Master_Thesis.R

2023-06-26

```
library(quantmod)
```

```
## Warning: package 'quantmod' was built under R version 4.1.2
```

```
## Loading required package: xts
```

```
## Loading required package: zoo
```

```
##
## Attaching package: 'zoo'
```

```
## The following objects are masked from 'package:base':
##
##     as.Date, as.Date.numeric
```

```
## Loading required package: TTR
```

```
## Registered S3 method overwritten by 'quantmod':
##   method            from
##   as.zoo.data.frame zoo
```

```
library(vtable)
```

```
## Warning: package 'vtable' was built under R version 4.1.2
```

```
## Loading required package: kableExtra
```

```
## Warning: package 'kableExtra' was built under R version 4.1.2
```

```
library(readxl)
library(stringr)
library(tidyr)
```

```
## Warning: package 'tidyr' was built under R version 4.1.2
```

```
library(dplyr)
```

```
## Warning: package 'dplyr' was built under R version 4.1.2
```

```
##
## Attaching package: 'dplyr'
```

```
## The following object is masked from 'package:kableExtra':
##
##     group_rows
```

```
## The following objects are masked from 'package:xts':
##
##     first, last

## The following objects are masked from 'package:stats':
##
##     filter, lag

## The following objects are masked from 'package:base':
##
##     intersect, setdiff, setequal, union

library(ggplot2)

## Warning: package 'ggplot2' was built under R version 4.1.2

library(tidyverse)

## Warning: package 'tidyverse' was built under R version 4.1.2

## ── Attaching packages
## ─────────────────────────────────────
## tidyverse 1.3.2 ──

## ✓ tibble  3.1.6     ✓ purrr   0.3.4
## ✓ readr   2.1.2     ✓ forcats 0.5.1

## Warning: package 'readr' was built under R version 4.1.2

## ── Conflicts ──────────────────────────────────────── tidyverse_conflict
s() ──
## ✕ dplyr::filter()     masks stats::filter()
## ✕ dplyr::first()      masks xts::first()
## ✕ dplyr::group_rows() masks kableExtra::group_rows()
## ✕ dplyr::lag()        masks stats::lag()
## ✕ dplyr::last()       masks xts::last()

library(tidyquant)

## Warning: package 'tidyquant' was built under R version 4.1.2

## Loading required package: lubridate
##
## Attaching package: 'lubridate'
##
## The following objects are masked from 'package:base':
##
##     date, intersect, setdiff, union
##
## Loading required package: PerformanceAnalytics
##
## Attaching package: 'PerformanceAnalytics'
```

```
##
## The following object is masked from 'package:graphics':
##
##     legend
```

```
library(PerformanceAnalytics)
library(psych)
```

```
## Warning: package 'psych' was built under R version 4.1.2
```

```
##
## Attaching package: 'psych'
##
## The following objects are masked from 'package:ggplot2':
##
##     %+%, alpha
```

```
library(moments)
```

```
## Warning: package 'moments' was built under R version 4.1.2
```

```
##
## Attaching package: 'moments'
##
## The following objects are masked from 'package:PerformanceAnalytics':
##
##     kurtosis, skewness
```

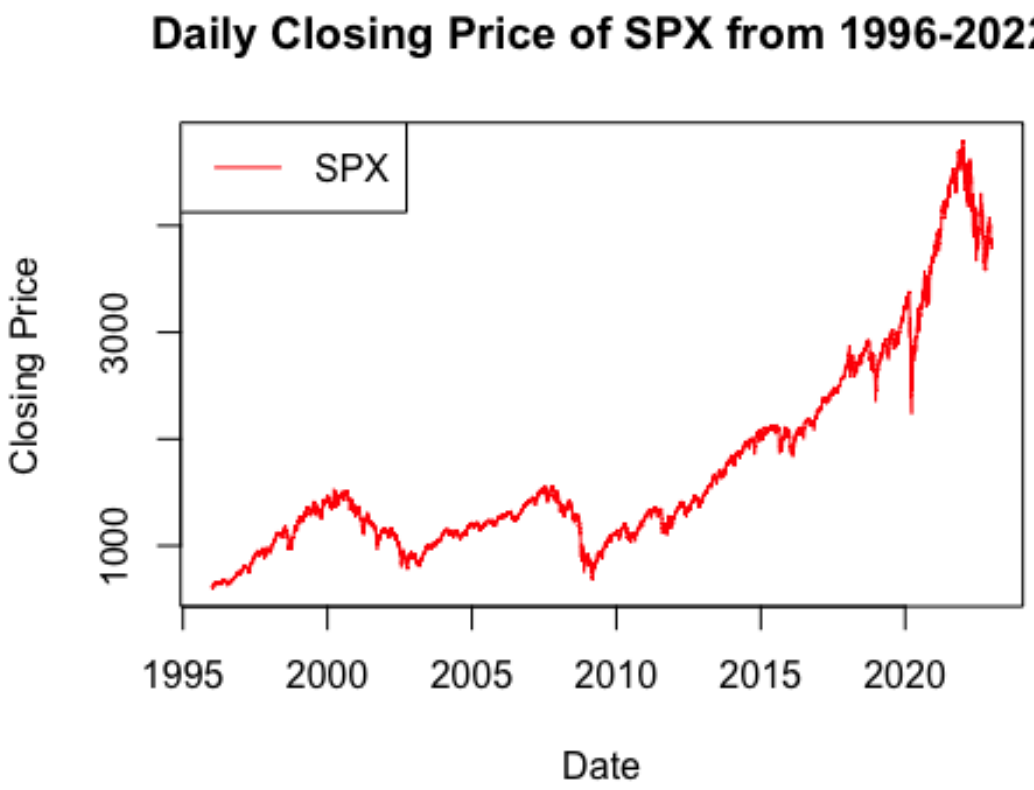
```
library(sandwich)
library(lmtest)
```

```
######################## Import data ########################
OSEBX_new = read_excel("/Users/torgilsmathisen/Desktop/stockprices.xlsx", she
et = "OSEBX new", col_types = c("date", "numeric", "numeric", "numeric", "num
eric", "date", "text"))

SPX_new = read_excel("/Users/torgilsmathisen/Desktop/stockprices.xlsx", sheet
= "SPX new", col_types = c("date", "numeric", "numeric", "numeric", "numeric"
, "date", "text"))
######################## Create datecolumn and dataframes ###################
###

SPX_new$Date = as.Date(SPX_new$Date)
SPX_new = as.data.frame(SPX_new)
str(SPX_new)
```

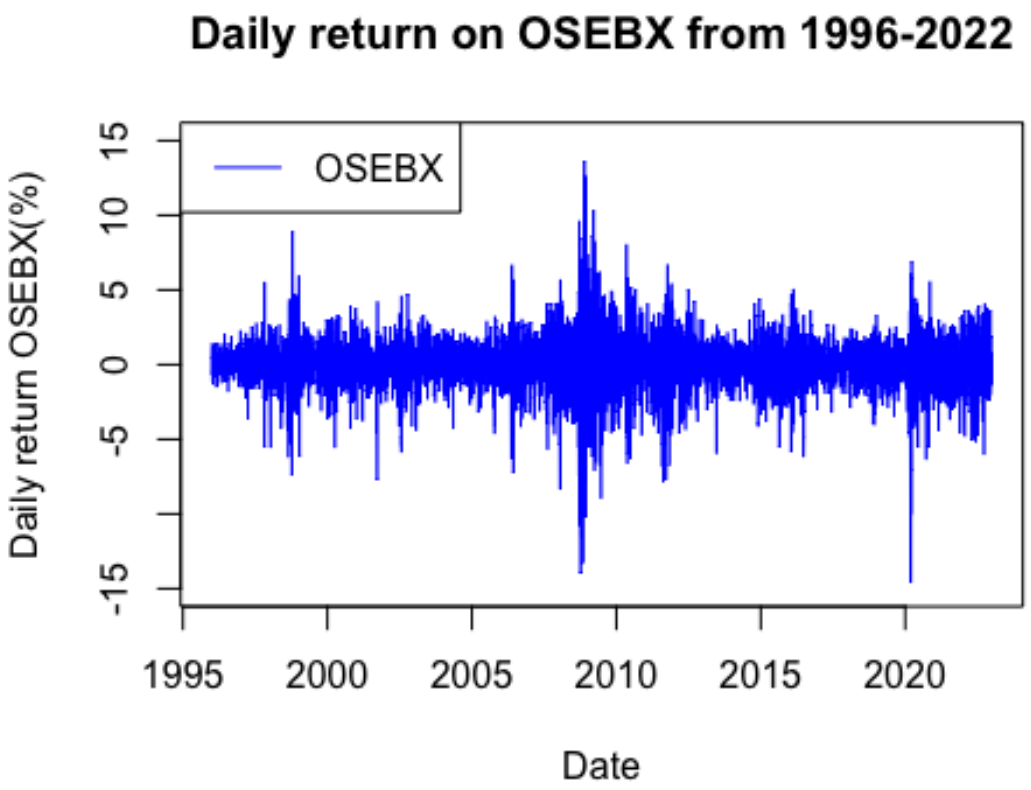
```
## 'data.frame':    6798 obs. of  7 variables:
##  $ Date   : Date, format: "1996-01-02" "1996-01-03" ...
##  $ Open   : num  616 621 621 618 617 ...
##  $ High   : num  621 623 624 618 618 ...
```

```
##  $ Low    : num  613 620 614 612 616 ...
##  $ Close  : num  621 621 618 617 618 ...
##  $ Ann    : POSIXct, format: NA "1996-01-19" ...
##  $ Weekday: chr  NA "Fri" "Tue" "Wed" ...

OSEBX_new$Date = as.Date(OSEBX_new$Date)
OSEBX_new = as.data.frame(OSEBX_new)
str(OSEBX_new)

## 'data.frame':    6798 obs. of  7 variables:
##  $ Date   : Date, format: "1996-01-02" "1996-01-03" ...
##  $ Open   : num  16 16.3 16.1 16.2 16.4 ...
##  $ High   : num  16 16.3 16.1 16.2 16.4 ...
##  $ Low    : num  16 16.3 16.1 16.2 16.4 ...
##  $ Close  : num  16 16.3 16.1 16.2 16.4 ...
##  $ Ann    : POSIXct, format: NA "1996-01-19" ...
##  $ Weekday: chr  NA "Fri" "Tue" "Wed" ...

##### We continue by using the closing prices as the main prices for the inde
xes #####
SPX_new_prices = SPX_new$Close
OSEBX_new_prices = OSEBX_new$Close

######################### Plotting of historical prices ########################
plot(OSEBX_new$Date, OSEBX_new_prices,
     type="l",
     col="blue",
     xlab="Date",
     ylab="Closing Price",
     xlim=as.Date(c("1996-01-01", "2022-12-30")),
     main = "Daily Closing Price of OSEBX from 1996-2022")
legend("topleft", c("OSEBX"),
       col = "blue",
       lty = 1,
       cex = 1)
```

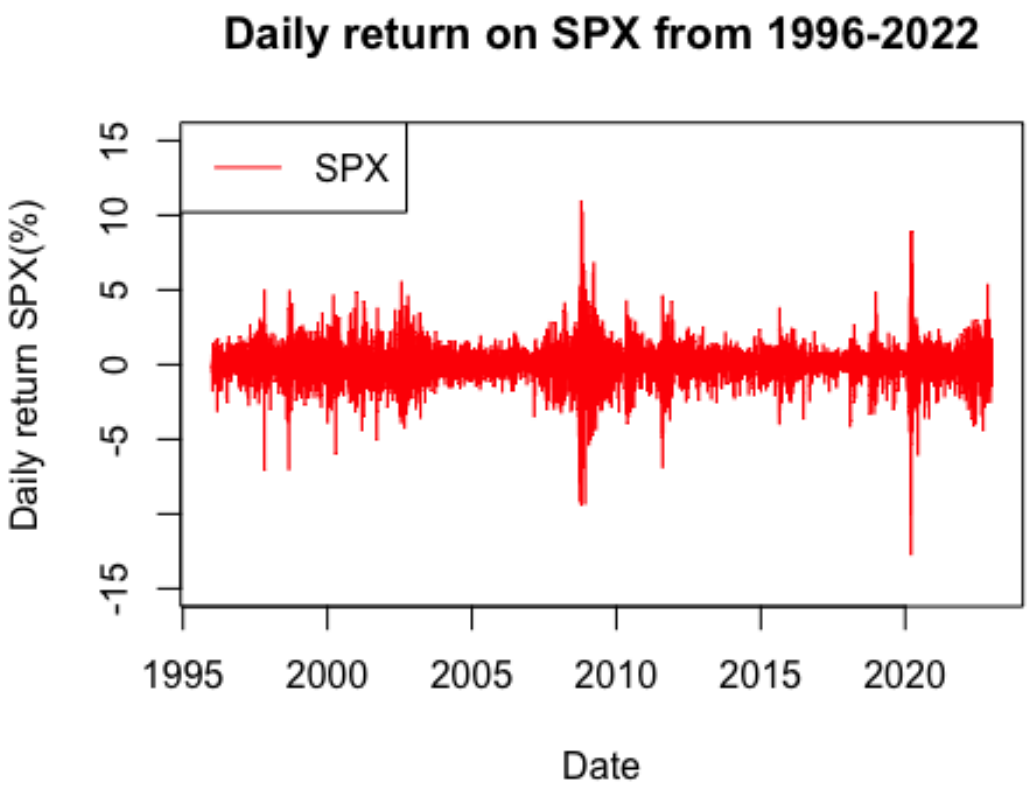

```
plot(SPX_new$Date, SPX_new_prices,
     type="l",
     col="red",
     xlab="Date",
     ylab="Closing Price",
     xlim=as.Date(c("1996-01-01", "2022-12-30")),
     main="Daily Closing Price of SPX from 1996-2022")
legend("topleft", c("SPX"),
       col = "red",
       lty = 1,
       cex = 1)
```




```
######################## Calculation of returns ########################
SPX_new$log_ret = c(NA, 100 * diff(log(SPX_new_prices)))
SPX_new = SPX_new[-1,]
OSEBX_new$log_ret = c(NA, 100 * diff(log(OSEBX_new_prices)))
OSEBX_new = OSEBX_new[-1,]

######################## Plotting of returns ########################
plot(OSEBX_new$Date, OSEBX_new$log_ret,
     type = "l",
     col = "blue",
     ylim = c(-15,15),
     xlim=as.Date(c("1996-01-01", "2022-12-30")),
     xlab = "Date",
     ylab = "Daily return OSEBX(%)",
     main = "Daily return on OSEBX from 1996-2022")
legend("topleft", c("OSEBX"),
       col = c("blue"),
       lty = 1,
       cex = 1)
```




```
plot(SPX_new$Date, SPX_new$log_ret,
     type = "l",
     col = "red",
     ylim = c(-15,15),
     xlim=as.Date(c("1996-01-01", "2022-12-30")),
     xlab = "Date",
     ylab = "Daily return SPX(%)",
     main = "Daily return on SPX from 1996-2022")
legend("topleft", c("SPX"),
       col = c("red"),
       lty = 1,
       cex = 1)
```




```
######################## Descriptive data summary ########################

## OSEBX new
summary(OSEBX_new$log_ret)

##       Min.    1st Qu.     Median       Mean    3rd Qu.       Max.
## -14.56926   -0.74775    0.08069    0.02977    0.89876   13.62500

sd(OSEBX_new$log_ret)

## [1] 1.716958

skewness(OSEBX_new$log_ret)

## [1] -0.604212

kurtosis(OSEBX_new$log_ret)

## [1] 10.37247

N_OSEBX_new = count(OSEBX_new)
N_OSEBX_new

##      n
## 1 6797
```

```
## SPX new
summary(SPX_new$log_ret)

##      Min.   1st Qu.    Median      Mean   3rd Qu.      Max.
## -12.76521  -0.49361   0.06227   0.02681   0.61063  10.95720

sd(SPX_new$log_ret)

## [1] 1.230494

skewness(SPX_new$log_ret)

## [1] -0.3909784

kurtosis(SPX_new$log_ret)

## [1] 12.74823

N_SPX_new = count(SPX_new)
N_SPX_new

##      n
## 1 6797

######################## All announcements combined on returns ###############
########

#### OSEBX ####

### Announcements
A_dates = as.Date(OSEBX_new$Ann)
Tot_days_OSEBX = as.Date(OSEBX_new$Date)

dummy_A_dates_OSEBX = rep(0, N_OSEBX_new)

for (i in 1:828) {
        for (j in 1:6788) {
                if (A_dates[i] == Tot_days_OSEBX[j]) dummy_A_dates_OSEBX[j]=1
        }
}
sum(dummy_A_dates_OSEBX)

## [1] 828

announce = OSEBX_new$log_ret * dummy_A_dates_OSEBX

announce[announce == 0] = NA


mean(announce, na.rm = TRUE)

## [1] 0.06961175
```

```r
StdDev(announce, na.rm = TRUE)
```

```
##            [,1]
## StdDev 1.723709
```

```r
skewness(announce, na.rm = TRUE)
```

```
## [1] -1.414319
```

```r
kurtosis(announce, na.rm = TRUE)
```

```
## [1] 13.9843
```

```r
median(announce, na.rm = TRUE)
```

```
## [1] 0.1238774
```

```r
quantile(announce,na.rm = TRUE, probs = c(0.01,0.25, 0.75, 0.99))
```

```
##         1%        25%        75%        99%
## -4.4558939 -0.6590899  0.9526875  4.5516947
```

```r
t.test(announce, mu=0)
```

```
##
##  One Sample t-test
##
## data:  announce
## t = 1.1621, df = 827, p-value = 0.2455
## alternative hypothesis: true mean is not equal to 0
## 95 percent confidence interval:
##  -0.04796811  0.18719160
## sample estimates:
##  mean of x
## 0.06961175
```

```r
### Nonannouncements
dummy_na_dates_OSEBX = rep(1, N_OSEBX_new)

for (i in 1:828) {
        for (j in 1:6788) {
                if (A_dates[i] == Tot_days_OSEBX[j]) dummy_na_dates_OSEBX[j]=
0
        }
}
sum(dummy_na_dates_OSEBX)
```

```
## [1] 5969
```

```r
nonannounce = OSEBX_new$log_ret * dummy_na_dates_OSEBX

nonannounce[nonannounce == 0] = NA
```

```r
mean(nonannounce, na.rm = TRUE)
```

```
## [1] 0.02427777
```

```r
StdDev(nonannounce, na.rm = TRUE)
```

```
##            [,1]
## StdDev 1.717387
```

```r
skewness(nonannounce, na.rm = TRUE)
```

```
## [1] -0.4903583
```

```r
kurtosis(nonannounce, na.rm = TRUE)
```

```
## [1] 9.862006
```

```r
median(nonannounce, na.rm = TRUE)
```

```
## [1] 0.07682678
```

```r
quantile(nonannounce, na.rm = TRUE, probs = c(0.01, 0.25, 0.75, 0.99))
```

```
##         1%        25%        75%        99%
## -5.3375569 -0.7654191  0.8924610  4.2871299
```

```r
t.test(nonannounce, mu=0)
```

```
##
##  One Sample t-test
##
## data:  nonannounce
## t = 1.0913, df = 5959, p-value = 0.2752
## alternative hypothesis: true mean is not equal to 0
## 95 percent confidence interval:
##  -0.01933175  0.06788728
## sample estimates:
##  mean of x
## 0.02427777
```

```r
## Difference in means
t.test(announce, nonannounce, var.equal = FALSE)
```

```
##
##  Welch Two Sample t-test
##
## data:  announce and nonannounce
## t = 0.70945, df = 1068, p-value = 0.4782
## alternative hypothesis: true difference in means is not equal to 0
## 95 percent confidence interval:
##  -0.08005029  0.17071824
```

```
## sample estimates:
##  mean of x  mean of y
## 0.06961175 0.02427777
```

```
#### SPX ####
```

```
### Announcements
A_dates_SPX = as.Date(SPX_new$Ann)
Tot_days_SPX = as.Date(SPX_new$Date)


dummy_A_dates_SPX = rep(0, N_SPX_new)

for (i in 1:836) {
        for (j in 1:6797) {
                if (A_dates_SPX[i] == Tot_days_SPX[j]) dummy_A_dates_SPX[j]=1
        }
}
sum(dummy_A_dates_SPX)
```

```
## [1] 836
```

```
announce_SPX = SPX_new$log_ret * dummy_A_dates_SPX

announce_SPX[announce_SPX == 0] = NA


mean(announce_SPX, na.rm = TRUE)
```

```
## [1] 0.08945321
```

```
StdDev(announce_SPX, na.rm = TRUE)
```

```
##            [,1]
## StdDev 1.256678
```

```
skewness(announce_SPX, na.rm = TRUE)
```

```
## [1] -1.128699
```

```
kurtosis(announce_SPX, na.rm = TRUE)
```

```
## [1] 12.79392
```

```
median(announce_SPX, na.rm = TRUE)
```

```
## [1] 0.1127844
```

```
quantile(announce_SPX,na.rm = TRUE, probs = c(0.01,0.25, 0.75, 0.99))
```

```
##         1%        25%        75%        99%
## -2.9742347 -0.5262545  0.7328393  3.2947181
```

```r
t.test(announce_SPX, mu=0)
```

```
##
##  One Sample t-test
##
## data:  announce_SPX
## t = 2.0581, df = 835, p-value = 0.03989
## alternative hypothesis: true mean is not equal to 0
## 95 percent confidence interval:
##  0.004143412 0.174763011
## sample estimates:
##  mean of x
## 0.08945321
```

```r
### Nonannouncements
dummy_na_dates_SPX = rep(1, N_SPX_new)

for (i in 1:836) {
        for (j in 1:6797) {
                if (A_dates_SPX[i] == Tot_days_SPX[j]) dummy_na_dates_SPX[j]=
0
        }
}
sum(dummy_na_dates_SPX)
```

```
## [1] 5961
```

```r
nonannounce_SPX = SPX_new$log_ret * dummy_na_dates_SPX

nonannounce_SPX[nonannounce_SPX == 0] = NA


mean(nonannounce_SPX, na.rm = TRUE)
```

```
## [1] 0.01803243
```

```r
StdDev(nonannounce_SPX, na.rm = TRUE)
```

```
##            [,1]
## StdDev 1.226938
```

```r
skewness(nonannounce_SPX, na.rm = TRUE)
```

```
## [1] -0.2811128
```

```r
kurtosis(nonannounce_SPX, na.rm = TRUE)
```

```
## [1] 12.76584
```

```r
median(nonannounce_SPX, na.rm = TRUE)
```

```
## [1] 0.0564794
```

```r
quantile(nonannounce_SPX, na.rm = TRUE, probs = c(0.01,0.25, 0.75, 0.99))
```

```
##         1%        25%        75%        99%
## -3.5204469 -0.4905859  0.5935595  3.3517834
```

```r
t.test(nonannounce_SPX, mu=0)
```

```
##
##  One Sample t-test
##
## data:  nonannounce_SPX
## t = 1.1344, df = 5957, p-value = 0.2567
## alternative hypothesis: true mean is not equal to 0
## 95 percent confidence interval:
##  -0.01312837  0.04919323
## sample estimates:
##  mean of x
## 0.01803243
```

```r
## Difference in means
t.test(announce_SPX, nonannounce_SPX, var.equal = FALSE)
```

```
##
##  Welch Two Sample t-test
##
## data:  announce_SPX and nonannounce_SPX
## t = 1.5433, df = 1070.6, p-value = 0.1231
## alternative hypothesis: true difference in means is not equal to 0
## 95 percent confidence interval:
##  -0.01938623  0.16222779
## sample estimates:
##  mean of x  mean of y
## 0.08945321 0.01803243
```

```r
######################## Different announcement effect on returns ############
############

#### OSEBX ####

# FOMC on OSEBX
ann_date = read_excel("/Users/torgilsmathisen/Desktop/new FOMC ann.xlsx", she
et = "Ann")
```

```
## New names:
## • `Weekday` -> `Weekday...2`
## • `Weekday` -> `Weekday...4`
## • `Weekday` -> `Weekday...6`
## • `` -> `...7`
## • `` -> `...8`
## • `` -> `...9`
## • `` -> `...11`
```

```
## • `` -> `...12`
## • `` -> `...13`
## • `` -> `...14`
## • `` -> `...15`
## • `` -> `...16`
## • `` -> `...17`
## • `` -> `...18`
## • `` -> `...19`
## • `` -> `...20`
## • `` -> `...21`

FOMC = drop_na(ann_date["FOMC"])
FOMC_date = as.Date(ann_date$`FOMC`)
Tot_days_OSEBX = as.Date(OSEBX_new$Date)

dummy_FOMC_dates_OSEBX = rep(0, N_OSEBX_new)

for (i in 1:205) {
        for (j in 1:6788) {
                if (FOMC_date[i] == Tot_days_OSEBX[j]) dummy_FOMC_dates_OSEBX
[j]=1
        }
}
sum(dummy_FOMC_dates_OSEBX)

## [1] 205

#PPI on OSEBX
PPI = drop_na(ann_date["PPI"])
PPI_date = as.Date(ann_date$`PPI`)

dummy_PPI_dates = rep(0, N_OSEBX_new)

for (i in 1:307) {
        for (j in 1:6788) {
                if (PPI_date[i] == Tot_days_OSEBX[j]) dummy_PPI_dates[j]=1
        }
}
sum(dummy_PPI_dates)

## [1] 307

#Employment on OSEBX
Emp = drop_na(ann_date["Employment"])
Emp_date = as.Date(ann_date$`Employment`)

dummy_emp_dates = rep(0, N_OSEBX_new)

for (i in 1:316) {
        for (j in 1:6788) {
```

```
                if (Emp_date[i] == Tot_days_OSEBX[j]) dummy_emp_dates[j]=1
        }
}
sum(dummy_emp_dates)
```

```
## [1] 316
```

```
#### Regression with separate announcements
OSEBX_sep_ann = lm(OSEBX_new$log_ret ~ dummy_FOMC_dates_OSEBX + dummy_PPI_dat
es + dummy_emp_dates, data = OSEBX_new)
summary(OSEBX_sep_ann)
```

```
##
## Call:
## lm(formula = OSEBX_new$log_ret ~ dummy_FOMC_dates_OSEBX + dummy_PPI_dates
+
##     dummy_emp_dates, data = OSEBX_new)
##
## Residuals:
##      Min       1Q   Median       3Q      Max
## -14.4781  -0.7825   0.0482   0.8710  13.6008
##
## Coefficients:
##                         Estimate Std. Error t value Pr(>|t|)
## (Intercept)              0.02424    0.02222   1.091   0.2753
## dummy_FOMC_dates_OSEBX   0.25731    0.12193   2.110   0.0349 *
## dummy_PPI_dates         -0.11537    0.10046  -1.148   0.2508
## dummy_emp_dates          0.06404    0.09909   0.646   0.5181
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 1.717 on 6793 degrees of freedom
## Multiple R-squared:  0.0009358,  Adjusted R-squared:  0.0004946
## F-statistic: 2.121 on 3 and 6793 DF,  p-value: 0.09534
```

```
coeftest(OSEBX_sep_ann, vcov. = NeweyWest(OSEBX_sep_ann, lag = 5, adjust = FA
LSE,
                                          prewhite = FALSE))
```

```
##
## t test of coefficients:
##
##                          Estimate Std. Error t value Pr(>|t|)
## (Intercept)              0.024241   0.022377  1.0833  0.27871
## dummy_FOMC_dates_OSEBX   0.257311   0.109987  2.3395  0.01934 *
## dummy_PPI_dates         -0.115370   0.107697 -1.0712  0.28410
## dummy_emp_dates          0.064040   0.097676  0.6556  0.51208
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

```
#### S&P ####

# FOMC on S&P
ann_date_SPX = read_excel("/Users/torgilsmathisen/Desktop/new FOMC ann.xlsx",
sheet = "Ann US")

## New names:
## • `Weekday` -> `Weekday...2`
## • `Weekday` -> `Weekday...4`
## • `Weekday` -> `Weekday...6`
## • `` -> `...7`
## • `` -> `...8`
## • `` -> `...9`
## • `` -> `...11`
## • `` -> `...12`
## • `` -> `...13`
## • `` -> `...14`
## • `` -> `...15`
## • `` -> `...16`
## • `` -> `...17`
## • `` -> `...18`
## • `` -> `...19`
## • `` -> `...20`
## • `` -> `...21`

FOMC_SPX = drop_na(ann_date_SPX["FOMC"])
FOMC_date_SPX = as.Date(ann_date_SPX$`FOMC`)
Tot_days_SPX = as.Date(SPX_new$Date)

dummy_FOMC_dates_SPX = rep(0, N_SPX_new)

for (i in 1:207) {
        for (j in 1:6797) {
                if (FOMC_date_SPX[i] == Tot_days_SPX[j]) dummy_FOMC_dates_SPX
[j]=1
        }
}
sum(dummy_FOMC_dates_SPX)

## [1] 207

#PPI on S&P
PPI_SPX = drop_na(ann_date_SPX["PPI"])
PPI_date_SPX = as.Date(ann_date_SPX$`PPI`)

dummy_PPI_dates_SPX = rep(0, N_SPX_new)

for (i in 1:313) {
        for (j in 1:6797) {
                if (PPI_date_SPX[i] == Tot_days_SPX[j]) dummy_PPI_dates_SPX[j
```

```
]=1
        }
}
sum(dummy_PPI_dates_SPX)
```

```
## [1] 313
```

```
#Employment on S&P
Emp_SPX = drop_na(ann_date_SPX["Employment"])
Emp_date_SPX = as.Date(ann_date_SPX$`Employment`)

dummy_emp_dates_SPX = rep(0, N_SPX_new)

for (i in 1:316) {
        for (j in 1:6797) {
                if (Emp_date_SPX[i] == Tot_days_SPX[j]) dummy_emp_dates_SPX[j
]=1
        }
}
sum(dummy_emp_dates_SPX)
```

```
## [1] 316
```

```
#### Regression with separate announcements
SPX_sep_ann = lm(SPX_new$log_ret ~ dummy_FOMC_dates_SPX + dummy_PPI_dates_SPX
+ dummy_emp_dates_SPX, data = SPX_new)
summary(SPX_sep_ann)
```

```
##
## Call:
## lm(formula = SPX_new$log_ret ~ dummy_FOMC_dates_SPX + dummy_PPI_dates_SPX
+
##     dummy_emp_dates_SPX, data = SPX_new)
##
## Residuals:
##      Min       1Q   Median       3Q      Max
## -12.7830  -0.5242   0.0392   0.5875  10.9394
##
## Coefficients:
##                       Estimate Std. Error t value Pr(>|t|)
## (Intercept)            0.01777    0.01593   1.115  0.26468
## dummy_FOMC_dates_SPX   0.22795    0.08696   2.621  0.00878 **
## dummy_PPI_dates_SPX   -0.03851    0.07133  -0.540  0.58927
## dummy_emp_dates_SPX    0.08323    0.07100   1.172  0.24118
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 1.23 on 6793 degrees of freedom
## Multiple R-squared:  0.001249,   Adjusted R-squared:  0.0008081
## F-statistic: 2.832 on 3 and 6793 DF,  p-value: 0.03687
```

```
coeftest(SPX_sep_ann, vcov. = NeweyWest(SPX_sep_ann, lag = 5, adjust = FALSE,
                                        prewhite = FALSE))

##
## t test of coefficients:
##
##                       Estimate Std. Error t value Pr(>|t|)
## (Intercept)           0.017771   0.014314  1.2415 0.214461
## dummy_FOMC_dates_SPX  0.227952   0.083246  2.7383 0.006192 **
## dummy_PPI_dates_SPX  -0.038510   0.077223 -0.4987 0.618020
## dummy_emp_dates_SPX   0.083226   0.069637  1.1951 0.232076
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

```
######################## Weekday effects ##########################

### OSEBX
D_mon = ifelse(OSEBX_new$Weekday == "Mon", 1, 0)
D_tue = ifelse(OSEBX_new$Weekday == "Tue", 1, 0)
D_wed = ifelse(OSEBX_new$Weekday == "Wed", 1, 0)
D_thu = ifelse(OSEBX_new$Weekday == "Thu", 1, 0)
D_fri = ifelse(OSEBX_new$Weekday == "Fri", 1, 0)



model_week_an = lm(OSEBX_new$log_ret ~ dummy_A_dates_OSEBX + D_mon + D_tue +
D_wed + D_thu + D_fri, data=OSEBX_new)
summary(model_week_an)

##
## Call:
## lm(formula = OSEBX_new$log_ret ~ dummy_A_dates_OSEBX + D_mon +
##     D_tue + D_wed + D_thu + D_fri, data = OSEBX_new)
##
## Residuals:
##     Min      1Q  Median      3Q     Max
## -7.4909 -0.6253  0.0007  0.7086  8.8830
##
## Coefficients: (1 not defined because of singularities)
##                      Estimate Std. Error t value Pr(>|t|)
## (Intercept)           0.08088    0.06924   1.168   0.2431
## dummy_A_dates_OSEBX   0.01915    0.14565   0.132   0.8954
## D_mon                 0.24040    1.36993   0.175   0.8607
## D_tue                -0.02151    0.13318  -0.161   0.8717
## D_wed                -0.28046    0.12160  -2.306   0.0213 *
## D_thu                 0.03646    0.16134   0.226   0.8213
## D_fri                      NA         NA      NA       NA
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
```

```
## Residual standard error: 1.368 on 822 degrees of freedom
##   (5969 observations deleted due to missingness)
## Multiple R-squared:  0.007417,   Adjusted R-squared:  0.00138
## F-statistic: 1.228 on 5 and 822 DF,  p-value: 0.2937
```

```
### S&P 500
D_mon_SPX = ifelse(SPX_new$Weekday == "Mon", 1, 0)
D_tue_SPX = ifelse(SPX_new$Weekday == "Tue", 1, 0)
D_wed_SPX = ifelse(SPX_new$Weekday == "Wed", 1, 0)
D_thu_SPX = ifelse(SPX_new$Weekday == "Thu", 1, 0)
D_fri_SPX = ifelse(SPX_new$Weekday == "Fri", 1, 0)


model_week_an_SPX = lm(SPX_new$log_ret ~ dummy_A_dates_SPX + D_mon_SPX + D_tu
e_SPX + D_wed_SPX + D_thu_SPX + D_fri_SPX, data = SPX_new)
summary(model_week_an_SPX)
```

```
##
## Call:
## lm(formula = SPX_new$log_ret ~ dummy_A_dates_SPX + D_mon_SPX +
##     D_tue_SPX + D_wed_SPX + D_thu_SPX + D_fri_SPX, data = SPX_new)
##
## Residuals:
##     Min      1Q  Median      3Q     Max
## -7.1363 -0.5588  0.0087  0.6238  4.8962
##
## Coefficients: (1 not defined because of singularities)
##                    Estimate Std. Error t value Pr(>|t|)
## (Intercept)        0.092495   0.056036   1.651   0.0992 .
## dummy_A_dates_SPX  0.256347   0.115951   2.211   0.0273 *
## D_mon_SPX          0.328923   1.097660   0.300   0.7645
## D_tue_SPX          0.004937   0.106381   0.046   0.9630
## D_wed_SPX         -0.143258   0.097132  -1.475   0.1406
## D_thu_SPX          0.003067   0.125321   0.024   0.9805
## D_fri_SPX                NA         NA      NA       NA
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 1.096 on 830 degrees of freedom
##   (5961 observations deleted due to missingness)
## Multiple R-squared:  0.008896,   Adjusted R-squared:  0.002926
## F-statistic:  1.49 on 5 and 830 DF,  p-value: 0.1906
```

```
######################## Robustness test ########################
############# Subsample all announcements ##############

# 2010-2013
# 2014-2017
# 2018-2022
```

```
###### OSEBX ######

data_1 = OSEBX_new[ (OSEBX_new$Date >= "1996-01-01") & (OSEBX_new$Date <= "20
02-12-31"), ]
data_2 = OSEBX_new[ (OSEBX_new$Date >= "2003-01-01") & (OSEBX_new$Date <= "20
09-12-31"), ]
data_3 = OSEBX_new[ (OSEBX_new$Date >= "2010-01-01") & (OSEBX_new$Date <= "20
16-12-31"), ]
data_4 = OSEBX_new[ (OSEBX_new$Date >= "2017-01-01") & (OSEBX_new$Date <= "20
22-12-31"), ]

#### Subsample 1: 1996-2002 ####

## Announcement
A_dates_sub1 = as.Date(OSEBX_new$Ann)
Tot_days_OSEBX_sub1 = as.Date(data_1$Date)
N_OSEBX_sub1 = count(data_1)


dummy_A_dates_OSEBX_sub1 = rep(0, N_OSEBX_sub1)

for (i in 1:828) {
        for (j in 1:1751) {
                if (A_dates_sub1[i] == Tot_days_OSEBX_sub1[j]) dummy_A_dates_
OSEBX_sub1[j]=1
        }
}
sum(dummy_A_dates_OSEBX_sub1)

## [1] 217

announce_sub1 = data_1$log_ret * dummy_A_dates_OSEBX_sub1

announce_sub1[announce_sub1 == 0] = NA



mean(announce_sub1, na.rm = TRUE)

## [1] 0.08282119

## Nonannouncement
dummy_na_dates_OSEBX_sub1 = rep(1, N_OSEBX_sub1)

for (i in 1:828) {
        for (j in 1:1751) {
                if (A_dates_sub1[i] == Tot_days_OSEBX_sub1[j]) dummy_na_dates
_OSEBX_sub1[j]=0
        }
```

```
}
sum(dummy_na_dates_OSEBX_sub1)
```

```
## [1] 1541
```

```
nonannounce_sub1 = data_1$log_ret * dummy_na_dates_OSEBX_sub1

nonannounce_sub1[nonannounce_sub1 == 0] = NA



mean(nonannounce_sub1, na.rm = TRUE)
```

```
## [1] -0.009429417
```

```
## Difference in means
t.test(announce_sub1, nonannounce_sub1, var.equal = FALSE)
```

```
##
##  Welch Two Sample t-test
##
## data:  announce_sub1 and nonannounce_sub1
## t = 0.99059, df = 292.59, p-value = 0.3227
## alternative hypothesis: true difference in means is not equal to 0
## 95 percent confidence interval:
##  -0.09103344  0.27553467
## sample estimates:
##    mean of x    mean of y
##  0.082821195 -0.009429417
```

```
#### Subsample 2: 2003-2009 ####

## Announcement
A_dates_sub2 = as.Date(OSEBX_new$Ann)
Tot_days_OSEBX_sub2 = as.Date(data_2$Date)
N_OSEBX_sub2 = count(data_2)



dummy_A_dates_OSEBX_sub2 = rep(0, N_OSEBX_sub2)

for (i in 1:828) {
        for (j in 1:1760) {
                if (A_dates_sub2[i] == Tot_days_OSEBX_sub2[j]) dummy_A_dates_
OSEBX_sub2[j]=1
        }
}
sum(dummy_A_dates_OSEBX_sub2)
```

```
## [1] 215
```

```r
announce_sub2 = data_2$log_ret * dummy_A_dates_OSEBX_sub2

announce_sub2[announce_sub2 == 0] = NA



mean(announce_sub2, na.rm = TRUE)
```

```
## [1] 0.1987302
```

```r
## Nonannouncement
dummy_na_dates_OSEBX_sub2 = rep(1, N_OSEBX_sub2)

for (i in 1:828) {
        for (j in 1:1760) {
                if (A_dates_sub2[i] == Tot_days_OSEBX_sub2[j]) dummy_na_dates
_OSEBX_sub2[j]=0
        }
}
sum(dummy_na_dates_OSEBX_sub2)
```

```
## [1] 1547
```

```r
nonannounce_sub2 = data_2$log_ret * dummy_na_dates_OSEBX_sub2

nonannounce_sub2[nonannounce_sub2 == 0] = NA



mean(nonannounce_sub2, na.rm = TRUE)
```

```
## [1] 0.0598027
```

```r
## Difference in means
t.test(announce_sub2, nonannounce_sub2, var.equal = FALSE)
```

```
##
##  Welch Two Sample t-test
##
## data:  announce_sub2 and nonannounce_sub2
## t = 0.85731, df = 273.8, p-value = 0.392
## alternative hypothesis: true difference in means is not equal to 0
## 95 percent confidence interval:
##  -0.1800975  0.4579526
## sample estimates:
## mean of x mean of y
## 0.1987302 0.0598027
```

```r
#### Subsample 3: 2010-2016 ####

## Announcement
```

```r
A_dates_sub3 = as.Date(OSEBX_new$Ann)
Tot_days_OSEBX_sub3 = as.Date(data_3$Date)
N_OSEBX_sub3 = count(data_3)


dummy_A_dates_OSEBX_sub3 = rep(0, N_OSEBX_sub3)

for (i in 1:828) {
        for (j in 1:1759) {
                if (A_dates_sub3[i] == Tot_days_OSEBX_sub3[j]) dummy_A_dates_
OSEBX_sub3[j]=1
        }
}
sum(dummy_A_dates_OSEBX_sub3)

## [1] 211

announce_sub3 = data_3$log_ret * dummy_A_dates_OSEBX_sub3

announce_sub3[announce_sub3 == 0] = NA



mean(announce_sub3, na.rm = TRUE)

## [1] -0.05671734

## Nonannouncement
dummy_na_dates_OSEBX_sub3 = rep(1, N_OSEBX_sub3)

for (i in 1:828) {
        for (j in 1:1759) {
                if (A_dates_sub3[i] == Tot_days_OSEBX_sub3[j]) dummy_na_dates
_OSEBX_sub3[j]=0
        }
}
sum(dummy_na_dates_OSEBX_sub3)

## [1] 1548

nonannounce_sub3 = data_3$log_ret * dummy_na_dates_OSEBX_sub3

nonannounce_sub3[nonannounce_sub3 == 0] = NA



mean(nonannounce_sub3, na.rm = TRUE)

## [1] 0.0215232
```

```r
## Difference in means
t.test(announce_sub3, nonannounce_sub3, var.equal = FALSE)
```

```
##
##  Welch Two Sample t-test
##
## data:  announce_sub3 and nonannounce_sub3
## t = -0.69439, df = 283.14, p-value = 0.488
## alternative hypothesis: true difference in means is not equal to 0
## 95 percent confidence interval:
##  -0.3000273  0.1435462
## sample estimates:
##   mean of x   mean of y
## -0.05671734  0.02152320
```

```r
#### Subsample 4: 2017-2022 ####
## Announcement
A_dates_sub4 = as.Date(OSEBX_new$Ann)
Tot_days_OSEBX_sub4 = as.Date(data_4$Date)
N_OSEBX_sub4 = count(data_4)


dummy_A_dates_OSEBX_sub4 = rep(0, N_OSEBX_sub4)

for (i in 1:828) {
        for (j in 1:1518) {
                if (A_dates_sub4[i] == Tot_days_OSEBX_sub4[j]) dummy_A_dates_
OSEBX_sub4[j]=1
        }
}
sum(dummy_A_dates_OSEBX_sub4)
```

```
## [1] 185
```

```r
announce_sub4 = data_4$log_ret * dummy_A_dates_OSEBX_sub4

announce_sub4[announce_sub4 == 0] = NA



mean(announce_sub4, na.rm = TRUE)
```

```
## [1] 0.04814424
```

```r
## Nonannouncement
dummy_na_dates_OSEBX_sub4 = rep(1, N_OSEBX_sub4)

for (i in 1:828) {
        for (j in 1:1518) {
                if (A_dates_sub4[i] == Tot_days_OSEBX_sub4[j]) dummy_na_dates
```

```
_OSEBX_sub4[j]=0
        }
}
sum(dummy_na_dates_OSEBX_sub4)
```

```
## [1] 1333
```

```
nonannounce_sub4 = data_4$log_ret * dummy_na_dates_OSEBX_sub4

nonannounce_sub4[nonannounce_sub4 == 0] = NA



mean(nonannounce_sub4, na.rm = TRUE)
```

```
## [1] 0.02509163
```

```
## Difference in means
t.test(announce_sub4, nonannounce_sub4, var.equal = FALSE)
```

```
##
##  Welch Two Sample t-test
##
## data:  announce_sub4 and nonannounce_sub4
## t = 0.17223, df = 225.05, p-value = 0.8634
## alternative hypothesis: true difference in means is not equal to 0
## 95 percent confidence interval:
##  -0.2407100  0.2868152
## sample estimates:
##  mean of x  mean of y
## 0.04814424 0.02509163
```

```
###### S&P ######

data_1_SPX = SPX_new[ (SPX_new$Date >= "1996-01-01") & (SPX_new$Date <= "2002
-12-31"), ]
data_2_SPX = SPX_new[ (SPX_new$Date >= "2003-01-01") & (SPX_new$Date <= "2009
-12-31"), ]
data_3_SPX = SPX_new[ (SPX_new$Date >= "2010-01-01") & (SPX_new$Date <= "2016
-12-31"), ]
data_4_SPX = SPX_new[ (SPX_new$Date >= "2017-01-01") & (SPX_new$Date <= "2022
-12-31"), ]

#### Subsample 1: 1996-2002 ####

## Announcement
A_dates_sub1_SPX = as.Date(SPX_new$Ann)
Tot_days_SPX_sub1 = as.Date(data_1_SPX$Date)
N_SPX_sub1 = count(data_1_SPX)
```

```r
dummy_A_dates_SPX_sub1 = rep(0, N_SPX_sub1)

for (i in 1:836) {
        for (j in 1:1762) {
                if (A_dates_sub1_SPX[i] == Tot_days_SPX_sub1[j]) dummy_A_date
s_SPX_sub1[j]=1
        }
}
sum(dummy_A_dates_SPX_sub1)
```

```
## [1] 219
```

```r
announce_SPX_sub1 = data_1_SPX$log_ret * dummy_A_dates_SPX_sub1

announce_SPX_sub1[announce_SPX_sub1 == 0] = NA



mean(announce_SPX_sub1, na.rm = TRUE)
```

```
## [1] 0.2326511
```

```r
## Nonannouncement
dummy_na_dates_SPX_sub1 = rep(1, N_SPX_sub1)

for (i in 1:836) {
        for (j in 1:1762) {
                if (A_dates_sub1_SPX[i] == Tot_days_SPX_sub1[j]) dummy_na_dat
es_SPX_sub1[j]=0
        }
}
sum(dummy_na_dates_SPX_sub1)
```

```
## [1] 1543
```

```r
nonannounce_SPX_sub1 = data_1_SPX$log_ret * dummy_na_dates_SPX_sub1

nonannounce_SPX_sub1[nonannounce_SPX_sub1 == 0] = NA



mean(nonannounce_SPX_sub1, na.rm = TRUE)
```

```
## [1] -0.01042055
```

```r
## Difference in means
t.test(announce_SPX_sub1, nonannounce_SPX_sub1, var.equal = FALSE)
```

```
##
##  Welch Two Sample t-test
```

```
##
## data:  announce_SPX_sub1 and nonannounce_SPX_sub1
## t = 2.5076, df = 273.79, p-value = 0.01273
## alternative hypothesis: true difference in means is not equal to 0
## 95 percent confidence interval:
##  0.05224434 0.43389901
## sample estimates:
##   mean of x   mean of y
##  0.23265113 -0.01042055
```

```
#### Subsample 2: 2003-2009 ####

## Announcement
A_dates_sub2_SPX = as.Date(SPX_new$Ann)
Tot_days_SPX_sub2 = as.Date(data_2_SPX$Date)
N_SPX_sub2 = count(data_2_SPX)


dummy_A_dates_SPX_sub2 = rep(0, N_SPX_sub2)

for (i in 1:836) {
        for (j in 1:1763) {
                if (A_dates_sub2_SPX[i] == Tot_days_SPX_sub2[j]) dummy_A_date
s_SPX_sub2[j]=1
        }
}
sum(dummy_A_dates_SPX_sub2)
```

```
## [1] 216
```

```
announce_SPX_sub2 = data_2_SPX$log_ret * dummy_A_dates_SPX_sub2

announce_SPX_sub2[announce_SPX_sub2 == 0] = NA


mean(announce_SPX_sub2, na.rm = TRUE)
```

```
## [1] 0.06725165
```

```
## Nonannouncement
dummy_na_dates_SPX_sub2 = rep(1, N_SPX_sub2)

for (i in 1:836) {
        for (j in 1:1763) {
                if (A_dates_sub2_SPX[i] == Tot_days_SPX_sub2[j]) dummy_na_dat
es_SPX_sub2[j]=0
        }
}
sum(dummy_na_dates_SPX_sub2)
```

```
## [1] 1547

nonannounce_SPX_sub2 = data_2_SPX$log_ret * dummy_na_dates_SPX_sub2

nonannounce_SPX_sub2[nonannounce_SPX_sub2 == 0] = NA


mean(nonannounce_SPX_sub2, na.rm = TRUE)

## [1] 0.005932631

## Difference in means
t.test(announce_SPX_sub2, nonannounce_SPX_sub2, var.equal = FALSE)

##
##  Welch Two Sample t-test
##
## data:  announce_SPX_sub2 and nonannounce_SPX_sub2
## t = 0.6538, df = 290.11, p-value = 0.5138
## alternative hypothesis: true difference in means is not equal to 0
## 95 percent confidence interval:
##  -0.1232724  0.2459104
## sample estimates:
##   mean of x   mean of y
## 0.067251646 0.005932631

#### Subsample 3: 2010-2016 ####

## Announcement
A_dates_sub3_SPX = as.Date(SPX_new$Ann)
Tot_days_SPX_sub3 = as.Date(data_3_SPX$Date)
N_SPX_sub3 = count(data_3_SPX)


dummy_A_dates_SPX_sub3 = rep(0, N_SPX_sub3)

for (i in 1:836) {
        for (j in 1:1762) {
                if (A_dates_sub3_SPX[i] == Tot_days_SPX_sub3[j]) dummy_A_date
s_SPX_sub3[j]=1
        }
}
sum(dummy_A_dates_SPX_sub3)

## [1] 213

announce_SPX_sub3 = data_3_SPX$log_ret * dummy_A_dates_SPX_sub3

announce_SPX_sub3[announce_SPX_sub3 == 0] = NA
```

```r
mean(announce_SPX_sub3, na.rm = TRUE)
```

```
## [1] 0.0474026
```

```r
## Nonannouncement
dummy_na_dates_SPX_sub3 = rep(1, N_SPX_sub3)

for (i in 1:836) {
        for (j in 1:1762) {
                if (A_dates_sub3_SPX[i] == Tot_days_SPX_sub3[j]) dummy_na_dat
es_SPX_sub3[j]=0
        }
}
sum(dummy_na_dates_SPX_sub3)
```

```
## [1] 1549
```

```r
nonannounce_SPX_sub3 = data_3_SPX$log_ret * dummy_na_dates_SPX_sub3

nonannounce_SPX_sub3[nonannounce_SPX_sub3 == 0] = NA


mean(nonannounce_SPX_sub3, na.rm = TRUE)
```

```
## [1] 0.03847913
```

```r
## Difference in means
t.test(announce_SPX_sub3, nonannounce_SPX_sub3, var.equal = FALSE)
```

```
##
##  Welch Two Sample t-test
##
## data:  announce_SPX_sub3 and nonannounce_SPX_sub3
## t = 0.12303, df = 271.6, p-value = 0.9022
## alternative hypothesis: true difference in means is not equal to 0
## 95 percent confidence interval:
##  -0.1338704  0.1517174
## sample estimates:
##  mean of x  mean of y
## 0.04740260 0.03847913
```

```r
#### Subsample 4: 2017-2022 ####
## Announcement
A_dates_sub4_SPX = as.Date(SPX_new$Ann)
Tot_days_SPX_sub4 = as.Date(data_4_SPX$Date)
N_SPX_sub4 = count(data_4_SPX)


dummy_A_dates_SPX_sub4 = rep(0, N_SPX_sub4)
```

```
for (i in 1:836) {
        for (j in 1:1510) {
                if (A_dates_sub4_SPX[i] == Tot_days_SPX_sub4[j]) dummy_A_date
s_SPX_sub4[j]=1
        }
}
sum(dummy_A_dates_SPX_sub4)
```

```
## [1] 188
```

```
announce_SPX_sub4 = data_4_SPX$log_ret * dummy_A_dates_SPX_sub4

announce_SPX_sub4[announce_SPX_sub4 == 0] = NA


mean(announce_SPX_sub4, na.rm = TRUE)
```

```
## [1] -0.004206502
```

```
## Nonannouncement
dummy_na_dates_SPX_sub4 = rep(1, N_SPX_sub4)

for (i in 1:836) {
        for (j in 1:1510) {
                if (A_dates_sub4_SPX[i] == Tot_days_SPX_sub4[j]) dummy_na_dat
es_SPX_sub4[j]=0
        }
}
sum(dummy_na_dates_SPX_sub4)
```

```
## [1] 1322
```

```
nonannounce_SPX_sub4 = data_4_SPX$log_ret * dummy_na_dates_SPX_sub4

nonannounce_SPX_sub4[nonannounce_SPX_sub4 == 0] = NA


mean(nonannounce_SPX_sub4, na.rm = TRUE)
```

```
## [1] 0.0414305
```

```
## Difference in means
t.test(announce_SPX_sub4, nonannounce_SPX_sub4, var.equal = FALSE)
```

```
##
##  Welch Two Sample t-test
##
## data:  announce_SPX_sub4 and nonannounce_SPX_sub4
## t = -0.43115, df = 234.26, p-value = 0.6668
## alternative hypothesis: true difference in means is not equal to 0
## 95 percent confidence interval:
```

```
##  -0.2541751  0.1629011
## sample estimates:
##    mean of x    mean of y
## -0.004206502  0.041430505

############## Subample each announcements ##############
###### OSEBX ######
#### 1996-2002 ####
### FOMC
Tot_days_OSEBX_sub1 = as.Date(data_1$Date)
dummy_FOMC_dates_OSEBX_sub1 = rep(0, N_OSEBX_sub1)

for (i in 1:205) {
        for (j in 1:1751) {
                if (FOMC_date[i] == Tot_days_OSEBX_sub1[j]) dummy_FOMC_dates_
OSEBX_sub1[j]=1
        }
}
sum(dummy_FOMC_dates_OSEBX_sub1)

## [1] 55

### PPI
dummy_PPI_dates_sub1 = rep(0, N_OSEBX_sub1)

for (i in 1:307) {
        for (j in 1:1751) {
                if (PPI_date[i] == Tot_days_OSEBX_sub1[j]) dummy_PPI_dates_su
b1[j]=1
        }
}
sum(dummy_PPI_dates_sub1)

## [1] 80

### Employment
dummy_emp_dates_sub1 = rep(0, N_OSEBX_sub1)

for (i in 1:316) {
        for (j in 1:1751) {
                if (Emp_date[i] == Tot_days_OSEBX_sub1[j]) dummy_emp_dates_su
b1[j]=1
        }
}
sum(dummy_emp_dates_sub1)

## [1] 82

#### Regression with separate announcements

OSEBX_sep_ann_sub1 = lm(data_1$log_ret ~ dummy_FOMC_dates_OSEBX_sub1 + dummy_
```

```
PPI_dates_sub1 + dummy_emp_dates_sub1, data = data_1)
summary(OSEBX_sep_ann_sub1)

##
## Call:
## lm(formula = data_1$log_ret ~ dummy_FOMC_dates_OSEBX_sub1 + dummy_PPI_date
s_sub1 +
##     dummy_emp_dates_sub1, data = data_1)
##
## Residuals:
##     Min      1Q  Median      3Q     Max
## -7.7087 -0.6578  0.0205  0.7647  8.9518
##
## Coefficients:
##                               Estimate Std. Error t value Pr(>|t|)
## (Intercept)                  -0.009387   0.034675  -0.271   0.7867
## dummy_FOMC_dates_OSEBX_sub1 -0.067434   0.186791  -0.361   0.7181
## dummy_PPI_dates_sub1         0.025779   0.156087   0.165   0.8688
## dummy_emp_dates_sub1         0.264094   0.154267   1.712   0.0871 .
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 1.361 on 1754 degrees of freedom
## Multiple R-squared:  0.00178,    Adjusted R-squared:  7.251e-05
## F-statistic: 1.042 on 3 and 1754 DF,  p-value: 0.3727

coeftest(OSEBX_sep_ann_sub1, vcov. = NeweyWest(OSEBX_sep_ann_sub1, lag = 5, a
djust = FALSE,
                                               prewhite = FALSE))

##
## t test of coefficients:
##
##                               Estimate Std. Error t value Pr(>|t|)
## (Intercept)                  -0.0093866  0.0362371 -0.2590  0.79564
## dummy_FOMC_dates_OSEBX_sub1 -0.0674344  0.1617478 -0.4169  0.67679
## dummy_PPI_dates_sub1         0.0257787  0.1379841  0.1868  0.85182
## dummy_emp_dates_sub1         0.2640937  0.1506079  1.7535  0.07969 .
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

#### 2003-2009 ####

### FOMC
Tot_days_OSEBX_sub2 = as.Date(data_2$Date)
dummy_FOMC_dates_OSEBX_sub2 = rep(0, N_OSEBX_sub2)

for (i in 1:205) {
        for (j in 1:1760) {
                if (FOMC_date[i] == Tot_days_OSEBX_sub2[j]) dummy_FOMC_dates_
OSEBX_sub2[j]=1
```

```
        }
}
sum(dummy_FOMC_dates_OSEBX_sub2)
```

```
## [1] 53
```

```
### PPI
dummy_PPI_dates_sub2 = rep(0, N_OSEBX_sub2)

for (i in 1:307) {
        for (j in 1:1760) {
                if (PPI_date[i] == Tot_days_OSEBX_sub2[j]) dummy_PPI_dates_su
b2[j]=1
        }
}
sum(dummy_PPI_dates_sub2)
```

```
## [1] 79
```

```
### Employment
dummy_emp_dates_sub2 = rep(0, N_OSEBX_sub2)

for (i in 1:316) {
        for (j in 1:1760) {
                if (Emp_date[i] == Tot_days_OSEBX_sub2[j]) dummy_emp_dates_su
b2[j]=1
        }
}
sum(dummy_emp_dates_sub2)
```

```
## [1] 83
```

```
#### Regression with separate announcements
OSEBX_sep_ann_sub2 = lm(data_2$log_ret ~ dummy_FOMC_dates_OSEBX_sub2 + dummy_
PPI_dates_sub2 + dummy_emp_dates_sub2, data = data_2)
summary(OSEBX_sep_ann_sub2)
```

```
##
## Call:
## lm(formula = data_2$log_ret ~ dummy_FOMC_dates_OSEBX_sub2 + dummy_PPI_date
s_sub2 +
##     dummy_emp_dates_sub2, data = data_2)
##
## Residuals:
##      Min       1Q   Median       3Q      Max
## -14.0548  -0.8935   0.1146   1.0549  13.5653
##
## Coefficients:
##                              Estimate Std. Error t value Pr(>|t|)
## (Intercept)                   0.05973    0.05552   1.076   0.2821
## dummy_FOMC_dates_OSEBX_sub2  0.57802    0.30502   1.895   0.0583 .
```

```
## dummy_PPI_dates_sub2        -0.07521    0.25186  -0.299   0.7653
## dummy_emp_dates_sub2         0.06256    0.24602   0.254   0.7993
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 2.184 on 1758 degrees of freedom
## Multiple R-squared:  0.00214,    Adjusted R-squared:  0.0004368
## F-statistic: 1.257 on 3 and 1758 DF,  p-value: 0.2878
```

```
coeftest(OSEBX_sep_ann_sub2, vcov. = NeweyWest(OSEBX_sep_ann_sub2, lag = 5, a
djust = FALSE,
                                               prewhite = FALSE))
```

```
##
## t test of coefficients:
##
##                               Estimate Std. Error t value Pr(>|t|)
## (Intercept)                   0.059725   0.056470  1.0577   0.2904
## dummy_FOMC_dates_OSEBX_sub2   0.578019   0.294455  1.9630   0.0498 *
## dummy_PPI_dates_sub2         -0.075206   0.273221 -0.2753   0.7832
## dummy_emp_dates_sub2          0.062558   0.250553  0.2497   0.8029
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

```
#### 2010-2016 ####

### FOMC
Tot_days_OSEBX_sub3 = as.Date(data_3$Date)
dummy_FOMC_dates_OSEBX_sub3 = rep(0, N_OSEBX_sub3)

for (i in 1:205) {
        for (j in 1:1759) {
                if (FOMC_date[i] == Tot_days_OSEBX_sub3[j]) dummy_FOMC_dates_
OSEBX_sub3[j]=1
        }
}
sum(dummy_FOMC_dates_OSEBX_sub3)
```

```
## [1] 52
```

```
### PPI
dummy_PPI_dates_sub3 = rep(0, N_OSEBX_sub3)

for (i in 1:307) {
        for (j in 1:1759) {
                if (PPI_date[i] == Tot_days_OSEBX_sub3[j]) dummy_PPI_dates_su
b3[j]=1
        }
}
sum(dummy_PPI_dates_sub3)
```

```
## [1] 79
```

```
### Employment
dummy_emp_dates_sub3 = rep(0, N_OSEBX_sub3)

for (i in 1:316) {
        for (j in 1:1759) {
                if (Emp_date[i] == Tot_days_OSEBX_sub3[j]) dummy_emp_dates_su
b3[j]=1
        }
}
sum(dummy_emp_dates_sub3)
```

```
## [1] 80
```

```
#### Regression with separate announcements
OSEBX_sep_ann_sub3 = lm(data_3$log_ret ~ dummy_FOMC_dates_OSEBX_sub3 + dummy_
PPI_dates_sub3 + dummy_emp_dates_sub3, data = data_3)
summary(OSEBX_sep_ann_sub3)
```

```
##
## Call:
## lm(formula = data_3$log_ret ~ dummy_FOMC_dates_OSEBX_sub3 + dummy_PPI_date
s_sub3 +
##     dummy_emp_dates_sub3, data = data_3)
##
## Residuals:
##     Min      1Q  Median      3Q     Max
## -7.8510 -0.8267  0.0602  0.8775  8.0305
##
## Coefficients:
##                              Estimate Std. Error t value Pr(>|t|)
## (Intercept)                   0.02152    0.04180   0.515    0.607
## dummy_FOMC_dates_OSEBX_sub3   0.05858    0.23188   0.253    0.801
## dummy_PPI_dates_sub3         -0.01251    0.18971  -0.066    0.947
## dummy_emp_dates_sub3         -0.23208    0.18858  -1.231    0.219
##
## Residual standard error: 1.645 on 1755 degrees of freedom
## Multiple R-squared:  0.0009143,  Adjusted R-squared:  -0.0007935
## F-statistic: 0.5354 on 3 and 1755 DF,  p-value: 0.6581
```

```
coeftest(OSEBX_sep_ann_sub3, vcov. = NeweyWest(OSEBX_sep_ann_sub3, lag = 5, a
djust = FALSE,
                                               prewhite = FALSE))
```

```
##
## t test of coefficients:
##
##                               Estimate Std. Error t value Pr(>|t|)
## (Intercept)                   0.021523   0.039926  0.5391   0.5899
## dummy_FOMC_dates_OSEBX_sub3   0.058581   0.188992  0.3100   0.7566
```

```
## dummy_PPI_dates_sub3         -0.012513   0.170957 -0.0732   0.9417
## dummy_emp_dates_sub3         -0.232081   0.183497 -1.2648   0.2061

#### 2017 - 2022 ####
### FOMC
Tot_days_OSEBX_sub4 = as.Date(data_4$Date)
dummy_FOMC_dates_OSEBX_sub4 = rep(0, N_OSEBX_sub4)

for (i in 1:205) {
        for (j in 1:1518) {
                if (FOMC_date[i] == Tot_days_OSEBX_sub4[j]) dummy_FOMC_dates_
OSEBX_sub4[j]=1
        }
}
sum(dummy_FOMC_dates_OSEBX_sub4)

## [1] 45

### PPI
dummy_PPI_dates_sub4 = rep(0, N_OSEBX_sub4)

for (i in 1:307) {
        for (j in 1:1518) {
                if (PPI_date[i] == Tot_days_OSEBX_sub4[j]) dummy_PPI_dates_su
b4[j]=1
        }
}
sum(dummy_PPI_dates_sub4)

## [1] 69

### Employment
dummy_emp_dates_sub4 = rep(0, N_OSEBX_sub4)

for (i in 1:316) {
        for (j in 1:1518) {
                if (Emp_date[i] == Tot_days_OSEBX_sub4[j]) dummy_emp_dates_su
b4[j]=1
        }
}
sum(dummy_emp_dates_sub4)

## [1] 71

#### Regression with separate announcements
OSEBX_sep_ann_sub4 = lm(data_4$log_ret ~ dummy_FOMC_dates_OSEBX_sub4 + dummy_
PPI_dates_sub4 + dummy_emp_dates_sub4, data = data_4)
summary(OSEBX_sep_ann_sub4)

##
## Call:
```

```
## lm(formula = data_4$log_ret ~ dummy_FOMC_dates_OSEBX_sub4 + dummy_PPI_date
s_sub4 +
##     dummy_emp_dates_sub4, data = data_4)
##
## Residuals:
##      Min       1Q   Median       3Q      Max
## -14.1522  -0.8108   0.0419   0.8274   6.8739
##
## Coefficients:
##                              Estimate Std. Error t value Pr(>|t|)
## (Intercept)                   0.02509    0.04220   0.595   0.5522
## dummy_FOMC_dates_OSEBX_sub4  0.50774    0.23353   2.174   0.0298 *
## dummy_PPI_dates_sub4        -0.44215    0.19023  -2.324   0.0202 *
## dummy_emp_dates_sub4         0.16795    0.18766   0.895   0.3709
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 1.541 on 1514 degrees of freedom
## Multiple R-squared:  0.007478,   Adjusted R-squared:  0.005512
## F-statistic: 3.803 on 3 and 1514 DF,  p-value: 0.009891

coeftest(OSEBX_sep_ann_sub4, vcov. = NeweyWest(OSEBX_sep_ann_sub4, lag = 5, a
djust = FALSE,
                                               prewhite = FALSE))

##
## t test of coefficients:
##
##                              Estimate Std. Error t value Pr(>|t|)
## (Intercept)                  0.025092   0.042717  0.5874 0.557024
## dummy_FOMC_dates_OSEBX_sub4  0.507743   0.186948  2.7160 0.006684 **
## dummy_PPI_dates_sub4        -0.442148   0.255970 -1.7273 0.084310 .
## dummy_emp_dates_sub4         0.167951   0.168077  0.9992 0.317833
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

###### S&P ######
#### 1996-2002 ####

### FOMC
Tot_days_SPX_sub1 = as.Date(data_1_SPX$Date)

dummy_FOMC_dates_SPX_sub1 = rep(0, N_SPX_sub1)

for (i in 1:207) {
        for (j in 1:1762) {
                if (FOMC_date_SPX[i] == Tot_days_SPX_sub1[j]) dummy_FOMC_date
s_SPX_sub1[j]=1
        }
```

```
}
sum(dummy_FOMC_dates_SPX_sub1)
```

```
## [1] 55
```

```
### PPI
dummy_PPI_dates_SPX_sub1 = rep(0, N_SPX_sub1)

for (i in 1:313) {
        for (j in 1:1762) {
                if (PPI_date_SPX[i] == Tot_days_SPX_sub1[j]) dummy_PPI_dates_
SPX_sub1[j]=1
        }
}
sum(dummy_PPI_dates_SPX_sub1)
```

```
## [1] 82
```

```
### Employment
dummy_emp_dates_SPX_sub1 = rep(0, N_SPX_sub1)

for (i in 1:316) {
        for (j in 1:1762) {
                if (Emp_date_SPX[i] == Tot_days_SPX_sub1[j]) dummy_emp_dates_
SPX_sub1[j]=1
        }
}
sum(dummy_emp_dates_SPX_sub1)
```

```
## [1] 82
```

```
#### Regression with separate announcements
SPX_sep_ann_sub1 = lm(data_1_SPX$log_ret ~ dummy_FOMC_dates_SPX_sub1 + dummy_
PPI_dates_SPX_sub1 + dummy_emp_dates_SPX_sub1, data = data_1_SPX)
summary(SPX_sep_ann_sub1)
```

```
##
## Call:
## lm(formula = data_1_SPX$log_ret ~ dummy_FOMC_dates_SPX_sub1 +
##     dummy_PPI_dates_SPX_sub1 + dummy_emp_dates_SPX_sub1, data = data_1_SPX
)
##
## Residuals:
##     Min      1Q  Median      3Q     Max
## -7.1023 -0.6673  0.0118  0.7181  5.5837
##
## Coefficients:
##                            Estimate Std. Error t value Pr(>|t|)
## (Intercept)                -0.01041    0.03227  -0.323   0.7470
## dummy_FOMC_dates_SPX_sub1   0.20639    0.17394   1.187   0.2356
## dummy_PPI_dates_SPX_sub1    0.22318    0.14365   1.554   0.1205
```

```
## dummy_emp_dates_SPX_sub1   0.28754    0.14365   2.002   0.0455 *
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 1.268 on 1758 degrees of freedom
## Multiple R-squared:  0.00409,    Adjusted R-squared:  0.00239
## F-statistic: 2.406 on 3 and 1758 DF,  p-value: 0.06561
```

```
coeftest(SPX_sep_ann_sub1, vcov. = NeweyWest(SPX_sep_ann_sub1, lag = 5, adjus
t = FALSE,
                                             prewhite = FALSE))
```

```
##
## t test of coefficients:
##
##                             Estimate Std. Error t value Pr(>|t|)
## (Intercept)                -0.010414   0.029888 -0.3484  0.72756
## dummy_FOMC_dates_SPX_sub1   0.206392   0.141523  1.4584  0.14492
## dummy_PPI_dates_SPX_sub1    0.223184   0.153291  1.4560  0.14558
## dummy_emp_dates_SPX_sub1    0.287543   0.169074  1.7007  0.08918 .
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

```
#### 2003-2009 ####
### FOMC
Tot_days_SPX_sub2 = as.Date(data_2_SPX$Date)

dummy_FOMC_dates_SPX_sub2 = rep(0, N_SPX_sub2)

for (i in 1:207) {
        for (j in 1:1763) {
                if (FOMC_date_SPX[i] == Tot_days_SPX_sub2[j]) dummy_FOMC_date
s_SPX_sub2[j]=1
        }
}
sum(dummy_FOMC_dates_SPX_sub2)
```

```
## [1] 53
```

```
### PPI
dummy_PPI_dates_SPX_sub2 = rep(0, N_SPX_sub2)

for (i in 1:313) {
        for (j in 1:1763) {
                if (PPI_date_SPX[i] == Tot_days_SPX_sub2[j]) dummy_PPI_dates_
SPX_sub2[j]=1
        }
}
sum(dummy_PPI_dates_SPX_sub2)
```

```
## [1] 80
```

```r
### Employment
dummy_emp_dates_SPX_sub2 = rep(0, N_SPX_sub2)

for (i in 1:316) {
        for (j in 1:1763) {
                if (Emp_date_SPX[i] == Tot_days_SPX_sub2[j]) dummy_emp_dates_
SPX_sub2[j]=1
        }
}
sum(dummy_emp_dates_SPX_sub2)

## [1] 83

#### Regression with separate announcements
SPX_sep_ann_sub2 = lm(data_2_SPX$log_ret ~ dummy_FOMC_dates_SPX_sub2 + dummy_
PPI_dates_SPX_sub2 + dummy_emp_dates_SPX_sub2, data = data_2_SPX)
summary(SPX_sep_ann_sub2)

##
## Call:
## lm(formula = data_2_SPX$log_ret ~ dummy_FOMC_dates_SPX_sub2 +
##     dummy_PPI_dates_SPX_sub2 + dummy_emp_dates_SPX_sub2, data = data_2_SPX
)
##
## Residuals:
##     Min      1Q  Median      3Q     Max
## -9.3588 -0.5435  0.0744  0.5660 10.9522
##
## Coefficients:
##                             Estimate Std. Error t value Pr(>|t|)
## (Intercept)                 0.004956   0.034799   0.142   0.8868
## dummy_FOMC_dates_SPX_sub2   0.479500   0.191201   2.508   0.0122 *
## dummy_PPI_dates_SPX_sub2   -0.115719   0.156934  -0.737   0.4610
## dummy_emp_dates_SPX_sub2   -0.014393   0.154214  -0.093   0.9257
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 1.369 on 1759 degrees of freedom
## Multiple R-squared:  0.003974,   Adjusted R-squared:  0.002275
## F-statistic: 2.339 on 3 and 1759 DF,  p-value: 0.07171

coeftest(SPX_sep_ann_sub2, vcov. = NeweyWest(SPX_sep_ann_sub2, lag = 5, adjus
t = FALSE,
                                             prewhite = FALSE))

##
## t test of coefficients:
##
##                              Estimate Std. Error t value Pr(>|t|)
## (Intercept)                 0.0049557  0.0309518  0.1601  0.87281
## dummy_FOMC_dates_SPX_sub2   0.4794999  0.1760809  2.7232  0.00653 **
```

```
## dummy_PPI_dates_SPX_sub2  -0.1157191  0.1591923 -0.7269  0.46738
## dummy_emp_dates_SPX_sub2  -0.0143926  0.1314252 -0.1095  0.91281
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

```
#### 2010-2016 ####
### FOMC
Tot_days_SPX_sub3 = as.Date(data_3_SPX$Date)

dummy_FOMC_dates_SPX_sub3 = rep(0, N_SPX_sub3)

for (i in 1:207) {
        for (j in 1:1762) {
                if (FOMC_date_SPX[i] == Tot_days_SPX_sub3[j]) dummy_FOMC_date
s_SPX_sub3[j]=1
        }
}
sum(dummy_FOMC_dates_SPX_sub3)
```

```
## [1] 53
```

```
### PPI
dummy_PPI_dates_SPX_sub3 = rep(0, N_SPX_sub3)

for (i in 1:313) {
        for (j in 1:1762) {
                if (PPI_date_SPX[i] == Tot_days_SPX_sub3[j]) dummy_PPI_dates_
SPX_sub3[j]=1
        }
}
sum(dummy_PPI_dates_SPX_sub3)
```

```
## [1] 80
```

```
### Employment
dummy_emp_dates_SPX_sub3 = rep(0, N_SPX_sub3)

for (i in 1:316) {
        for (j in 1:1762) {
                if (Emp_date_SPX[i] == Tot_days_SPX_sub3[j]) dummy_emp_dates_
SPX_sub3[j]=1
        }
}
sum(dummy_emp_dates_SPX_sub3)
```

```
## [1] 80
```

```
#### Regression with separate announcements
SPX_sep_ann_sub3 = lm(data_3_SPX$log_ret ~ dummy_FOMC_dates_SPX_sub3 + dummy_
PPI_dates_SPX_sub3 + dummy_emp_dates_SPX_sub3, data = data_3_SPX)
summary(SPX_sep_ann_sub3)
```

```
##
## Call:
## lm(formula = data_3_SPX$log_ret ~ dummy_FOMC_dates_SPX_sub3 +
##     dummy_PPI_dates_SPX_sub3 + dummy_emp_dates_SPX_sub3, data = data_3_SPX
)
##
## Residuals:
##     Min      1Q  Median      3Q     Max
## -6.9343 -0.4381  0.0157  0.4879  4.4866
##
## Coefficients:
##                             Estimate Std. Error t value Pr(>|t|)
## (Intercept)                  0.03848    0.02492   1.544    0.123
## dummy_FOMC_dates_SPX_sub3  0.14406    0.13703   1.051    0.293
## dummy_PPI_dates_SPX_sub3   -0.04560    0.11247  -0.405    0.685
## dummy_emp_dates_SPX_sub3   -0.02609    0.11247  -0.232    0.817
##
## Residual standard error: 0.9809 on 1758 degrees of freedom
## Multiple R-squared:  0.000779,   Adjusted R-squared:  -0.0009262
## F-statistic: 0.4568 on 3 and 1758 DF,  p-value: 0.7125

coeftest(SPX_sep_ann_sub3, vcov. = NeweyWest(SPX_sep_ann_sub3, lag = 5, adjus
t = FALSE,
                                             prewhite = FALSE))

##
## t test of coefficients:
##
##                              Estimate Std. Error t value Pr(>|t|)
## (Intercept)                 0.038479   0.023443  1.6414   0.1009
## dummy_FOMC_dates_SPX_sub3  0.144065   0.159418  0.9037   0.3663
## dummy_PPI_dates_SPX_sub3   -0.045596   0.100197 -0.4551   0.6491
## dummy_emp_dates_SPX_sub3   -0.026088   0.114267 -0.2283   0.8194

#### 2017-2022 ####
### FOMC
Tot_days_SPX_sub4 = as.Date(data_4_SPX$Date)

dummy_FOMC_dates_SPX_sub4 = rep(0, N_SPX_sub4)

for (i in 1:207) {
        for (j in 1:1510) {
                if (FOMC_date_SPX[i] == Tot_days_SPX_sub4[j]) dummy_FOMC_date
s_SPX_sub4[j]=1
        }
}
sum(dummy_FOMC_dates_SPX_sub4)

## [1] 46
```

```r
### PPI
dummy_PPI_dates_SPX_sub4 = rep(0, N_SPX_sub4)

for (i in 1:313) {
        for (j in 1:1510) {
                if (PPI_date_SPX[i] == Tot_days_SPX_sub4[j]) dummy_PPI_dates_
SPX_sub4[j]=1
        }
}
sum(dummy_PPI_dates_SPX_sub4)
```

```
## [1] 71
```

```r
### Employment
dummy_emp_dates_SPX_sub4 = rep(0, N_SPX_sub4)

for (i in 1:316) {
        for (j in 1:1510) {
                if (Emp_date_SPX[i] == Tot_days_SPX_sub4[j]) dummy_emp_dates_
SPX_sub4[j]=1
        }
}
sum(dummy_emp_dates_SPX_sub4)
```

```
## [1] 71
```

```r
#### Regression with separate announcements
SPX_sep_ann_sub4 = lm(data_4_SPX$log_ret ~ dummy_FOMC_dates_SPX_sub4 + dummy_
PPI_dates_SPX_sub4 + dummy_emp_dates_SPX_sub4, data = data_4_SPX)
summary(SPX_sep_ann_sub4)
```

```
##
## Call:
## lm(formula = data_4_SPX$log_ret ~ dummy_FOMC_dates_SPX_sub4 +
##     dummy_PPI_dates_SPX_sub4 + dummy_emp_dates_SPX_sub4, data = data_4_SPX
)
##
## Residuals:
##      Min       1Q   Median       3Q      Max
## -12.8066  -0.4228   0.0381   0.5784   8.9269
##
## Coefficients:
##                             Estimate Std. Error t value Pr(>|t|)
## (Intercept)                  0.04140    0.03506   1.181    0.238
## dummy_FOMC_dates_SPX_sub4    0.06153    0.19117   0.322    0.748
## dummy_PPI_dates_SPX_sub4    -0.24574    0.15527  -1.583    0.114
## dummy_emp_dates_SPX_sub4     0.08511    0.15527   0.548    0.584
##
## Residual standard error: 1.275 on 1506 degrees of freedom
## Multiple R-squared:  0.00201,    Adjusted R-squared:  2.188e-05
## F-statistic: 1.011 on 3 and 1506 DF,  p-value: 0.3869
```

```
coeftest(SPX_sep_ann_sub4, vcov. = NeweyWest(SPX_sep_ann_sub4, lag = 5, adjus
t = FALSE,
                                             prewhite = FALSE))

##
## t test of coefficients:
##
##                             Estimate Std. Error t value Pr(>|t|)
## (Intercept)                 0.041399   0.029641  1.3967   0.1627
## dummy_FOMC_dates_SPX_sub4   0.061534   0.186566  0.3298   0.7416
## dummy_PPI_dates_SPX_sub4   -0.245737   0.195132 -1.2593   0.2081
## dummy_emp_dates_SPX_sub4    0.085112   0.129989  0.6548   0.5127
```

```
############## Remove outliers ##############
###### All announcements combined ######
#### OSEBX ####

OSEBX_quant = quantile(OSEBX_new$log_ret, c(0.01, 0.99))
OSEBX_quant
```

```
##        1%       99%
## -5.166839  4.340772
```

```
OSEBX_out_rmd = OSEBX_new[OSEBX_new$log_ret > OSEBX_quant[1] &
                            OSEBX_new$log_ret < OSEBX_quant[2], ]
##Number of data removed from the OSEBX sample
count(OSEBX_new) - count(OSEBX_out_rmd)
```

```
##     n
## 1 136
```

```
N_OSEBX_out_rmd = count(OSEBX_out_rmd)
## All announcements combined

## Announcements
Tot_days_OSEBX_out_rmd = as.Date(OSEBX_out_rmd$Date)

dummy_A_dates_OSEBX_out_rmd = rep(0, N_OSEBX_out_rmd)

for (i in 1:828) {
        for (j in 1:6652) {
                if (A_dates[i] == Tot_days_OSEBX_out_rmd[j]) dummy_A_dates_OS
EBX_out_rmd[j]=1
        }
}
sum(dummy_A_dates_OSEBX_out_rmd)
```

```
## [1] 812
```

```
announce_out_rmd = OSEBX_out_rmd$log_ret * dummy_A_dates_OSEBX_out_rmd
```

```
announce_out_rmd[announce_out_rmd == 0] = NA



mean(announce_out_rmd, na.rm = TRUE)
```

```
## [1] 0.07735454
```

```
t.test(announce_out_rmd, mu=0)
```

```
##
##  One Sample t-test
##
## data:  announce_out_rmd
## t = 1.5724, df = 811, p-value = 0.1163
## alternative hypothesis: true mean is not equal to 0
## 95 percent confidence interval:
##  -0.01921144  0.17392052
## sample estimates:
##  mean of x
## 0.07735454
```

```
## Nonannouncement
dummy_na_dates_OSEBX_out_rmd = rep(1, N_OSEBX_out_rmd)

for (i in 1:828) {
        for (j in 1:6652) {
                if (A_dates[i] == Tot_days_OSEBX_out_rmd[j]) dummy_na_dates_O
SEBX_out_rmd[j]=0
        }
}
sum(dummy_na_dates_OSEBX_out_rmd)
```

```
## [1] 5849
```

```
nonannounce_out_rmd = OSEBX_out_rmd$log_ret * dummy_na_dates_OSEBX_out_rmd

nonannounce_out_rmd[nonannounce_out_rmd == 0] = NA



mean(nonannounce_out_rmd, na.rm = TRUE)
```

```
## [1] 0.03898405
```

```
t.test(nonannounce_out_rmd, mu=0)
```

```
##
##  One Sample t-test
##
## data:  nonannounce_out_rmd
```

```
## t = 2.0964, df = 5839, p-value = 0.03609
## alternative hypothesis: true mean is not equal to 0
## 95 percent confidence interval:
##  0.002529432 0.075438660
## sample estimates:
##  mean of x
## 0.03898405

t.test(announce_out_rmd, nonannounce_out_rmd, var.equal = FALSE)

##
##  Welch Two Sample t-test
##
## data:  announce_out_rmd and nonannounce_out_rmd
## t = 0.72957, df = 1056.3, p-value = 0.4658
## alternative hypothesis: true difference in means is not equal to 0
## 95 percent confidence interval:
##  -0.06482813  0.14156912
## sample estimates:
##  mean of x  mean of y
## 0.07735454 0.03898405

#### S&P ####
SPX_quant = quantile(SPX_new$log_ret, c(0.01, 0.99))
SPX_quant

##        1%       99%
## -3.455939  3.349200

SPX_out_rmd = SPX_new[SPX_new$log_ret > SPX_quant[1] &
                          SPX_new$log_ret < SPX_quant[2], ]
## Number of data removed from the SPX sample
count(SPX_new) - count(SPX_out_rmd)

##     n
## 1 136

N_SPX_out_rmd = count(SPX_out_rmd)

## Announcements
Tot_days_SPX_out_rmd = as.Date(SPX_out_rmd$Date)


dummy_A_dates_SPX_out_rmd = rep(0, N_SPX_out_rmd)

for (i in 1:836) {
        for (j in 1:6661) {
                if (A_dates_SPX[i] == Tot_days_SPX_out_rmd[j]) dummy_A_dates_
SPX_out_rmd[j]=1
        }
```

```
}
sum(dummy_A_dates_SPX_out_rmd)

## [1] 824

announce_SPX_out_rmd = SPX_out_rmd$log_ret * dummy_A_dates_SPX_out_rmd

announce_SPX_out_rmd[announce_SPX_out_rmd == 0] = NA


mean(announce_SPX_out_rmd, na.rm = TRUE)

## [1] 0.08621616

t.test(announce_SPX_out_rmd, mu=0)

##
##  One Sample t-test
##
## data:  announce_SPX_out_rmd
## t = 2.3113, df = 823, p-value = 0.02107
## alternative hypothesis: true mean is not equal to 0
## 95 percent confidence interval:
##  0.01299638 0.15943594
## sample estimates:
##  mean of x
## 0.08621616

## Nonannouncement
dummy_na_dates_SPX_out_rmd = rep(1, N_SPX_out_rmd)

for (i in 1:836) {
        for (j in 1:6661) {
                if (A_dates_SPX[i] == Tot_days_SPX_out_rmd[j]) dummy_na_dates
_SPX_out_rmd[j]=0
        }
}
sum(dummy_na_dates_SPX_out_rmd)

## [1] 5837

nonannounce_SPX_out_rmd = SPX_out_rmd$log_ret * dummy_na_dates_SPX_out_rmd

nonannounce_SPX_out_rmd[nonannounce_SPX_out_rmd == 0] = NA


mean(nonannounce_SPX_out_rmd, na.rm = TRUE)

## [1] 0.02326152

t.test(nonannounce_SPX_out_rmd, mu=0)
```

```
##
##  One Sample t-test
##
## data:  nonannounce_SPX_out_rmd
## t = 1.7986, df = 5833, p-value = 0.07214
## alternative hypothesis: true mean is not equal to 0
## 95 percent confidence interval:
##  -0.002092512  0.048615555
## sample estimates:
##  mean of x
## 0.02326152
```

```
t.test(announce_SPX_out_rmd, nonannounce_SPX_out_rmd, mu=0)
```

```
##
##  Welch Two Sample t-test
##
## data:  announce_SPX_out_rmd and nonannounce_SPX_out_rmd
## t = 1.5945, df = 1030.7, p-value = 0.1111
## alternative hypothesis: true difference in means is not equal to 0
## 95 percent confidence interval:
##  -0.01451812  0.14042740
## sample estimates:
##  mean of x  mean of y
## 0.08621616 0.02326152
```

```
###### Different announcement effect ######
#### OSEBX ####
# FOMC on OSEBX
Tot_days_OSEBX_out_rmd = as.Date(OSEBX_out_rmd$Date)

dummy_FOMC_dates_OSEBX_out_rmd = rep(0, N_OSEBX_out_rmd)

for (i in 1:200) {
        for (j in 1:6652) {
                if (FOMC_date[i] == Tot_days_OSEBX_out_rmd[j]) dummy_FOMC_dat
es_OSEBX_out_rmd[j]=1
        }
}
sum(dummy_FOMC_dates_OSEBX_out_rmd)
```

```
## [1] 195
```

```
#PPI on OSEBX
dummy_PPI_dates_out_rmd = rep(0, N_OSEBX_out_rmd)

for (i in 1:299) {
        for (j in 1:6652) {
                if (PPI_date[i] == Tot_days_OSEBX_out_rmd[j]) dummy_PPI_dates
_out_rmd[j]=1
        }
```

```
}
sum(dummy_PPI_dates_out_rmd)
```

```
## [1] 291
```

```
#Employment on OSEBX
dummy_emp_dates_out_rmd = rep(0, N_OSEBX_out_rmd)

for (i in 1:313) {
        for (j in 1:6652) {
                if (Emp_date[i] == Tot_days_OSEBX_out_rmd[j]) dummy_emp_dates
_out_rmd[j]=1
        }
}
sum(dummy_emp_dates_out_rmd)
```

```
## [1] 310
```

```
#### Regression with separate announcements
OSEBX_sep_ann_out_rmd = lm(OSEBX_out_rmd$log_ret ~ dummy_FOMC_dates_OSEBX_out
_rmd + dummy_PPI_dates_out_rmd + dummy_emp_dates_out_rmd, data = OSEBX_out_rm
d)
summary(OSEBX_sep_ann_out_rmd)
```

```
##
## Call:
## lm(formula = OSEBX_out_rmd$log_ret ~ dummy_FOMC_dates_OSEBX_out_rmd +
##     dummy_PPI_dates_out_rmd + dummy_emp_dates_out_rmd, data = OSEBX_out_rm
d)
##
## Residuals:
##     Min      1Q  Median      3Q     Max
## -5.2009 -0.7693  0.0368  0.8381  4.2861
##
## Coefficients:
##                                Estimate Std. Error t value Pr(>|t|)
## (Intercept)                     0.03849    0.01851   2.079   0.0376 *
## dummy_FOMC_dates_OSEBX_out_rmd  0.18054    0.10320   1.749   0.0803 .
## dummy_PPI_dates_out_rmd        -0.04967    0.08514  -0.583   0.5596
## dummy_emp_dates_out_rmd         0.04306    0.08262   0.521   0.6023
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 1.418 on 6657 degrees of freedom
## Multiple R-squared:  0.0005583,  Adjusted R-squared:  0.0001079
## F-statistic:  1.24 on 3 and 6657 DF,  p-value: 0.2936
```

```
coeftest(OSEBX_sep_ann_out_rmd, vcov. = NeweyWest(OSEBX_sep_ann_out_rmd, lag
= 5, adjust = FALSE,
                                          prewhite = FALSE))
```

```
##
## t test of coefficients:
##
##                                  Estimate Std. Error t value Pr(>|t|)
## (Intercept)                      0.038490   0.018320  2.1010  0.03568 *
## dummy_FOMC_dates_OSEBX_out_rmd   0.180537   0.093176  1.9376  0.05272 .
## dummy_PPI_dates_out_rmd         -0.049673   0.078961 -0.6291  0.52932
## dummy_emp_dates_out_rmd          0.043059   0.087769  0.4906  0.62373
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

```
#### S&P ####
Tot_days_SPX_out_rmd = as.Date(SPX_out_rmd$Date)

dummy_FOMC_dates_SPX_out_rmd = rep(0, N_SPX_out_rmd)

for (i in 1:203) {
        for (j in 1:6661) {
                if (FOMC_date_SPX[i] == Tot_days_SPX_out_rmd[j]) dummy_FOMC_d
ates_SPX_out_rmd[j]=1
        }
}
sum(dummy_FOMC_dates_SPX_out_rmd)
```

```
## [1] 201
```

```
#PPI on S&P
dummy_PPI_dates_SPX_out_rmd = rep(0, N_SPX_out_rmd)

for (i in 1:299) {
        for (j in 1:6661) {
                if (PPI_date_SPX[i] == Tot_days_SPX_out_rmd[j]) dummy_PPI_dat
es_SPX_out_rmd[j]=1
        }
}
sum(dummy_PPI_dates_SPX_out_rmd)
```

```
## [1] 293
```

```
#Employment on S&P
dummy_emp_dates_SPX_out_rmd = rep(0, N_SPX_out_rmd)

for (i in 1:312) {
        for (j in 1:6661) {
                if (Emp_date_SPX[i] == Tot_days_SPX_out_rmd[j]) dummy_emp_dat
es_SPX_out_rmd[j]=1
        }
}
sum(dummy_emp_dates_SPX_out_rmd)
```

```
## [1] 308
```

```r
#### Regression with separate announcements
SPX_sep_ann_out_rmd = lm(SPX_out_rmd$log_ret ~ dummy_FOMC_dates_SPX_out_rmd +
dummy_PPI_dates_SPX_out_rmd + dummy_emp_dates_SPX_out_rmd, data = SPX_out_rmd
)
summary(SPX_sep_ann_out_rmd)

##
## Call:
## lm(formula = SPX_out_rmd$log_ret ~ dummy_FOMC_dates_SPX_out_rmd +
##     dummy_PPI_dates_SPX_out_rmd + dummy_emp_dates_SPX_out_rmd,
##     data = SPX_out_rmd)
##
## Residuals:
##     Min      1Q  Median      3Q     Max
## -3.4775 -0.5104  0.0336  0.5628  3.3266
##
## Coefficients:
##                               Estimate Std. Error t value Pr(>|t|)
## (Intercept)                   0.022316   0.013038   1.712  0.08701 .
## dummy_FOMC_dates_SPX_out_rmd  0.194142   0.071590   2.712  0.00671 **
## dummy_PPI_dates_SPX_out_rmd  -0.005403   0.059743  -0.090  0.92795
## dummy_emp_dates_SPX_out_rmd   0.067084   0.058341   1.150  0.25024
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 0.998 on 6657 degrees of freedom
## Multiple R-squared:  0.001275,   Adjusted R-squared:  0.0008248
## F-statistic: 2.833 on 3 and 6657 DF,  p-value: 0.03685

coeftest(SPX_sep_ann_out_rmd, vcov. = NeweyWest(SPX_sep_ann_out_rmd, lag = 5,
adjust = FALSE,
                                        prewhite = FALSE))

##
## t test of coefficients:
##
##                                Estimate Std. Error t value Pr(>|t|)
## (Intercept)                   0.0223162  0.0123762  1.8032 0.071410 .
## dummy_FOMC_dates_SPX_out_rmd  0.1941418  0.0749512  2.5902 0.009612 **
## dummy_PPI_dates_SPX_out_rmd  -0.0054026  0.0582375 -0.0928 0.926090
## dummy_emp_dates_SPX_out_rmd   0.0670842  0.0659639  1.0170 0.309198
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

######################## Weekday effects ##########################

### OSEBX
D_mon_out_rmd = ifelse(OSEBX_out_rmd$Weekday == "Mon", 1, 0)
D_tue_out_rmd = ifelse(OSEBX_out_rmd$Weekday == "Tue", 1, 0)
D_wed_out_rmd = ifelse(OSEBX_out_rmd$Weekday == "Wed", 1, 0)
D_thu_out_rmd = ifelse(OSEBX_out_rmd$Weekday == "Thu", 1, 0)
```

```r
D_fri_out_rmd = ifelse(OSEBX_out_rmd$Weekday == "Fri", 1, 0)



model_week_an_out_rmd = lm(OSEBX_out_rmd$log_ret ~ dummy_A_dates_OSEBX_out_rm
d + D_mon_out_rmd + D_tue_out_rmd + D_wed_out_rmd + D_thu_out_rmd + D_fri_out
_rmd, data=OSEBX_out_rmd)
summary(model_week_an_out_rmd)

##
## Call:
## lm(formula = OSEBX_out_rmd$log_ret ~ dummy_A_dates_OSEBX_out_rmd +
##     D_mon_out_rmd + D_tue_out_rmd + D_wed_out_rmd + D_thu_out_rmd +
##     D_fri_out_rmd, data = OSEBX_out_rmd)
##
## Residuals:
##     Min      1Q  Median      3Q     Max
## -4.9046 -0.5912  0.0502  0.7138  3.7570
##
## Coefficients: (1 not defined because of singularities)
##                              Estimate Std. Error t value Pr(>|t|)
## (Intercept)                   0.07761    0.05846   1.328   0.1847
## dummy_A_dates_OSEBX_out_rmd  0.04672    0.12203   0.383   0.7019
## D_mon_out_rmd                 0.24367    1.14613   0.213   0.8317
## D_tue_out_rmd                -0.20076    0.11288  -1.779   0.0757 .
## D_wed_out_rmd                -0.18833    0.10259  -1.836   0.0668 .
## D_thu_out_rmd                 0.03719    0.13518   0.275   0.7833
## D_fri_out_rmd                      NA         NA      NA       NA
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 1.145 on 808 degrees of freedom
##   (5847 observations deleted due to missingness)
## Multiple R-squared:  0.007554,   Adjusted R-squared:  0.001412
## F-statistic:  1.23 on 5 and 808 DF,  p-value: 0.293
```

S&P 500

```r
D_mon_SPX_out_rmd = ifelse(SPX_out_rmd$Weekday == "Mon", 1, 0)
D_tue_SPX_out_rmd = ifelse(SPX_out_rmd$Weekday == "Tue", 1, 0)
D_wed_SPX_out_rmd = ifelse(SPX_out_rmd$Weekday == "Wed", 1, 0)
D_thu_SPX_out_rmd = ifelse(SPX_out_rmd$Weekday == "Thu", 1, 0)
D_fri_SPX_out_rmd = ifelse(SPX_out_rmd$Weekday == "Fri", 1, 0)



model_week_an_SPX_out_rmd = lm(SPX_out_rmd$log_ret ~ dummy_A_dates_SPX_out_rm
d + D_mon_SPX_out_rmd + D_tue_SPX_out_rmd + D_wed_SPX_out_rmd + D_thu_SPX_out
_rmd + D_fri_SPX_out_rmd, data = SPX_out_rmd)
summary(model_week_an_SPX_out_rmd)
```

```
##
## Call:
## lm(formula = SPX_out_rmd$log_ret ~ dummy_A_dates_SPX_out_rmd +
##     D_mon_SPX_out_rmd + D_tue_SPX_out_rmd + D_wed_SPX_out_rmd +
##     D_thu_SPX_out_rmd + D_fri_SPX_out_rmd, data = SPX_out_rmd)
##
## Residuals:
##     Min      1Q  Median      3Q     Max
## -3.3583 -0.5497  0.0164  0.6098  2.9756
##
## Coefficients: (1 not defined because of singularities)
##                            Estimate Std. Error t value Pr(>|t|)
## (Intercept)                 0.10178    0.05008   2.033   0.0424 *
## dummy_A_dates_SPX_out_rmd  0.20809    0.10359   2.009   0.0449 *
## D_mon_SPX_out_rmd           0.31964    0.97543   0.328   0.7432
## D_tue_SPX_out_rmd          -0.02307    0.09490  -0.243   0.8080
## D_wed_SPX_out_rmd          -0.08642    0.08677  -0.996   0.3195
## D_thu_SPX_out_rmd          -0.08279    0.11249  -0.736   0.4619
## D_fri_SPX_out_rmd                NA         NA      NA       NA
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 0.9741 on 821 degrees of freedom
##   (5834 observations deleted due to missingness)
## Multiple R-squared:  0.006707,   Adjusted R-squared:  0.0006574
## F-statistic: 1.109 on 5 and 821 DF,  p-value: 0.3541
```