Financial Econometrics — Rauli Susmel
FINA 4397/FINA 7354

Homework 1 - Solutions

1.1 (Calculating moments).

PPP_da <- read.csv("http://www.bauer.uh.edu/rsusmel/4397/ppp_2020_m.csv",head=TRUE,sep=",")

x_dkk <- PPP_da$DKK_USD
x_sgd <- PPP_da$SGD_USD

T_dkk <- length(x_dkk)
lr_dkk <- log(x_dkk[-1]/x_dkk[-T_dkk])

T_sgd <- length(x_sgd)
lr_sgd <- log(x_sgd[-1]/x_sgd[-T_sgd])   # There are NA (or NAN = not a number) entries here.

Different ways to redefine the data, start working with SGD from 1981:Jan (T=98) or use na.omit (it omits NA from data)

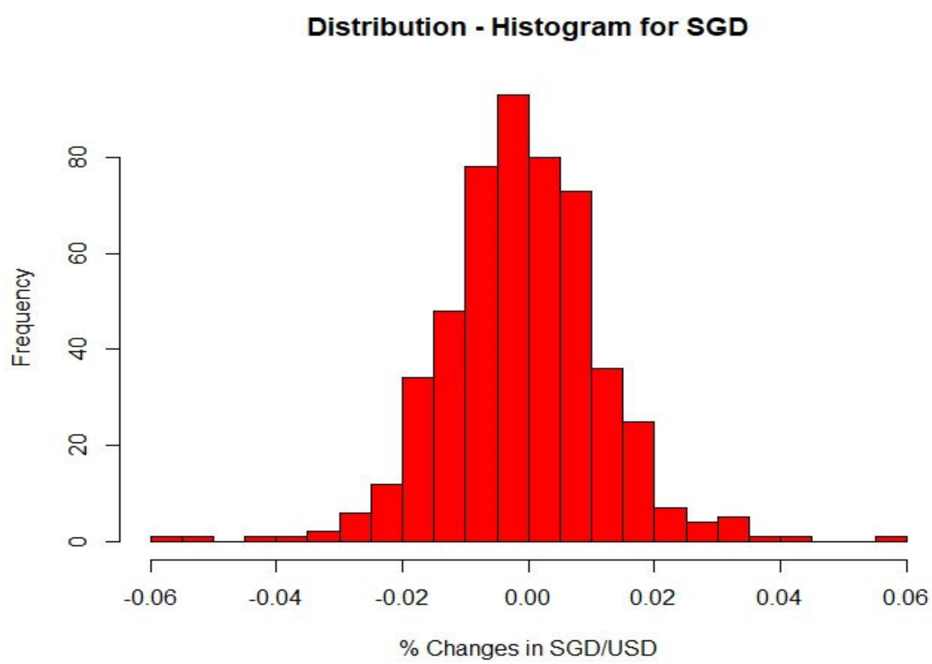
lr_sgd_T <- lr_sgd[97:(T_sgd-1)]   # Redefining your data from actual start of sample (best)
lr_sgd_na <- na.omit(lr_sgd)   # Redefining sample by ignoring NA

* For DKK
```
> x <- lr_dkk
> m1 <- sum(x)/T                     # Mean
> m1
[1] -5.913333e-05
> m2 <- sum((x-m1)^2)/T              # Variance
> sd <- sqrt(m2)                # SD
> sd
[1] 0.03177049
> m3 <- sum((x-m1)^3)/T              # For numerator of S
> m4 <- sum((x-m1)^4)/T              # For numerator of K
> b1 <- m3/m2^(3/2)             # Sample Skewness
> b1
[1] -0.002014793
> b2 <- (m4/m2^2)                    # Sample Kurtosis
> b2
[1] 1.957438
```

* For SGD
```
> x <- lr_sgd_T
> m1 <- sum(x)/T                     # Mean
> m1
[1] -0.001223524
> x <- lr_sgd_T
> m1 <- sum(x)/T                     # Mean
> m1
[1] -0.001223524
> m2 <- sum((x-m1)^2)/T              # Variance
> sd <- sqrt(m2)                # SD
> sd
[1] 0.014694
> m3 <- sum((x-m1)^3)/T              # For numerator of S
```

```
> m4 <- sum((x-m1)^4)/T                    # For numerator of K
> b1 <- m3/m2^(3/2)             # Sample Skewness
> b1
[1] 0.1239574
> b2 <- (m4/m2^2)                          # Sample Kurtosis
> b2
[1] 3.728407
```

```
n_breaks = 40
h <- hist(x, breaks=n_breaks, col="red", xlab="% Changes in SGD/USD",
  main = "Distribution - Histogram for SGD")
```



Notes: SGD has a "Managed Exchange Rate System," where the Monetary Authority of Singapore closely pegs the value of the SGD against a basket of currencies (the USD is included in the basket.) As a result, we observe a difference in the pdf of both currencies (check skewness and kurtosis).

1.2 (**Testing Normality**)

* For DKK

```
> JB <- (b1^2 + (b2-3)^2/4) * T/6
> JB
[1] 16.48544
```

$\Rightarrow$ reject H_0 (normality) at 5% level.

* For SGD

```
> JB <- (b1^2 + (b2-3)^2/4) * T/6
> JB
[1] 8.979252
```

$\Rightarrow$ reject H_0 (normality) at 5% level.

1. 3 (**Testing and Confidence Intervals**)

a. Using the log return approximation, derive the quarterly mean and standard deviation.

quarterly mean = .01 * 3 = 3% & annual mean = .01 * 12 = 12%

quarterly SD = 0.15 * sqrt(3) = 25.98% & annual SD = 0. 15 * sqrt(12) = 51.96%

b. Build a 98% confidence interval for the sample mean.

98% C.I. = {.01 – 2.33 * 0. 15; .01 + 2.33 * 0.15} = { **-0.3395**; **0.3595**}

c. Build a 98% confidence interval for the variance (and SD) using the chi-square distribution.

```
> m <- .01
> N <- 100
> s2 = 0.15^2
> s <-sqrt(s2)
> var_CI_lb <- (N-1)*s2/qchisq(.99, df=N-1)
> var_CI_ub <- (N-1)*s2/qchisq(.01, df=N-1)
> sd_CI_lb <- sqrt(var_CI_lb)
> sd_CI_lb
[1] 0.128623
> sd_CI_ub <- sqrt(var_CI_ub)
> sd_CI_ub
[1] 0.179375
```

Note: A 98% confidence interval for the variance (and SD) using the asymptotic normal approximation delivers very similar results:

```
> SE_s <- s/sqrt(2*(N-1))
> s - 2.33 * SE_s
[1] 0.125162
> s + 2.33 * SE_s
[1] 0.174838
```

d. Test H_0: $\mu = 0\%$ against H_1: $\mu \neq 0\%$, at the 5% level.

```
> t_hat <- (m - 0)/(s/sqrt(N))
> t_hat
[1] 0.66667
```

$\Rightarrow$ cannot reject H_0:$\mu = 0\%$ at 5% level.

1.4 (**Practice Linear Algebra**) Use R.

Run R (Fec_prog_HW1.txt) program on my webpage.

1.5 (**Practice Linear Algebra**) Use R.

Run R (Fec_prog_HW1.txt) program on my webpage.

1.6 (**Regression**).

```
SFX_da <-
read.csv("http://www.bauer.uh.edu/rsusmel/4397/Stocks_FX_1973.csv",head=TRUE,sep=",")
x_pfe <- SFX_da$PFE
T <- length(x_pfe)
x_Mkt_RF<- SFX_da$Mkt_RF
x_RF<- SFX_da$RF
lr_pfe <- log(x_pfe[-1]/x_pfe[-T])
```

Mkt_RF <- x_Mkt_RF[-1]/100
RF <- x_RF[-1]/100
pfe_x <- lr_pfe – RF

a. Plot PFE excess returns against market excess returns. ⇒ positive relation.
plot(pfe_x, Mkt_RF, main = "Excess Returns: Pfizer vs Market")

b. Report the regression.
> fit_capm <- lm(pfe_x ~ Mkt_RF)
> summary(fit_capm)

lm(formula = pfe_x ~ Mkt_RF)

```
Coefficients:
              Estimate Std. Error t value Pr(>|t|)
(Intercept) -0.0003242  0.0027108  -0.120    0.905
Mkt_RF       0.4910229  0.0580450   8.459   <2e-16 ***
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Residual standard error: 0.06617 on 604 degrees of freedom
Multiple R-squared:  0.1059,	Adjusted R-squared:  0.1044
F-statistic: 71.56 on 1 and 604 DF,  p-value: < 2.2e-16
```

c. Test the CAPM –i.e., the constant is equal to zero.
t = **--0.120** (*p-value* = 0.905 > .05) ⇒ cannot reject H_0 at 5% level.

d. Test if Pfizer's beta is greater than 1 (against different or less than 1) at the 5% level (You need to do a one-sided C.I. for the H_0).
t = (**0.49103** – 1)/ 0.058045 = **-8.768667** < **1.645** ⇒ reject H_0: β > 1 at 5% level

Note: You also reject H_0:β = 1 at 5%, since | t = **--8.7687** | > **1.96**.

e. Suppose the market excess returns are equal to 0.005. Predict the excess returns for PFE.

$\hat{y}$ = -0.0003242 + **0.491023** * 0.005 = **0.002131**

1. 7 (Regression)

a. Write down the null and alternative hypotheses.

H_0: $\beta = 0$

H_0: $\beta \neq 0$

b. Test this null hypothesis against a two-sided alternative at the 5% level.

t = (0.92 – 0)/0.26 = **3.5385** < **1.96** ⇒ Reject H_0 at 5% level. That is, ARLO faces systematic risk