Portfolio Management with Tidyquant

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2020/12/13

Abstract

As the epidemic changes, the stock market is still full of uncertainty. But through comprehensive analysis of various viewpoints, I think it is feasible to remain optimistic about the future market. To be specific, We believe that the technology companies and the medical companies are worth investing, including ZOOM, Amazon, PFE, BioNTech and so on. However, in order to maximize the return and control the total risks, we need scientific portfolio management of the stocks of our interest.

Introduction

A. Background

The COVID-19 pandemic has had a devastating effect on the economy in the United States. In early March 2020, the first lockdown began and the stock market plunged. After this initial reaction, however, the market recovered.

As the epidemic changes, the stock market is still full of uncertainty. But through comprehensive analysis of various viewpoints, I think it is feasible to remain optimistic about the future market. To be specific, We believe that the technology companies and the medical companies are worth investing, including ZOOM, Amazon, PFE, BioNTech and so on. However, in order to maximize the return and control the total risks, we need scientific portfolio management of the stocks of our interest.

What needs to be emphasized is that, in this project, we are not making real investments. Our projects are more like back testing of possible investment portfolios. Therefore, we should treat the data after July 2020 as unknown when we are managing investment portfolios. The data after July 2020 can only be used when analyzing the performance of the designed portfolio.

B. Goal

In this project, we will develop a stock visualization & portfolio tracking tool with Shiny and Tidyquant. With this Shiny app, we can visualize the historical prices of stocks in various forms and forecast the future prices. In addition, based on the historical stock prices and the online investment advice that was available before 2020/07/01, we will manage the portfolio with different methods and compare the performance of each portfolio through the fall until 2020/12/01.

For this project, we assume an initial position of $250,000 in cash starting on 1 July 2020. The final transaction in the project should return the portfolio to cash on 1 December 2020. To simplify, we ignore trading costs, taxes, and any other fees. We also ignore minimum investment requirements.

C. Data Preparation

Firstly, we downloaded the stock data from financial Yahoo using tq_get() of tidyquant package. We select 11 stocks in total of technology and medical fields as following: Facebook, Apple, Google, Amazon, NETFLEX, Zoom, AMD, NVDA, Pfizer, BioNTech and Moderna.We choose these stocks because we are optimistic about the performance of these stocks during the epidemic after comprehensively analyzing various investment opinions. However, We will only select 3 stocks from these 11 stocks based on different methods for investment portfolio.

Then we separate the data into two parts: historical data & validation data. We will use the historical data for visualization and making investment decisions. And the data after 2020/07/01 will be used to validate the performance of different portfolios.

Exploratory Data Analysis

A. Historical Stock Prices Visualization

Figure 1: These line charts above show the trend of the adjusted price of BioNTech, Google, Moderna and Zoom.

Candlestick charts are used to determine possible price movement based on past patterns. Candlesticks are useful when trading as they show four price points (open, close, high, and low) throughout the period of time the trader specifies.

Figure 2: These candlestick charts above shows the trend of the adjusted price of BioNTech, Google, Moderna and Zoom.

B. Trading Volume Visualization

Trading volume means the number of shares traded during a period. It can potentially give you a sense of the true strength behind a price move.

The idea is that huge amount of volume or increasing trading volume imply that traders are truly committed to this stock, while small amount of volume or decreasing volume sometimes can signal a lack of passion in the market. Therefore, it can be used to help confirm the trends of stocks that have already formed. Also, sometimes it can indicate the potential mean reversal.

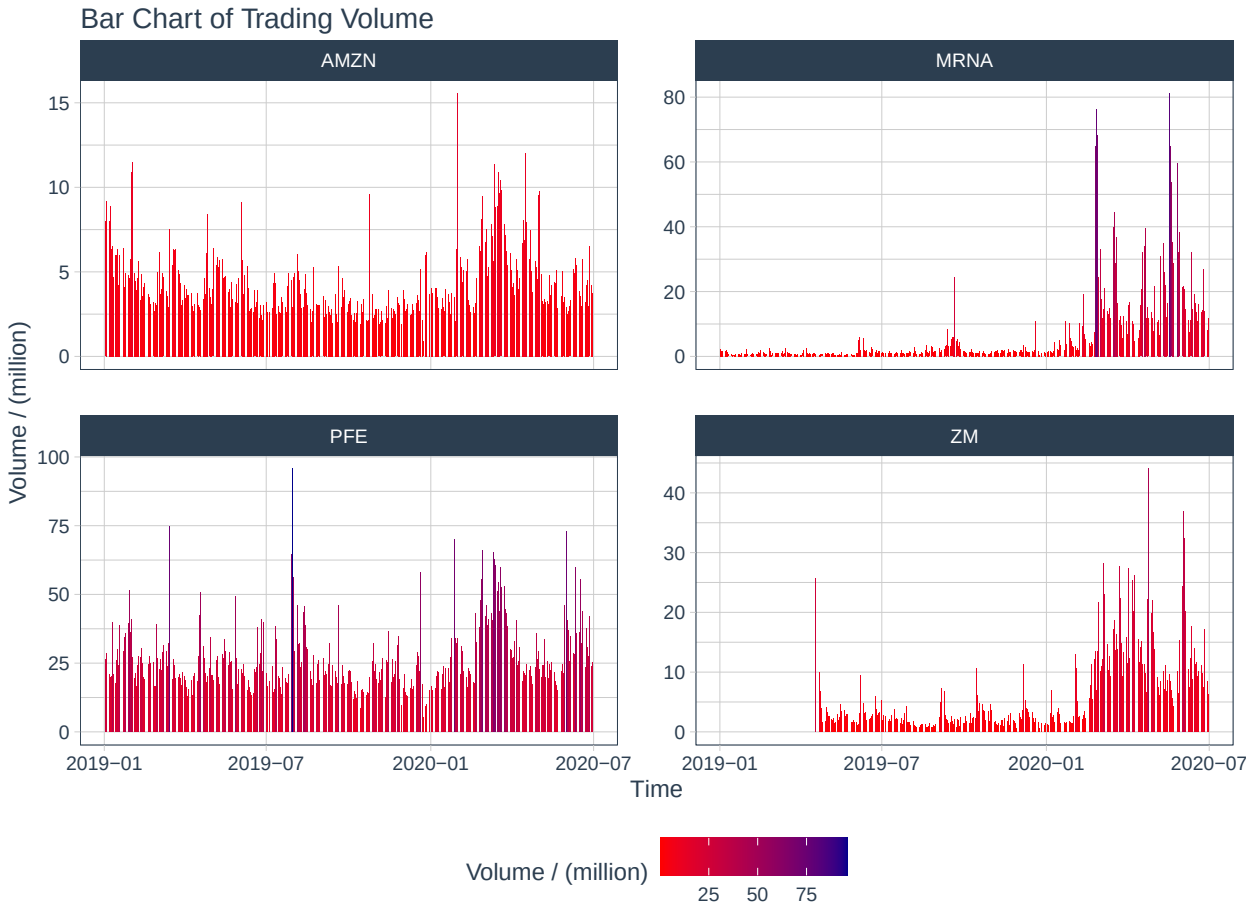

Figure 3: These bar charts above shows the trading volume of BioNTech, Google, Moderna and Zoom.

Stock Price Forecasting

In order to help us better manage the investment, we can apply the classic time-series forecasting algorithm, ARIMA, to predict the stock prices from 1st July to 1st December of 2020. However, the result of forecasting will only be treated as a reference. Because there are many influencing factors in the stock market and it is not wise to rely on the simple model with many assumptions being violated.

Portfolio Management

As mentioned before, based on the professional opinions and suggestions, I select 11 stocks of the technology field and medical field. These stocks were selected because I believe that technology companies that provide online services and vaccine-related companies during the epidemic will embrace an upward trend.

When managing the portfolio, it is recommended to put all eggs in one basket, which means that invest in only one stock. Also, it is too tired to purchase too many stocks as a beginner in the stock market. Therefore, considering the risk and convenience, we decided to select four stocks from the total 11 stocks.

I think there are two steps for making a portfolio investment plan: the first step is to decide the 4 stocks to invest; the second step is to determine the proportion of money for each stock.

Method 1. Quantitative Trading:

CAPM Alpha Ranking & Mean-Variance Portfolio Optimaization

Quantitative Trading means we will use the quantitative models to help us select the stocks and determine the way of combination.

Considering the upward trend of the stocks at the end of June 2020, I chose the CAMP alpha ranking model to help me choose the 4 stocks. This strategy performs well when the market is smooth. However when the market volatility increases the model fails to capture alpha and it performs poorly. Alpha shows how well a stock has performed in comparison to the SP500 index. Beta indicates how volatile a stock's price has been in comparison to the market as a whole. A high alpha is always good. A high beta may be preferred by an investor in growth stocks but shunned by investors who seek steady returns and lower risk.

With CAMP alpha ranking strategy, I calculated the alpha and beta for each stock according to the historical prices ranging from 2020/04/01 to 2020/07/01. I chose this period because we can notice that the stock market has been gradually recovered since April, 2020. Then I ranked the stocks according to the values of alpha and chose the 4 stocks with the highest alpha value.

symbol	Alpha	Beta
ZM	0.2608	-1.6303
BNTX	0.1361	-1.6372
NVDA	0.0825	0.8930
MRNA	0.0793	3.1770

Table 1:
The four stocks with highest Alpha value

After decided the stocks we were going to invest, we need the Mean-Variance Portfolio Optimization strategy to help us decide the weight of each stock. With the expected excess returns and the covariance matrix of each stock, I conducted the Mean-Variance Portfolio Optimization to get the optimal weight of each stock so that the Sharpe Ratio of the portfolio is maximized.

$$Portfolio\_plan1 \sim 10\% * Zoom + 20\% * BioNTech + 10\% * NVIDIA + 60\% * Moderna.$$

Method 2. Mannual Trading

In the certain context, manual trading means selecting and designing the combination of different stocks based on personal knowledge of these companies and personal experience of stock market volatility patterns. I think that is why many people say that trading is art, not science.

$$Portfolio\_plan2 \sim 30\% * Zoom + 20\% * AMZN + 20\% * PFE + 30\% * Moderna.$$

I made this portfolio plan for the following reasons:

1. Zoom is more and more important during pandemic. Almost all the students and workers who can work at home need the online meeting service.
2. Amazon has been a great company for many years. During the pandemic, the demand for online shopping is only increase in the future.
3. Pfizer and Moderna are both the vaccine development companies. Even though the routes of technology are different, but I am confident in both of them. What is more, if only one vaccine can succeed, this strategy can reduce the risk because it is a kind of hedge investment.

Performance Analysis

In this section, we will compare the performance of different investment portfolio strategies. In additon, we use the SP500 returns as the market return. And we also compare our investment portfolios with the market performance.

A. Portfolio Plan1 VS Portfolio Plan2

According to Figure 4, we can find that portfolio plan 1 which is calculated by CAMP is better the manual portfolio plan 2.

Based on the Figure 5, we can find that both portfolio plans selected Zoom and Moderna. These two stocks are really good choice for investing during this time. However, the portfolio 1 successfully chose the BioNTech rather than PFE and this the weight of portfolio 1 is more reasonable. In general, the quantitative trading strategy here is better the manual trading.

A. Best Portfolio Plan VS Market Performance

According to Table 2, our best investing portfolio plan 1 is better than the whole matket performance(IVE).

symbol	Alpha	Beta
ZM	0.1860	-1.2995
NVDA	0.0528	0.7427
BNTX	0.1151	1.7026
MRNA	0.0270	7.9153

Table 2:
The Alpha and Beta for Best portfolio compared with market.

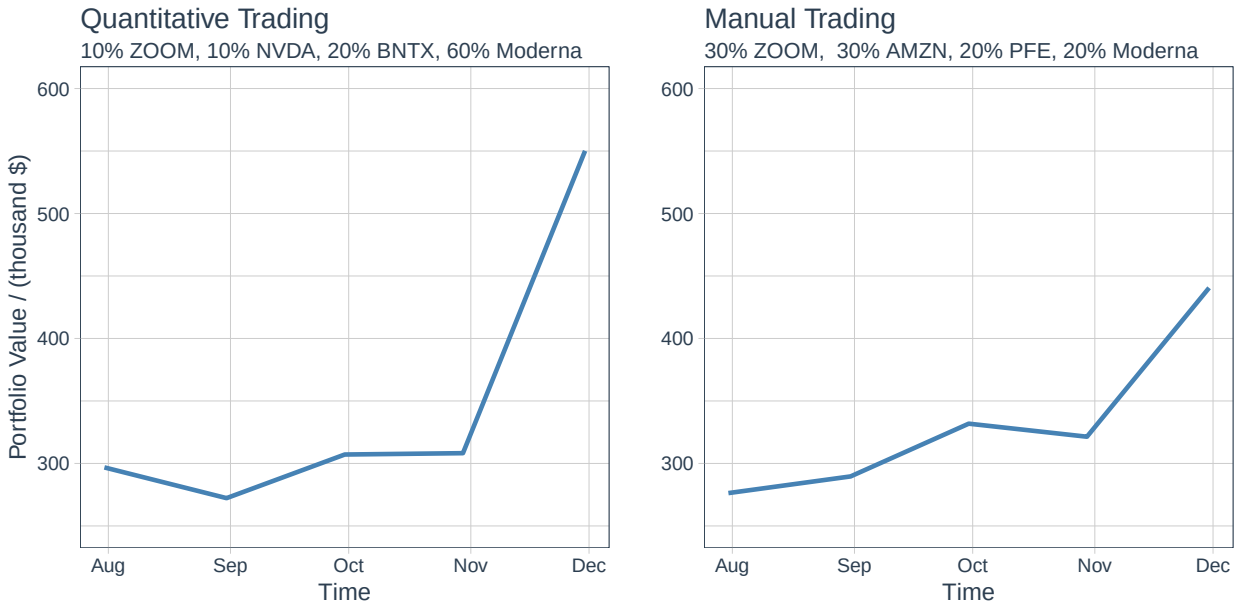

Figure 4: The line charts above compares the trends of two portfolios.

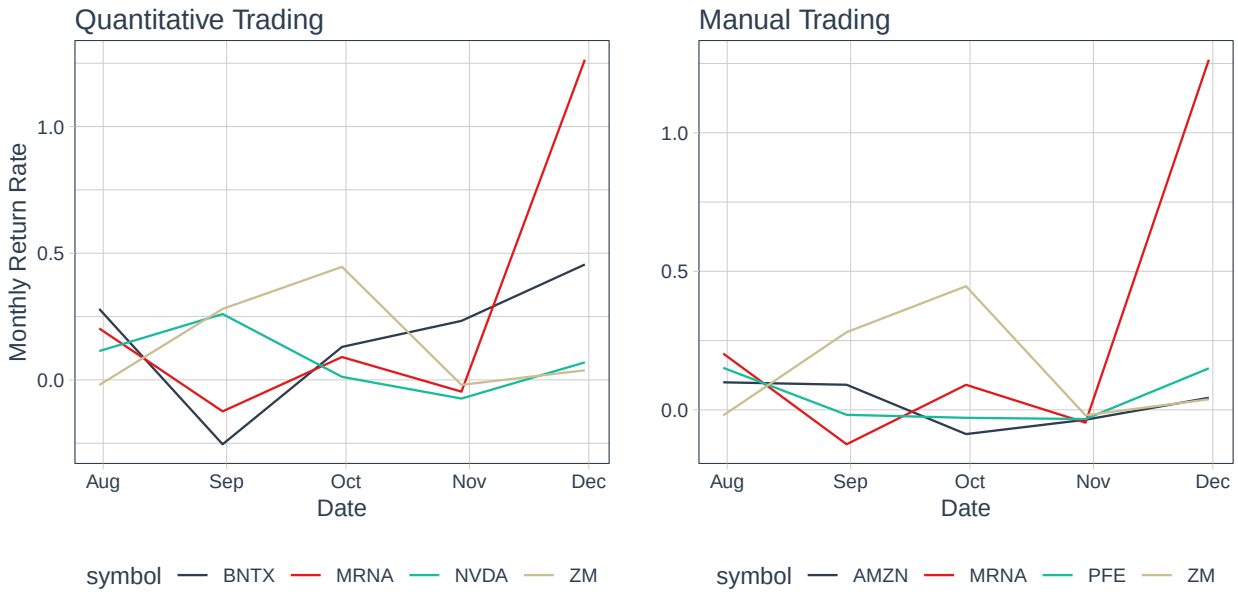

Figure 5: The line charts above shows the trends of each stock selected by different portfolios.

Reference

Matt Dancho, tidyquant: Tidy Quantitative Financial Analysis, Version: 1.0.2.

Investopia.(https://www.investopedia.com/ask/answers/102714/whats-difference-between-alpha-and-beta.asp)

Matt Dancho, Performance Analysis with tidyquant(https://cran.r-project.org/web/packages/tidyquant/vignettes/TQ05-performance-analysis-with-tidyquant.html)

Ulland Investment Advisors(https://www.ullandinvestment.com/2020/06/)