Open Access Library Journal
2024, Volume 11, e11441
ISSN Online: 2333-9721
ISSN Print: 2333-9705

Linear Regression Analysis of Fixed Asset Investment and Regional GDP in Shandong Province

Shuyang Yu[1], Rui Zhang[2]

[1]School of Geography and Environmental Sciences, Zhejiang Normal University, Jinhua, China
[2]Faculty of Education, Yunnan Normal University, Kunming, China
Email: hqbysy@163.com, 1851439151 @qq.com

How to cite this paper: Yu, S.Y. and Zhang, R. (2024) Linear Regression Analysis of Fixed Asset Investment and Regional GDP in Shandong Province. *Open Access Library Journal*, **11**: e11441.
https://doi.org/10.4236/oalib.1111441

Received: March 15, 2024
Accepted: April 15, 2024
Published: April 18, 2024

Abstract

Univariate linear regression mainly studies the linear correlation between two variables. This article mainly selects Shandong Province's total social fixed asset investment and regional gross product (GDP) as variables to explore the relationship between the two from 1975 to 2017, and performs a regression analysis. The results show that there is a positive correlation between the two, and Shandong Province's whole-society fixed asset investment has a positive prediction effect on Shandong Province's GDP.

Subject Areas

Mathematics

Keywords

Linear Regression, Gross Regional Product, Fixed Asset Investment

1. Introduction

Fixed asset investment is the main means of social fixed asset reproduction. Through the activities of building and purchasing fixed assets, the national economy continues to adopt advanced technology and equipment, establish emerging sectors, further adjust the economic structure and regional distribution of productivity, enhance economic strength, and create material conditions for improving people's material and cultural life [1] [2]. Gross regional product (GDP) is an important indicator to measure the overall economic status of a region. It refers to the market value of all final products and services produced by all resident units in a region within a certain period [3] [4]. Judging from the

current research status, although it is intuitively believed that the fixed asset investment of the whole society in a region should be positively correlated with the GDP of the region [5], most of the existing research results collect data from the national perspective to conduct the fixed asset investment of the whole society. Linear regression analysis is performed on investment and GDP. There are few studies on linear regression analysis on fixed asset investment and GDP of the whole society in a first-level administrative region within a country [6]. At the same time, considering the difficulty in obtaining data, this article tries to cover as many years as possible. Therefore, this article collects the fixed asset investment and GDP data of Shandong Province from 1975 to 2017, and conducts linear regression analysis on both (See Table 1).

2. Data Sources and Research Methods

2.1. Data Source

The data used in this article come from the "Shandong Province Statistical Yearbook".

2.2. Research Methods

SPSS is a type of statistical analysis software. Its full name is Statistical Package for the Social Sciences. It is a software used for statistical analysis and data mining. It can be used for data management, descriptive statistical analysis, hypothesis testing, Regression analysis, factor analysis, cluster analysis, non-parametric analysis, etc. SPSS is widely used in social sciences, market research, health research and other fields [7].

The linear regression model is a statistical model used to establish and analyze the linear relationship between two variables. In a linear regression model, there is one independent variable and one dependent variable. The basic form of the model can be expressed as:

$$Y = \beta_0 + \beta_1 X + \varepsilon \quad (1)$$

where Y is the dependent variable, X is the independent variable, β_0 is the intercept, β_1 is the slope, *and ε is the error term.* The goal of the model is to best fit the observed data points by estimating the intercept and slope, Make the dependent variable value predicted by the model as close as possible to the actual observed value.

Table 1. Data sample of fixed asset investment and regional GDP in Shandong Province.

years	Shandong Province's total social fixed asset investment/100 million yuan	Shandong Province GDP/100 million yuan
1975	20.36	43.41
1976	20.03	61.39
1977	18.18	64.38
1978	41.87	86.25
1979	61.35	126.31
in 1980	69.97	166.19

This article uses SPSS software to select Shandong Province's total social fixed asset investment and Shandong Province's GDP as variables. It first analyzes the correlation between the two, and then establishes a linear regression model for further research.

3. Analysis of the Correlation between Shandong Province's Whole-Society Fixed Asset Investment and Shandong Province's GDP

In order to understand the correlation between the two, the software SPSS was used to calculate the correlation coefficient between Shandong Province's total social fixed asset investment and Shandong Province's GDP from 1975 to 2017. The results are shown in Table 2.

As shown in Table 2, the correlation coefficient is 0.987, and the significance level is less than 0.01. It shows that there is a very high degree of positive correlation between the two, and the linear relationship is very stable. It shows that the more fixed asset investment in the whole society, the higher the GDP.

4. Regression Analysis of Shandong Province's Whole-Society Fixed Asset Investment and Shandong Province's GDP

This article assumes that the dependent variable *Y is the GDP of Shandong Province over the years*, *and* the independent variable

$$Y = \beta_0 + \beta_1 X + \varepsilon \quad (2)$$

Among them, $(\beta_0 + \beta_1 X)$ is the influence of explanatory variable In order to further study whether the assumptions of the established regression model are established, the residuals were used to create the data shown in Table 3.

As shown in Table 3, the regression coefficients are 2792.161 and 1.366 respectively. Therefore, the linear regression equation of Shandong Province's total social fixed asset investment X and Shandong Province's GDP Y *over the years is* $Y = 2792.161 + 1.366X$. Judging from the goodness of fit of the data, the R^2 value is 0.975, close to 1, indicating that the prediction accuracy of the equation is high, which means that the fixed asset investment in Shandong Province's entire society can explain 97.5% of the changes in Shandong Province's GDP. An F test was conducted on the regression model and it was found that the model was established ($F = 1575.992$, $p = 0.000 < 0.05$). The results showed that Shandong Province's whole-society fixed asset investment can predict Shandong Province's GDP. A t test was performed on the regression coefficient. The regression coefficient value of Shandong Province's whole society fixed asset investment was 1.366 ($t = 39.699$, $p = 0.000 < 0.01$), which means that Shandong Province's whole society fixed asset investment will have a significant impact on Shandong Province's GDP. Positive prediction effect, that is, the more fixed asset investment in the whole society, the higher the GDP.

After fitting the linear regression model using the least squares method, the

Table 2. Correlation analysis results.

	Fixed asset investment of the whole society in Shandong Province/100 million yuan	Shandong Province GDP/100 million yuan
Fixed asset investment of the whole society in Shandong Province/100 million yuan	1	0.987 **
Shandong Province GDP/100 million yuan	0.987 **	1

* $p < 0.05$ ** $p < 0.01$.

Table 3. Linear regression analysis results.

	Regression coefficients	95% CI	Collinearity Diagnosis	
			VIF	Tolerance
Constant	2792.161** (4.389)	1545.245 - 4039.077	-	-
Shandong Province's total social fixed asset investment/100 million yuan	1.366** (39.699)	1.298 - 1.433	1.000	1.000
Sample size	43			
R^2	0.975			
Adjust R^2	0.974			
F value	$F(1, 41) = 1575.992$, $p = 0.000$			
Dependent variable: Shandong Province GDP/100 million yuan				
DW value: 0.130				

* $p < 0.05$ ** $p < 0.01$ The t value is in the brackets.

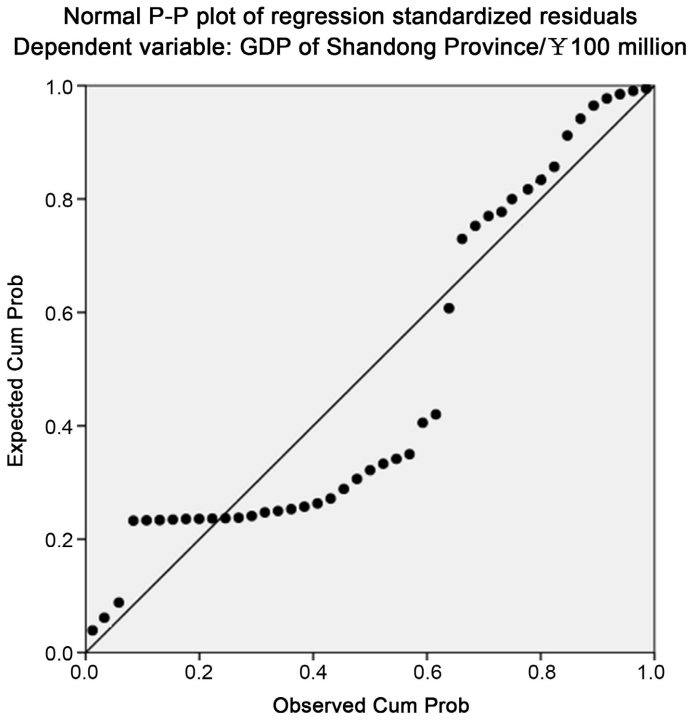

Figure 1. Normal PP plot.

fitted values and residuals of the model are obtained. The standardized residuals are obtained by further dividing the residuals by their standard deviations. Finally, draw a normal PP diagram. The horizontal axis is the measured cumulative probability and the vertical axis is the expected cumulative probability. If the residual conforms to the normal distribution, the two should correspond one to one and form a 45-degree straight line. After checking **Figure 1**, we found that the residuals basically conform to the normal distribution, so the model is relatively reasonable and reliable.

5. Conclusion

This article uses SPSS statistical software to conduct correlation analysis and regression analysis on the data of Shandong Province's whole society fixed asset investment and Shandong Province GDP from 1975 to 2017, and presents the specific linear regression equations for the Shandong Province's whole society fixed asset investment and the Shandong Province's GDP. Finally, this article concludes that there is a positive correlation between the fixed asset investment of the whole society in Shandong Province and the GDP of Shandong Province. That is, the higher the fixed asset investment of the whole society in Shandong Province, the higher the GDP of Shandong Province. Regression analysis shows that Shandong Province's whole-society fixed asset investment has a positive predictive effect on Shandong Province's GDP. This shows that the impact of fixed asset investment in the whole society on GDP is of practical significance, and the research results also have certain practical significance.

Conflicts of Interest

The authors declare no conflicts of interest.

References

[1] Zhang, Y., Zhu, Y.Z., Liu, R.G., *et al.* (2022) Analysis of Factors Affecting Regional Economic Growth—Taking Henan Province as an Example. *Inner Mongolia Science and Technology and Economy*, No. 14, 48-51.

[2] Su, X.C., Wu, J.J. and Yang, X.D. (2021) Analysis of the History of China's Economic Growth and Its Influencing Factors. *Chinese Business Theory*, No. 19, 186-188.

[3] Wang, H. (2019) Analysis of Factors Affecting Tianjin's Economic Growth. *Bohai Rim Economic Outlook*, No. 12, 87.

[4] Liu, J.Q. and Ru, S.F. (2019) Analysis of Factors Affecting Economic Growth in the Western Region and Path Selection for High-Quality Development. *Exploration of Economic Issues*, No. 9, 82-90.

[5] Sun, D.-D. (2000) Selection of the Linear Regression Model According to the Parameter Estimation. *Wuhan University Journal of Natural Sciences*, **5**, 400-405. https://doi.org/10.1007/BF02850764

[6] Cameron, A.C. and Trivedi, P.K. (2005) Microeconometrics: Methods and Applications. Cambridge University Press, Cambridge.

https://doi.org/10.1017/CBO9780511811241

[7] Zhang, H.C. and Xu, J.P. (2009) Modern Psychology and Educational Statistics. Beijing Normal University Press, Beijing.