STA4003 Report

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1 Checking data

Use images to observe changes of each stock, especially its variance and trend.
After plotting each stocks' graph, there is no obvious trending in the series (descending or ascending) and the variance of them are almost constant except some points.

2 ARMA model

The general procedure is following:
Step1: Plot the ACF or PACF to choose the value of p, q.
(While plotting the ACF and PACF, some graphs just show the value of p and q are 0. In this sitution, we just use the ARMA(1,1) to fit it. Since $(1-\theta B)X_t = (1-\theta B)W_t \Rightarrow X_t = \theta X_{t-1} + W_t - \theta W_{t-1}$)
Step2: Build each model.Besides, in order to check whether our choices are good or not, use the Ljung-Box test to test the independence of residuals.
Step3: Calculate the MSE.
Drawbacks: While choosing the value of p and q, there is high chance that it turns out to be 0 and 0, so just use the ARMA(1,1) to replace it. However, this means that we default the coefficient of X_{t-1} and W_{t-1} are opposite to each other. However, we do not have this constraint while building the model.

	1 step MSE	2 step MSE	3 step MSE
ARMA	0.2427	0.2344	0.2313

3 ARIMA model with d=1

The general procedure is following:
Step1: Calculate the difference once between each time in each stocks. Then, plot the ACF or PACF

of the difference to choose the value of p, q.

Step2: Use the pp-test to check whether ∇X_t is stationary or not. The results show that all are stationary.

Step3: Build each model.Besides, in order to check whether our choices are good or not, use the Ljung-Box test to test the independence of residuals.

Step4: Calculate the MSE.

	1 step MSE	2 step MSE	3 step MSE
ARIMA	0.2387	0.2359	0.2296

4 Auto-ARIMA model without seasonal effect

Auto-ARIMA model is more efficient. Just need to fit the model and get the MSE.

	1 step MSE	2 step MSE	3 step MSE
Auto-ARIMA	0.2372	0.2322	0.2278

Comparing with the second model, MSE is improved since choosing the value of p and q by ACF and PACF are hard to guaranteed the behavior of models.

5 Auto-ARIMA model (adjust x)

Since while fitting the model, some value extremely small difference, which lead to small variance. However, for the stock, the variance could be huge. So we just guess that using the technique of exp() to adjust the value of stock may help to improve the model behaviors.

The general procedure is following:

Step1: Use images to observe changes of adjusted stock, especially its variance and trend. We could found that the variance increase a little but not much. So the adjustment does not affect much.

Step2: Fit the Auto-ARIMA model and get the MSE.

	1 step MSE	2 step MSE	3 step MSE
Auto-ARIMA*	0.2329	0.2301	0.2299

Comparing with the third model, MSE is improved for the 1 step MSE and 2 step MSE, but it does not improve the 3 step MSE. However, this method is truly depending on the value of stocks. If it is higher, the variance could be huge after transformation, thus it is not feasible.

In the conclusion, we will choose the Auto-ARIMA model consider the above drawbacks and advantages.

6 Trading strategy

Strategy1: After calculating the mean value of each stock, use this number to determine the weight. Since the goal is to maximized the value, maybe the weight is similar to which is to minimize the value of mean of S&P500 minus the weight times the mean of each stock. After getting the weight, we calculate the target value which is 0.125.

Strategy2: Trading strategy is buy and sell each stock with same weight. Setting the weight, 0.1 for each stock, we calculate the target value which is 0.163.

Strategy3: Trading strategy is buy and sell each stock based on the stocks' increments of the whole period. And we calculate the target value with 0.135.

Strategy4: Trading strategy is based on the sectors' increments of the whole procedure. And we calculate the target value with 0.156.

Thus, we just choose the second one, which is buy and sell each stock with same weight.