

Stock Price Forecast based on ARIMA Model-Taking Yowant Technology and New Oriental Online as Examples

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Abstract. With the growth in the personal standard of living, public play is also undergoing tremendous changes. Increasingly people begin to take note of and participate in share market investment. Shares have high returns, but also high risks. Many factors limit the share market and unpredictable prices. The share price forecast is of great significance. So, since the birth of the share market, stock price prediction has been a hard nut for shareholders and researchers to probe. This paper selects the closing prices of Shenzhen A-share Yowant Technology and Hong Kong stock New Oriental Online as the time series empirical analysis data forecasts the change price trend of these two stocks in the next 30 days by establishing the ARIMA model, and analyzes which stock will rise more. The empirical results show that the imitative effect of the model is well, and the conclusion is that Hong Kong shares of New Oriental Online will increase significantly in the future, which can supply utility assistance for enterprises and investors enterprises to make corresponding decisions.

Keywords: Stock price forecast; time series analysis; ARIMA model.

1. Introduction

As the world's second-largest financial condition, China's financial condition situation continues to improve. With the growth in the people's level of consumption, people's consumption purpose is no longer easy message demand, but also still more experiential and entertaining. The original online shopping was a graphic display, but now it is a video display, now there is a live broadcast with goods, which is displayed through live broadcast, thanks to the promotion of technology, but more importantly, consumers' demand for the upgrading of consumer experience and the guidance of social capital strength [1]. Now, live e-business has become a popular form of e-commerce.

At the moment, selling goods through live-streaming has become a new engine to stimulate consumption and boost the economy. Local governments also pay more and more attention to live broadcast e-commerce. According to incomplete statistics, in 2020, more than 30 local governments across the country introduced support policies for live broadcast e-commerce. Many governments have clearly proposed to build "the capital of live broadcast e-commerce" and "the headquarters base of the live broadcast economy", and have included e-commerce anchors in the talent introduction policy. They have issued a series of relevant talent training support policies, which promote the development of live broadcasts with goods [2]. The industry has a very broad prospect for development. If you can choose live broadcast e-commerce stocks, the future returns will be considerable.

Yowant technology, live broadcast with goods, "Yowant Network" has a very good set [3]. In order to increase the number of viewers and sales of the live broadcast room, "Yowant Network" has made great efforts. From investment promotion and selection, commodity price negotiation, and flow file setting to live delivery, return, and after-sales, every link cannot be separated from the company's professional, systematic, and refined team support. The anchor with goods is also a famous star today, which can attract a large number of fans. New Oriental Online became very popular after it started live broadcasting [4]. The company adopts "bilingual delivery", teaching English while delivering goods. It is humorous and has outstanding talent. It allows netizens to broaden their horizons and learn knowledge without being bored. It seems that class is the main task and shopping has become a sideline. And they have their own industrial chain and sell their own products. They are 24-hour live broadcasts, moreover, the biggest feature is the combination of knowledge sharing and good

things recommendations. Almost all the anchor teams selected by Dongfang are transformed into New Oriental teachers, who can be learning knowledge, and watch and listen to jokes in the live broadcast room, which are particularly novel and will have a lot of space in the future [5].

Based on the Arima model, this paper uses python to predict the two stocks of Yuanwang Technology and New Oriental Online, tests the fitting degree of the Arima model to the data of these two stocks during the period, and makes assumptions and verifications [6].

2. Method

2.1 Model Introduction

The autoregressive moving average ARIMA model is a kind of econometric model. It takes time series as a group of random variables that depend on time t (except the observation value caused by individual accidental factors) as its basic idea [7]. Box and Jenkins primarily proposed the ARIMA model, which is, first stabilizes the non-stationary time series is decomposed into a d -order difference, and then autoregressive (AR (p) process) and shifting average process (MA (q) process) to acquire a stationary time series, and identify the autocorrelation coefficient of the sample (ACF), part of the autocorrelation coefficient (PCF) and other data [8, 9]. Moreover, there is a complete build of modeling evaluation, inspection, and control means. Let the mean value of $\{Y\}$ t stationary time series be zero, so that the ARMA (p, q) formula of the hierarchical moving average of autoregressive q of order p can be expressed as:

$$Y_t - \phi_t Y_{t-1} - \dots - \phi Y_{t-p} = \varepsilon_t - \theta_1 \varepsilon_{t-1} - \dots - \theta_q \varepsilon_{t-q} \quad (1)$$

It can be abbreviated as $\phi_{(B)} Y_t = \theta_{(B)} \varepsilon_t$. D is the difference first order is ARIMA (p, d, q) model. The time sequence data in the financial marketplace is usually non-stationary. The difference is among the manners to stabilize, this difference of ARIMA modeling procedure is almost the same as that in the ARMA [10].

2.2 Model Building

This paper selects 3074 groups of data, including the date, open, high, low, close, and volume of Yowant Technology (002291) stock from September 3, 2009, to December 5, 2022, and New Oriental Online (01797) share from March 28, 2019, to December 5, 2022, on each trading day, the outcomes are displayed in Table 1 and 2, and uses jumper software for smoothing processing and stability testing to complete a model identification and order determination, Select an appropriate ARIMA model and carry out relevant tests. Finally, predict and analyze the stock on the future trading day. Predict the future trend of the stock price, which can provide investors with a reasonable investment direction and provide a certain reference for gaining income in the stock market, as Tables 1 and 2 show.

Table 1. Yowant Technology data

	Date	Open	Close	High	Low	Volume
0	2009/9/3	12.461	12.855	13.956	12.235	33,446,938
1	2009/9/4	12.426	12.809	13.157	12.113	20,313,324
2	2009/9/5	12.930	13.174	13.707	12.844	17,220,720
3	2009/9/6	12.983	13.185	13.388	12.820	9,103,497
4	2009/9/7	13.185	14.507	14.507	12.896	15,332,864
...	...	...	...	...	...	...
3070	2022/11/29	14.160	14.470	14.720	14.110	16,057,369
3071	2022/11/30	14.480	14.610	14.700	14.360	13,501,318
3072	2022/12/1	14.660	15.120	15.500	14,620	28,471,917
3073	2022/12/2	15.050	15.600	15.820	15.000	29,761,815
3073	2022/12/25	15.580	15.280	15.650	15.230	17,098,664

Table 2. New Oriental Online data

	Date	Open	Close	High	Low	Volume
0	2019/3/28	10.20	10.20	10.56	9.53	68,956,200
1	2019/3/29	10.20	10.14	10.20	9.96	8,198,514
2	2019/4/1	10.20	11.06	11.18	10.04	17,410,510
3	2019/4/2	11.18	11.10	11.80	10.88	9,609,040
4	2019/4/3	11.00	10.20	11.20	10.80	7,454,500
...	...	...	...	...	...	...
907	2022/11/29	37.00	37.90	38.80	36.25	11,622,021
908	2022/11/30	38.35	41.00	41.00	38.00	42,438,181
909	2022/12/1	41.00	39.65	42.20	39.20	18,560,496
910	2022/12/2	39.60	39.60	40.95	39.30	7,881,346
911	2022/12/25	40.35	42.20	42.50	39.65	19,505,007

2.3 Stability Test

By watching the time series diagram, autocorrelation, partial autocorrelation diagram, and the test of unit root ($P < 0.05$), it can judge that the sequence is stable. To ensure the exact of the experiment, first, carry out the stationarity test to determine whether the model is stable, and then carry out the difference operation. From the results of the trial of the order after the 1st difference, the outcome Exhibited that the order is firm after the first-order difference. Finally, the white noise trial is carried out on the order of the first-order difference $P < 0.05$ means the result of the sequence after the first-order difference is a stationary white noise sequence [9]. Through the stationarity test of the model, the autocorrelation diagram results as shown in Figure 1 and Figure 2.

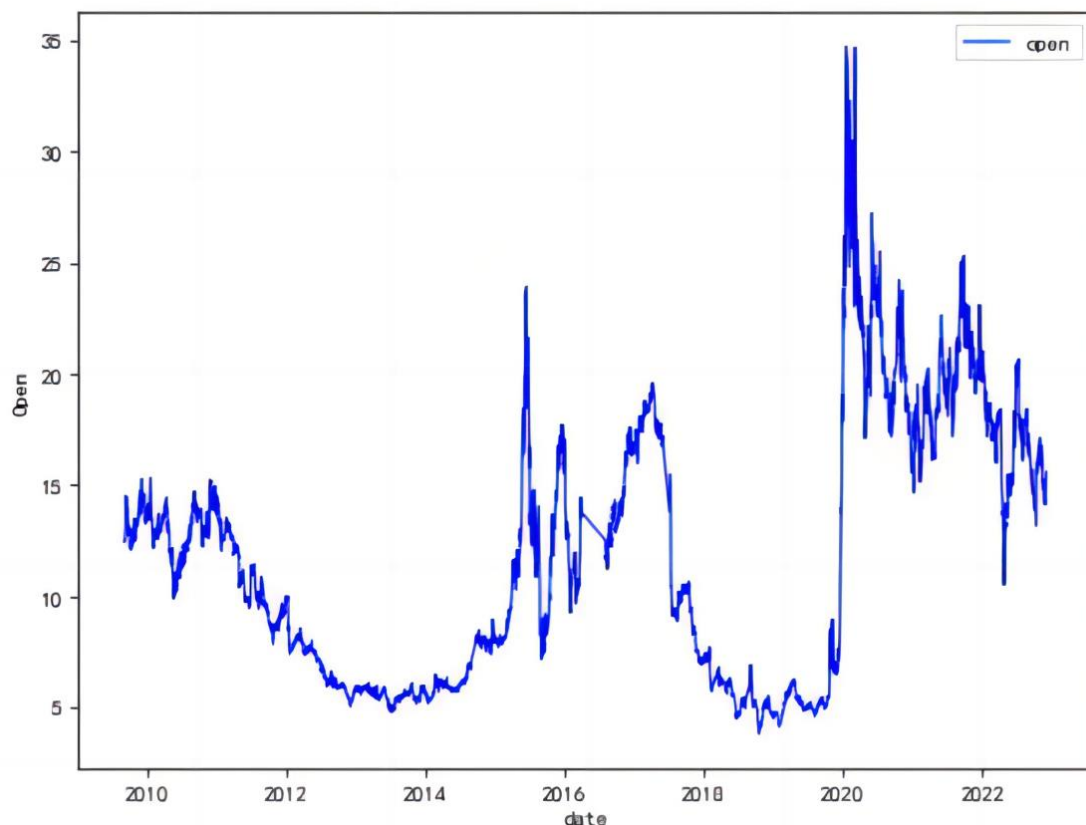


Figure 1. Yowant technology Stationarity test

As figure 1 shows, the trend chart of the opening price shows that the opening price tag of the share is volatile.

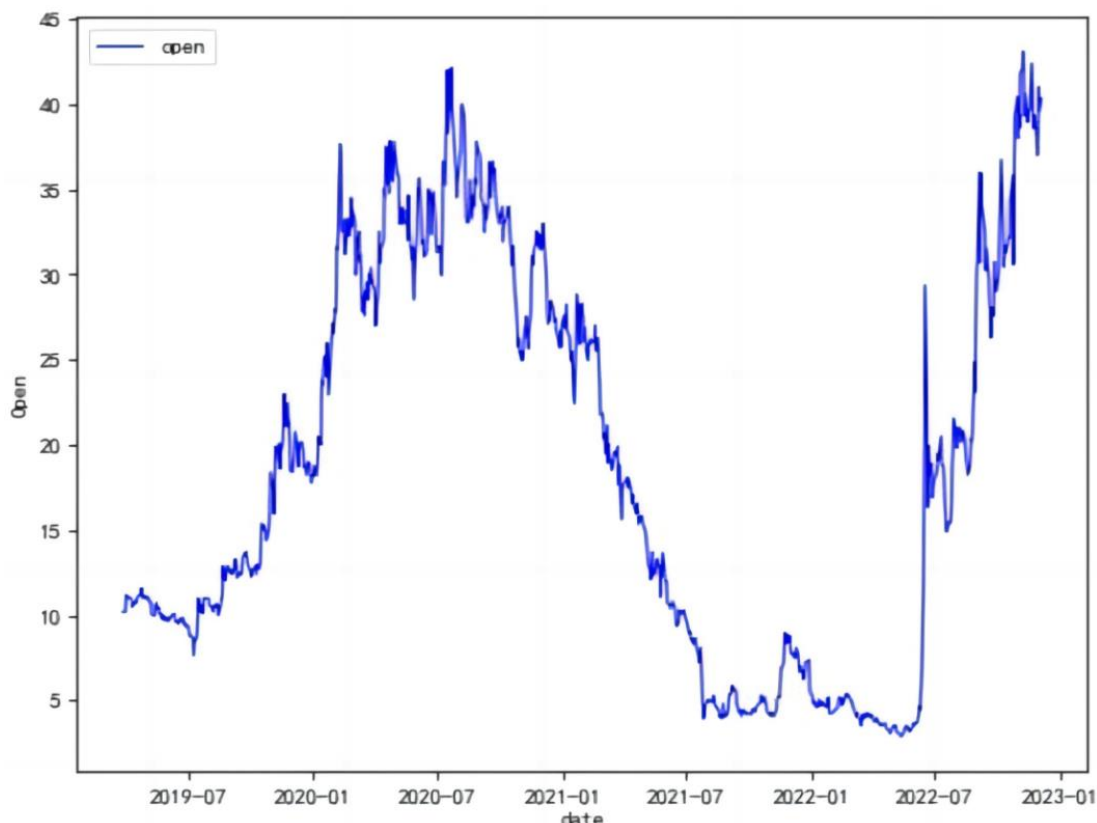


Figure 2. New Oriental Online Stationarity test

As figure 2 shows, the trend chart of the opening price shows that the opening price tag of the share is volatile.

Table 3. Yowant technology Autocorrelation test

	t-Statistic	Prob*
Augmented Dickey-Fuller test statistic	- 2.598	0.000
Test critical Values 1%level	-3.433	
5%level	-2.862	
10%level	-2.567	

As shown in Table 3 the number of the test statistic is - 2.598, this is superior to the critical value given by the critique value by 1%, and the critical price under the 5% significance level, although greater than 10%, is not significant. At the same time, $p\text{-value} = -2.598 > 5\% \text{ level } (-2.862)$, so the initial hypothesis may not be disallowed, an indication that the stock opening price sequence is not static.

Table 4. New Oriental Online Autocorrelation test

	t-Statistic	Prob*
Augmented Dickey-Fuller test statistic	-0.997	0.000
Test critical Values 1%level	-3.438	
5%level	-2.865	
10%level	-2.568	

As shown in Table 4 that the number of the test statistic is -0.996, it's more than a critical value given by the critique value at 1%level, 5%level and 10%level significance levels, and $p\text{-value} = -0.996 > 5\% \text{ level } (-2.865)$. So, the initial hypothesis may not be disallowed, an indication that the stock opening price sequence is not static.

3. Results and Discussion

3.1 Differencing Operator

To remove the influence of random trends on inventory data modeling, Text chose to apply the differential to clean up the random pattern and plot the time-after-difference sequence graph, as shown in Figure 3 and Figure 4.

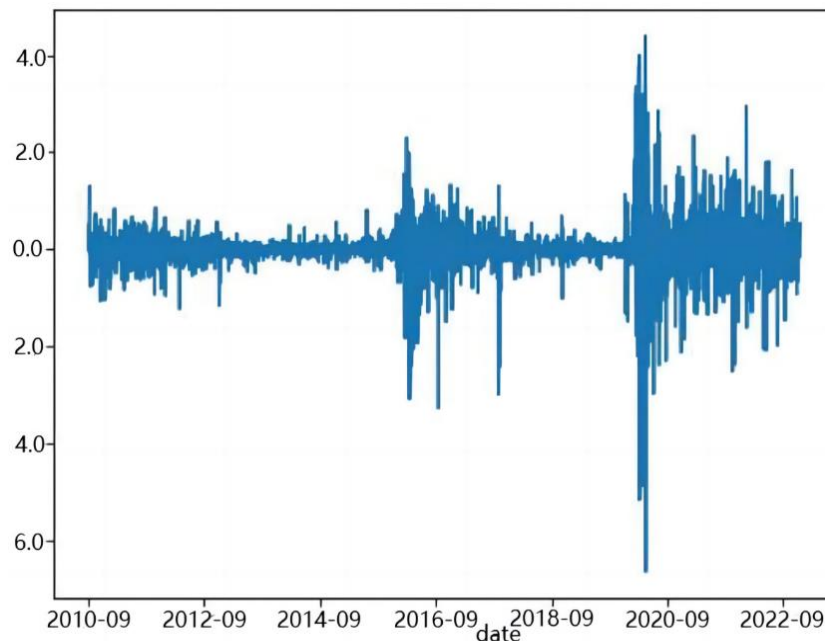


Figure 3. Yowant technology Sequence chart according to difference

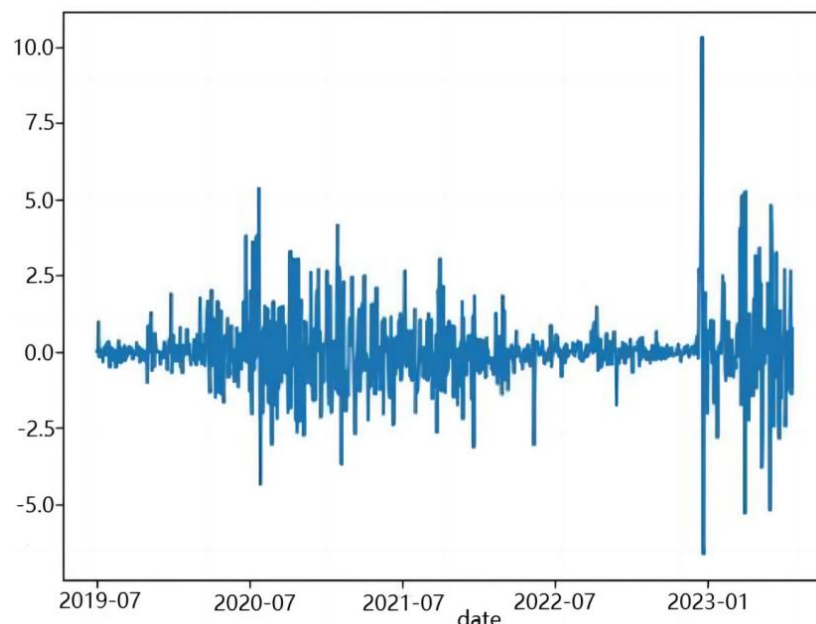


Figure 4. New Oriental Online Sequence chart according to difference

At the Sequence chart according to difference, the trend in opening prices can be seen as random of both stocks incline to stabilize. Draw a first-order differential self-correlation chart, as shown in Figures 5 and 6.

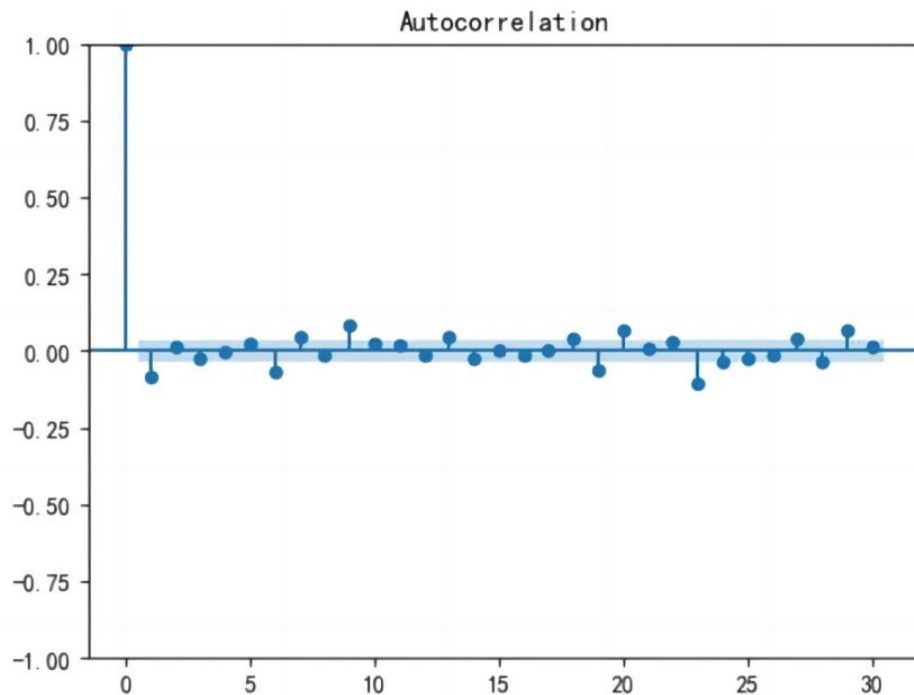


Figure 5. Yowant technology first-order differential self-correlation chart

Figure 5, the primary order differential self-correlation chart, is able to see that the order tends to be steady.

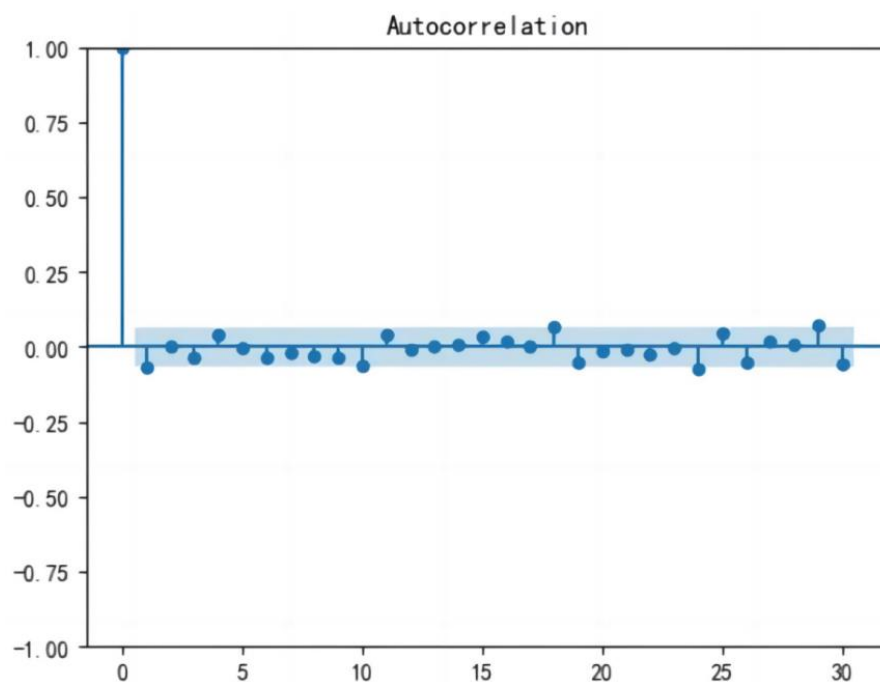


Figure 6. New Oriental Online first-order differential self-correlation chart

Figure 6, the primary order differential self-correlation chart, is able to notice that the order tends to be steady. Then make a premium differential partial auto-correlation chart, and the outcomes are as follows, as displayed in Fig. 7 and Fig. 8.

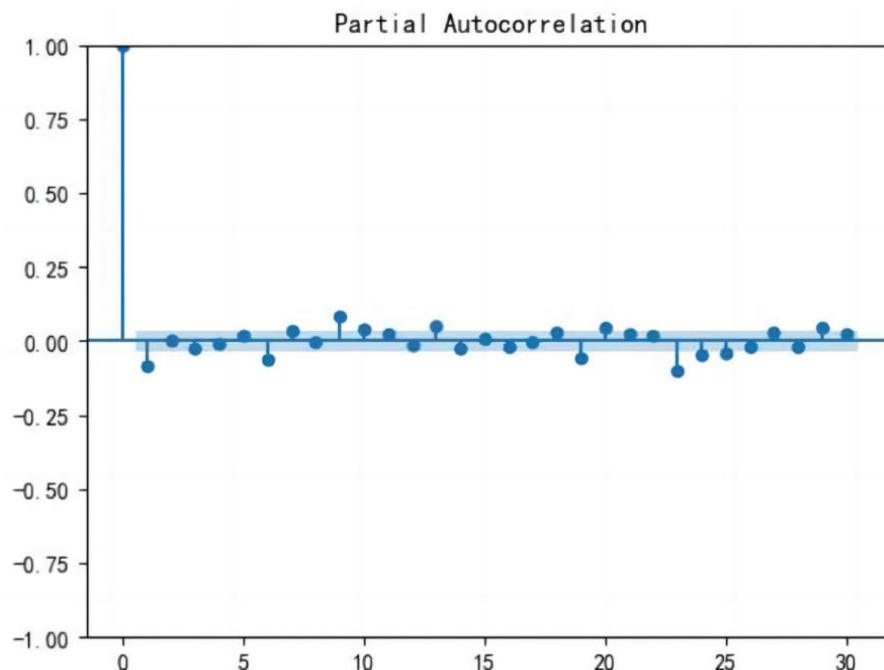


Figure 7. Yowant technology First-order differential partial auto-correlation chart

In figure 7, the premium differential partial auto-correlation chart, it is also possible to observe that the sequence has a tendency to be stable. Carry out a white noise test on the data after the difference, the white noise trial is carried out on the information later the difference. If the value of P is greater than 0.5, it is white noise. According to the python operation, the p-value=3.051e-11 of Yowant Technology is greater than 0.5, and the p-value=0.167 of New Oriental Online is greater than 0.5, indicating that neither of the two stocks can dismiss the original premise, in other words, the starting price series after the current difference at this time is a steady series of white noise.

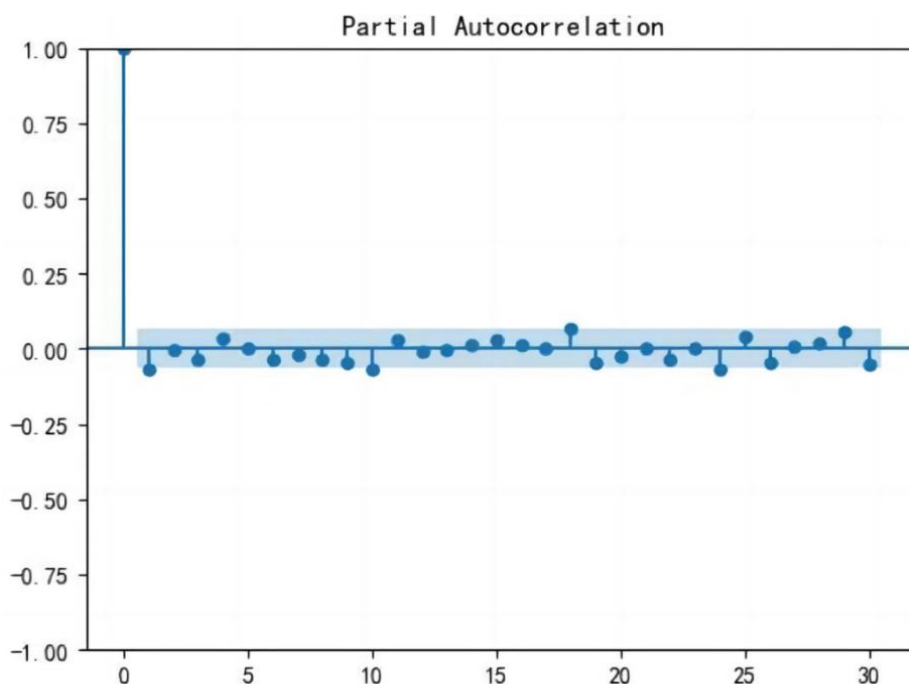


Figure 8. New Oriental Online First-order differential partial auto-correlation chart

It can be seen from Figure 8 that the sequence tends to be stable from the first-order differential partial autocorrelation graph.

The root of the unity test is carried out in the data after the differential. The ADF test results for the original sequence can be found in Tables 5 and 6.

Table 5. Yowant technology ADF test of first-order difference sequence

	t-Statistic	Prob*
Augmented Dickey-Fuller test statistic	-10.396	0.000
Test critical Values		
1%level	-3.432	
5%level	-3.432	
10%level	-2.567	

According to the test results, the statistical value of the test is -10.396, which is less than the threshold given by the Critical Value at 1%level, 5%level and 10%level significance levels, and $p\text{-value}=1.968\text{e-}18 < 5\% \text{level}$ (-3.432). So, the primary assumption was refuted, indicating that the opening price sequence was stable after the initial difference.

Table 6. New Oriental Online ADF test of first-order difference sequence

	t-Statistic	Prob*
Augmented Dickey-Fuller test statistic	-32.176	0.0000
Test critical Values		
1%level	-32.176	
5%level	-32.176	
10%level	-2.568	

According to the test results in Table 6, the statistical value of the test is -32.176, which is less than the threshold given by the Critical Value at 1%level, 5%level, and 10%level significance levels, and $p\text{-value}=0 < 5\% \text{level}$ (-32.176). So, the primary assumption is rejected, indicating that the opening price sequence was stable after the initial difference.

Yowant technology white noise test is carried out concerning data after the difference, and the outcome is $4.63\text{e-}5$. From the results of the operation, it can see that $p\text{-value}=4.63\text{e-}5 > 5\% \text{level}$ (-32.176), thus, it cannot deny the original assumption that the opening price sequence is a stable white noise sequence after the time difference.

New Oriental Online white noise test is carried out with regard to data behind the difference, and the outcome is 0.168. At the outcome of the operation, it may see that $p\text{-value}=0.168 > 5\% \text{level}$ (-32.176), thus, it cannot deny the original assumption that the opening price sequence is a stable white noise sequence after the time difference.

3.2 Model Order Determination

It can be seen from the sequence correlation diagram in Figure 1 that the value of P is less than 5%, and the data is a steady white noise sequence with correlation and certain rules to follow. After $k=1$, part of the autocorrelation coefficient quickly approaches zero, and at the end of the first-order partial autocorrelation, it may attempt to fit the AR (1) model. When $k=2$ occurs, twice the standard deviation is the edge of the confidence band, it may try the AR (2) model; the autocorrelation coefficient is significant nope zero when $k=1$, and at the edge of the confidence band of twice the standard deviation when $k=2$ and 3, it is possible to try to fit MA (1), MA (2) and MA (3) models; At the same time, ARIMA (1, 1, 1) and ARI-MA (3, 1, 1) models can be established. Table 7 and Table 8 are comparisons table of the predicted outcomes of the three models.

Table 7. Yowant technology Model Result

P Value	ar. L1	ar. L2	ar. L3	ma. L1
ARIMA (1,1,1)	0.001	0.050	---	---
ARIMA (2,2,1)	0.000	0.328	---	0.000
ARIMA (3.3.1)	0.000	0.000	0.000	0.004

Table 8. New Oriental Online Model Result

P Value	ar. L1	ar. L2	ar. L3	ma. L1
ARIMA (1,1,1)	0.493	---	---	-0.533
ARIMA (2,2,1)	0.000	0.328	---	0.000
ARIMA (3,3,1)	0.000	0.328	0.000	-1.058

Comparing the P values in Table 7 and Table 8, and combining the P values of ar (p) and ma (q), it is found that the minimum of ARIMA (3,1,1) is less than 5% of the significance level, that is, ARIMA (3,1,1) model is selected.

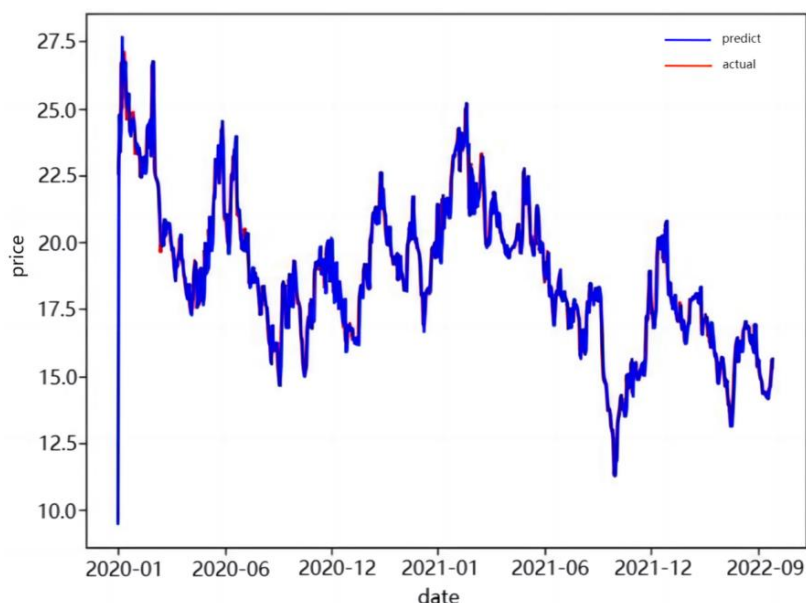
Table 9. Yowant technology Function calculation model

	0	1
ar. L1	-8.651	7.705
ar. L2	-7.366	8.291
ma. L1	-7.786	8.572
ma. L2	-7.686	6.657
ma. L3	-0.704	0.795

Table 10. New Oriental Online Function calculation model

	0	1
ar. L1	-0.633	-0.542
ar. L2	-0.993	-0.896
ma. L1	0.473	0.580
ma. L2	0.870	0.963
ma. L3	-0.121	-0.059

It can be seen from the results that the latest modified model is ARIMA (3,3,1), and a proper diagnosis has been made. Table 9 and Table 10 show the diagnostic results of the prediction model. Through the above test, it is found that the size of all P is less than 0.05, which means that the original hypothesis is denied and the model diagnosis is passed. To make the model more accurate and calculate the coefficient interval in the model, the const () function is used. From the above calculation outcomes, it may be seen that under the 5% confidence level, all coefficients are significant, which is, the model has passed the test. Select 20% of the test set, predict the set, and test set to see if they are consistent.


Figure 9. Yowant technology Fitting diagram

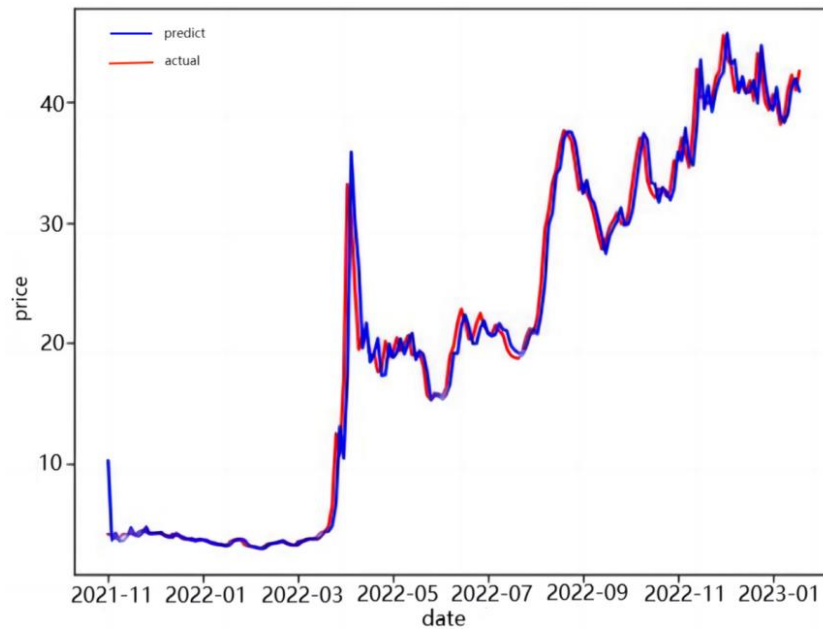


Figure 10. New Oriental Online Fitting diagram

As shown in Figure 9 and Figure 10, 20% of the test set is selected, and the result prediction set of the two is completely consistent with the test set, indicating that the ARIMA model has an accurate prediction effect, reaches the prediction effect, and can conduct the final test. Through the model, the 30-day forecast stock price is obtained, and the following Figure 11 and Figure 12:

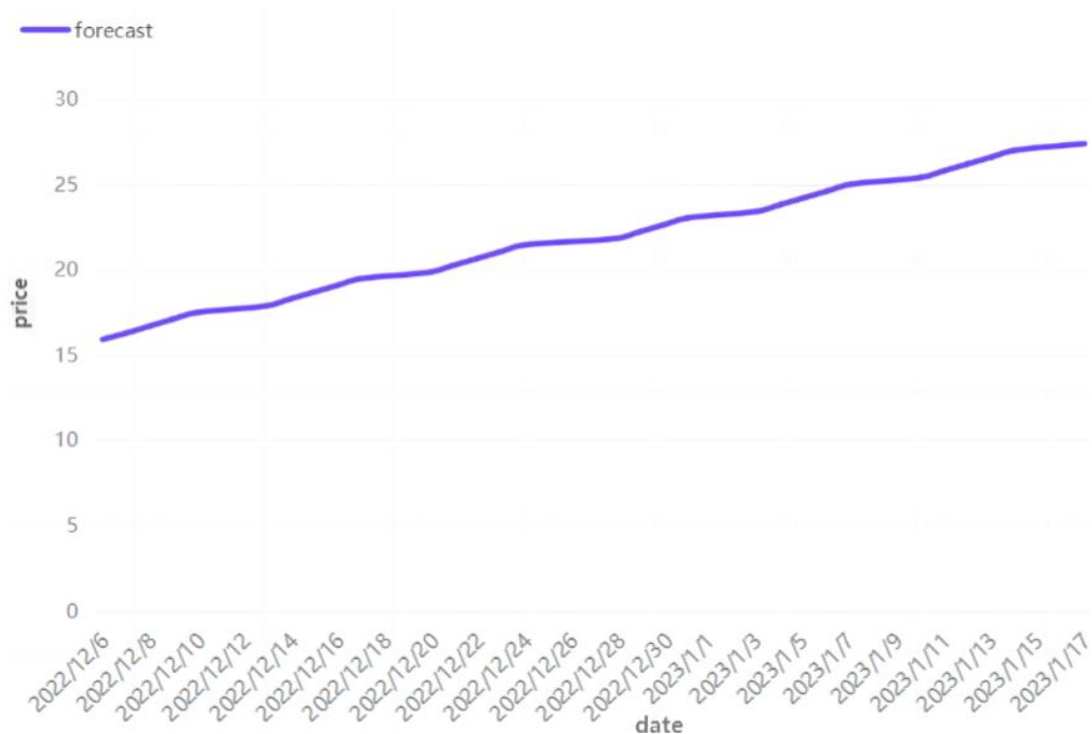


Figure 11. Yowant technology Stock price forecast chart

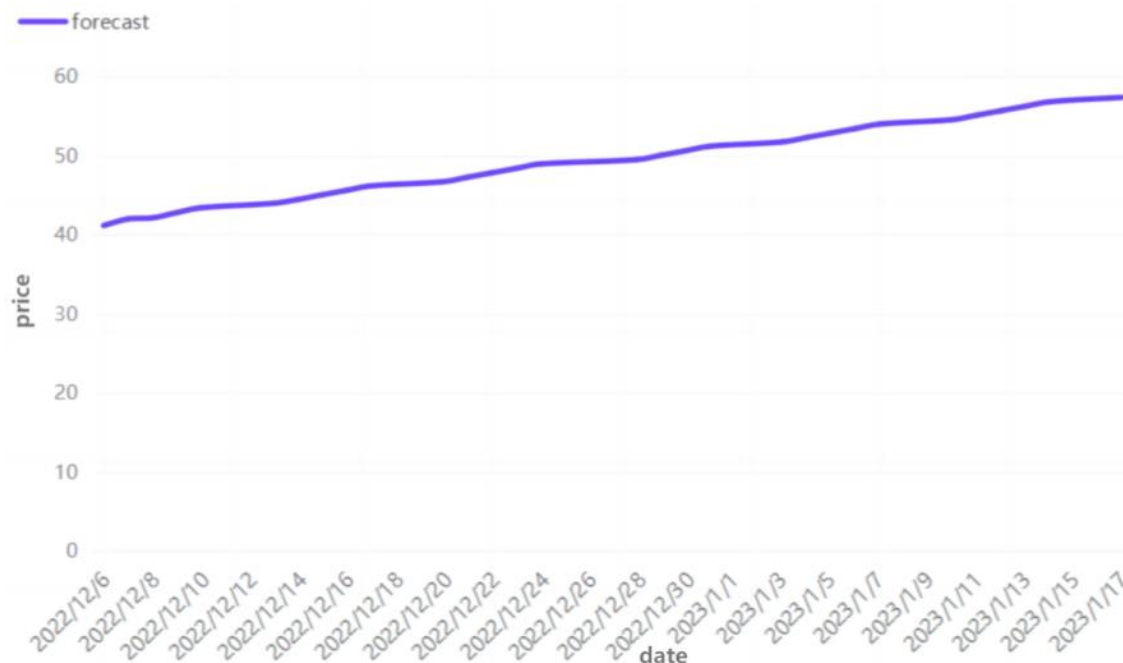


Figure 12. New Oriental Online price forecast chart

3.3 Discussion

Following the prediction fitting diagram which the fitting influence of the mold is good, which can be used as a reference basis, and the following results can be obtained:

First, according to the forecast, the stock of New Oriental Online will show a rising drift in the next 30 days, while the stock of Yowant Technology will also show a rising drift in the next 30 days, but the increase will not be as large as that of New Oriental Online. Therefore, it will choose the stock investment of New Oriental Online, which has a large income.

Second, the characteristic of time-series itself is to predict the trend through historical useful data. Else elements that affect the stock price are only reflected in random mode items. This defect is due to the time series model. The paper can't dominate other factors that affect the share price. When choosing information, it should try to avoid the policy and other factors, to reduce the prediction error.

4. Conclusion

Online as the research object, and through empirical research, uses the ARIMA model to fit the closing price series of Vanke Company and carries out the error analysis. Through the ADF stationarity test, it is concluded that the primeval time series is instability, and the time series after the first-order difference is stable. The model order determination principle ARIMA (3, 3, 1) can be further carried out. Finally, the model prediction is carried out, and the 30-day prediction value of the two stocks is awarded. Finally, according to the ARIMA model, it is determined that the future growth of New Oriental Online is relatively large.

The inadequacy of this paper is that only one model is used for comparison, which cannot completely explain why the stock price increase of New Oriental Online will exceed that of Yowant Technology. If more models can be used to prove it, it shows that the conclusion is more convincing. At the same time, the stock price trend is determined by many factors. The above prediction is only for reference. More consideration should be given to the changes in the stock market itself, the national economic policy, the inflation rate, the increase and decrease of GDP, and other factors.

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