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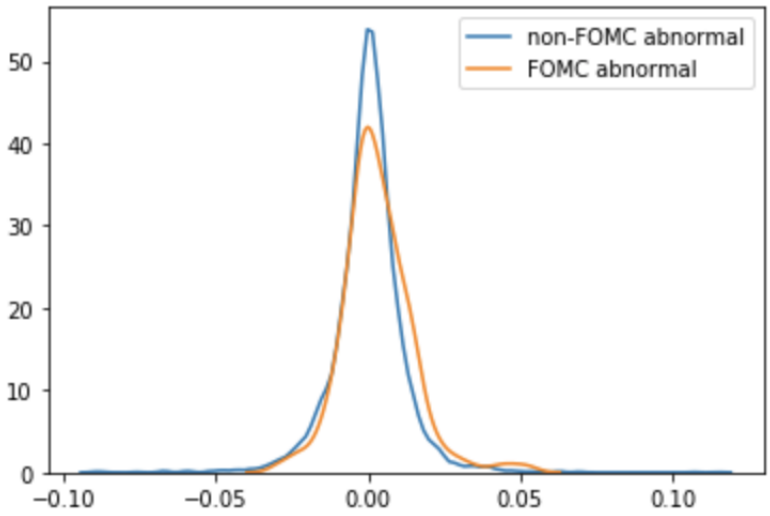
1.(a) False. The true parameter values of baseline model may change over time. If increasing the length of estimation window too much, the estimated baseline model may not be appropriate to estimate normal returns within the event window.

(b) Since event windows overlap across securities, the abnormal returns are more likely to be correlated contemporaneously or at lags. In this case, we can form a portfolio of the securities with the same event window. Then we can follow with the same testing procedure for individual securities from here on. Another method is to conduct an event study via (panel) regression.

2.(a)
(1) The event is the FOMC announcement. The event window is $T_1 = 0$ to $T_2 = 1$ (the day when the announcement is made).
(2) The reference model for normal returns is the constant-mean-return model.
(3) Null: return distribution (including mean and variance) unchanged on FOMC announcement dates.
(4) On each FOMC announcement day, we estimate the normal return using the average of past year daily SP500 returns, and compute the abnormal return as the difference between announcement day return and this normal return. Assume in the reference model, the abnormal returns are iid, and follow a distribution of $N(0, \sigma^2)$. Under the null hypothesis, this announcement day abnormal return will follow the same distribution as non-announcement day abnormal returns. When aggregated, announcement day abnormal returns' mean divided by their standard error will asymptotically follow $N(0, 1)$.
(5) Compare the z-score to the 95% critical value from $N(0, 1)$.

(b) The z-score is 3.3437, greater than 1.96. Therefore, we reject the null hypothesis under 95% confidence level.

(c)



(d) Since the announcement day abnormal returns are significantly positive, and announcement day abnormal returns approximately follow a normal distribution and center at a positive level, I would recommend long the SP500 ETF at the market close 1 day before the announcement day, and clear the position at the market close on the announcement day.

Practical issues: 1. Transaction costs (bid-ask spread) and other fees and taxes may reduce profit. 2. May not be able to exactly trade at market close, so need to trade maybe 10 minutes before the market close. Such time discrepancy is not tested. 3. If this FOMC effect is discovered by many people, the potential profits may be driven away.

(e) i. The FOMC return is not significant post 2016, since the z-score is -0.5970. In this case, we cannot reject the null hypothesis.

ii. Use US 10-year treasury yield (TNX) in this question. The FOMC does not seem to have a significant effect on TNX. From 1993 to 2016, the z-score is -0.1515, which is not significant. Post 2016, the z-score is -1.6126. The FOMC seems to be more significant after 2016 than before 2016. However, since after 2016, we only have 10 FOMC dates, which may not be sufficient to compute an accurate z-score.

Question 3

(a) There is at least three ways to interpret the question:

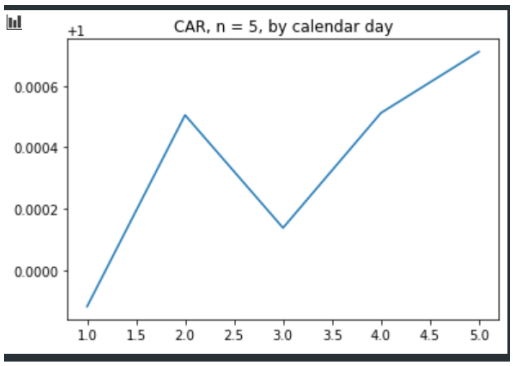
1) Regard every stock's 30-day average return as one data point, and we can have two arrays of datapoints, one for most positive standardized excess return stocks and one for most negative standardized excess return stocks. We want to test the hypothesis that these two arrays have the same mean. Using ANOVA method, we have the f-statistic of 3100 and p statistic of 1.5%, which means we can reject the null hypothesis.

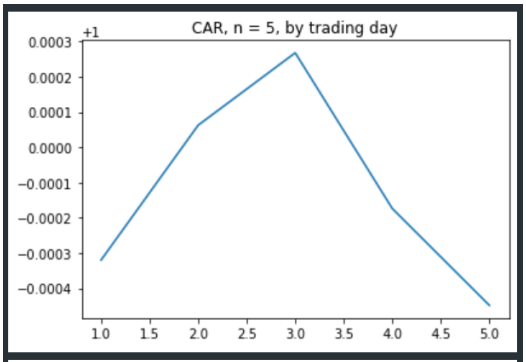
2) Regard every stock's 30-day returns as a sequence of observations, the null hypothesis is that sequences of most positive **or** most negative stocks have the same mean. Use ANOVA method again, we have the f-statistic of 0.55 and p statistic of 82.08% for most positive stocks, so we cannot reject the null hypothesis that most positive stocks have the same mean return. We have p statistic of 82.17% for most negative stocks, so we cannot reject the null hypothesis that most negative stocks have the same mean return.

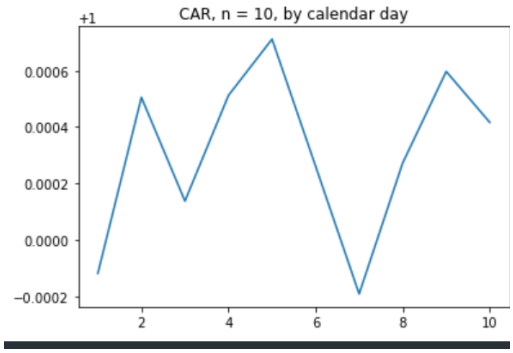
3) With very similar setup as 2), the null hypothesis is that sequences of most positive **and** most negative stocks have the same mean. Use ANOVA again, the p statistic is now 69.25%, which still can not reject the null hypothesis.

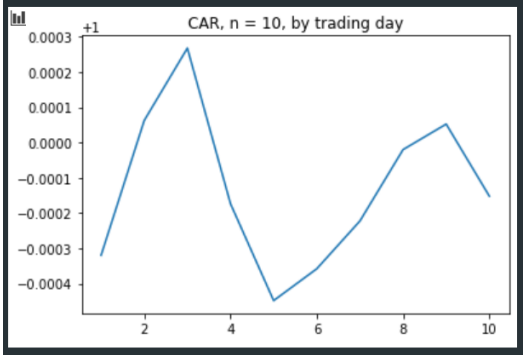
(b) I have prepared two ways to implement and test the idea: one is typical CAR plots in the event window, another is a net value of a simulated fund that implements this strategy over time. If there are multiple holdings in the same day, I assume those holdings are of equal value.

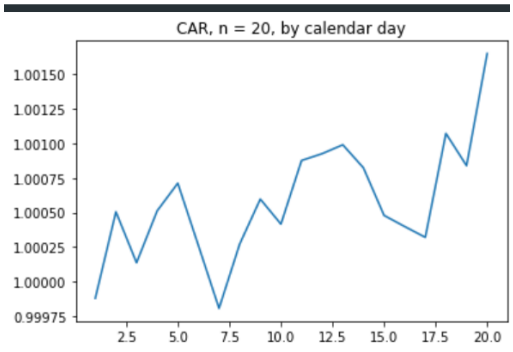
It is also ambiguous whether the n days refers to calendar days or trading days.

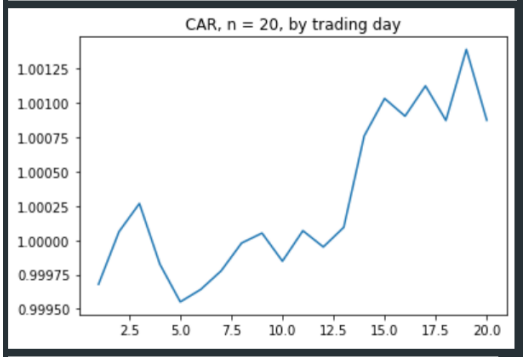

CAR, n = 5, by calendar day
+1
0.0006
0.0004
0.0002
0.0000
1.0 1.5 2.0 2.5 3.0 3.5 4.0 4.5 5.0

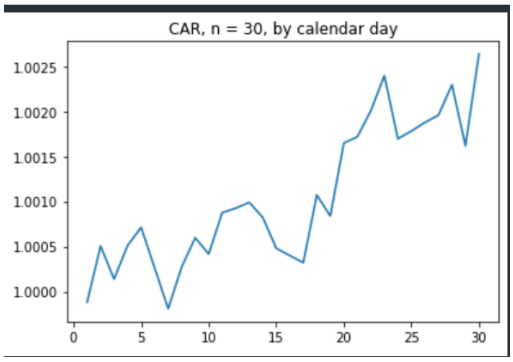

CAR, n = 5, by trading day
+1
0.0003
0.0002
0.0001
0.0000
−0.0001
−0.0002
−0.0003
−0.0004
1.0 1.5 2.0 2.5 3.0 3.5 4.0 4.5 5.0

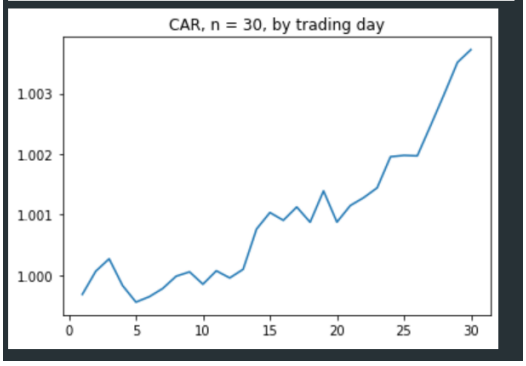

CAR, n = 10, by calendar day
+1
0.0006
0.0004
0.0002
0.0000
−0.0002
2 4 6 8 10

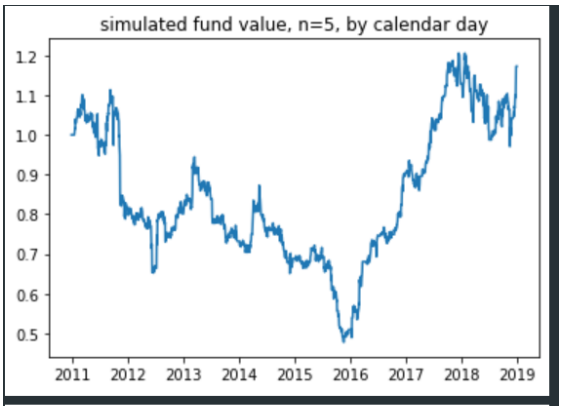

CAR, n = 10, by trading day
+1
0.0003
0.0002
0.0001
0.0000
−0.0001
−0.0002
−0.0003
−0.0004
2 4 6 8 10

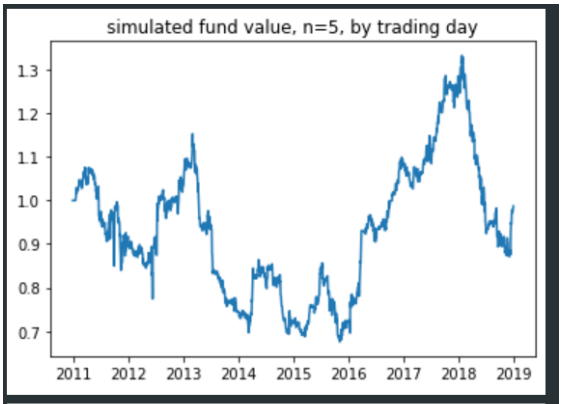

CAR, n = 20, by calendar day
1.00150
1.00125
1.00100
1.00075
1.00050
1.00025
1.00000
0.99975
2.5 5.0 7.5 10.0 12.5 15.0 17.5 20.0

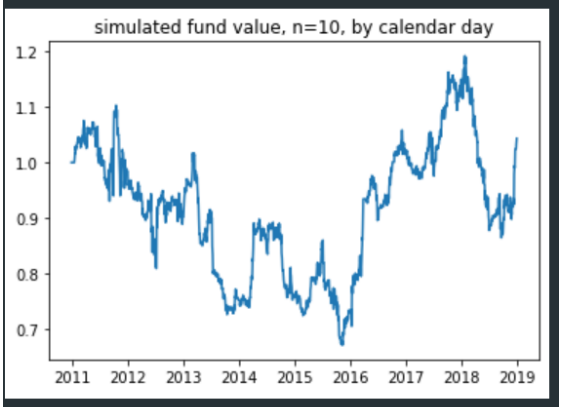

CAR, n = 20, by trading day
1.00125
1.00100
1.00075
1.00050
1.00025
1.00000
0.99975
0.99950
2.5 5.0 7.5 10.0 12.5 15.0 17.5 20.0

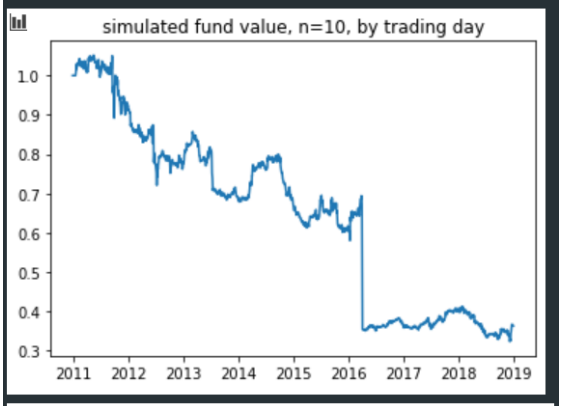

CAR, n = 30, by calendar day
1.0025
1.0020
1.0015
1.0010
1.0005
1.0000
0 5 10 15 20 25 30

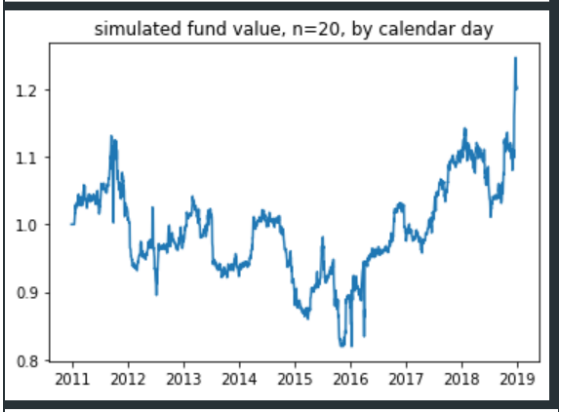

CAR, n = 30, by trading day
1.003
1.002
1.001
1.000
0 5 10 15 20 25 30

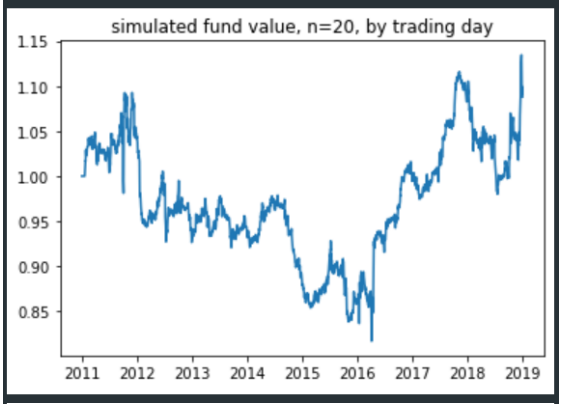

simulated fund value, n=5, by calendar day
1.2
1.1
1.0
0.9
0.8
0.7
0.6
0.5
2011
2012
2013
2014
2015
2016
2017
2018
2019

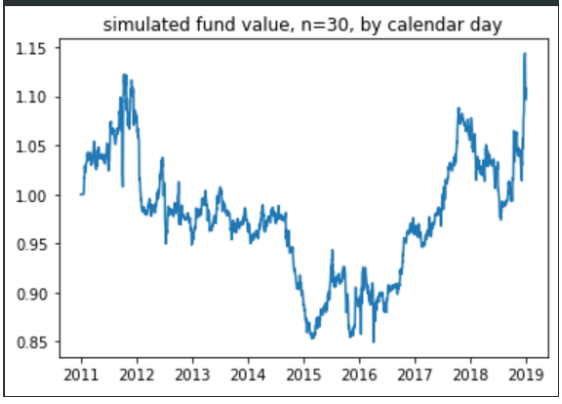

simulated fund value, n=5, by trading day
1.3
1.2
1.1
1.0
0.9
0.8
0.7
2011
2012
2013
2014
2015
2016
2017
2018
2019

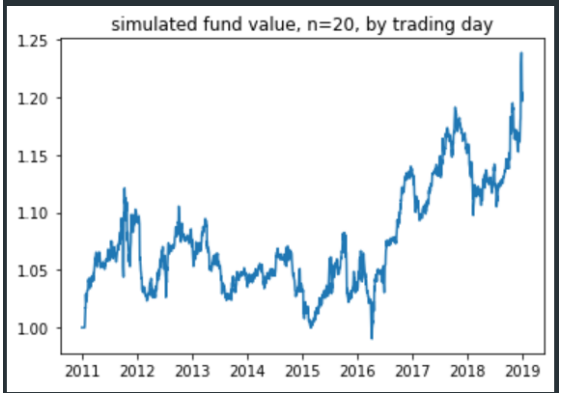

simulated fund value, n=10, by calendar day
1.2
1.1
1.0
0.9
0.8
0.7
2011
2012
2013
2014
2015
2016
2017
2018
2019


simulated fund value, n=10, by trading day
1.0
0.9
0.8
0.7
0.6
0.5
0.4
0.3
2011
2012
2013
2014
2015
2016
2017
2018
2019


simulated fund value, n=20, by calendar day
1.2
1.1
1.0
0.9
0.8
2011
2012
2013
2014
2015
2016
2017
2018
2019


simulated fund value, n=20, by trading day
1.15
1.10
1.05
1.00
0.95
0.90
0.85
2011
2012
2013
2014
2015
2016
2017
2018
2019


simulated fund value, n=30, by calendar day
1.15
1.10
1.05
1.00
0.95
0.90
0.85
2011
2012
2013
2014
2015
2016
2017
2018
2019


simulated fund value, n=20, by trading day
1.25
1.20
1.15
1.10
1.05
1.00
2011
2012
2013
2014
2015
2016
2017
2018
2019

(c) Here we regress the simulated fund values against daily three-factor models. All eight funds represent significant negative alphas (details attached in the code file).