Analysis of the Influence Factors of China's per-capita Food Expenditure

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Abstract. This paper analyzes the relationship between food expenditure, income and grain price, which is the basic demand of daily food. With the help of SAS 9.2. Statistical software, we constructed the regression model based on analyzing 31 provinces sample via the descriptive analysis, regression model selection and variable selection. To determine the validity of the regression model, the variance homogeneity test, the collinearity test, the autocorrelation test and the analysis of the validity of the samples are also carried out. Finally, the reliability of the regression model is determined. The analysis results show that the per - capita food expenditure in China is affected by the grain price, and the influence of per - capita income on food expenditure is relatively weak.

1. Introduction

With the rapid development of the economy, Chinese people's income and living standard have been greatly improved. People's consumption demand has gradually expanded from basic daily consumption to more consumption demand, including basic necessities, general consumer goods, luxury goods and spiritual consumer goods, etc. The basic necessities are the basic needs to maintain peoples' daily lives, including food, beverage products, clothing, transportation etc., which are goods that people have to consume no matter what the economic situation is [1,2]. Hence the production of these commodities is relatively less affected by the economic performance [3].

As a supplement to the basic necessities, general consumer goods play an important role in enriching people's daily life [4]. After solving the basic problem of food and clothing, people will naturally pursue a better life, thus providing a rich demand for the food processing industry, clothing design and other consumer industries and industries engaged in the production of means of production [5]. Further, some people have a lot of wealth in their hands, and these people, in order to reflect the self-existence and the self-worth, are not satisfied with the general consumer goods and become the basis of the luxury demand. Luxury goods are divided into two categories, one that does not directly promote investment in commodities and has a very limited contribution to economic growth, such as antique calligraphy and painting, stamps and other collectibles; The other, through appropriate inducement, can bring some promotion to science and technology and economy, such as real estate, space tourism, high-tech consumption, and so on. But such consumption, if misguided, will have a very negative impact on the economy as a whole. Spiritual consumer goods are people's spiritual needs outside of material life, and have a very important impact on people's living standards, including tourism, service industry, opera music, painting and fine arts, industrial design, psychology and many other aspects.

Food consumption as the most basic daily consumption, will food consumption increase with the increase in income and living standards, and how do they relate to each other? In order to understand this problem, on the basis of collecting monthly per-capita food expenditure and per-capita income of 31 provinces in China, this paper analyzes the relationship between food expenditure and income with the help of SAS statistical analysis software.

2. Data description

In order to study the influencing factors of per - capita food expenditure in China, we take per - capita food expenditure (yuan) as dependent variable, take grain price (yuan) and per - capita income (RMB) as the main factors affecting per - capita food expenditure. The data were collected from 31 provinces in China, and will be analyzed via SAS 9.2.

3. Model construction and analysis

3.1 Descriptive statistics

First of all, we do descriptive analysis of the sample to understand the basic situation of the sample. The results show that the average of per - capita food expenditure (Pay) is 794.8 yuan, the standard deviation is 185.8 yuan, the maximum value is 1267 yuan, and the minimum value is 540 yuan. This shows that the per - capita food expenditure among provinces and cities is quite different. The average value of grain price (Price) is 0.83 yuan, the standard deviation is 0.21 yuan, the minimum value is 0.61 yuan, and the maximum value is 1.49 yuan. This shows that the grain price difference among provinces and cities is small and relatively stable. The average of per - capita income (Income) is 2003 yuan, the standard deviation is 405.26 yuan, the maximum value is 3329 yuan, the minimum value is 1532 yuan, we can judge the difference of per - capita income among 31 provinces is large.

The correlation analysis can be used to understand the relationship between per - capita expenditure and per - capita income and food price. It can be seen from the Pearson correlation analysis that there is a significant positive correlation between per - capita income and grain price, and the regression fitting can be performed.

3.2 Regression model

3.2.1 Multiple regression model

In order to understand the relationship among per - capita food expenditure, per - capita income and food price, a multiple regression fitting analysis is performed, and the results are shown in Fig.1.

Analysis of Variance					
Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	2	915129	457565	106.16	<.0001
Error	28	120680	4309.99244		
Corrected Total	30	1035809			

Parameter Estimates						
Variable	Label	DF	Parameter Estimate	Standard Error	t Value	Pr > |t|
Intercept	Intercept	1	-87.36759	61.68018	-1.42	0.1677
Price	grain price	1	213.42266	73.27792	2.91	0.0070
Income	per capita income	1	0.35154	0.03827	9.19	<.0001

Fig.1. Multiple regression model fitting results

From the fitting results of Fig. 1, we can see that when considering the relationship between food price (Price) and per - capita income (Income) and per - capita food expenditure (Pay), per - capita income (Income) is a good fit for the model. However, the fitting of grain price (Price) and intercept to the model is not ideal, so it is necessary to analyze each variable further.

3.2.2 One-dimensional regression model

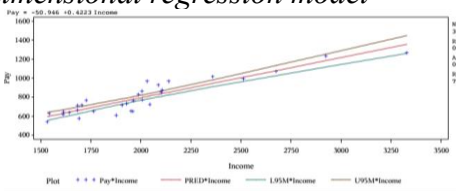

Fig.2. One-dimensional regression model—Income

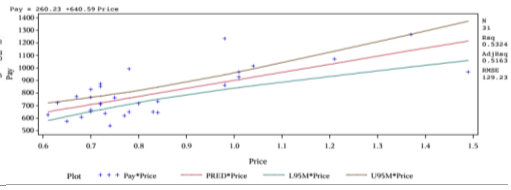

Fig.3. One-dimensional regression model—Price

Fig. 2 and Fig. 3 show the results of the one-dimensional regression fitting, and you can see that, the per - capita income (Income) and the grain price (Price) had a good regression relationship with the per - capita food expenditure (Pay), respectively. But the intercept fitting of two one-dimensional regression models are both not very ideal. In order to further determine the regression model between the three variables, it is necessary to select the variables scientifically.

3.3 Regression model variable selection

The variables are selected using the Mallows Cp method in SAS. According to the criteria of the Cp

method: The closer the Cp value to the number of arguments, the better the model is, the larger the Cp, and the worse the model fit. The result shows that the model fitting is optimal when two independent variables of per - capita income (Income) and grain price (Price) are selected to fit.

Based on the previous analysis, the regression fitting equation can be constructed as follows:

$$Pay = \beta_0 + \beta_1 \times \mathrm{Pr}ice + \beta_2 \times Income + \varepsilon \quad . \tag{1}$$

where β_0 β_1 β_1 are the corresponding variable coefficients, ε is an adjusting parameter.

3.4 Model checking

3.4.1 Autocorrelation analysis

We do auto-correlation test with BG method in SAS. The results of the autocorrelation BG test show that each variable is not significant, indicating that there is no autocorrelation between the model variables, which satisfies the model hypothesis of linear regression and passes the test.

3.4.2 Variance homogeneity test

The test of homogeneity of variances are discussed by using the Spearman test in SAS. The test results show that there is no significant correlation between the independent variable per - capita (Income) and the grain price (Price) and random error, and there is no heteroscedasticity in the model, which satisfies the hypothesis of the regression model.

3.4.3 Collinearity test of variables

The collinearity test of variables is discussed via using the VIF test in SAS. The results show that the p value of the total variance analysis of the model is less than 0.001, the model fitting is good, and the expansion factors of the variance are all less than 10, indicating that there is no multi-collinearity of the variables, and the model fitting is good.

3.4.4 Sample influence analysis

Output Statistics								
						DFBETAS		
Obs	Residual	RStudent	Hat Diag H	Cov Ratio	DFFITS	Intercept	Price	Income
1	29.8401	0.4854	0.1470	1.2738	0.2015	-0.0712	-0.1310	0.1763
2	10.4906	0.1625	0.0667	1.1915	0.0434	0.0117	-0.0312	0.0201
3	87.8758	1.4021	0.0572	0.9580	0.3453	-0.0781	0.2101	-0.0649
4	-108.2839	-2.2856	0.4007	1.0946	-1.8688	1.6568	-0.3161	-1.1626
14	0.2359	0.003600	0.0389	1.1604	0.0007	0.0002	-0.0003	0.0001
15	-39.2319	-0.6425	0.1530	1.2582	-0.2731	0.2032	-0.1190	-0.0879
16	11.3371	0.1745	0.0540	1.1750	0.0417	0.0321	-0.0057	-0.0164
17	83.9713	1.4962	0.2368	1.1508	0.8334	-0.5624	-0.3062	0.7442
18	-69.8041	-1.1009	0.0602	1.0402	-0.2786	-0.2131	0.1029	0.0580
19	-37.0199	-0.5669	0.0345	1.1148	-0.1071	-0.0343	-0.0193	0.0271
20	23.0472	0.5176	0.5521	2.4171	0.5746	-0.0962	0.5575	-0.3460

Fig.4. Hat Diag、CovRatio and DFBETAS result

①Cook's D analysis. Comparing the Cook's D value of each sample in the graph with that of 4/n, that is, 0.129, the larger the Cook's D value than 0.129, the greater the influence of the sample on the overall model, and then the possible existence of sample outliers. The Cook's D value of sample 17 is 0.222, slightly larger than 0.129, requiring attention. At the same time, the Cook's D value of sample 4 is 1.012, which is much larger than the standard value of 0.129, which may be an outliner. It needs to be paid more attention to and further determine the reliability of the sample.

②Hat-value. The judging standard value of Hat-value is $2\sqrt{p/n}$. If the value is exceeded, the sample may be a high impact point. The judging standard value of the sample is about 0.5. It can be seen from Fig. 4 that the Hat value of sample 20 is higher than 0.5, but because the Cook's D value of sample 20 is less than 0.129, sample 20 cannot be regarded as an abnormal sample. The Hat values of samples 4 and 17 are less than 0.5, so they can be considered as normal samples.

③CovRatio. This judgment reflects the effect of the observed value on the accuracy of the model estimation. If the CovRatio value of the sample is greater than 1, then it indicates that the sample improves the precision estimation of the model parameters. The results of CovRatio analysis given in Fig.4 show that the CovRatio values of samples 3,9,12,28,30 are slightly less than 1, but there is little difference between them and 1, which has a slight effect on the simulation accuracy of the model.

④PRESS/SSE. This ratio can be used to judge the goodness of the fitting model. The smaller the ratio, the better the fitting effect of the model is. The value of PRESS/SSE fitted by this model is 1.335, less than 2, which indicates that the model fits well.

Through the comprehensive analysis of each judgment index, there are no abnormal sample points in the whole sample, the quality of the sample is better, the fitting of the regression model is relatively

good, and there is no need to delete and re-collect the sample. Meet the sample requirements of regression model construction.

3.5 Model construction

Through the above-mentioned sample analysis, variable selection, model selection, and model test, we can see that the regression fitting of per - capita food expenditure (Pay) should choose two independent variables: per - capita income (Income) and grain price (Price). The regression model can be described as follows:

$$Pay = -87.37 + 213.42 \times Price + 0.35 \times Income + \varepsilon \quad , \tag{2}$$

we prove the validity of the regression model by means of variance homogeneity test, autocorrelation test, collinearity test and sample anomaly test. It is proved that the model accords with the hypothesis of the regression model and the model fitting is good.

The regression model shows that per - capita food expenditure is affected by both food price and per - capita income. Among them, for every 1 yuan increase in grain prices, per - capita food expenditure will increase 213.42 yuan, and the impact of the increase in per - capita income on per - capita food expenditure is not particularly obvious. For every increase in per - capita income of 1 yuan, per - capita food expenditure will only increase 0.35 yuan. It shows that food expenditure, as a consumption to meet basic daily needs, is not affected by income, but greatly affected by food price.

4. Summary

This paper mainly analyzes the relationship between food expenditure, income and food price, which is the basic demand of daily food. With the help of SAS 9.2, descriptive analysis, regression model selection and variable selection were carried out on samples collected from 31 provinces. On the basis of this, the related regression model is constructed. In order to determine the validity of the regression model, the variance homogeneity test, the collinearity test, the autocorrelation test and the analysis of the validity of the samples are also carried out in order to determine the validity of the regression model. Finally, the reliability of the regression model is determined. The analysis results show that the per - capita food expenditure in China is mainly affected by the grain price, and the influence of per - capita income on food expenditure is relatively weak.

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