

Research on resident consumption pattern under slow population Growth- -Take Anhui Province as an example

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Abstract

In recent years, the population of Anhui province has shown a low growth trend. Through the gray prediction model, the consumption data of residents from 2012 to 2021 is calculated to obtain the forecast value of the consumption structure of residents in Anhui province from 2022 to 2024. Finally, some reasonable suggestions are put forward.

Keywords

Consumption structure; consumption forecast; gray forecast.

1. Preface

Since the implementation of the reform and opening up, the sources of residents' income have become increasingly diversified. At the same time, the continuous improvement of the national infrastructure has provided a broad space for residents' consumption. The continuous development of economy brings about the improvement of residents' consumption power and the upgrading of consumption structure. Consumption plays a fundamental role in economic development and plays an important role in promoting economic transformation and upgrading and achieving high-quality development. It is of great significance to ensuring and improving people's livelihood and meeting the people's growing needs for a better life. As the main body of all economic activities, people should also be paid attention to the impact of their own consumption demand and consumption structure on residents' consumption, because it is of great practical significance to stimulating domestic demand and improving the socialist economic system. With the rapid development of economy and the increasing of urban and rural residents' income, the consumption structure of Chinese residents is also changing. On May 11, 2021, the State Information Office held a press conference to announce the results of the seventh population census. According to the published data, China's population still grew at a low growth rate in the past 10 years, and the low growth of population is bound to lead to the adjustment of consumption structure. This question selects Anhui province residents as the research object to study the consumption structure of Anhui province residents.

2. The consumption situation of residents in Anhui Province

Table 1 Consumption expenditure structure of residents in Anhui Province from 2012 to 2021

a particular year	Total per capita consumption expenditure (yuan)	Per capita expenditure on food, tobacco and alcohol (yuan)	Per capita clothing expenditure (yuan)	Per capita residential expenditure (RMB)	Per capita transportation expenditure (RMB)	Per capita expenditure on education, culture and entertainment (yuan)	Health expenditure per capita (RMB)	Per capita expenditure on daily necessities and services (RMB)
2012	9878	3791.392	389.256	2469.012	506.741	592.284	482.352	530.928
2013	10544	3916.294	422.544	2682.856	634.925	653.928	602.937	557.892
2014	11727	4125.027	556.103	2874.069	647.139	718.204	625.924	642.672
2015	12840	4019.203	594.942	3148.913	842.562	907.127	769.212	799.264
2016	14712	4358.738	704.839	3365.816	1092.395	1230.215	894.526	828.027
2017	15752	4557.846	860.301	3640.715	1278.027	1346.253	1035.829	960.214
2018	17045	4980.852	993.837	3893.521	1679.263	1489.629	1283.027	957.025
2019	19137	5334.795	1165.963	4194.832	1965.084	1694.068	1490.201	1023.239
2020	18877	6286.041	1208.128	4379.464	2170.855	1849.946	1547.914	1113.743
2021	21911	7142.986	1424.215	4667.043	2475.943	2585.498	1774.791	1336.571

The data in Table 1 shows the consumption expenditure structure of residents in Anhui province from 2012 to 2021. In the past decade, the total per capita consumption expenditure has increased steadily, and the per capita expenditure on food, tobacco and alcohol ranks first, fully reflecting the "food is the priority of the people". The ratio of per capita expenditure on food, tobacco and alcohol to per capita housing expenditure showed an overall downward trend, while the proportion of the remaining structures showed an overall upward trend, among which the per capita expenditure on clothing and per capita transportation expenditure increased significantly. This shows that the income level of Anhui residents is constantly improving. While ensuring the basic living needs, more and more attention is being paid to improving the quality of life and planning the development of families.

3. Consumption structure forecast

3.1. Prediction principle

The gray prediction model establishes a gray differential prediction model through a small amount of incomplete information to make a prediction description of the development law of things. GM (1,1) model represents the first order and a variable, which can model and predict according to a small amount of information, and the accuracy of gray prediction is high and small on the number of data, which can be used to study the change of the consumption structure of residents in Anhui Province.

3.2. Modeling steps

In this section, the data in Table 1 will be used to construct GM (1,1) models to explore the changes in the consumption structure of residents in Anhui Province. This paper through Anhui province residents in 2012-2021 per capita food and tobacco spending (yuan), per capita clothing (yuan), per capita living spending (yuan), per capita transportation (yuan), per capita education culture entertainment spending (yuan), per capita health care spending (yuan) per capita and supplies and services (yuan) to predict the consumption structure of Anhui province residents in the next three years, finally through the model test to build accurate prediction model.

3.2.1. Construct the original sequence

Firstly, first of all, according to the consumption expenditure structure data of Table 1 Anhui residents from 2012 to 2021 to establish the original sequence of GM (1,1) model, that is, the time series of various consumption expenditure:

$$X^{(0)} = \{X^{(0)}(1), X^{(0)}(2), X^{(0)}(3), \dots, X^{(0)}(10)\}$$

3.2.2. Calculate the level ratio of the sequence

Use the formula

$$\lambda(k) = \frac{X^{(0)}(k-1)}{X^{(0)}(k)}, k = 2, 3, \dots, 10$$

It is known that almost all variable data levels fall in the coverage interval

$$(e^{-2/(n+1)}, e^{2/(n+1)}) = (0.834, 1.199)$$

$X^{(0)}$ Therefore, the data passed the ratio test, allowing the GM (1,1) model and gray prediction.

3.2.3. Generates the increment number of the columns

Use the formula

$$X^{(1)} = \sum_{i=1}^{10} X^{(0)}(i)$$

GM (1,1) model the original sequence $X^{(0)}$ The single generated sequence is: $(1 - AGO)X^{(1)}$

$$X^{(1)} = \{X^{(1)}(1), X^{(1)}(2), X^{(1)}(3), \dots, X^{(1)}(10)\}$$

After adding the original sequence is generated, the influence of the bad data and data randomness in the original sequence on the prediction model is weakened, so that the data has an approximate exponential growth rule, and the differential equation model is further established.

3.2.4. Construct the data matrix B and the data vector Y:

$$B = \begin{bmatrix} -(x^{(1)}(1) + x^{(1)}(2))/2 & 1 \\ -(x^{(1)}(2) + x^{(1)}(3))/2 & 1 \\ -(x^{(1)}(3) + x^{(1)}(4))/2 & 1 \\ -(x^{(1)}(4) + x^{(1)}(5))/2 & 1 \\ -(x^{(1)}(5) + x^{(1)}(6))/2 & 1 \\ -(x^{(1)}(6) + x^{(1)}(7))/2 & 1 \\ -(x^{(1)}(7) + x^{(1)}(8))/2 & 1 \\ -(x^{(1)}(8) + x^{(1)}(9))/2 & 1 \\ -(x^{(1)}(9) + x^{(1)}(10))/2 & 1 \end{bmatrix} \quad Y = \begin{bmatrix} x^{(0)}(2) \\ x^{(0)}(3) \\ x^{(0)}(4) \\ x^{(0)}(5) \\ x^{(0)}(6) \\ x^{(0)}(7) \\ x^{(0)}(8) \\ x^{(0)}(9) \\ x^{(0)}(10) \end{bmatrix}$$

3.2.5. The reduced predicted value of the original sequence was calculated

$\hat{u} = [\alpha \mu]^T = (B^T \cdot B)^{-1} B^T Y \alpha \mu$, Among them, for the development of gray number, for the endogenous control gray number. Through MATLAB programming can get table 1 per capita food and tobacco spending (yuan), per capita clothing spending (yuan), per capita living spending (yuan), per capita transportation spending (yuan), per capita education culture entertainment spending (yuan), per capita health care spending (yuan) and per capita supplies and service spending (yuan) and variables, as shown in table 2. $\alpha \mu$

Table 2 Calculation results of developing grey number and endogenous control grey number

count bear fruit	Total per capita consumption expenditure (yuan)	Per capita expenditure on food, tobacco and alcohol (yuan)	Per capita clothing expenditure (yuan)	Per capita residential expenditure (RMB)	Per capita transportation expenditure (RMB)	Per capita expenditure on education, culture and entertainment (yuan)	Health expenditure per capita (RMB)	Per capita expenditure on daily necessities and services (RMB)
α	-0.0857	-0.0805	-0.1396	-0.0686	-0.1737	-0.1608	-0.1392	-0.0930
μ	9663.4	3114.9	387.829	2469.1	507.3564	519.150	492.429	534.305

Thus, the time response sequence of the available GM (1,1) model is

$$\hat{x}^{(1)}(k + 1) = \left(X^{(0)}(1) - \frac{\mu}{\alpha} \right) e^{-\alpha k} + \frac{\mu}{\alpha}, \quad k = 0, 2, \dots, 9.$$

To reducing the original sequence, the predicted value: $X^{(0)}$

$$\hat{x}^0(k + 1) = \hat{x}^{(1)}(k + 1) - \hat{x}^{(1)}(k)$$

And obtain the simulated sequence. $\hat{x}^0(k)$

3.3. Test of the 3 GM (1,1) model

Whether the constructed GM (1,1) model can predict the change of the structure of residential consumption expenditure in Anhui province in the next three years remains to be discussed. Generally, the three indicators of the relative residual Q, small error probability and mean variance ratio need to be verified. If the constructed GM (1,1) model can pass the test of these three indicators, the model can be considered to be extremely accurate and capable of predictive analysis.

3.3.1. Q test for relative residual difference

The residue sequence was first calculated

$$\varepsilon_k = X^{(0)}(k) - \hat{x}^0(k), \quad k = 1, 2, \dots, 10$$

And then obtain the relative error sequence

$$\Delta(k) = \varepsilon_k / X^{(0)}(k), \quad k = 1, 2, \dots, 10$$

$\Delta(k) = \frac{1}{10} \{ \Delta(1) + \Delta(2) + \dots + \Delta(10) \}$ Thus, the mean relative error can be expressed as. With MATLAB programming, the results are shown in Table 3.

Table 3 The Q test values for the relative residuals

Inspection value	Total per capita consumption expenditure (yuan)	Per capita expenditure on food, tobacco and alcohol (yuan)	Per capita clothing expenditure (yuan)	Per capita residential expenditure (RMB)	Per capita transportation expenditure (RMB)	Per capita expenditure on education, culture and entertainment (yuan)	Health expenditure per capita (RMB)	Per capita expenditure on daily necessities and services (RMB)
Q	0.0247	0.0499	0.0417	0.0107	0.0536	0.0513	0.0359	0.0471

Compared with the data in Table 4, we show that the residual Q test of the model reaches the second-level precision and belongs to the qualified level.

Table 4 Precision Test Comparison Table (1)

accuracy class	one-level	two stage	three-level	level Four
Average relative error	0.01	0.05	0.1	0.2

3.3.2. C test of variance ratio and P test of probability of small error

The ratio of the mean variance and the small error probability values for each variable in Table 1 were calculated by MATLAB programming, and the results are shown in Table 5.

Table 5 C test values and P test values

Inspection value	Total per capita consumption expenditure (yuan)	Per capita expenditure on food, tobacco and alcohol (yuan)	Per capita clothing expenditure (yuan)	Per capita residential expenditure (RMB)	Per capita transportation expenditure (RMB)	Per capita expenditure on education, culture and entertainment (yuan)	Health expenditure per capita (RMB)	Per capita expenditure on daily necessities and services (RMB)
C	0.1323	0.2498	0.1141	0.0627	0.1255	0.1737	0.1221	0.1919
P	1	1	1	1	1	1	1	1

By comparing Table 6, we show that the mean variance ratio of the model C and the small error probability P both the excellent level. Therefore, the model passed the ratio of mean variance and the minimum probability error index.

Table 6 Precision Test Control Table (2)

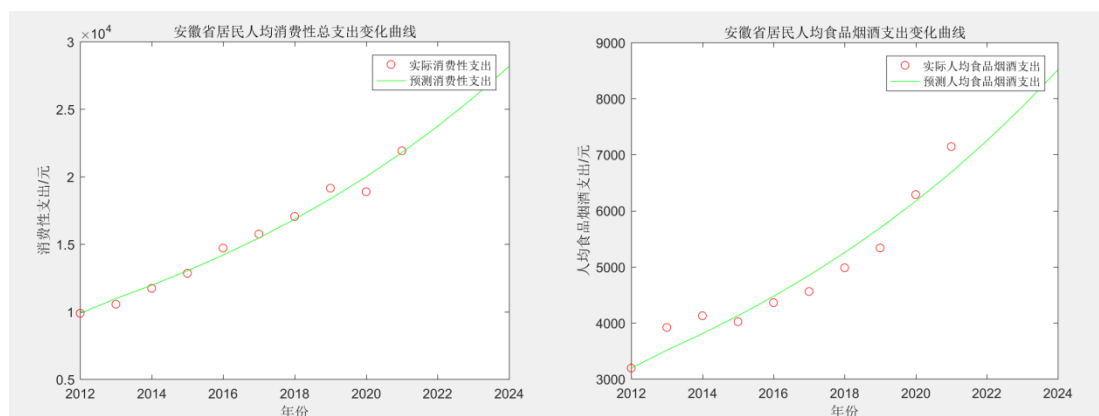
C	P	Prediction accuracy level
<0.35	>0.95	outstanding
<0.50	>0.80	qualified
<0.65	>0.70	Just qualified
≥0.65	≤0.70	unqualified

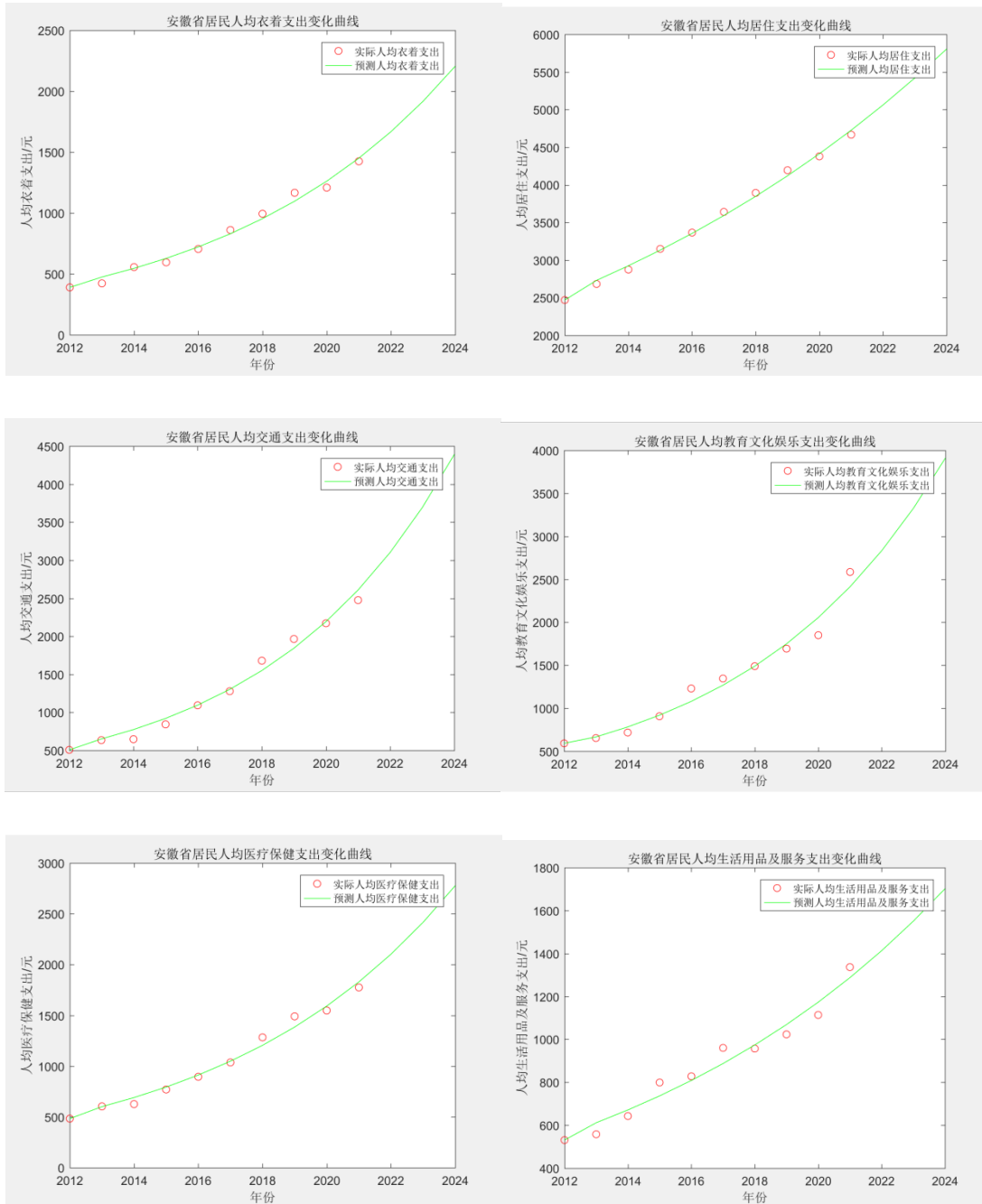
3.4. Model prediction

Since the GM (1,1) model has passed the relative residual Q test, small error probability P test and mean variance ratio C test, it is considered that the model can predict the structural change of consumption expenditure of Anhui residents in the next three years. The prediction results are shown in Table 7.

Table 7 Forecast of consumption expenditure of Anhui Province residents from 2022 to 2024

a particular year	Total per capita consumption expenditure (yuan)	Per capita expenditure on food, tobacco and alcohol (yuan)	Per capita clothing expenditure (yuan)	Per capita residential expenditure (RMB)	Per capita transportation expenditure (RMB)	Per capita expenditure on education, culture and entertainment (yuan)	Health expenditure per capita (RMB)	Per capita expenditure on daily necessities and services (RMB)
2022	23730	7245.3	1667.6	5062.0	3103.5	2834.6	2102.1	1412.9
2023	25853	7852.6	1917.5	5421.3	3692.1	3329.3	2416.2	1550.7
2024	28166	8510.8	2204.9	5806.1	4392.3	3910.2	2777.1	1701.9





As can be seen from Table 7, residents' consumption items such as clothing, education and entertainment are still on the rise, indicating that there is still a large space for consumption level growth in the next few years, and there is great potential for consumption power growth.

4. Suggestions to improve the consumption level of residents

- a. Strengthen the employment-first policy and improve the social security system;
- b. Develop new forms of service consumption and improve the efficiency of public service expenditure;
- c. Strengthen the weak links of urban and rural logistics, and improve the trade circulation system;
- d. Promote the rural revitalization strategy and support the diversified development of rural industries;
- f. Improve the consumption environment and increase residents' willingness to consume.

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Reference documentation:

- [1] Luo Yanyan. Analysis of the Current situation of Chinese Household Consumption and the Future Trend prediction [J], Science and Technology Entrepreneurship Monthly, 2011,24 (09): 35-37.
- [2] Guo Ying Difficulties and Outlets for the Transformation and Upgrading of Rural Residents in Anhui Province [J] Journal of Beijing Vocational College of Finance and Trade, 2023,39 (01): 12-16.
- [3] Xu Xuchu, Xiong Kang Research on Regional Equilibrium of Economic Development in Anhui Province [J] Journal of Heilongjiang Institute of Technology (comprehensive edition), 2019,19 (03): 76-80.
- [4] Deng Julong Grey Theoretical Foundation [M] Wuhan: Huazhong University of Science and Technology Press, 2002.