Seasonality at the Oslo Stock Exchange

Exercise

January Effect OSE - R

The *January effect* in financial markets can very summarized as:
The stock return in the month of january is higher than that in other months.
Using the monthly returns on an index for the Norwegian market, test whether January returns are different.
Do the analysis using R.

Solution

January Effect OSE - R

This can be formulated as a regression.

$$r_{ew,t} = \mu + \alpha_{jan} 1_{jan,t} + \varepsilon_t$$

where $1_{jan,t}$ is a dummy variable equal to one if the month is january.

The proposed test is to test whether $\alpha_{jan} = 0$

In R it is simplest to just read in the dates and observations, and figure out the month from the date

```
library(zoo)
Rm <- read.zoo("../stock_market_data/market_portfolio_returns_mo
                          header=TRUE,sep=";",format="%Y%m%d")
dates  <-  as.POSIXlt(index(Rm))
jan <- as.numeric(dates$mon==0)
reg1 <- lm(Rm$EW~jan)
summary(reg1)
```

results in

```
lm(formula = Rm$EW ~ jan)

Residuals:
      Min         1Q    Median         3Q        Max
-0.197261 -0.036369  0.003344  0.033067  0.140390

Coefficients:
            Estimate Std. Error t value Pr(>|t|)
(Intercept) 0.013987   0.003066   4.562 6.91e-06 ***
jan         0.047600   0.010622   4.481 9.90e-06 ***

Residual standard error: 0.05662 on 370 degrees of freedom
Multiple R-squared: 0.05148,Adjusted R-squared: 0.04892
F-statistic: 20.08 on 1 and 370 DF,  p-value: 9.905e-06
```

Here look either at the coefficient on jan, or the F statistic, both give the same answer, january is different.

Exercise: *Day of Week Effect OSE - R* [5]
In finance one has identified various "calendar anomalies", that stock returns depend on calendar time. One of these is the "Day of the week effect," that stock returns seem to be different across days of the week.
Using returns for a market index for the Norwegian stock market, test the hypothesis that the expected return is different across days of the week.
In implementing this use indicator variables in a regression framework.

Solution *Day of Week Effect OSE - R* [5]
Using R we create indicator variables using the date library zoo

```
> library(zoo)
> Rm <- read.zoo("../../../data/norway/stock_market_indices/mark
> dates  <-  as.POSIXlt(index(Rm))
> mon <- as.numeric(dates$wday==1)
> tue <- as.numeric(dates$wday==2)
> wed <- as.numeric(dates$wday==3)
> thu <- as.numeric(dates$wday==4)
> fri <- as.numeric(dates$wday==5)
```

This can be formulated (at least) two ways. One is a regression on the five dummies, without a constant

```
> reg1 <- lm(Rm$EW~0+mon+tue+wed+thu+fri)

Residuals:
      Min         1Q    Median         3Q        Max
-0.147359 -0.004338  0.000312  0.004559  0.114473

Coefficients:
     Estimate Std. Error t value Pr(>|t|)
mon 0.0007726  0.0002436   3.172  0.00152 **
tue 0.0006311  0.0002388   2.642  0.00825 **
wed 0.0010231  0.0002389   4.282 1.87e-05 ***
thu 0.0013983  0.0002437   5.739 9.90e-09 ***
fri 0.0022569  0.0002414   9.347  < 2e-16 ***

Residual standard error: 0.009515 on 7772 degrees of freedom
Multiple R-squared: 0.01964,Adjusted R-squared: 0.01901
F-statistic: 31.14 on 5 and 7772 DF,  p-value: < 2.2e-16
```

	Estimate	Std. Error	t value	Pr(>|t|)
mon	0.0006	0.0002	2.70	0.0069
tue	0.0006	0.0002	2.45	0.0144
wed	0.0010	0.0002	4.33	0.0000
thu	0.0013	0.0002	5.62	0.0000
fri	0.0022	0.0002	9.44	0.0000

One benefit of this formulation is that the coefficients are interpretable as the mean on each date.

Another is to leave out one day, say monday. and use dummies for the other weekdays.

```
> reg2 <- lm(Rm$EW~tue+wed+thu+fri)

Residuals:
      Min         1Q    Median         3Q        Max
-0.147359 -0.004338  0.000312  0.004559  0.114473

Coefficients:
             Estimate Std. Error t value Pr(>|t|)
(Intercept)  0.0007726  0.0002436   3.172  0.00152 **
tue         -0.0001415  0.0003411  -0.415  0.67842
wed          0.0002505  0.0003412   0.734  0.46279
thu          0.0006257  0.0003445   1.816  0.06940 .
fri          0.0014843  0.0003430   4.328 1.52e-05 ***

Residual standard error: 0.009515 on 7772 degrees of freedom
Multiple R-squared: 0.003731,Adjusted R-squared: 0.003218
F-statistic: 7.276 on 4 and 7772 DF,  p-value: 7.62e-06
```

This formulation has the benefit that it directly tests the desired hypothesis: The F test test for nonzero all coefficients except the intercept.

If we wanted to test the hypothesis of equality of coeffisients using the first formulation, we would need to write it as a linear hypothesis test, and test for equality of the coefficients against each other.

```
> C <- c(c(1, -1, 0, 0, 0), c(0, 1, -1, 0, 0 ), c(0, 0 ,1, -1, 0
> C <- matrix(C,nrow=4,ncol=5,byrow=TRUE)
> r <- c(0, 0, 0, 0)
> linearHypothesis(reg1,hypothesis.matrix=C,rhs=r)
Hypothesis:
mon - tue = 0
tue - wed = 0
wed - thu = 0
thu - fri = 0
Model 1: restricted model
Model 2: ew ~ 0 + mon + tue + wed + thu + fri

  Res.Df     RSS Df Sum of Sq      F    Pr(>F)
1   8029 0.72858
2   8025 0.72565  4 0.0029344 8.1129 1.592e-06 ***
```

The test rejects the null of equality.

Exercise

There is a long literature in finance that investigates whether Friday the Thirteenth is a particularly unlucky day, by looking at the returns on those Fridays, and checking whether the return on those fridays is different from other fridays. Kolb and Rodriguez (1987) finds a lower than normal return on friday the thirteenth for the US, while Lucey (2000) shows the opposite for more recent, worldwide, data.

Choose a daily stock market index at the Oslo Stock Exchange, and investigate whether returns on OSE has been special on friday thirteenths, in the post 1980 period.

Solution

Reading in the data and creating the dummy for friday thirteenth

```
> Rm <- read.zoo("../../../data/norway/stock_market_indices
+                  header=TRUE,sep=";",format="%Y%m%d")
> dates  <-  as.POSIXlt(index(Rm))
> fri <- dates$wday==5
> thirteenth <- dates$mday==13
> dummy <- as.numeric(fri & thirteenth)
> sum(dummy)
[1] 52
```

The sum of the dummy variables is 52, hence there are 52 friday the thirteenth in the period.

First doing this for the EW index.

```
lm(formula = as.matrix(Rm$EW) ~ dummy, na.action = na.omit)

Residuals:
      Min         1Q    Median         3Q        Max
-0.147880 -0.004368  0.000408  0.004564  0.114344

Coefficients:
             Estimate Std. Error t value Pr(>|t|)
(Intercept) 0.0011524  0.0001066  10.806   <2e-16 ***
dummy       0.0017194  0.0013253   1.297    0.195

Multiple R-squared: 0.0002096,Adjusted R-squared: 8.51e-05
F-statistic: 1.683 on 1 and 8028 DF,  p-value: 0.1945
```

	Estimate	Std. Error	t value	Pr(>|t|)
(Intercept)	0.0012	0.0001	10.81	0.0000
dummy	0.0017	0.0013	1.30	0.1945

The VW index

```
Call:
lm(formula = as.matrix(Rm$VW) ~ dummy)

Residuals:
      Min         1Q     Median         3Q        Max
-0.179138 -0.006443  0.000236  0.006668  0.112676

Coefficients:
             Estimate Std. Error t value Pr(>|t|)
(Intercept) 0.0010311  0.0001493   6.908  5.3e-12 ***
dummy       0.0017401  0.0018549   0.938    0.348

Multiple R-squared: 0.0001096,Adjusted R-squared: -1.494e-05
F-statistic: 0.8801 on 1 and 8028 DF,  p-value: 0.3482
```

	Estimate	Std. Error	t value	Pr(>|t|)
(Intercept)	0.0010	0.0001	6.91	0.0000
dummy	0.0017	0.0019	0.94	0.3482

The Oslo Bors total index (TOTX) (spliced from the exchange's official indices)

```
> reg3 <- lm(as.matrix(Rm$TOTX)~ dummy)

Residuals:
      Min         1Q     Median         3Q        Max
-0.191748 -0.006212  0.000384  0.006877  0.109938

Coefficients:
             Estimate Std. Error t value Pr(>|t|)
(Intercept) 0.0005606  0.0001584   3.540 0.000402 ***
dummy       0.0025007  0.0019700   1.269 0.204339

Multiple R-squared: 0.0002215,Adjusted R-squared: 8.405e-05
F-statistic: 1.611 on 1 and 7272 DF,  p-value: 0.2043
```

	Estimate	Std. Error	t value	Pr(>|t|)
(Intercept)	0.0006	0.0002	3.54	0.0004
dummy	0.0025	0.0020	1.27	0.2043

The OBX index

```
> reg4 <- lm(as.matrix(Rm$OBX)~ dummy)

Residuals:
      Min         1Q     Median         3Q        Max
-0.213672 -0.007364  0.000332  0.007828  0.117099

Coefficients:
             Estimate Std. Error t value Pr(>|t|)
(Intercept) 0.0004206  0.0001999   2.104   0.0354 *
dummy       0.0026268  0.0025040   1.049   0.2942

Multiple R-squared: 0.0001754,Adjusted R-squared: 1.602e-05
F-statistic: 1.101 on 1 and 6275 DF,  p-value: 0.2942
```

	Estimate	Std. Error	t value	Pr(>|t|)
(Intercept)	0.0004	0.0002	2.10	0.0354
dummy	0.0026	0.0025	1.05	0.2942

The dummy is always very positive, but we can never reject the null that it is zero.

Robert Kolb and Ricardo Rodriguez. Friday the thirteenth part VII: A note. *Journal of Finance*, 42:1385–1387, 1987.

Brian M Lucey. Friday the 13th and the philosophical basis of financial economics. *Journal of Economics and Finance*, 24(3):294–301, 2000.