

# Prediction of Stock Return based on ARMA Model

Yuqing Yao

School of finance, Anhui University of Finance and Economics, Bengbu 233000, China

## Abstract

**In the process of investment, investors in the market often care about the rate of return of stocks and choose stocks with higher rate of return to invest. It is helpful for investors to choose appropriate real-time machines to enter the stock market and obtain higher returns. Through the study of return, this paper attempts to establish ARMA model to predict the return of stocks.**

## Keywords

Yield; ARMA Model.

## 1. Research Significance of Yield

China's securities market is still an emerging market, which is not a completely effective market, so there are many interesting phenomena in the market. For example, before the company announces good news, the company's share price will rise, so the actual income of investors will increase. There will also be a fall in the share price of the company, and investors' investment will soon become a bubble. Therefore, the stock return calculated by the stock price is an indicator that investors are particularly concerned about in the market. Some scholars believe that if the future stock return is predicted and calculated through historical data, unnecessary risks can be avoided to a great extent, and excess income may be obtained.

Foreign securities markets have developed for hundreds of years, there is less chaos in the market, and there is a relatively perfect theoretical basis. Scholars also have a comprehensive study on stock returns. For foreign research results, China can not fully apply them, because the actual situation of the two countries is not the same. Compared with foreign financial markets, China's securities market has only a few decades, domestic scholars' understanding of the market is not complete, and the research on yield is not comprehensive. It is unwise to simply apply foreign research results. The research on yield should be combined with micro and macro factors.

## 2. Macro Factors Affecting Stock Return

The overall situation of the stock market is also affected by the current economic situation. When the overall external environment is stable and the economic level is stable, the Chinese people have a good attitude towards the future prospects and are willing to invest the surplus money in the stock industry. The supply in the stock market exceeds the demand, and the stock price rises, the people have the opportunity to obtain more benefits. However, when the external environment is unpredictable, the overall return of the stock market may become worse because of the concern of not investing too much. Just as a country's economic environment is linked to the economic environment of the whole world, a country's stock market is also linked to the country's overall economic level. There is no country with a low economic level, and the country's stock market is very developed. Therefore, the stock return of individual stocks corresponds to the overall return of the market. According to the value theory, the price of individual shares is related to the operation of listed companies, and the operation of listed companies is also related to the national economic environment. If the

economic situation is good or the economy is booming, the overall income of the company is good.

The rate of return of stock needs to consider the bank interest rate, which will affect the change of stock price. There is a negative relationship between interest rate and stock price, that is, interest rate increases and stock price decreases; Interest rates fell and share prices rose. The flow of social funds is often affected by the change of interest rate, so the amount of funds flowing into the stock market is affected by interest rate to a certain extent. When the deposit interest rate increases, the interest income increases. For some risk averse investors, investing funds in the bank's relatively risky stock market is a safe investment means. As a result, the amount of funds circulating to the stock market decreases, the stock price decreases and the investment risk increases. When the interest rate drops, the income of bank deposits decreases. At this time, the income of investing funds in banks is low. People turn to invest their existing funds in the stock market, hoping to obtain better income in the stock market. The demand of the stock market increases, so that the stock price rises and the income increases. On the other hand, when the loan interest rate increases, the cost of speculators using bank loans to obtain funds to invest in the stock market increases. Wise investors will reduce the amount invested in the stock market, and will be more cautious, choose relatively conservative investment strategies, and reduce the opportunity for investors to obtain excess returns. For the company, the rise of loan interest rate may change the company's business strategy and reduce the company's loan demand from banks. When the company's funds are tight, the high-cost loan method may reduce the company's output, thus affecting the company's operating profit and indirectly affecting the company's stock price and stock price yield. On the contrary, when the interest rate drops, the funds obtained from bank loans are invested in the stock market, and then the stock market returns the bank loans. The cost is more cost-effective than investing their principal in the stock market. Similarly, reducing the cost of raising funds can expand the company's cost, increase the company's income and attract investors to invest in the company's shares.

The return of stock has a certain relationship with the industry boom in the market, and the stock price has a positive relationship with the industry boom. When the industry in the market is booming, when the sales volume and sales price of the company's goods rise, under the condition that other costs remain unchanged, the company's overall operating revenue will inevitably increase, the company's operation is good, the market value will increase, the corresponding external evaluation of the company will also increase, and the corresponding stock price of the company will also rise with the rise of the company's reputation, Therefore, under the same conditions, investors' real income increases and obtain excess returns. When the overall industry is in recession, the company can only obtain the market share by reducing the product price. When the company's cost remains unchanged, the company's overall income is relatively reduced, or even in a state of loss, the stock price of the corresponding company will also be reduced, and the rate of return of investors will also be reduced.

On the surface, inflation has no direct relationship with the company's stock price and stock return, but there is a certain correlation. Inflation is essentially the reason for more money in the market. Inflation can stimulate the stock market and also have a negative impact on market output. A certain proportion of inflation can stimulate production, promote prices, increase the company's profits, increase the company's dividends, and attract market investors to invest in the company's shares. However, if inflation exceeds a certain proportion, it will reduce the actual purchasing power and people's living standards. In order to avoid the reduction of the quality of life in the future, people will choose to preserve the value by certain means. Investing in the stock market is an important means for people to preserve their value. Moreover, the rise of inflation reduces the gap between the real value of stocks and the nominal value of stocks, so that the actual income of investors decreases and the stock market shrinks.

Tax is also an important factor affecting the stock return. Usually, the increase of tax reduces the company's income, the company's interests and the income distributed to shareholders, resulting in the decline of stock price. On the contrary, the decline of tax will stimulate the stock market. On the one hand, the interests of the company will increase, and the interests obtained by shareholders are mostly related to the expected income. On the other hand, the decline of tax will increase the income for ordinary shareholders if the tax paid in the investment process is reduced and the intangible expenditure is reduced.

### 3. Micro Factors Affecting Stock Return

On the surface, China's stock market does not conform to the efficient market theory. The stock price is affected by many factors. It seems that the investor's mood can make the stock price rise. Most investors in the market buy a stock, the stock price will rise, and the capital of large institutions will flow out of a stock, and the stock price will fall. However, in the long run, China's stock market is still in line with the value theory. Only valuable enterprises will have higher stock prices and have the opportunity to obtain excess returns. The leading stocks of Listed Companies in the market are excellent operators in the industry. The company's operation, company structure and company management are in line with the first-class level. There is no company with internal turbulence, poor management and large losses, which is the leading company in the industry. In the short term, these garbage companies may have high stock prices, but they are all caused by some special reasons, and will face the result of being eliminated by the market in the long term. Truly intelligent professional investors will adhere to the principle of "stock price adjusts with performance", judge the future profitability of the company through operating efficiency and performance, buy the company's shares at a lower price when the company is just starting, and wait for the company's stock price to increase with the improvement of performance. Blind investors in the market will choose stocks invested by more investors regardless of the company's performance. Generally, such investors will lose money. Baijiu, a Baijiu leader in liquor industry, has always been known for its good quality. Its stock price has been rising steadily in many stocks of the Baijiu industry, while some of the poor quality liquor companies have long disappeared on the stock market. In fact, growing companies have higher share prices.

Company size is also the influencing factor of stock price. Generally speaking, the company size has a positive relationship with the company's anti risk ability, and the expected return of investors will also be affected. Generally, in the event of an economic crisis, the risk ability of large companies is stronger than that of small companies, and the ability to deal with the crisis is also better than that of small companies, so most of the large companies survive the economic crisis. Although some small companies have good future prospects, they will eventually fail in the economic crisis, so investors tend to choose larger companies for investment. Moreover, large companies have easier access to resources than small companies, and have better fund-raising ability and innovation ability. In comparison, the earnings of large companies are more stable and the stock price is more gratifying.

There are many micro factors that determine the stock price of listed companies, such as the ability of the company's managers. A good manager can guide the company's direction and effectively deal with the crisis faced by the company. In today's era, companies are blindly conservative and stick to the previous things, which can easily be replaced by competitors in the industry. The company's innovation ability is also what investors need to pay attention to. It can be seen that micro factors are important factors affecting the individual performance of listed companies.

## 4. Classification of Stock Returns

Stock return is an intuitive indicator to measure the return of investors. If the return of a stock is positive, it means that investors invest lower expenses and obtain higher income. The high return of the company's stock reflects the company's good operating conditions and good development prospects. Investors can pay attention to the company. This index can be classified into dividend yield and holding period yield. The dividend yield is calculated based on the dividend distributed by the company, and the proportion with the stock market price is taken as the dividend yield.

Holding period yield refers to the ratio of the sum of dividend income and bid ask spread to the purchase price of stocks during the period when investors hold stocks. If the stock has no maturity date, investors hold the stock for a short period of several days, and some investors hold the stock of a company for several years. Holding period yield is one of the most concerned indicators for investors.

## 5. Relevant Theoretical Basis

From the previous analysis, we can see that the return of stock is related to the value of the company in the long run, which is in line with the value theory. Value theory means that the price of stock should be unified with the value of stock, and the value determines the price of stock. However, later scholars found that there is a certain gap between value and price, that is, in reality, price is not equal to value. Sometimes value is higher than price, and sometimes value is lower than price. In short, price fluctuates around value.

The behavior of calculating the future return of stock according to the stock price is the investment analysis theory of symbolic stock. The basic idea is that investors calculate and predict the future stock situation according to the historical data, so as to buy high-quality stocks that have not been found by other investors in order to obtain dividends, dividends and other income. Stock investment analysis theory is a part of securities investment theory. The theory is to find out individual stocks whose price deviates from value from a large number of data for investment. There are many theoretical methods for stock price analysis. Some investors judge the trend of stock price according to some basic historical data, and some investors can get the prediction of stock price through some high-tech means.

Basic analysis analyzes the time of stock purchase through the operation status, strategic development and other economic problems of each company. Basic analysis is generally to examine the basic financial data of listed companies, such as relevant data in financial statements and the company's future strategic plan to determine the value of the company. If the predicted real value of the stock is lower or higher than the current market price, the price of the stock is overvalued or undervalued. Although undervalued or overvalued stocks will eventually be corrected, this short deviation will still bring benefits to investors. The order of basic analysis is to analyze the overall economy first, followed by the industry, and finally the company. There are many advantages of basic analysis. This method is not useful for short-term stocks, but for long-term prediction, this method can be used as a reference in daily investment. Technical analysis does not have as much perceptual understanding as basic analysis. Technical analysis is to collect all the data about the stock through big data analysis and other means, judge the future development prospect of the stock and the future trend of the stock price according to scientific and technical analysis, and calculate when the individual stock is the best time to buy, The best price and the best selling time create opportunities for investors to make profits. Technical analysis is to use some historical data to judge the future change direction of the whole stock market or individual stock prices. Technical analysis often requires certain professional knowledge and certain configuration, which is a little big for ordinary investors.

But now there are a lot of software that can simply calculate some judgment indicators and buy relatively valuable stocks. Technical analysis is useful in a short time, but it is a little difficult for the current technology to use in long-term prediction, because the stock market is changing rapidly, and it is impossible to accurately predict the stock price and corresponding rate of return for a long time in the future.

## 6. Literature Review

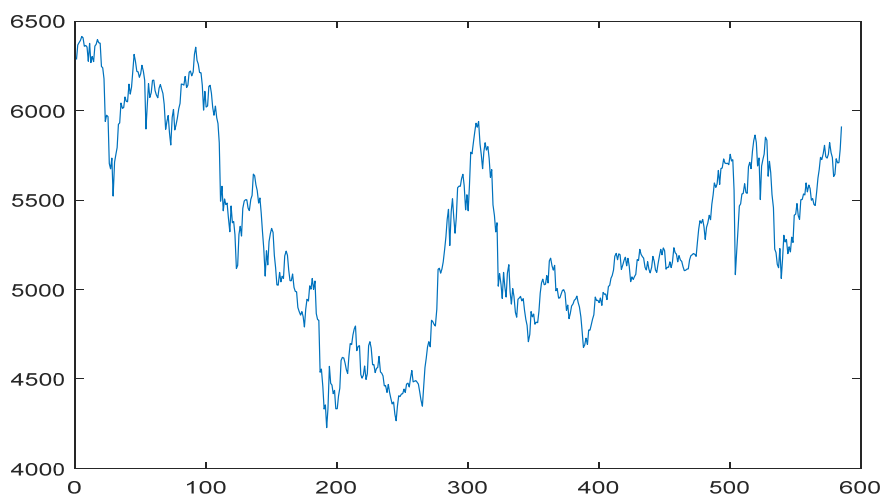
Domestic scholars have conducted the following research on the rate of return: Li Hong (2019) studied the stock rate of return from the perspective of dividend policy and found that the rate of return of the portfolio with cash dividend is different from that without cash dividend. Chen Kang (2018) turned to the relationship between air quality and investor sentiment and stock return. The study found that air quality can affect investor sentiment, reduce investors' investment intention and reduce the liquidity of the stock market. Wang Yuwei (2018) used tvp-var-sv model to analyze the relationship between stock return and inflation, and found that on the surface, inflation will have a negative impact on the return, but unexpected inflation will have a positive impact on the return. Zhong Hui (2017) analyzed the relationship between differences of opinion and stock return based on investors' differences of opinion. The study found that China's Shenzhen market is different from Shanghai market. Yan Cuiling (2017) analyzed stock returns from different perspectives. Geographical location has an impact on stock prices and returns, and central cities will have more returns. Xu bu (2015) analyzed the yield of China's stock market by judging the classification of information in analysts' forecasts. The study found that there were more anomalies in neutral news. In Zhang Weiwei's (2019) research on the expected return of stocks, it is found that the credit spread has a negative impact on the expected return of stocks, and the impact of credit spread on the return of stocks is more obvious in highly leveraged companies. Xu Junhua (2001) and Li Qiya have studied the relationship between stock market policy and yield, and concluded that there is a positive correlation between continuous policy and China's stock market, but the degree of explanation is small. The stock market operation is greatly affected by short-term policy events, but the impact of policy events on the stock market is gradually weakening, and the stock market policy regulation tends to mature.

## 7. Empirical Research

In the statistical modeling of financial asset prices, the rate of return is used in most cases. The change trend of yield can not only reflect the stock market trend, but also make a short-term prediction of the stock market trend. There are two kinds of yield: percentage system and logarithm system. Logarithmic rate of return has more statistical properties, which is convenient for better statistical analysis. Therefore, this paper will convert the rate of return data into logarithmic form for analysis and modeling. This paper selects the 586 day closing price of SSE 100 (000132) from January 2018 to June 2020 as the research object, and the data is from "guotai'an" database.

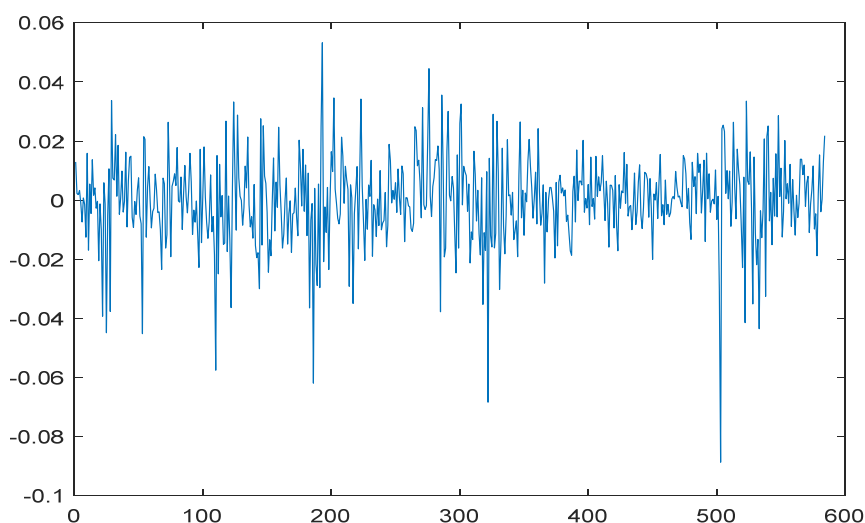
### 7.1. Trend and Unit Root Test of Data

By analyzing the trend of the closing price of the original data (as shown in Figure 1), it is found that the volatility of the data is obvious. In these 600 days, the closing price is a violent fluctuation curve, with the maximum value reaching 6500 and the minimum value only 4200. The closing price first reached the peak, sharply decreased to the minimum in the middle of 18 years, and then showed an upward trend. If an investor buys this stock for 18 years and holds it for 20 years, it is worth caring about its yield.



**Figure 1.** Closing price of SSE 100 from 2018 to June 2020

Investors have been paying more attention to the stock yield. Using the closing price to convert the data into the daily yield data of the stock, it can be clearly found that the daily yield data is a non-stationary sequence. Therefore, further process the daily yield data, take pairs of the data, and then use the time trend chart to observe the trend of logarithmic yield. (as shown in Figure 2)



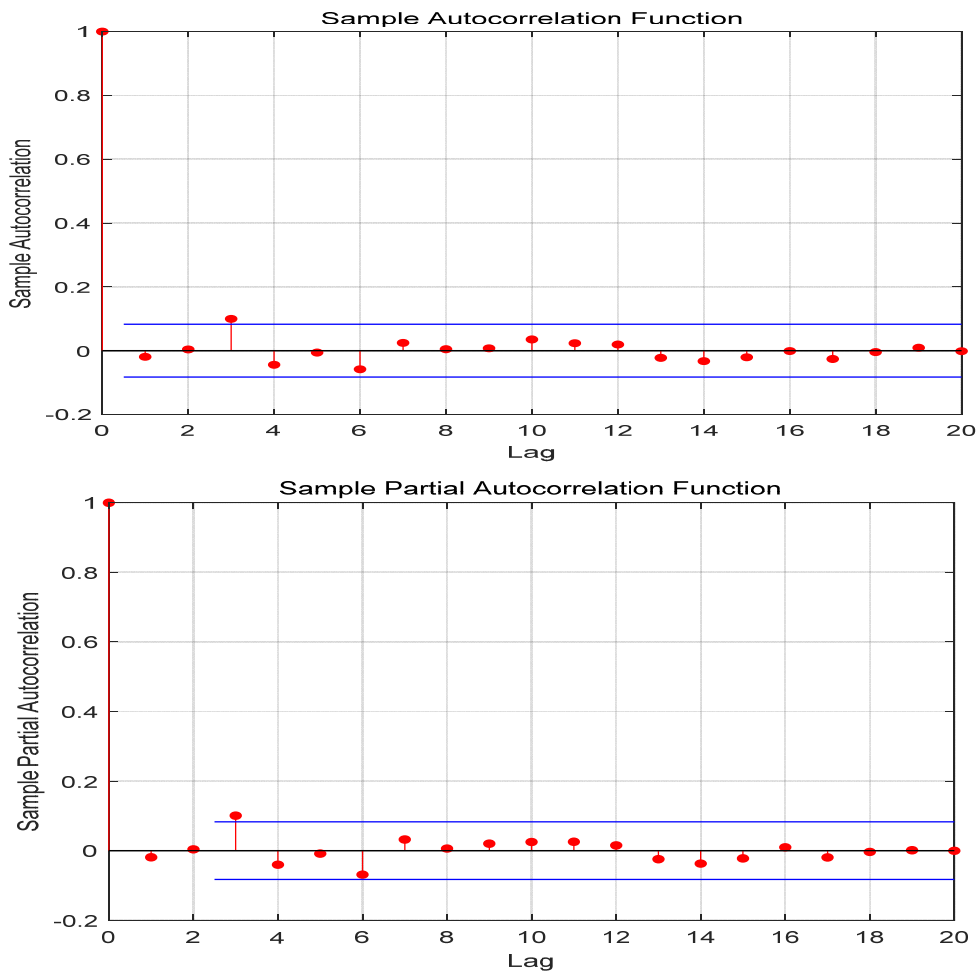
**Figure 2.** Time trend of logarithmic rate of return

By observing the time trend chart of logarithmic rate of return, it can be found that the data is stable, the data is concentrated in the fluctuation up and down in the middle region, and only a few data exceed this interval. The intuitive understanding from the graph is still lack of preciseness. Therefore, the unit root test is carried out on the data, and the test result is 1, indicating that the logarithmic rate of return is a stationary series.

**7.2. Autocorrelation and Partial Autocorrelation of Time Series**

The measurement model of time series data is determined by the results of autocorrelation diagram and partial autocorrelation diagram. The autocorrelation diagram and partial autocorrelation diagram of log return of Shanghai Stock Exchange 100 are shown in Figure 3.





**Figure 3.** Autocorrelation diagram and partial autocorrelation diagram of log return

As can be seen from the above figure, the autocorrelation chart and partial autocorrelation chart of logarithmic return break through the range in the third period, fluctuate up and down around the value of 0 from the fourth period, and there is tailing in both charts. Therefore, the data should use ARMA (P, q) model.

### 7.3. Establishing ARMA (P, q) Model

The ARMA model with three orders of P and Q is established by software, and the mathematical expression is as follows:

$$y_t = -0.3494y_{t-1} - 0.1179y_{t-2} - 0.2756y_{t-3} + \varepsilon_t + 0.3362\varepsilon_{t-1} + 0.1177\varepsilon_{t-2} + 0.3912\varepsilon_{t-3}$$

### 7.4. White Noise Inspection

The software is used to test the residual of aeam (3,3) model with white noise. If the residual test of the model is passed, the information of swimming is extracted from the data. The results are shown in Figure 4:

As can be seen from the above figure, the standard deviation of the residual conforms to the normal distribution, the correlation diagram and partial autocorrelation diagram of the residual fluctuate up and down around 0, and the QQ diagram shows that there is no autocorrelation, so this model well contains all useful data.

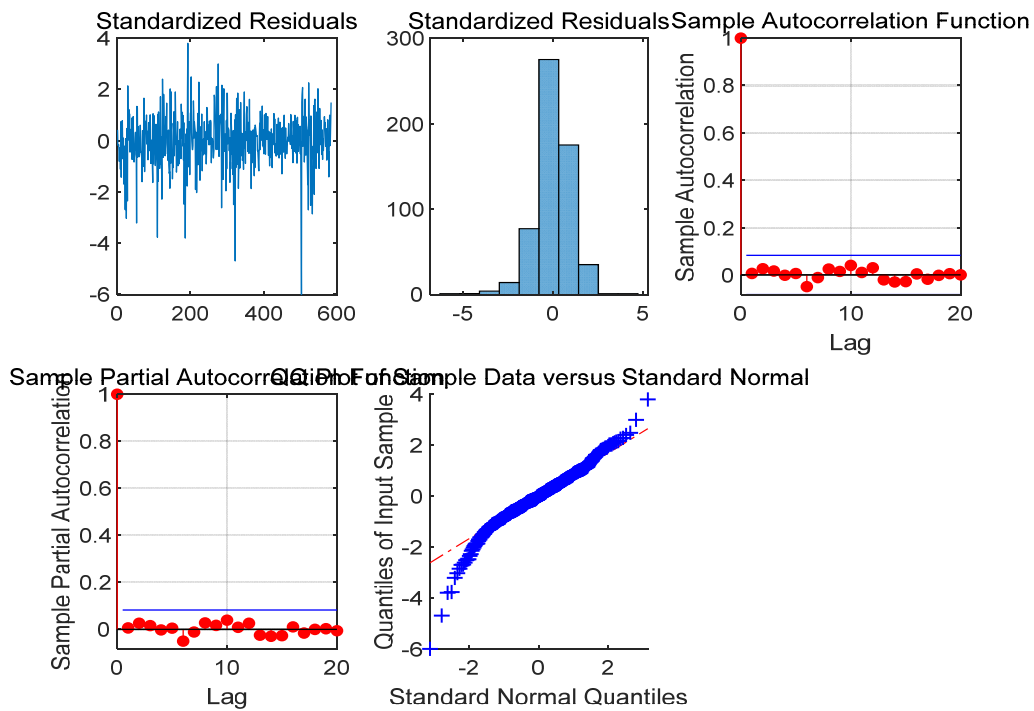


Figure 4. White noise test of data residuals

### 8. Conclusion

The last 15 data are selected and predicted by the model. The prediction results show that the blue line in the figure is the value of the initial logarithmic return of the stock, and the red line is the value measured by the model after the model is established. It can be clearly found that there is a great error between the value of the original data and the predicted value. It can be concluded that the effect of using Aram model to predict the return of stocks is not ideal. The results are shown in Figure 5:

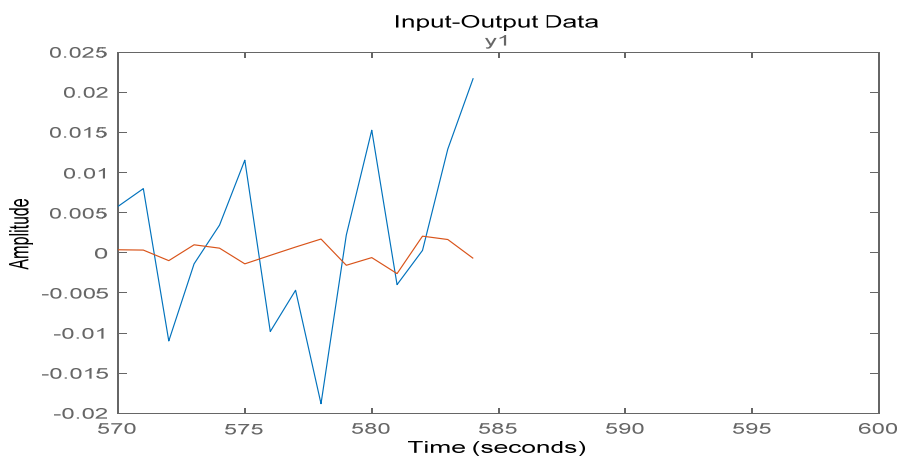


Figure 5. Revenue perdition

### References

[1] Li Hong, Zeng lifeI. Research on the impact of cash dividend policy on stock return in China's A-share market -- Also on the semi mandatory dividend policy [J]. Zhejiang finance, 2019 (09): 37-46 + 36.



- [2] Wang Yuwei, Ding Hui, Sheng Tianxiang. Study on the dynamic relationship between stock return and inflation expectation -- An Empirical Study Based on tvp-var-sv model [J]. Nankai economic research, 2018 (06): 129-148.
- [3] Chen Kang, Jiang Jiajun, Liu Qi, Li Xin. Air quality, investor sentiment and stock return [J]. Management science, 2018,31 (06): 145-160.
- [4] Zhong Hui, Hu Jiayang. Investor differences and stock return bias [J]. Chinese and foreign entrepreneurs, 2017 (35): 91-92.
- [5] Yan Cuiling. Research on company geographical location and stock return [J]. Cooperative economy and technology, 2017 (12): 57-59.
- [6] Xu bu. Stock returns from the perspective of information uncertainty: An Empirical Study Based on a shares [J]. China price, 2015 (12): 36-39.
- [7] Zhang Weiwei. Impact of credit spread on expected return of stocks [D]. Nanjing University of technology, 2019.
- [8] Xu Junhua, Li Qiya. Empirical Study on the impact of macro policies on China's stock market [J]. Economic research, 2001 (09): 12-21 + 95.