demand for petroleum than the first and third industries, so the proportion of the second industry in various industries has a significant impact on the demand for refined oil products[19, 2]; technological progress affects the demand for refined oil products by improving the utilization efficiency of petroleum, reducing the energy consumption per unit of product, shortening the transaction process and reducing the consumption intensity of refined oil products[23]. Based on the foregoing literature and economic theory analysis, this paper selects four factors, economic growth, population size, industrial structure, and technological progress, as the driving variables affecting the demand for refined oil products in Changdu Region, Tibet. Among them, the growth of the economy is represented by the GDP, the population size is represented by the total population, the industrial structure is represented by the proportion of the second industry in various industries (the output value of the second industry/GDP), and the technological progress is represented by the ratio of refined oil consumption to GDP (refined oil consumption/GDP).

In order to further verify the feasibility of the driving variables for refined oil demand forecasting, it is also necessary to use statistical methods to test the data, and the grey correlation analysis method is used for analysis. Its principle is to judge the degree of correlation between the two factors according to the similarity of the change trend of the two factors over time. The more similar the trend, the higher the correlation degree, and vice versa.

2.2 Gray Correlation Analysis

As a factor analysis method, grey correlation analysis uses a quantitative approach to obtain the grey correlation degree and thereby distinguishes the degree of closeness of the relationship between system variables. To establish a grey correlation model, the reference sequence and the comparison sequence must first be set. Suppose there are m evaluation objects and n evaluation indicators.

The driving variables affecting the demand for refined oil products in the Qamdo region of Tibet: GDP, total population, Secondary Industry output/GDP, and refined oil product consumption/GDP were used as comparative sequence variables, and refined oil product consumption was used as a reference sequence variable, and 2001-2022 Table 1 Data Sets was substituted into the model.

Gray correlation analysis is carried out for 4 evaluation items (GDP, total population, Secondary Industry Output/GDP, consumption of refined oil/GDP) and 22 data, and refined oil consumption is used as the “reference value” to study the correlation relationship between the 4 evaluation items and refined oil products consumption, and the discrimination coefficient is taken to be 0.5, and the correlation coefficient is combined with the formula to calculate the correlation coefficient value. The correlation coefficient is 0.5, the correlation coefficient value is calculated by the formula, and the correlation degree value is calculated according to the correlation coefficient value for the evaluation judgment, and the results are shown in Figure 1 and Table 2.

Figure 1 uses a graphical form to present the correlation coefficient, which is very intuitive to show that GDP and Secondary Industry output/GDP have a greater impact on the consumption of refined oil products in most years.

The value of the correlation is between 0 and 1, the larger the value means the stronger the correlation between it and the reference series, which means the higher its evaluation. As can be seen from Table 2 below: for the 4 evaluation items, GDP has the highest evaluation, with a correlation of 0.843, followed by Secondary Industry output/GDP, with a correlation of 0.697.

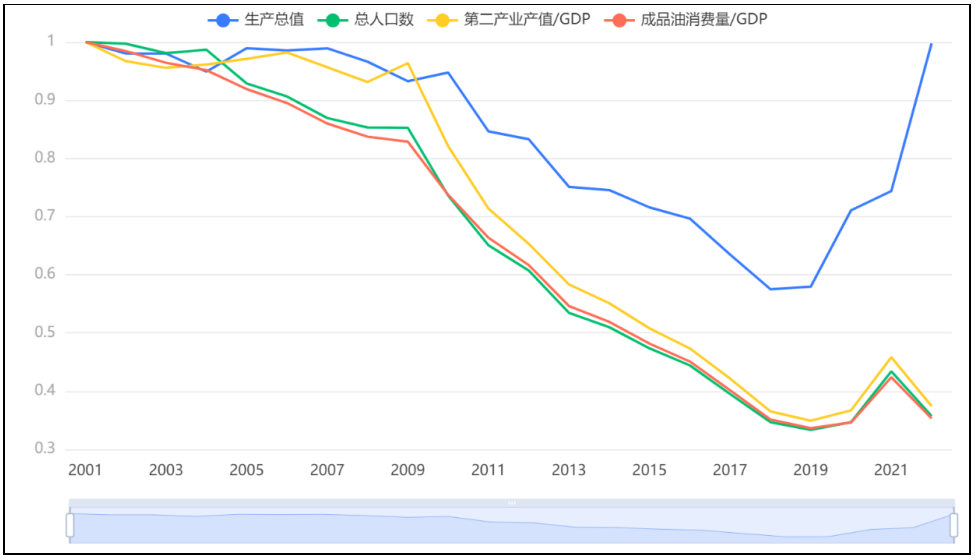

Figure 1 *Correlation Coefficient*

Table 2 Gray Correlation

Evaluation Item	Correlation	Rank
GDP	0.843	1
Secondary Industry Output/GDP	0.697	2
Total Population	0.661	3
Consumption of Refined Oil/GDP	0.658	4

3. Construction and Analysis of Refined Oil Products Demand Forecasting Model

Through gray correlation analysis to find out the degree of correlation between the key influencing factors and other influencing factors, it is proved that the above four influencing factors have a strong correlation on the consumption of refined oil products in Qamdo region. In the following section, BP neural network model is used to predict the demand of refined oil products in Qamdo region.

Table 1 Data Sets

Year	GDP (billion yuan)	Total Population (10,000)	Secondary Industry Output/GDP	Consumption of Refined Oil/GDP	Consumption of Refined Oil (10,000 tons)
2001	18.07	59.37	0.16934145	0.03969009	0.7172
2002	20.96	60.08	0.21660305	0.03374523	0.7073
…	…	…	…	…	…
2021	279.24	76.10	0.39482166	0.03208996	8.9608
2022	303.01	76.30	0.40343234	0.03964389	12.0121

3.1 Data Preprocessing

The input variables of the BP neural network model were used to influence the demand of refined oil products, and the output variables of the BP neural network model were refined oil consumption. Firstly, Table 1 Data Sets are substituted into the gray prediction model GM (1, 1) to predict the four influencing factors in 2023-2027, and then it is

substituted into the trained BP neural network model to get the demand of refined oil products in 2023-2027.

After substituting the data, we get Table 3 Gray Modeling. The development coefficient indicates the development law and trend of the series, and the gray role quantity reflects the change relationship of the series, and the a posteriori difference ratio can verify the accuracy of the gray prediction, and the a posteriori difference ratios of the four variables are all less than 0.35 indicating that the model is highly accurate.

According to the output fitting results table of the prediction model, the average relative errors of the four variables are less than 0.1, which means that the model fits well, as shown in Table 4 Average Relative Error.

The final output of the prediction results of the driving variables affecting the demand for refined oil products in 2023-2027 is shown in Table 5 Projected Results.

Table 3 Gray Modeling

	Development Factor A	Gray Effector B	A Posteriori Difference Ratio C
GDP	-0.034	275.581	0.039
Total Population	-0.013	58.419	0.025
Secondary Industry Output/GDP	-0.007	1.258	0.184
Consumption of Refined Oil/GDP	-0.001	1.034	0.173

Table 4 Average Relative Error

	Average Relative Error
GDP	5.797%
Total Population	0.903%
Secondary Industry Output/GDP	7.646%
Consumption of Refined Oil/GDP	7.164%

3.2 BP Neural Network Model Prediction

Five data items were entered in MATLAB for the years 2001-2022. The four components of GDP, total population, Secondary Industry Output/GDP, and consumption of Refined Oil/GDP are used as input vectors, and consumption of Refined Oil is used as an output vector. The input data are shown in Table 1 Data Sets.

Then the data from 2001-2011 is divided into a training set for training, and the prediction results are back-normalized and the real value for error comparison, and repeated until the error line. Then the trained model is tested by simulation using the data from 2012-2022 as a test set, and the root mean square error is calculated between the predicted and true values to check the simulation effect. The results of this series of results are visualized and plotted, and the results are shown in Figures 2 and 3 below.

As can be seen from Figs. 2 and 3, the fitted values of the trained 2001-2022 refined oil consumption and the corresponding actual values have the same trend, and the RMSE is 0.56858 and 0.45463, respectively, which indicates that the model can fit the data of refined oil consumption in the Qamdo region from 2001-2022 well, and the predicted data and the actual data are not very much different, and the actual fitting of BP neural network is The effect is very good.

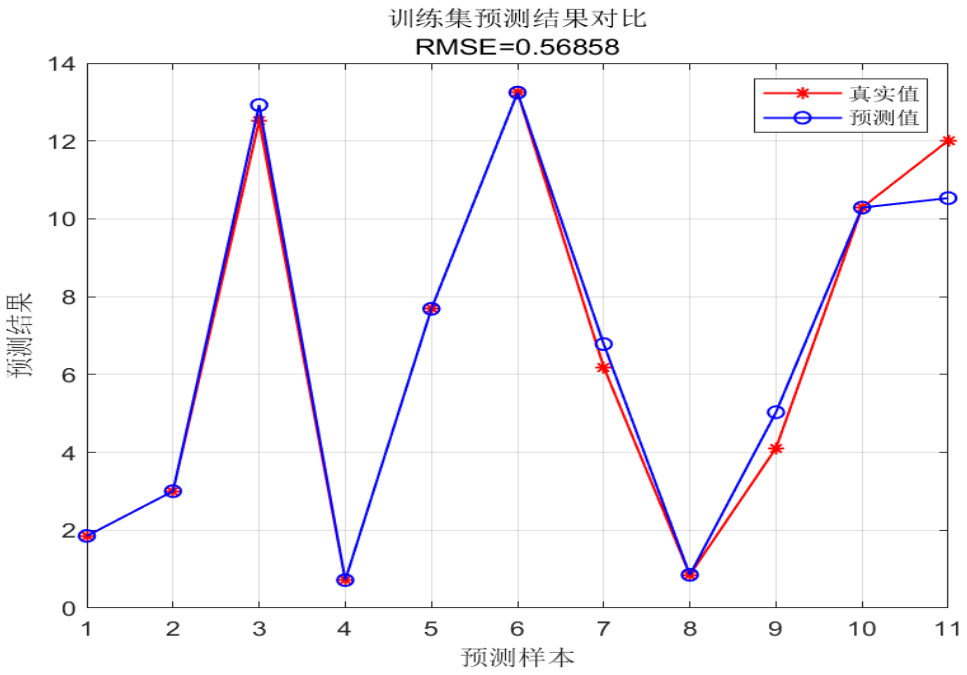

Figure 2 *RMSE of Training Set*

Table 5 Projected Results

Year	GDP (billion yuan)	Total Population (10,000)	Secondary Industry Output/GDP	Consumption of Refined Oil/GDP
2023	294.433	77.711	0.47	0.058
2024	315.201	78.703	0.48	0.059
2025	336.69	79.707	0.49	0.06
2026	358.927	80.724	0.501	0.061
2027	381.936	81.754	0.511	0.062

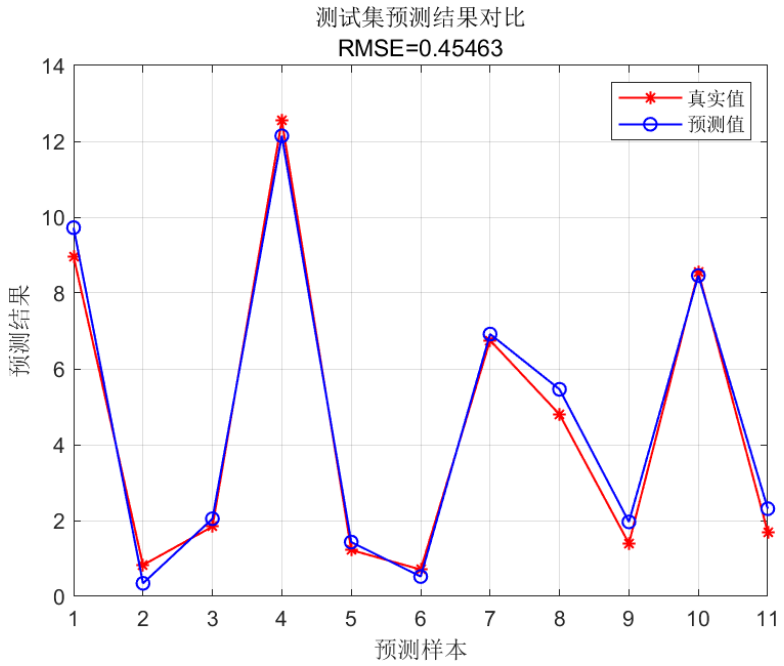

Figure 3 *RMSE of Test Set*

Figure 4 Training Process shows that with the iteration, the fitting results of BP neural network gradually converge to the actual data, after five iterations of the neural network can achieve the optimal prediction effect, the overall error of BP neural network training results can reach 0.0032425.

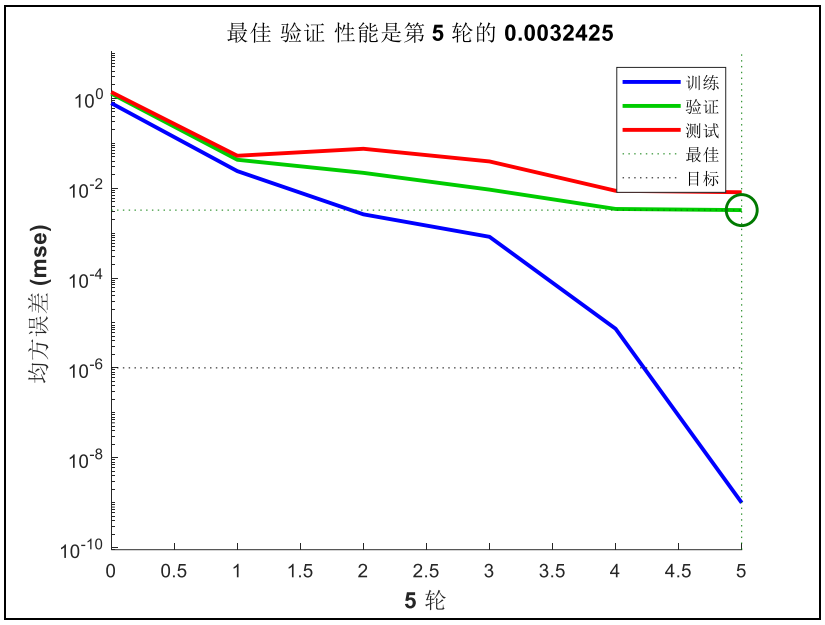

Figure 4 *Training Process*

It shows that the model establishment is effective, with this trained model imported into Table 5 Projected Results gray prediction 2023-2027 four to be predicted component data, the 2023-2027 Qamdo region refined oil demand prediction. The prediction results are shown in Table 6 Model Prediction Results.

Table 6 Model Prediction Results

Year	Demand of Refined Oil (10,000 tons)
2023	13.45287345
2024	14.0352439
2025	14.75116664
2026	15.1078987
2027	15.41882977

4. RESULTS AND ANALYSIS

As can be seen from Table 6 Model Prediction Results, the demand for refined oil products will continue to maintain growth, the overall upward trend, BP neural network in the whole prediction process prediction accuracy is very high, in the prediction of multi-factor and non-linear model has a strong adaptability, more reference significance and practical significance.

The speed of economic development, international oil price fluctuations, changes in energy consumption per unit of GDP, industrial structure adjustment, urbanization process and energy substitution will all have a certain impact on the demand for refined oil products. At present, the state vigorously devel-ops and promotes clean energy, and from the long-term development trend, the state will be more and more stringent environmental protection requirements to ensure the sustainable development of the economy, which, to a certain extent, will

have an impact on the demand for refined oil products, and may also cause the decline in the demand for refined oil prod-ucts.

Therefore, there is a certain deviation in the prediction re-sults, which requires the decision makers to make certain ad-justments based on the prediction results and according to the actual situation.

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