

The Study on Statistical Variables for Modeling the Market

Kerui Chen

Suffield Academy, Connecticut, United States

sam.chen040218@gmail.com

Abstract. Observe BB and NIO stocks from 2019 to 2021, and make different histograms of each stock every month. By observing the histograms of each month's stocks, we may know the trend of this stock in the future. But the experimental results show that it cannot, so we use the second way to find the variables of the stock market.

Keywords: Stocks; Histograms; Variables.

1. Data Setting

This data is the actual price of two stocks (BB and NIO) every day from January 23, 2019 to January 22, 2021.

2. An Initial Analysis and Conclusion

For BB stocks, there will be a significant decline from the end of March 2019 to the beginning of March 2020, and this decline will stop and replace with a complete rebound. Until January 2021, the stock price has returned to its highest value. For NIO stock, from January 2019 to June 2020, the fluctuation of stock price is small, and the price of single stock is very low. But since June 2020, the stock has been rising from the original 6 yuan to 57 yuan, which only occurs in the seven months from June 2020 to January 2021.

2.1 Different Stocks in the Same Period

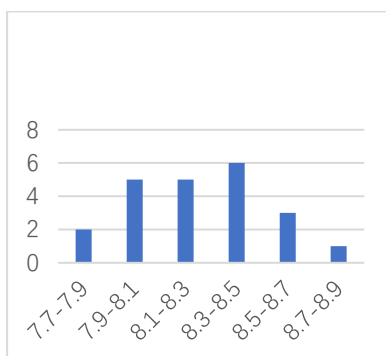


Figure 1. Histogram of Stock BB over the period 2019.1.23 - 2019.2.22

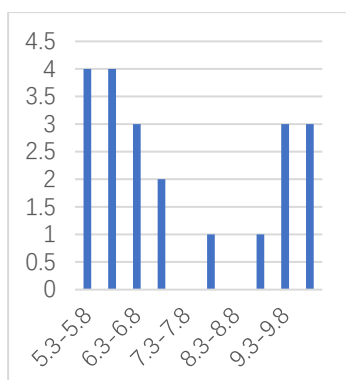


Figure 2. Histogram of Stock NIO over the period 2019.1.23 - 2019.2.22

Price-Frequency plot Figure 1
2019.1.23 - 2019.2.22

In contrast, BB's repeated highest price in this month is far less than NIO's repeated highest price in this month. BB's most repeated price in this month is in the middle price, while NIO's most repeated price is the lowest price.

2021.1.4 - 2021.1.22

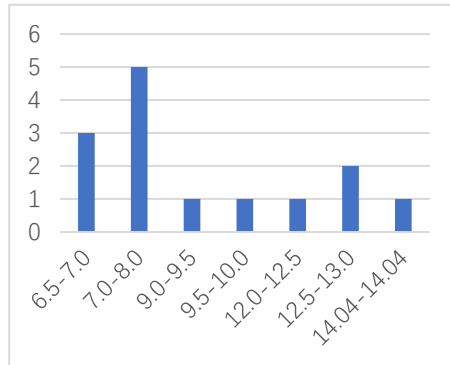


Figure 3. Histogram of Stock BB over the period 2021.1.4 - 2021.1.22

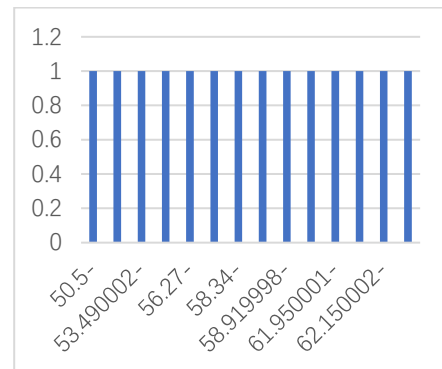


Figure 4. Histogram of Stock NIO over the period 2021.1.4 - 2021.1.22

In contrast, BB shares in this month's repeated single price is obviously more than NIO shares. The low price of BB stock this month is often repeated in this month. NIO shares this month, however, did not have a repeat price.

2.2 The Same Stock in Different Time Periods

Price-Frequency plot Figure 2

BB stock (2019.2.25-2019.3.25 / 2020.4.1 - 2020.4.30)

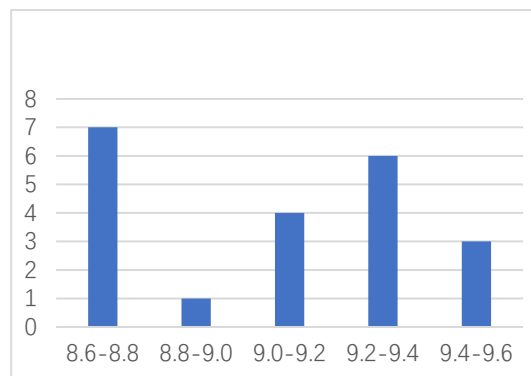


Figure 5. Histogram of Stock BB, over the period 2019.2.25-2019.3.25

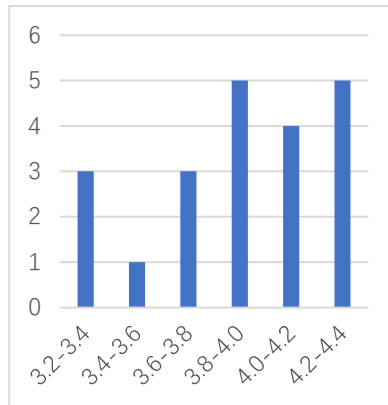


Figure 6. Histogram of Stock BB, over the period 2020.4.1 - 2020.4.30

Compare the trend of the same stock (BB) in different time periods. In March 2019, the single stock price of BB is significantly higher than that in April 2020. This shows that BB shares are falling from March 2019 to April 2020 at least.

NIO stock (2019.10.1-2019.10.31 / 2021.1.4 - 2021.1.22)

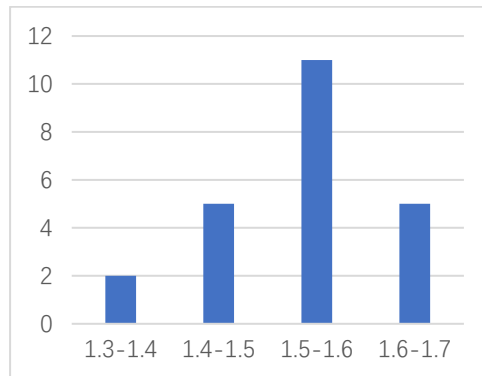


Figure 7. Histogram of Stock NIO, over the period 2019.10.1-2019.10.31

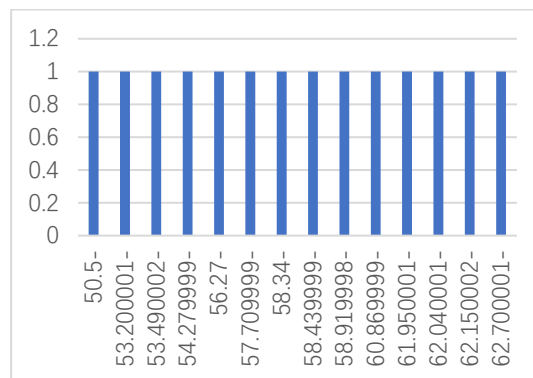


Figure 8. Histogram of Stock NIO, over the period 2021.1.4 - 2021.1.22

Compare the trend of the same stock (NIO) in different time periods. We can clearly see that the price change of this stock at these two different times is very big. From the lowest price in October 2019 (also the lowest price of NIO in the past two years) to the highest price in January 2021 (the one of highest price of NIO stock), the price span is very large. It is not difficult to analyze that NIO's stock has been rising since 2019. I believe that in the short time future, this stock may rise, but it is not sure that there will be such a big change.

2.3. Conclusion

(1) In general, from January 23, 2019 to January 22, 2021, the shares of BB and NIO both have risen.

(2) For BB stock, the probability of two or more times of the same price stage in a month is very high. And it's interesting to imagine that the price change of BB stock every month is very unstable. The price gap between some months is very large, while some do has very little change.

(3) Look at the BB stock, the gap between November and December 2020 is very large, while the gap between March and April is very close. In terms of each month itself, there are also differences between the prices of each day, and only a few of the highest prices of each month appear twice or more, most of which indicate that the highest price does not appear most often in a month.

(4) In general, BB stock has not changed much in the past two years. From the initial price to the final price, it does not rise much. Although it will fall a lot in the middle, it will rise back in the next few months. The market of BB stock is not very good in September and October every year, which is the lowest price every year.

(5) For NIO, the stock price has obviously increased in the past two years, with a rising trend.

(6) Like BB company, NIO's highest price every month does not repeat many times, but most of them are short-lived. Compared with BB stock, NIO stock did not fall significantly, on the contrary, it is gradually rising.

(7) In the first year (2019), NIO didn't see much, and even fell a little, but it was very small. But in June 2020, NIO stock began to rise, and this period is the rise of electric vehicles in China. Before, not so many people came into contact with these new energy vehicles.

(8) From mid-2020, people began to accept and popularize new energy vehicles, which led to many people willing to buy new energy vehicles, just like NIO, which led to the rise of NIO stock from mid-2020. And this rise is very frightening, from the average of 6.49 yuan in June to 57.92 yuan in January 2021, which is a terrible rise. But I think NIO stock will go up, but there won't be a big change.

(9) The price is NOT a suitable variable to model the market!

3. A New Variable

Judging from the trend in recent months, the price of BB may rise gradually. And NIO may stop rising, because I don't think the crazy rise in recent months will continue. The variance of BB stock is rising in the past few months, so it is not difficult to launch BB stock, which may rise again. But for me, I don't think NIO is likely to rise like this. On the contrary, I think NIO may rise by a small margin in recent weeks after January 2021, but in the long run, NIO is likely to rebound. From the variance point of view, when NIO hit a high price, NIO suddenly fell down. From the industry point of view, NIO is no longer the only choice for domestic electric vehicles, so I believe NIO may not rise, even if there is a small rise.

In the following, we consider the following new variable:

$$\text{Variable 1: } (P_t - P_{t-1}) / P_{t-1}$$

and

$$\text{Variable 2: } \ln(P_t / P_{t-1})$$

which are the percentage change in prices and log of total return, respectively.

Variable 1:

BB:

January 2021:

$$(6.71 - 7.11) / 7.11 = -0.0562$$

$$(6.77 - 6.71) / 6.71 = 0.0089$$

$$(6.58 - 6.77) / 6.77 = -0.0280$$

$(7.06 - 6.58)/6.58 = 0.0729$
 $(9.84 - 7.06)/7.06 = 0.3938$
 $(12.79 - 9.84)/9.84 = 0.2998$
 $(12.85 - 12.79)/12.79 = 0.0047$
 $(12.35 - 12.85)/12.85 = -0.0389$
 $(7.56 - 12.35)/12.35 = -0.3879$
 $(9.11 - 7.56)/7.56 = 0.2050$
 $(14.04 - 9.11)/9.11 = 0.5412$
 $(7.63 - 14.04)/14.04 = -0.4566$
 $(7.44 - 7.63)/7.63 = -0.0249$
 $(7.65 - 7.44)/7.44 = 0.0282$

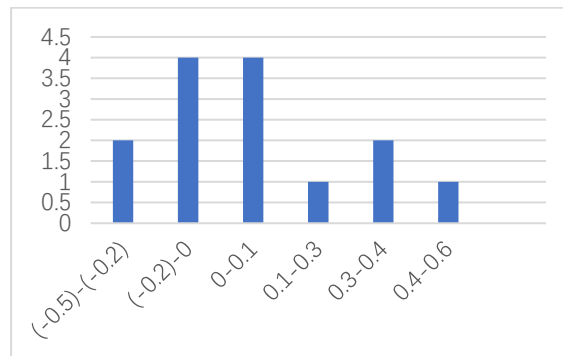


Figure 9. Histogram of Variable 1 of Stock BB, over the period of January 2021

NIO:

January 2021:

$(50.50 - 48.95)/48.95 = 0.0317$
 $(53.20 - 50.50)/50.50 = 0.0534$
 $(53.49 - 53.20)/53.20 = 0.0050$
 $(54.28 - 53.49)/53.49 = 0.0147$
 $(56.27 - 54.28)/54.28 = 0.0367$
 $(57.71 - 56.27)/56.27 = 0.0256$
 $(58.34 - 57.71)/57.71 = 0.0109$
 $(58.44 - 58.34)/58.34 = 0.0017$
 $(58.92 - 58.44)/58.44 = 0.0080$
 $(60.87 - 58.92)/58.92 = 0.0330$
 $(61.95 - 60.87)/60.87 = 0.0178$
 $(62.04 - 61.95)/61.95 = 0.0015$
 $(62.15 - 62.04)/62.04 = 0.0018$
 $(62.70 - 62.15)/62.15 = 0.0088$

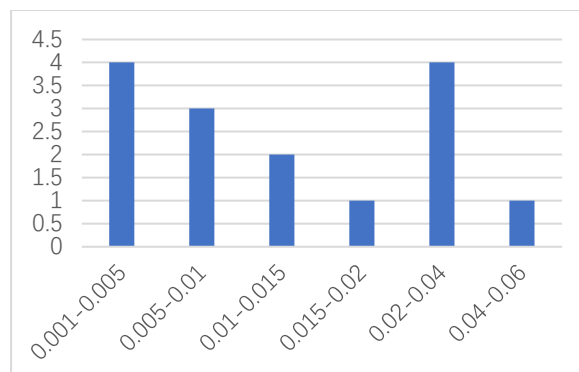


Figure 10. Histogram of Variable 1 of Stock NIO, over the period of January 2021

Variable 2:

BB

January 2021:

$$\ln(6.71/7.11) = -0.0579$$

$$\ln(6.77/6.71) = 0.0089$$

$$\ln(6.58/6.77) = -0.0284$$

$$\ln(7.06/6.58) = 0.0704$$

$$\ln(9.84/7.96) = 0.2120$$

$$\ln(12.79/9.84) = 0.2622$$

$$\ln(12.85/12.79) = 0.0047$$

$$\ln(12.35/12.85) = -0.0396$$

$$\ln(7.56/12.35) = -0.4908$$

$$\ln(9.11/7.56) = 0.1865$$

$$\ln(14.04/9.11) = 0.4325$$

$$\ln(7.63/14.04) = -0.6098$$

$$\ln(7.44/7.63) = -0.0252$$

$$\ln(7.65/7.44) = 0.0278$$

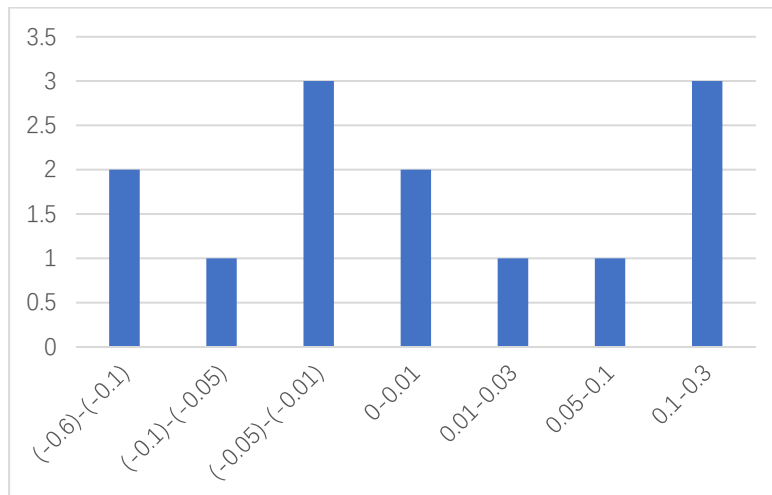


Figure 11. Histogram of Variable 2 of Stock BB, over the period of January 2021

NIO

January 2021:

$$\ln(50.5/48.95) = 0.0252$$

$$\ln(53.2/50.2) = 0.0580$$

$$\ln(53.49/53.2) = 0.0054$$

$$\ln(54.28/53.49) = 0.0147$$

$$\ln(56.27/54.28) = 0.0360$$

$$\ln(57.71/56.27) = 0.0253$$

$$\ln(58.32/57.71) = 0.0105$$

$$\ln(58.44/58.34) = 0.0017$$

$$\ln(58.92/58.44) = 0.0081$$

$$\ln(60.87/58.92) = 0.0326$$

$$\ln(61.95/60.87) = 0.0175$$

$$\ln(62.04/61.95) = 0.0015$$

$$\ln(62.15/62.04) = 0.0018$$

$$\ln(62.70/62.15) = 0.0088$$

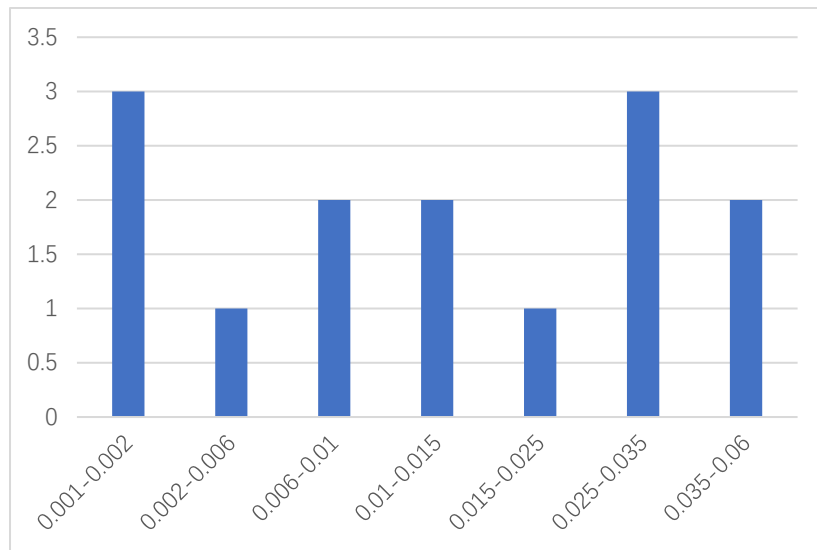


Figure 12. Histogram of Variable 2 of Stock BB, over the period of January 2021

In general, the results of variable 1 and variable 2 are very similar, or even the same. Through variables, we can find that for BB stock, their variables in January 2021 are uneven, sometimes negative and sometimes positive, so it is difficult to infer the future trend of this stock. But for NIO stock, the variables of the whole month are all positive, and they are all rising trend, so we can infer that NIO stock may continue to rise from the variables of the whole month.

1) Variables 1 and 2 has nearly the same results.

2) For Stock BB in both Variable 1 and 2, negative results account for about one-third of the total, but there are still a large proportion of positive results, so we may be able to judge that stock BB will hover in the whole price range in the next period of time, and there will be no obvious rise or fall.

3) For Stock NIO in both Variable 1 and 2, negative results don't exist, the highest result and the lowest result appear the most times respectively, but generally speaking, stock NIO has been rising this month, so we have enough reasons to believe that this stock will also rise in the next couple weeks.

Variable 1:
 BB
 November 2020 - January 2021

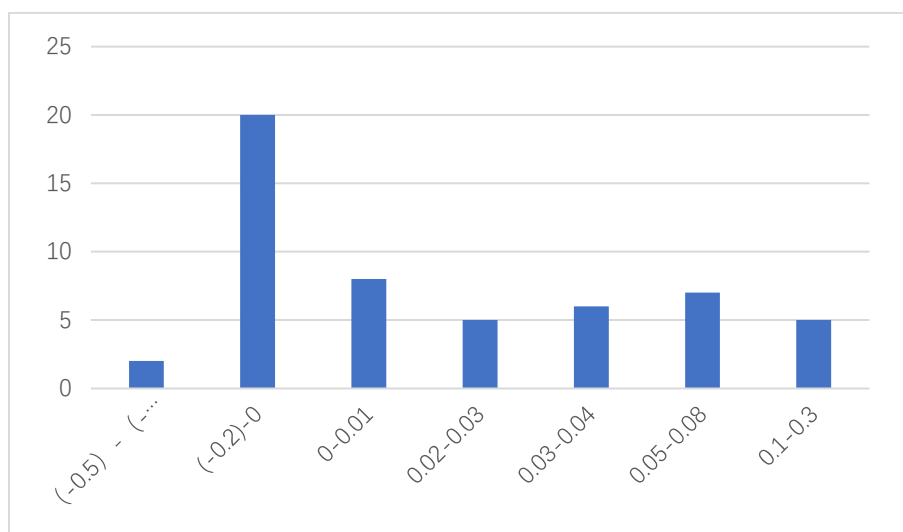


Figure 13. Histogram of Variable 1 of Stock BB, over the period of November 2020 to January 2021

Aug 2020 - Oct 2020:

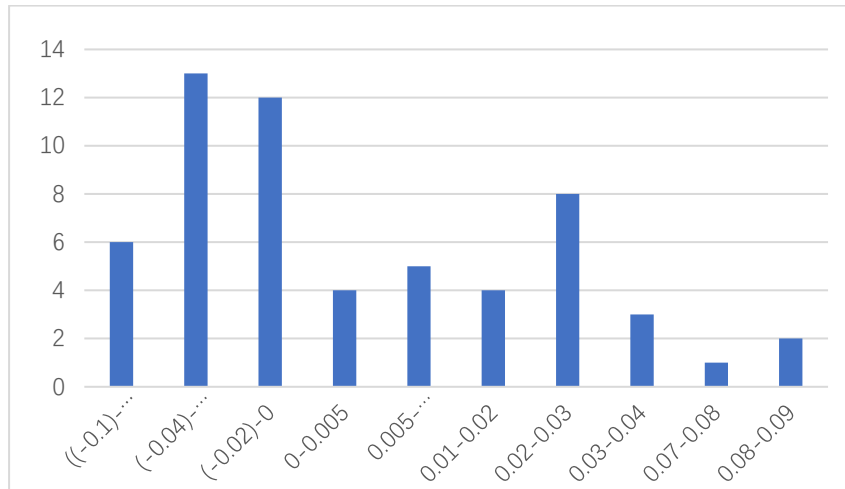


Figure 14. Histogram of Variable 1 of Stock BB, over the period of August 2020 to October 2021

NIO

November 2020 - January 2021

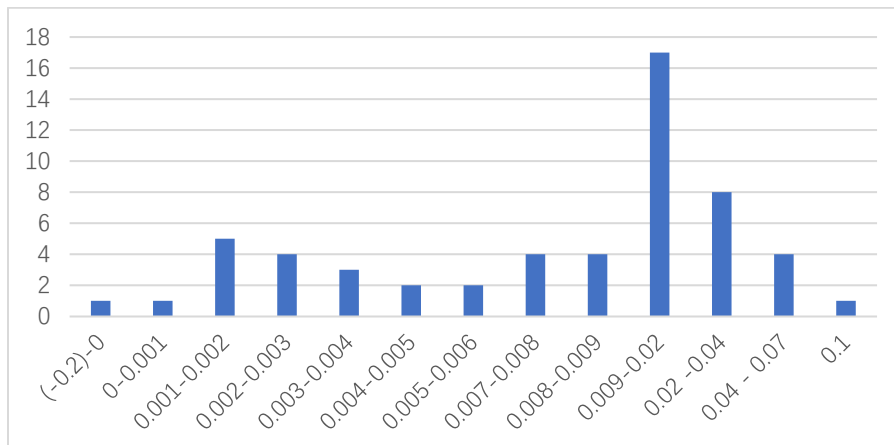


Figure 15. Histogram of Variable 1 of Stock NIO, over the period of November 2020 to January 2021

Aug 2020 - Oct 2020:

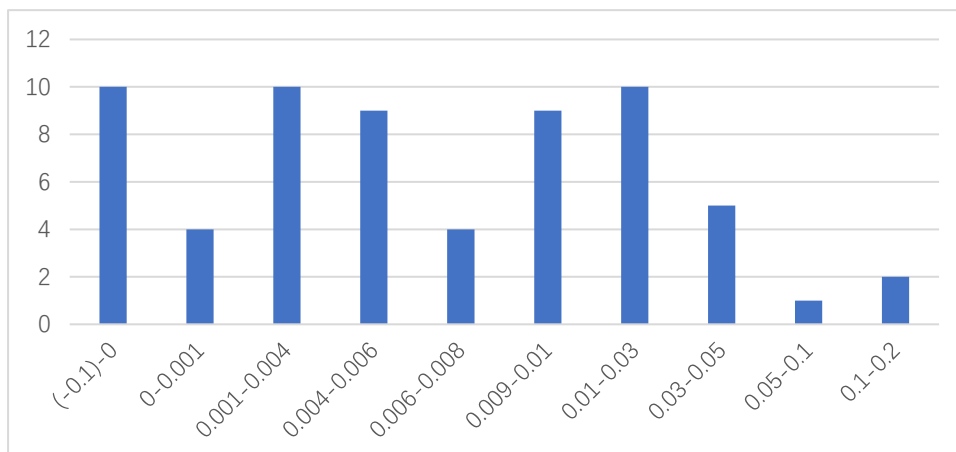


Figure 16. Histogram of Variable 1 of Stock NIO, over the period of August 2020 to October 2021

Variable 2:
BB
November 2020 - January 2021

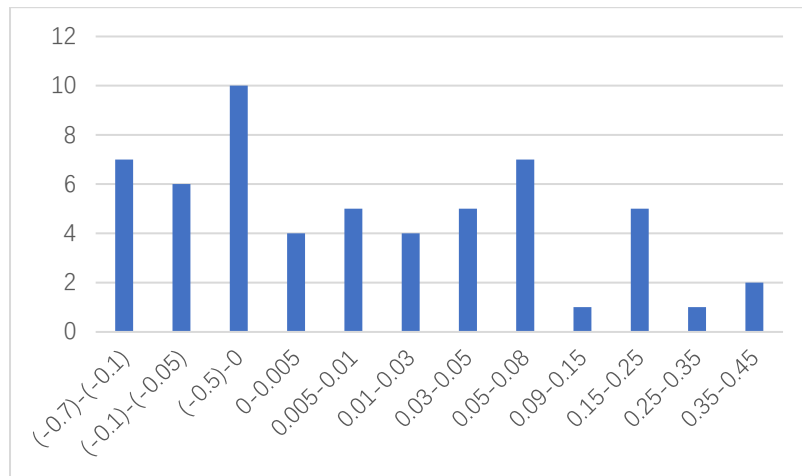


Figure 17. Histogram of Variable 2 of Stock BB, over the period of November 2020 to January 2021

Aug 2020 - Oct 2020:

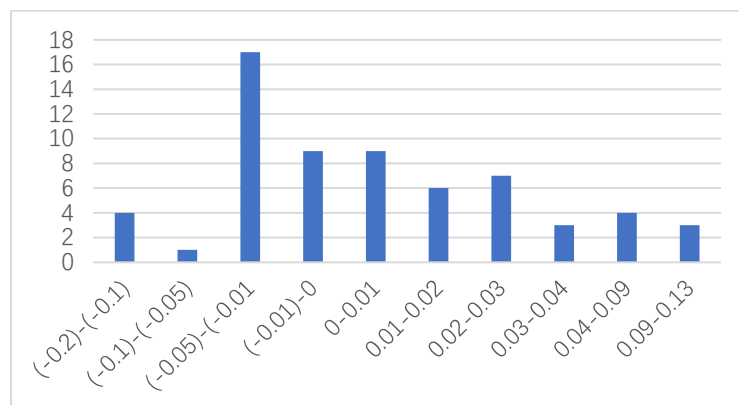


Figure 18. Histogram of Variable 2 of Stock BB, over the period of August 2020 to October 2021

NIO:
November 2020 - January 2021

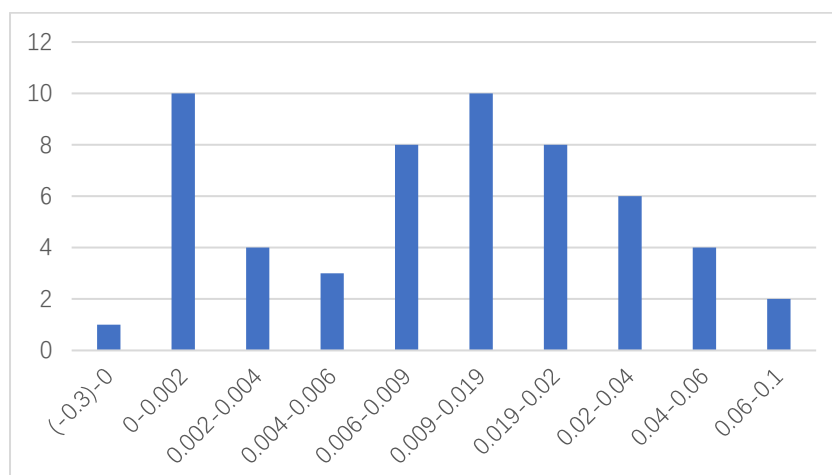


Figure 19. Histogram of Variable 2 of Stock NIO, over the period of November 2020 - January 2021

Aug 2020 - Oct 2020:

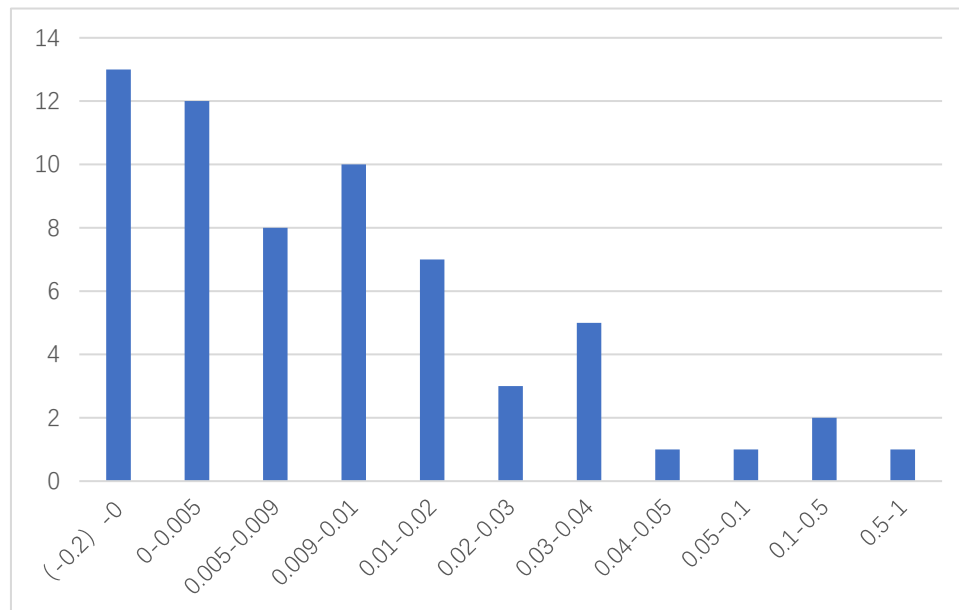


Figure 20. Histogram of Variable 2 of Stock NIO, over the period of August 2020 to October 2021

4. Conclusion

In the whole experiment, we use three ways to observe and compare the changes of two stocks in two years, and try to judge the future trend of this stock by one of them. In the first way, price frequency, we can't effectively see the future trend of this stock, because in this way, both stocks are changing irregularly, and the repetition of each month is different. Compared with price frequency, the difference between the second and the third way is obvious. Variable 1 & 2 becomes more stable, and we can see whether the stock is rising or falling steadily. For the stock BB, it is rising, and the repeated variables of each month are larger than those of the previous month. And the same thing happened to the stock NIO, and the rise of NIO is more obvious.

References

- [1] Kim T H. Impact of the Change in Market Conditions on a Test for Market Cointegration[J]. Communications for Statistical Applications & Methods, 2011, 24(1).
- [2] Szulczyk K R, Zhang C. Switching-regime regression for modeling and predicting a stock market return [J]. Empirical Economics, 2020, 59.
- [3] Nagayasu J. Modeling and Predicting Japanese Stock Returns Based on the ARFIMA-FIGARCH [J]. 2006.
- [4] Zhu H. Study on the Influence of Stock Index Futures on the Volatility of Spot Market[C]// 2019 International Conference on Economic Management and Model Engineering (ICEMME). Shanghai University, 2019.