Week 1 Homework

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1 Read Chapter 1 of the book.

2 Download and analyze excess returns of S&P 500

Calculate continuous daily excess returns of SP500 ("^GSPC") for the period from 1/1/2014 until 12/31/2014 using overnight Fed Funds rates as risk-free rates.

```
datapath<-"C:/Users/mjdun/Desktop/Financial Analytics/Week 1/"
SP500<-read.csv(file=paste(datapath,'SP500_NB2014.csv',sep='/'))

#if you wanted to download the SP500 data and do the continuous compounding calculations on the
#closing price yourself:
#library(quantmod)
#getSymbols("^GSPC", from="2014-1-1", to="2014-12-31")
#CC_Returns<-diff(log(GSPC$GSPC.Close))
#you will see that these are the values in the .csv file
```

```
head(SP500)
```

```
##        date SP500Returns RIFSPFF_N.B
## 1  1/3/2014 -0.000333020        0.08
## 2  1/6/2014 -0.002514927        0.08
## 3  1/7/2014  0.006063345        0.07
## 4  1/8/2014 -0.000212232        0.07
## 5  1/9/2014  0.000348249        0.07
## 6 1/10/2014  0.002304030        0.07
```

Here I will assume that the values in the SP500Returns column is already in the form of the continuously compounded return. The excess return of this asset at time t is the difference between the asset's return and the return on some reference asset (here the overnight Fed Funds Rate).

```
#FFR is per year. Must convert to per day. Convention is to divide by 360.
SP500$Daily.FFR<-SP500$RIFSPFF_N.B/360
#subtract that from SP500Returns column, which is the continuous compounding return to get the Excess r
SP500$ExcessReturn<-SP500$SP500Returns-SP500$Daily.FFR
library(formattable)
SP500$ExcessReturn_Readable<-percent(SP500$ExcessReturn)
```

The continuous daily excess returns of SP500 over the Fed Funds rate are found in the last column

```
head(SP500[,c(1:5)], 5)
```

```
##       date SP500Returns RIFSPFF_N.B    Daily.FFR  ExcessReturn
## 1 1/3/2014 -0.000333020        0.08 0.0002222222 -0.0005552422
## 2 1/6/2014 -0.002514927        0.08 0.0002222222 -0.0027371492
## 3 1/7/2014  0.006063345        0.07 0.0001944444  0.0058689006
## 4 1/8/2014 -0.000212232        0.07 0.0001944444 -0.0004066764
## 5 1/9/2014  0.000348249        0.07 0.0001944444  0.0001538046
```

Translated to a more readable format the continuous daily excess returns of the SP500 are:

```
head(SP500[,c(1,6)], 5)
```

```
##       date ExcessReturn_Readable
## 1 1/3/2014                -0.06%
## 2 1/6/2014                -0.27%
## 3 1/7/2014                 0.59%
## 4 1/8/2014                -0.04%
## 5 1/9/2014                 0.02%
```

3 Download and analyze exchange rates

Answer the same questions as in Exercise 5 on page 37 as a refresher of statistical analysis skills. Try to do it without using R demo code from the book.

1. Find out how to download:

- GBP/USD exchange rate, i.e. price of 1 British pound in US dollars, from Oanda using quantmode;
- USD/JPY exchange rate, i.e. price of 1 US dollar in Japanese yen, from Oanda using quantmode.

```
pound_in_dollars<-read.csv(file=paste(datapath,'GBPUSD.csv',sep='/'))
dollars_in_yen<-read.csv(file=paste(datapath,'USDJPY.csv',sep='/'))
```

Note: Got a 404 error when I used quantmode. It does not appear to work for currencies anymore.

2. Calculate daily log returns of both exchange rates

```
empty<-c(NA)
p_in_d_daily_log<-diff(log(pound_in_dollars$GBP.USD))
pound_in_dollars$daily_log_returns<-c(empty, p_in_d_daily_log)
d_in_y_daily_log<-diff(log(dollars_in_yen$USD.JPY))
dollars_in_yen$daily_log_returns<-c(empty, d_in_y_daily_log)
```

Here are the daily log returns of GBP/USD

```
head(pound_in_dollars)
```

```
##   X  GBP.USD daily_log_returns
## 1 1 1.234200                NA
## 2 2 1.234200      0.0000000000
## 3 3 1.228010     -0.0050280139
## 4 4 1.226785     -0.0009980468
## 5 5 1.234255      0.0060706229
## 6 6 1.236225      0.0015948321
```

And the daily log returns of USD/JPY

```
head(dollars_in_yen)
```

```
##   X  USD.JPY daily_log_returns
## 1 1 117.0170                NA
## 2 2 117.0170      0.000000e+00
## 3 3 117.6795      5.645604e-03
```

```
## 4 4 117.6840      3.823872e-05
## 5 5 116.2885     -1.192889e-02
## 6 6 116.1340     -1.329476e-03
```

3. Calculate sample min, mean, sd, skewness, kurtosis, max of log returns for both exchange rates

```r
metrics<-list("min", "mean", "SD", "Skewness", "Kurtosis", "Max")
```

First for the Pounds to Dollars exchange rate:

```r
#MEAN
pound_mean<-mean(pound_in_dollars$daily_log_returns, na.rm = TRUE)
#SD
pound_sd<-sd(pound_in_dollars$daily_log_returns, na.rm = TRUE)
#take out the NA
pound_new<-pound_in_dollars$daily_log_returns[-1]
#SKEWNESS
#number of observations
pound_n<-length(pound_new)
#for sample skewness calculation
pound_mult<-sqrt(pound_n-1)*pound_n/(pound_n-2)
pound_skew_numerator<-sum((pound_new-pound_mean)^3)
pound_skew_denominator<-sum((pound_new-pound_mean)^2)^(3/2)
#this gives a slightly different answer than basicStats()
pound_skew<-pound_mult*pound_skew_numerator/pound_skew_denominator
#KURTOSIS
#for sample kurtosis
#this gives a slightly different answer than basicStats(), population kurtosis is closer
pound_kurt_numerator<-sum((pound_new-pound_mean)^4)
pound_kurt_denominator<-sum((pound_new-pound_mean)^2)^2
pound_kurtosis<-pound_n*(pound_n+1)*(pound_n-1)/(pound_n-2)/(pound_n-3)*pound_kurt_numerator/pound_kurt_
#MIN/MAX
pound_min<-min(pound_in_dollars$daily_log_returns, na.rm = TRUE)
pound_max<-max(pound_in_dollars$daily_log_returns, na.rm = TRUE)

#put these into a data frame for easier viewing
pound_metrics<-rbind.data.frame(pound_min, pound_mean, pound_sd, pound_skew, pound_kurtosis, pound_max)
rownames(pound_metrics)<-metrics
names(pound_metrics)<-"Log Returns of GBP/USD"
```

```r
print(pound_metrics)
```

```
##          Log Returns of GBP/USD
## min               -0.0163659835
## mean               0.0002285286
## SD                 0.0038016374
## Skewness          -0.2364859877
## Kurtosis           2.9296090865
## Max                0.0133547819
```

Now the Dollars to Yen exchange rate:

```r
#MEAN
dollars_mean<-mean(dollars_in_yen$daily_log_returns, na.rm = TRUE)
```

```
#SD
dollars_sd<-sd(dollars_in_yen$daily_log_returns, na.rm = TRUE)
#take out the NA
dollars_new<-dollars_in_yen$daily_log_returns[-1]
#SKEWNESS
#number of observations
dollars_n<-length(dollars_new)
#for population skewness calculation
dollars_mult<-sqrt(dollars_n-1)*dollars_n/(dollars_n-2)
dollars_skew_numerator<-sum((dollars_new-dollars_mean)^3)
dollars_skew_denominator<-sum((dollars_new-dollars_mean)^2)^(3/2)
#this gives a slightly different answer than basicStats()
dollars_skew<-dollars_mult*dollars_skew_numerator/dollars_skew_denominator
#KURTOSIS
#for population kurtosis
#this gives a slightly different answer than basicStats(), population kurtosis is closer
dollars_kurt_numerator<-sum((dollars_new-dollars_mean)^4)
dollars_kurt_denominator<-sum((dollars_new-dollars_mean)^2)^2
dollars_kurtosis<-dollars_n*(dollars_n+1)*(dollars_n-1)/(dollars_n-2)/(dollars_n-3)*dollars_kurt_numera
#MIN/MAX
dollars_min<-min(dollars_in_yen$daily_log_returns, na.rm = TRUE)
dollars_max<-max(dollars_in_yen$daily_log_returns, na.rm = TRUE)

#put these into a data frame for easier viewing
dollars_metrics<-rbind.data.frame(dollars_min, dollars_mean, dollars_sd, dollars_skew, dollars_kurtosis
rownames(dollars_metrics)<-metrics
names(dollars_metrics)<-"Log Returns of USD/JPY"
```

```
print(dollars_metrics)
```

```
##          Log Returns of USD/JPY
## min                -0.0125435250
## mean               -0.0002373043
## SD                  0.0041680718
## Skewness           -0.1747095516
## Kurtosis            1.4153149936
## Max                 0.0136990846
```

4. Test hypothesis H0: mu=0 against alternative H0: mu does not = 0

For GBP/USD our t score is:

```
#First for the pound
#get the standard Error
pound_SE<-pound_sd/sqrt(pound_n)
#get the t score (for Null Hypothesis true mean=0)
pound_T<-(pound_mean-0)/pound_SE
print(pound_T)
```

```
## [1] 0.80201
```

With a t score of 0.8021 and 177 Degrees of Freedom (178-1), a t distribution calculator shows that a number that extreme (far from 0) has a probability of 0.4236 - so we **do not reject the Null Hypothesis** that the mean daily log return of the GBP/USD exchange rate = 0.

For USD/JPY our t score is:

```
#get the standard Error
dollars_SE<-dollars_sd/sqrt(dollars_n)
#get the t score (for Null Hypothesis true mean=0)
dollars_T<-(dollars_mean-0)/dollars_SE
print(dollars_T)
```

```
## [1] -0.7595922
```

With a t score of -0.7595922 and 177 Degrees of Freedom (178-1), a t distribution calculator shows that a number that extreme (far from 0) has a probability of 0.4489 - so we **do not reject the Null Hypothesis** that the mean daily log return of the GBP/USD exchange rate = 0.