Problem Set #4

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Question 1

Interview Questions

a) Conditional variance of abnormal returns has two components: variance from future disturbances $\sigma^2_{\epsilon i}$ and additional variance due to sampling error in $\hat{\theta}_i$. The sampling error in turn leads to serial correlation of abnormal returns despite that the true disturbances are independent across time. Hence, as we increase the estimation window, the uncertainty stemming from sampling error will vanish and the variance of abnormal returns would decrease since it will only depend on the $\sigma^2_{\epsilon i}$, and observations of abnormal returns would become independent through time. The length of estimation window should be chosen to be large enough to make it reasonable to assume that there is no uncertainty coming from sampling error and abnormal returns are independent through time as well as that we are using relevant data.

b) In the event study framework, abnormal return observations must be aggregated for the event window for each firm/security and across firms/securities. This analysis assumes that the event windows of included securities do not overlap in time, which allows us to calculate the variance of aggregated abnormal returns while assuming that covariances across securities are zero. However, when the event windows overlap, the covariances between abnormal returns will not be zero making the distribution results for abnormal returns not applicable for making inferences. When this is the case, the abnormal returns can be aggregated into a portfolio and the security level analysis done before would be applied to the portfolio instead. This approach would allow for cross correlation of abnormal returns. The second method to deal with overlapping events is to analyze abnormal returns without aggregation, meaning that we would test the null hypothesis of the event not having impact using unaggregated security by security date.

Question 2

Event Study: FOMC Announcement Effect

a) In this study we are interested to estimate whether there are post-announcement excess returns in the SP 500 index for the period from 1993 to 2016. The event window is one day, indicating from the day of the announcement to the next day. The estimation window is the day of the announcement -249 days, which is one year of estimation window. We define our null hypothesis:

H_0 : Return distribution of SP 500 index including mean and variance is unchanged on FOMC dates.

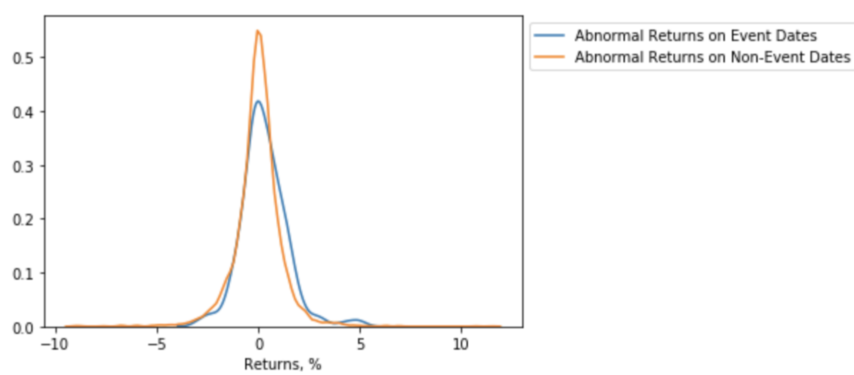
In order to assess whether we reject or fail to reject the null hypothesis, we need to calculate abnormal returns. Since, we are using the constant mean model, we define abnormal return as the realized return minus the average of returns on non-announcement dates. Afterwards, we calculate the average of those abnormal returns for all the 1 period days after the announcement and assess if it is significant.

b) There are total of 186 announcements in our sample period. The average of returns on non-announcement dates is 0.0329%. For every announcement day, we calculate the abnormal returns of the next day by subtracting the mean from above from the realized return on that day. Since, in this case there is one stock and one event day, this means that our average CAR is the same as the average AR, which we obtain to equal 0.29% and its variance, $\hat{\bar{\sigma}}$ is 0.086%. Given these indicators, our test statistic is

$$t_{stat} = \frac{C\bar{A}R}{\hat{\bar{\sigma}}} = 3.368 \tag{1}$$

This is greater than 1.96 statistic for 95% confidence, hence we reject the null hypothesis at with 5% significance.

c) Below we plot the Kernel Density plots for both abnormal returns on announcement and non-announcement dates

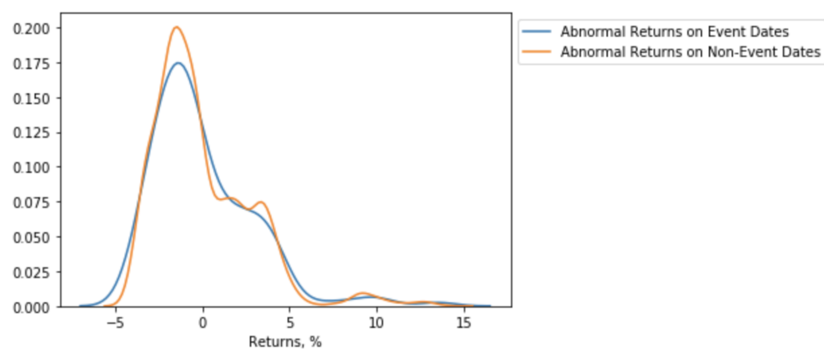


The density plot show that compared to event dates abnormal returns the non-event date abnormal returns have more values concentrated around zero and lower values, which seems to confirm that we obtained significant positive abnormal returns after announcements.

d) Our findings so far suggest that FOMC announcements have significant effect on the SP500 index and we can take advantage of that information with a trading strategy whereby we buy the index one day before announcement dates and sell it on the announcement date close. Since, FOMC meeting are regular and we are able to know in advance when they will make an announcement, this strategy would be possible to execute. Issues that would affect trade execution or performance include not correct timing of the buy and sell, and with some illiquid stocks, it would there would be high transaction costs.

e) We extend our study, by performing it on the ICE BofA US High Yield Index, which tracks the performance of US dollar denominated below investment grade rated corporate debt publically issued in the US. In this case we obtain the average return on non-announcement dates equal to 9.25%. We obtain $C\bar{A}R = 0.005\%$ and $\hat{\bar{\sigma}} = 0.228\%$. Hence, we get our statistic equal to 0.022 which indicates that the abnormal returns are not significant.

Below is the plot for the kernel densities for abnormal returns on announcement and non-announcement dates of the index.



As can be seen from the graph, compared to the SP500 index, here both abnormal return series are very closely distributed, which confirms that we obtain insignificant results. Overall, we observed that while FOMC announcements had positive impact on SP500 index, that wasn't the case for an index of high yield corporate bonds. This suggests that these announcements as expected would affect some type of securities more than others which we would take into account when trying to execute a strategy.

Question 3

Event-driven strategy: PEAD

a) We design a study to assess the effect of announcements of companies' earnings on their stock returns. To do so, we define standardized excess returns on the day after the earnings announcement to be:

$$s_{i,t} = \frac{R_{i,t} - R_{m,t}}{\sigma_{i,t}} \tag{2}$$

Where $R_{i,t}$ and $R_{m,t}$ are the stocks i's return and market return on day t respectively. $\sigma_{i,t}$ is the volatility of stock i's returns for the past 60 days.

We define the null hypothesis as follows:

H_0: Stocks with the most positive/negative standardized excess returns on the day after the announcement have the same average returns in the next 30 days

Where we define the most positive/negative standardized excess returns with k = 3 as

$$s_{i,t} > k \quad and \quad s_{i,t} < -k \tag{3}$$

Hence, we calculate the rolling previous standard deviations for all 1000 stocks in our database, and which we obtain the standardized excess returns(Sharpe Ratios) of our stocks. After classifying stocks into high and low groups as mentioned above, we calculate average abnormal returns(AAR) for the next 30 days for each stock as well as cumulative excess returns(CAR) for each stock for the next 30 days. We obtain the following results:

	Events with SER >3	**Events with SER <-3**
Number of Events	2702	2627
Mean AR	0.0002	0.000043
CAR	0.00635	0.0013
t-stat	4.084	0.7413

b) Given the results obtained above, portfolio strategy is going long on stocks with the highest Sharpe Ratios the day after the announcement and short the stocks with lowest Sharpe Ratios, we do this with equal weights for all positions. We would close the positions in n = 5,10,20 and 30 days. We also assume that we would have a funding gap that is positive is we are net short and negative when we are net long. Than means that if we are net short, we will invest in risk free rate and obtain 1% return annualized and if we are net long, we will borrow at an annualized rate of 3%. Hence, our portfolio dollar return would look like this

$$R_t = \sum_i \theta_i r_{i,t} + \theta_f r_f \tag{4}$$

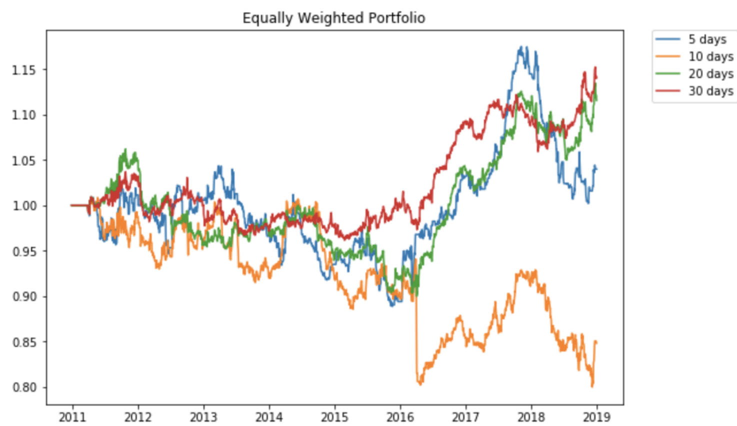
Where θ_f is our funding gap and r_f is the respective risk free rate. Since, θ's are all in nominal amounts, in order to calculate our portfolio return we need to divide by the funding gap θ_f, which would give us

$$\frac{R_t}{\theta_f} = \frac{\sum_i \theta_i r_{i,t} + \theta_f r_f}{\theta_f} \tag{5}$$

Since, in our sample, there are instances when the funding gap is zero(meaning equal number of long and short positions) we overcome this problem by also including the total dollars invested, which is the sum of long and short positions making our portfolio return be equal to

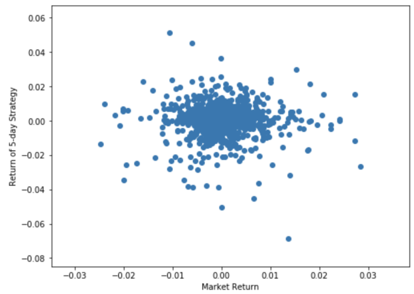
$$\frac{R_t}{\theta_f + Doll_{inv}} = \frac{\sum_i \theta_i r_{i,t} + \theta_f r_f}{\theta_f + Doll_{inv}} \tag{6}$$

Performing this strategy we obtain the following cumulative returns:

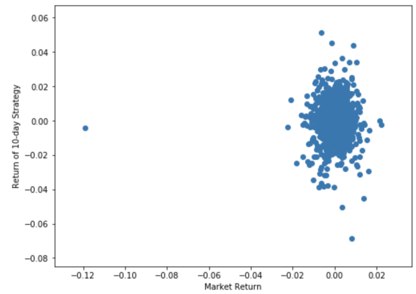


As can be seen from the graph above, the worst performing strategy is when we hold our position for 10 days which produces an overall loss for the sample period. The other ones all give is positive cumulative returns, especially we should note that the strategy with holding our position for 30 days outperforms the others. This result is consistent with what we would above that stocks with highest Sharpe Ratios have significant cumulative abnormal returns 30 days after the announcement. Even though, the stocks that had lowest Sharpe Ratios did not have significant negative cumulative returns, we can see that still out 30 day holding strategy produces positive returns.

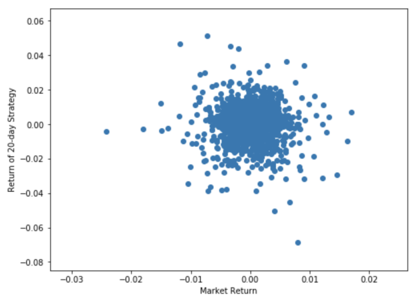
c) Below are the scatter plots for the portfolio strategy with each holding period against the market return:



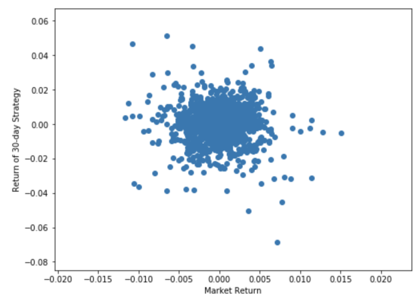
(a)



(b)



(c)



(d)

Figure 1: Portfolio Returns Against Market

As can be seen from the graphs, there is no apparent relationship between the portfolio and the market returns.

To further look into the returns produced by the strategies, we plot the boxplots below:

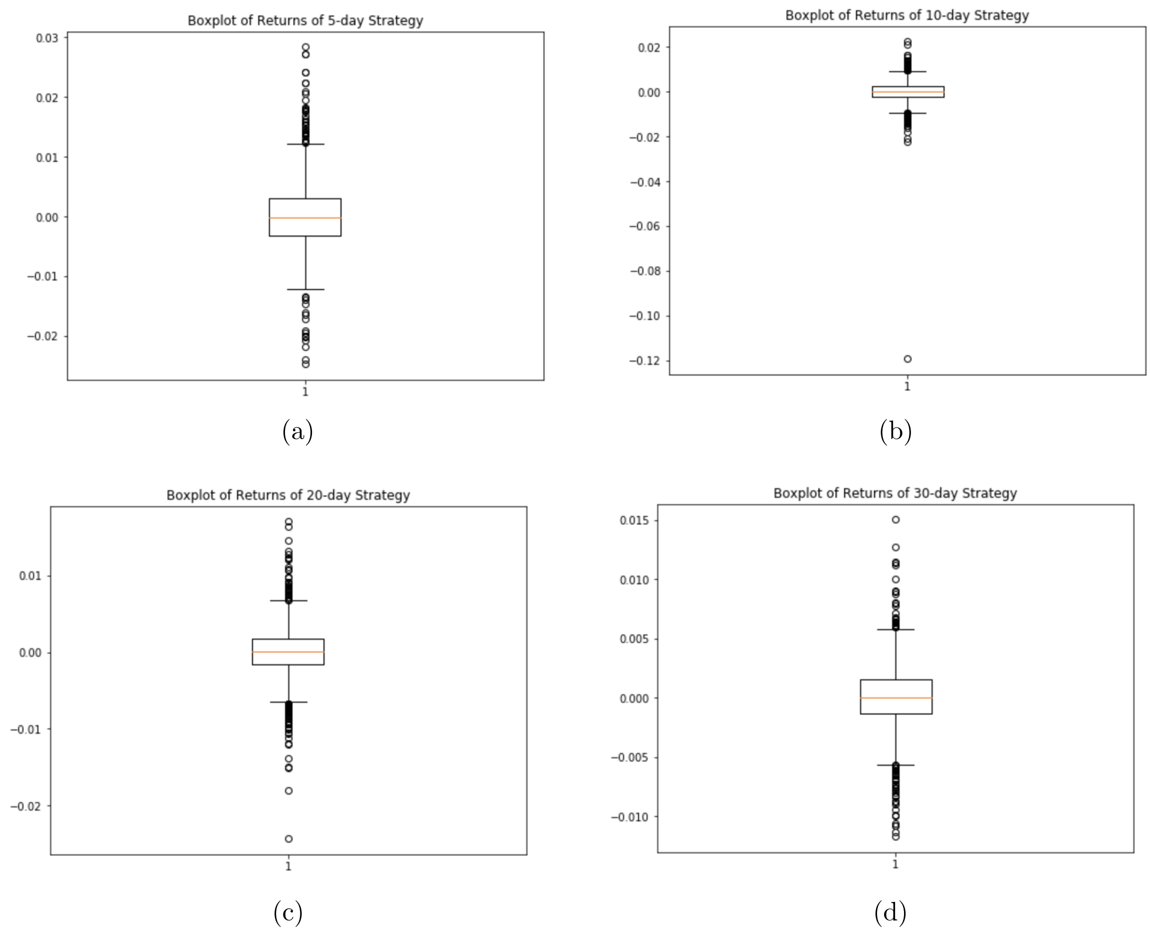


Figure 2: Boxplots of Portfolio Returns

The boxplots show that there are many outliers in our portfolio return with different holding period, we can also observe that the median value is close to 0 in all cases.

Below we report the summary statistics of portfolio returns of 4 strategies. All the values are reported on annualized basis.

	Mean Return, %	**Standard Deviation,%**	**Sharpe Ratio**	**Information Ratio**	**Maximum Drawdown,%**
n=5	-2.949	18.039	-0.163	-0.482	14.854
n=10	-11.671	16.69	-0.699	-0.735	20.721
n=20	-6.502	15.864	-0.41	-0.537	15.289
n=30	-7.565	15.451	-0.49	-0.537	7.292

When regressing the portfolio returns on Fama-French factors, we obtain the results presented in the table below. As can be observed, none of the alphas are significant even for the case with 30 day holding period. Taking into account all the information presented above, we could conclude that even though there are significant abnormal returns and they produce positive cumulative return for the sample period, they do not produce alpha when the market or other factors are controlled for.

	Alpha, %	**P-Value**
n=5	1.012	0.838
n=10	-2.572	0.412
n=20	1.346	0.482
n=30	1.483	0.334