HW6

Estimation

3/14/2021

pacman::p\_load(pacman, tidyverse, tseries, psych, knitr, here)  
knitr::opts\_chunk$set(message = FALSE, tidy = TRUE)

#QUESTION 6.1

x1 = get.hist.quote(instrument = "PZZA", start = "2010-12-01", end = "2015-12-31",   
 quote = "AdjClose", compression = "m")

## time series ends 2015-12-01

x1

## Adjusted  
## 2010-12-01 12.52363  
## 2011-01-01 12.97574  
## 2011-02-01 13.19276  
## 2011-03-01 14.31853  
## 2011-04-01 13.59062  
## 2011-05-01 14.97862  
## 2011-06-01 15.03739  
## 2011-07-01 14.11055  
## 2011-08-01 13.45046  
## 2011-09-01 13.74434  
## 2011-10-01 15.26345  
## 2011-11-01 17.13521  
## 2011-12-01 17.03575  
## 2012-01-01 17.50595  
## 2012-02-01 16.80065  
## 2012-03-01 17.02671  
## 2012-04-01 18.21124  
## 2012-05-01 21.03246  
## 2012-06-01 21.50718  
## 2012-07-01 23.06246  
## 2012-08-01 23.27948  
## 2012-09-01 24.14753  
## 2012-10-01 24.10685  
## 2012-11-01 23.93053  
## 2012-12-01 24.83476  
## 2013-01-01 25.36374  
## 2013-02-01 23.51458  
## 2013-03-01 27.94984  
## 2013-04-01 28.48333  
## 2013-05-01 29.12986  
## 2013-06-01 29.55485  
## 2013-07-01 30.22851  
## 2013-08-01 30.80269  
## 2013-09-01 31.59389  
## 2013-10-01 34.33732  
## 2013-11-01 38.51659  
## 2013-12-01 41.33588  
## 2014-01-01 43.82150  
## 2014-02-01 46.34354  
## 2014-03-01 47.57389  
## 2014-04-01 40.04203  
## 2014-05-01 39.57642  
## 2014-06-01 38.81234  
## 2014-07-01 38.17142  
## 2014-08-01 36.25781  
## 2014-09-01 36.74034  
## 2014-10-01 42.96018  
## 2014-11-01 48.49099  
## 2014-12-01 51.40813  
## 2015-01-01 58.46522  
## 2015-02-01 56.97272  
## 2015-03-01 57.07035  
## 2015-04-01 56.66409  
## 2015-05-01 63.44123  
## 2015-06-01 69.96485  
## 2015-07-01 69.91858  
## 2015-08-01 62.22903  
## 2015-09-01 63.52051  
## 2015-10-01 65.08810  
## 2015-11-01 53.31716  
## 2015-12-01 51.97595

pzza\_m = as.vector(x1)  
n1 = length(pzza\_m)  
pzza\_m\_ret = (pzza\_m[-1] - pzza\_m[-n1])/pzza\_m[-n1]  
  
tibble(mu1 = mean(pzza\_m\_ret), sd1 = sd(pzza\_m\_ret))

## # A tibble: 1 x 2  
## mu1 sd1  
## <dbl> <dbl>  
## 1 0.0265 0.0715

x2 = get.hist.quote(instrument = "BBBY", start = "2010-12-01", end = "2015-12-31",   
 quote = "AdjClose", compression = "m")

## time series ends 2015-12-01

x2

## Adjusted  
## 2010-12-01 42.85329  
## 2011-01-01 41.85062  
## 2011-02-01 41.98140  
## 2011-03-01 42.08602  
## 2011-04-01 48.93907  
## 2011-05-01 46.98603  
## 2011-06-01 50.89210  
## 2011-07-01 50.99672  
## 2011-08-01 49.57554  
## 2011-09-01 49.96790  
## 2011-10-01 53.91754  
## 2011-11-01 52.75793  
## 2011-12-01 50.54333  
## 2012-01-01 52.92359  
## 2012-02-01 52.08658  
## 2012-03-01 57.34405  
## 2012-04-01 61.37219  
## 2012-05-01 62.99391  
## 2012-06-01 53.88266  
## 2012-07-01 53.14156  
## 2012-08-01 58.56470  
## 2012-09-01 54.92893  
## 2012-10-01 50.29049  
## 2012-11-01 51.19725  
## 2012-12-01 48.74725  
## 2013-01-01 51.17981  
## 2013-02-01 49.47964  
## 2013-03-01 56.16701  
## 2013-04-01 59.98588  
## 2013-05-01 59.50635  
## 2013-06-01 61.86044  
## 2013-07-01 66.67326  
## 2013-08-01 64.29302  
## 2013-09-01 67.44924  
## 2013-10-01 67.41438  
## 2013-11-01 68.03342  
## 2013-12-01 70.01260  
## 2014-01-01 55.67004  
## 2014-02-01 59.13143  
## 2014-03-01 59.98588  
## 2014-04-01 54.17039  
## 2014-05-01 53.05437  
## 2014-06-01 50.02891  
## 2014-07-01 55.18178  
## 2014-08-01 56.02752  
## 2014-09-01 57.39639  
## 2014-10-01 58.71292  
## 2014-11-01 63.97042  
## 2014-12-01 66.41169  
## 2015-01-01 65.19106  
## 2015-02-01 65.09514  
## 2015-03-01 66.94355  
## 2015-04-01 61.43321  
## 2015-05-01 62.18303  
## 2015-06-01 60.14283  
## 2015-07-01 56.87325  
## 2015-08-01 54.15296  
## 2015-09-01 49.71505  
## 2015-10-01 51.99067  
## 2015-11-01 47.53533  
## 2015-12-01 42.06858

bbby\_m = as.vector(x2)  
n2 = length(bbby\_m)  
bbby\_m\_ret = (bbby\_m[-1] - bbby\_m[-n2])/bbby\_m[-n2]  
  
  
  
  
tibble(mu2 = mean(bbby\_m\_ret), sd2 = sd(bbby\_m\_ret))

## # A tibble: 1 x 2  
## mu2 sd2  
## <dbl> <dbl>  
## 1 0.00199 0.0678

#c  
#Correlation   
cor(pzza\_m\_ret, bbby\_m\_ret) %>% round(5)

## [1] 0.2668

#QUESTION 6.3

x1 = get.hist.quote(instrument = "PZZA", start = "2010-12-01", end = "2015-12-31",   
 quote = "AdjClose", compression = "m")

## time series ends 2015-12-01

x1

## Adjusted  
## 2010-12-01 12.52363  
## 2011-01-01 12.97574  
## 2011-02-01 13.19276  
## 2011-03-01 14.31853  
## 2011-04-01 13.59062  
## 2011-05-01 14.97862  
## 2011-06-01 15.03739  
## 2011-07-01 14.11055  
## 2011-08-01 13.45046  
## 2011-09-01 13.74434  
## 2011-10-01 15.26345  
## 2011-11-01 17.13521  
## 2011-12-01 17.03575  
## 2012-01-01 17.50595  
## 2012-02-01 16.80065  
## 2012-03-01 17.02671  
## 2012-04-01 18.21124  
## 2012-05-01 21.03246  
## 2012-06-01 21.50718  
## 2012-07-01 23.06246  
## 2012-08-01 23.27948  
## 2012-09-01 24.14753  
## 2012-10-01 24.10685  
## 2012-11-01 23.93053  
## 2012-12-01 24.83476  
## 2013-01-01 25.36374  
## 2013-02-01 23.51458  
## 2013-03-01 27.94984  
## 2013-04-01 28.48333  
## 2013-05-01 29.12986  
## 2013-06-01 29.55485  
## 2013-07-01 30.22851  
## 2013-08-01 30.80269  
## 2013-09-01 31.59389  
## 2013-10-01 34.33732  
## 2013-11-01 38.51659  
## 2013-12-01 41.33588  
## 2014-01-01 43.82150  
## 2014-02-01 46.34354  
## 2014-03-01 47.57389  
## 2014-04-01 40.04203  
## 2014-05-01 39.57642  
## 2014-06-01 38.81234  
## 2014-07-01 38.17142  
## 2014-08-01 36.25781  
## 2014-09-01 36.74034  
## 2014-10-01 42.96018  
## 2014-11-01 48.49099  
## 2014-12-01 51.40813  
## 2015-01-01 58.46522  
## 2015-02-01 56.97272  
## 2015-03-01 57.07035  
## 2015-04-01 56.66409  
## 2015-05-01 63.44123  
## 2015-06-01 69.96485  
## 2015-07-01 69.91858  
## 2015-08-01 62.22903  
## 2015-09-01 63.52051  
## 2015-10-01 65.08810  
## 2015-11-01 53.31716  
## 2015-12-01 51.97595

pzza\_m = as.vector(x1)  
n1 = length(pzza\_m)  
pzza\_m\_ret = (pzza\_m[-1] - pzza\_m[-n1])/pzza\_m[-n1]  
  
data1 = read.table(file.choose(),header = T,sep = ",")  
data1

## TimePeriod Yield  
## 1 2011-01 0.15  
## 2 2011-02 0.13  
## 3 2011-03 0.10  
## 4 2011-04 0.06  
## 5 2011-05 0.04  
## 6 2011-06 0.04  
## 7 2011-07 0.04  
## 8 2011-08 0.02  
## 9 2011-09 0.01  
## 10 2011-10 0.02  
## 11 2011-11 0.01  
## 12 2011-12 0.01  
## 13 2012-01 0.03  
## 14 2012-02 0.09  
## 15 2012-03 0.08  
## 16 2012-04 0.08  
## 17 2012-05 0.09  
## 18 2012-06 0.09  
## 19 2012-07 0.10  
## 20 2012-08 0.10  
## 21 2012-09 0.11  
## 22 2012-10 0.10  
## 23 2012-11 0.09  
## 24 2012-12 0.07  
## 25 2013-01 0.07  
## 26 2013-02 0.10  
## 27 2013-03 0.09  
## 28 2013-04 0.06  
## 29 2013-05 0.04  
## 30 2013-06 0.05  
## 31 2013-07 0.04  
## 32 2013-08 0.04  
## 33 2013-09 0.02  
## 34 2013-10 0.05  
## 35 2013-11 0.07  
## 36 2013-12 0.07  
## 37 2014-01 0.04  
## 38 2014-02 0.05  
## 39 2014-03 0.05  
## 40 2014-04 0.03  
## 41 2014-05 0.03  
## 42 2014-06 0.04  
## 43 2014-07 0.03  
## 44 2014-08 0.03  
## 45 2014-09 0.02  
## 46 2014-10 0.02  
## 47 2014-11 0.02  
## 48 2014-12 0.03  
## 49 2015-01 0.03  
## 50 2015-02 0.02  
## 51 2015-03 0.03  
## 52 2015-04 0.02  
## 53 2015-05 0.02  
## 54 2015-06 0.02  
## 55 2015-07 0.03  
## 56 2015-08 0.07  
## 57 2015-09 0.02  
## 58 2015-10 0.02  
## 59 2015-11 0.11  
## 60 2015-12 0.22

rff1 = data1$Yield  
table(is.na(rff1))

##   
## FALSE   
## 60

rff1

## [1] 0.15 0.13 0.10 0.06 0.04 0.04 0.04 0.02 0.01 0.02 0.01 0.01 0.03 0.09 0.08  
## [16] 0.08 0.09 0.09 0.10 0.10 0.11 0.10 0.09 0.07 0.07 0.10 0.09 0.06 0.04 0.05  
## [31] 0.04 0.04 0.02 0.05 0.07 0.07 0.04 0.05 0.05 0.03 0.03 0.04 0.03 0.03 0.02  
## [46] 0.02 0.02 0.03 0.03 0.02 0.03 0.02 0.02 0.02 0.03 0.07 0.02 0.02 0.11 0.22

rfree1 = (1 + rff1/100)^(1/12) - 1  
head(rfree1)

## [1] 1.249141e-04 1.082688e-04 8.329516e-05 4.998626e-05 3.332722e-05  
## [6] 3.332722e-05

length(rfree1)

## [1] 60

d1 = tibble(pzza\_m\_ret, rfree1)  
d1 = d1 %>% mutate(pzza\_ex = pzza\_m\_ret - rfree1)  
d1

## # A tibble: 60 x 3  
## pzza\_m\_ret rfree1 pzza\_ex  
## <dbl> <dbl> <dbl>  
## 1 0.0361 0.000125 0.0360   
## 2 0.0167 0.000108 0.0166   
## 3 0.0853 0.0000833 0.0852   
## 4 -0.0508 0.0000500 -0.0509   
## 5 0.102 0.0000333 0.102   
## 6 0.00392 0.0000333 0.00389  
## 7 -0.0616 0.0000333 -0.0617   
## 8 -0.0468 0.0000167 -0.0468   
## 9 0.0218 0.00000833 0.0218   
## 10 0.111 0.0000167 0.111   
## # ... with 50 more rows

# mean excess returns  
pzza = d1$pzza\_ex  
  
tibble(mu\_ex1 = mean(pzza), sd\_ex1 = sd(pzza))

## # A tibble: 1 x 2  
## mu\_ex1 sd\_ex1  
## <dbl> <dbl>  
## 1 0.0264 0.0715

x2 = get.hist.quote(instrument = "BBBY", start = "2010-12-01", end = "2015-12-31",   
 quote = "AdjClose", compression = "m")

## time series ends 2015-12-01

x2

## Adjusted  
## 2010-12-01 42.85329  
## 2011-01-01 41.85062  
## 2011-02-01 41.98140  
## 2011-03-01 42.08602  
## 2011-04-01 48.93907  
## 2011-05-01 46.98603  
## 2011-06-01 50.89210  
## 2011-07-01 50.99672  
## 2011-08-01 49.57554  
## 2011-09-01 49.96790  
## 2011-10-01 53.91754  
## 2011-11-01 52.75793  
## 2011-12-01 50.54333  
## 2012-01-01 52.92359  
## 2012-02-01 52.08658  
## 2012-03-01 57.34405  
## 2012-04-01 61.37219  
## 2012-05-01 62.99391  
## 2012-06-01 53.88266  
## 2012-07-01 53.14156  
## 2012-08-01 58.56470  
## 2012-09-01 54.92893  
## 2012-10-01 50.29049  
## 2012-11-01 51.19725  
## 2012-12-01 48.74725  
## 2013-01-01 51.17981  
## 2013-02-01 49.47964  
## 2013-03-01 56.16701  
## 2013-04-01 59.98588  
## 2013-05-01 59.50635  
## 2013-06-01 61.86044  
## 2013-07-01 66.67326  
## 2013-08-01 64.29302  
## 2013-09-01 67.44924  
## 2013-10-01 67.41438  
## 2013-11-01 68.03342  
## 2013-12-01 70.01260  
## 2014-01-01 55.67004  
## 2014-02-01 59.13143  
## 2014-03-01 59.98588  
## 2014-04-01 54.17039  
## 2014-05-01 53.05437  
## 2014-06-01 50.02891  
## 2014-07-01 55.18178  
## 2014-08-01 56.02752  
## 2014-09-01 57.39639  
## 2014-10-01 58.71292  
## 2014-11-01 63.97042  
## 2014-12-01 66.41169  
## 2015-01-01 65.19106  
## 2015-02-01 65.09514  
## 2015-03-01 66.94355  
## 2015-04-01 61.43321  
## 2015-05-01 62.18303  
## 2015-06-01 60.14283  
## 2015-07-01 56.87325  
## 2015-08-01 54.15296  
## 2015-09-01 49.71505  
## 2015-10-01 51.99067  
## 2015-11-01 47.53533  
## 2015-12-01 42.06858

bbby\_m = as.vector(x2)  
n2 = length(bbby\_m)  
bbby\_m\_ret = (bbby\_m[-1] - bbby\_m[-n2])/bbby\_m[-n2]  
  
  
data2 = read.table(file.choose(),header = T,sep = ",")  
data2

## TimePeriod Yield  
## 1 2011-01 0.15  
## 2 2011-02 0.13  
## 3 2011-03 0.10  
## 4 2011-04 0.06  
## 5 2011-05 0.04  
## 6 2011-06 0.04  
## 7 2011-07 0.04  
## 8 2011-08 0.02  
## 9 2011-09 0.01  
## 10 2011-10 0.02  
## 11 2011-11 0.01  
## 12 2011-12 0.01  
## 13 2012-01 0.03  
## 14 2012-02 0.09  
## 15 2012-03 0.08  
## 16 2012-04 0.08  
## 17 2012-05 0.09  
## 18 2012-06 0.09  
## 19 2012-07 0.10  
## 20 2012-08 0.10  
## 21 2012-09 0.11  
## 22 2012-10 0.10  
## 23 2012-11 0.09  
## 24 2012-12 0.07  
## 25 2013-01 0.07  
## 26 2013-02 0.10  
## 27 2013-03 0.09  
## 28 2013-04 0.06  
## 29 2013-05 0.04  
## 30 2013-06 0.05  
## 31 2013-07 0.04  
## 32 2013-08 0.04  
## 33 2013-09 0.02  
## 34 2013-10 0.05  
## 35 2013-11 0.07  
## 36 2013-12 0.07  
## 37 2014-01 0.04  
## 38 2014-02 0.05  
## 39 2014-03 0.05  
## 40 2014-04 0.03  
## 41 2014-05 0.03  
## 42 2014-06 0.04  
## 43 2014-07 0.03  
## 44 2014-08 0.03  
## 45 2014-09 0.02  
## 46 2014-10 0.02  
## 47 2014-11 0.02  
## 48 2014-12 0.03  
## 49 2015-01 0.03  
## 50 2015-02 0.02  
## 51 2015-03 0.03  
## 52 2015-04 0.02  
## 53 2015-05 0.02  
## 54 2015-06 0.02  
## 55 2015-07 0.03  
## 56 2015-08 0.07  
## 57 2015-09 0.02  
## 58 2015-10 0.02  
## 59 2015-11 0.11  
## 60 2015-12 0.22

rff2 = data2$Yield  
table(is.na(rff2))

##   
## FALSE   
## 60

rff2

## [1] 0.15 0.13 0.10 0.06 0.04 0.04 0.04 0.02 0.01 0.02 0.01 0.01 0.03 0.09 0.08  
## [16] 0.08 0.09 0.09 0.10 0.10 0.11 0.10 0.09 0.07 0.07 0.10 0.09 0.06 0.04 0.05  
## [31] 0.04 0.04 0.02 0.05 0.07 0.07 0.04 0.05 0.05 0.03 0.03 0.04 0.03 0.03 0.02  
## [46] 0.02 0.02 0.03 0.03 0.02 0.03 0.02 0.02 0.02 0.03 0.07 0.02 0.02 0.11 0.22

rfree2 = (1 + rff2/100)^(1/12) - 1  
head(rfree2)

## [1] 1.249141e-04 1.082688e-04 8.329516e-05 4.998626e-05 3.332722e-05  
## [6] 3.332722e-05

length(rfree2)

## [1] 60

d2 = tibble(bbby\_m\_ret, rfree2)  
d2 = d2 %>% mutate(bbby\_ex = bbby\_m\_ret - rfree2)  
d2

## # A tibble: 60 x 3  
## bbby\_m\_ret rfree2 bbby\_ex  
## <dbl> <dbl> <dbl>  
## 1 -0.0234 0.000125 -0.0235   
## 2 0.00313 0.000108 0.00302  
## 3 0.00249 0.0000833 0.00241  
## 4 0.163 0.0000500 0.163   
## 5 -0.0399 0.0000333 -0.0399   
## 6 0.0831 0.0000333 0.0831   
## 7 0.00206 0.0000333 0.00202  
## 8 -0.0279 0.0000167 -0.0279   
## 9 0.00791 0.00000833 0.00791  
## 10 0.0790 0.0000167 0.0790   
## # ... with 50 more rows

# mean excess returns  
bbby = d2$bbby\_ex  
  
tibble(mu\_ex2 = mean(bbby), sd\_ex2 = sd(bbby))

## # A tibble: 1 x 2  
## mu\_ex2 sd\_ex2  
## <dbl> <dbl>  
## 1 0.00195 0.0678

#c  
#Correlation   
tibble(Correlation = cor(d1$pzza\_ex, d2$bbby\_ex)) %>% round(5)

## # A tibble: 1 x 1  
## Correlation  
## <dbl>  
## 1 0.267

#d  
#Comparison  
tibble(SD\_PZZA\_1 = sd(pzza\_m\_ret), SD\_PZZA\_2 = sd(pzza),SD\_BBBY\_1 = sd(bbby\_m\_ret), SD\_BBY\_2 = sd(bbby)) %>% round(3)

## # A tibble: 1 x 4  
## SD\_PZZA\_1 SD\_PZZA\_2 SD\_BBBY\_1 SD\_BBY\_2  
## <dbl> <dbl> <dbl> <dbl>  
## 1 0.071 0.071 0.068 0.068

tibble(Correlation\_1 = cor(pzza\_m\_ret, bbby\_m\_ret),Correlation\_2 = cor(d1$pzza\_ex, d2$bbby\_ex)) %>% round(3)

## # A tibble: 1 x 2  
## Correlation\_1 Correlation\_2  
## <dbl> <dbl>  
## 1 0.267 0.267

#This comparison shows that the both are same and the slight difference is ignored  
#The answers in part (b) and (c) in exercise 1 are not much different with the answers in part (b) and (c) in exercise 3 because the federal funds rate is very less. We used excess returns to find standard deviation and correlation in exercise 3 and used mean returns to find standard deviation and correlation in exercise 1 and solution we obtained are almost close for both scenarios. The underlying reason is that the federal fund rate is quite smaller number.

#QUESTION 6.6

#PZZA  
x1 = get.hist.quote(instrument = "PZZA", start = "2010-12-01", end = "2015-12-31",   
 quote = "AdjClose", compression = "m") # monthly

## time series ends 2015-12-01

## time series ends 2015-12-01  
pzza\_m = as.vector(x1)  
n = length(pzza\_m)  
  
pzza\_m\_ret = (pzza\_m[-1] - pzza\_m[-n])/pzza\_m[-n]  
  
d1 = tibble(pzza\_m\_ret, rfree1)  
d1 = d1 %>% mutate(PZZA = pzza\_m\_ret - rfree1)  
d1

## # A tibble: 60 x 3  
## pzza\_m\_ret rfree1 PZZA  
## <dbl> <dbl> <dbl>  
## 1 0.0361 0.000125 0.0360   
## 2 0.0167 0.000108 0.0166   
## 3 0.0853 0.0000833 0.0852   
## 4 -0.0508 0.0000500 -0.0509   
## 5 0.102 0.0000333 0.102   
## 6 0.00392 0.0000333 0.00389  
## 7 -0.0616 0.0000333 -0.0617   
## 8 -0.0468 0.0000167 -0.0468   
## 9 0.0218 0.00000833 0.0218   
## 10 0.111 0.0000167 0.111   
## # ... with 50 more rows

#BBBY  
x2 = get.hist.quote(instrument = "BBBY", start = "2010-12-01", end = "2015-12-31",   
 quote = "AdjClose", compression = "m") # monthly

## time series ends 2015-12-01

## time series ends 2015-12-01  
bbby\_m = as.vector(x2)  
n = length(bbby\_m)  
  
bbby\_m\_ret = (bbby\_m[-1] - bbby\_m[-n])/bbby\_m[-n]  
  
d2 = tibble(bbby\_m\_ret, rfree1)  
d2 = d2 %>% mutate(BBBY = bbby\_m\_ret - rfree1)  
d2

## # A tibble: 60 x 3  
## bbby\_m\_ret rfree1 BBBY  
## <dbl> <dbl> <dbl>  
## 1 -0.0234 0.000125 -0.0235   
## 2 0.00313 0.000108 0.00302  
## 3 0.00249 0.0000833 0.00241  
## 4 0.163 0.0000500 0.163   
## 5 -0.0399 0.0000333 -0.0399   
## 6 0.0831 0.0000333 0.0831   
## 7 0.00206 0.0000333 0.00202  
## 8 -0.0279 0.0000167 -0.0279   
## 9 0.00791 0.00000833 0.00791  
## 10 0.0790 0.0000167 0.0790   
## # ... with 50 more rows

#NFLX  
  
x3 = get.hist.quote(instrument = "NFLX", start = "2010-12-01", end = "2015-12-31",   
 quote = "AdjClose", compression = "m") # monthly

## time series ends 2015-12-01

## time series ends 2015-12-01  
nflx\_m = as.vector(x3)  
n = length(nflx\_m)  
  
nflx\_m\_ret = (nflx\_m[-1] - nflx\_m[-n])/nflx\_m[-n]  
  
d3 = tibble(nflx\_m\_ret, rfree1)  
d3 = d3 %>% mutate(NFLX = nflx\_m\_ret - rfree1)  
d3

## # A tibble: 60 x 3  
## nflx\_m\_ret rfree1 NFLX  
## <dbl> <dbl> <dbl>  
## 1 0.218 0.000125 0.218   
## 2 -0.0346 0.000108 -0.0347  
## 3 0.151 0.0000833 0.150   
## 4 -0.0215 0.0000500 -0.0215  
## 5 0.164 0.0000333 0.164   
## 6 -0.0299 0.0000333 -0.0300  
## 7 0.0126 0.0000333 0.0125  
## 8 -0.116 0.0000167 -0.116   
## 9 -0.518 0.00000833 -0.518   
## 10 -0.275 0.0000167 -0.275   
## # ... with 50 more rows

#T  
  
X4 = get.hist.quote(instrument = "T", start = "2010-12-01", end = "2015-12-31",   
 quote = "AdjClose", compression = "m") # monthly

## time series ends 2015-12-01

## time series ends 2015-12-01  
t\_m = as.vector(X4)  
n = length(t\_m)  
  
t\_m\_ret = (t\_m[-1] - t\_m[-n])/t\_m[-n]  
  
d4 = tibble(t\_m\_ret, rfree1)  
d4 = d4 %>% mutate(T = t\_m\_ret - rfree1)  
d4

## # A tibble: 60 x 3  
## t\_m\_ret rfree1 T  
## <dbl> <dbl> <dbl>  
## 1 -0.0633 0.000125 -0.0634   
## 2 0.0463 0.000108 0.0461   
## 3 0.0786 0.0000833 0.0785   
## 4 0.0167 0.0000500 0.0166   
## 5 0.0285 0.0000333 0.0285   
## 6 -0.00475 0.0000333 -0.00479  
## 7 -0.0684 0.0000333 -0.0685   
## 8 -0.0132 0.0000167 -0.0133   
## 9 0.00140 0.00000833 0.00140  
## 10 0.0277 0.0000167 0.0277   
## # ... with 50 more rows

#VZ  
  
X5 = get.hist.quote(instrument = "VZ", start = "2010-12-01", end = "2015-12-31",   
 quote = "AdjClose", compression = "m") # monthly

## time series ends 2015-12-01

## time series ends 2015-12-01  
vz\_m = as.vector(X5)  
n <- length(vz\_m)  
  
vz\_m\_ret = (vz\_m[-1] - vz\_m[-n])/vz\_m[-n]  
  
d5 = tibble(vz\_m\_ret, rfree1)  
d5 = d5 %>% mutate(VZ = vz\_m\_ret - rfree1)  
d5

## # A tibble: 60 x 3  
## vz\_m\_ret rfree1 VZ  
## <dbl> <dbl> <dbl>  
## 1 -0.00447 0.000125 -0.00460  
## 2 0.0501 0.000108 0.0500   
## 3 0.0439 0.0000833 0.0438   
## 4 -0.0197 0.0000500 -0.0198   
## 5 -0.00991 0.0000333 -0.00994  
## 6 0.00812 0.0000333 0.00809  
## 7 -0.0521 0.0000333 -0.0521   
## 8 0.0383 0.0000167 0.0383   
## 9 0.0174 0.00000833 0.0174   
## 10 0.00489 0.0000167 0.00487  
## # ... with 50 more rows

#BIG5  
big5 = tibble(PZZA = d1$PZZA, BBBY = d2$BBBY, NFLX = d3$NFLX, T = d4$T, VZ = d5$VZ)  
  
big5

## # A tibble: 60 x 5  
## PZZA BBBY NFLX T VZ  
## <dbl> <dbl> <dbl> <dbl> <dbl>  
## 1 0.0360 -0.0235 0.218 -0.0634 -0.00460  
## 2 0.0166 0.00302 -0.0347 0.0461 0.0500   
## 3 0.0852 0.00241 0.150 0.0785 0.0438   
## 4 -0.0509 0.163 -0.0215 0.0166 -0.0198   
## 5 0.102 -0.0399 0.164 0.0285 -0.00994  
## 6 0.00389 0.0831 -0.0300 -0.00479 0.00809  
## 7 -0.0617 0.00202 0.0125 -0.0685 -0.0521   
## 8 -0.0468 -0.0279 -0.116 -0.0133 0.0383   
## 9 0.0218 0.00791 -0.518 0.00140 0.0174   
## 10 0.111 0.0790 -0.275 0.0277 0.00487  
## # ... with 50 more rows

#b  
RF1 = mean(rfree1)  
RF1

## [1] 4.664866e-05

pzza\_rf\_mean = mean(pzza\_m\_ret) - RF1  
pzza\_rf\_mean

## [1] 0.02644981

bbby\_rf\_mean = mean(bbby\_m\_ret) - RF1  
bbby\_rf\_mean

## [1] 0.001947207

nflx\_rf\_mean = mean(nflx\_m\_ret) - RF1  
nflx\_rf\_mean

## [1] 0.04577506

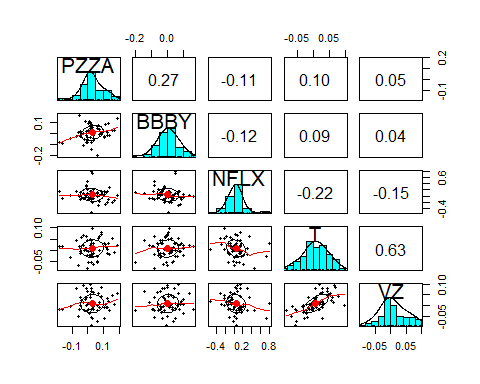
t\_rf\_mean = mean(t\_m\_ret) - RF1  
t\_rf\_mean

## [1] 0.007820163

vz\_rf\_mean = mean(vz\_m\_ret) - RF1  
vz\_rf\_mean

## [1] 0.009055951

pairs.panels(big5)



# Rbar = colMeans(big8)  
Rbar = apply(big5, MARGIN = 2, FUN = mean)  
  
SDbar = apply(big5, 2, sd)  
  
tibble(Stocks = names(big5), Rbar, SDbar)

## # A tibble: 5 x 3  
## Stocks Rbar SDbar  
## <chr> <dbl> <dbl>  
## 1 PZZA 0.0264 0.0715  
## 2 BBBY 0.00195 0.0678  
## 3 NFLX 0.0458 0.211   
## 4 T 0.00782 0.0385  
## 5 VZ 0.00906 0.0424

#ALTERNATIVELY  
x = big5  
sapply(x, function(x) c(Mean = mean(x, na.rm = TRUE), `Stand dev` = sd(x), n = length(x)))

## PZZA BBBY NFLX T VZ  
## Mean 0.02644981 0.001947207 0.04577506 0.007820163 0.009055951  
## Stand dev 0.07145934 0.067800970 0.21053699 0.038529125 0.042415292  
## n 60.00000000 60.000000000 60.00000000 60.000000000 60.000000000

#Covariance  
  
Smat = cov(big5)  
Smat

## PZZA BBBY NFLX T VZ  
## PZZA 0.0051064378 0.0012931020 -0.001622088 0.0002678709 0.0001435675  
## BBBY 0.0012931020 0.0045969715 -0.001699432 0.0002372765 0.0001249200  
## NFLX -0.0016220884 -0.0016994323 0.044325822 -0.0017500378 -0.0013030471  
## T 0.0002678709 0.0002372765 -0.001750038 0.0014844935 0.0010327064  
## VZ 0.0001435675 0.0001249200 -0.001303047 0.0010327064 0.0017990570

#Correlation  
cor(big5)

## PZZA BBBY NFLX T VZ  
## PZZA 1.00000000 0.26689341 -0.1078170 0.09729205 0.04736685  
## BBBY 0.26689341 1.00000000 -0.1190528 0.09083007 0.04343839  
## NFLX -0.10781696 -0.11905279 1.0000000 -0.21573960 -0.14591813  
## T 0.09729205 0.09083007 -0.2157396 1.00000000 0.63192460  
## VZ 0.04736685 0.04343839 -0.1459181 0.63192460 1.00000000

#QUESTION 6.10

Rbar

## PZZA BBBY NFLX T VZ   
## 0.026449810 0.001947207 0.045775058 0.007820163 0.009055951

S2 = apply(big5, 2, var)  
S2

## PZZA BBBY NFLX T VZ   
## 0.005106438 0.004596972 0.044325822 0.001484493 0.001799057

tau2 = mean((Rbar - mean(Rbar))^2)  
tau2

## [1] 0.0002567901

t = 60 # time periods  
psi = (mean(S2)/t)/(tau2 + (mean(S2/t)))  
psi

## [1] 0.4265937

muhat = psi \* mean(Rbar) + (1 - psi) \* Rbar  
muhat

## PZZA BBBY NFLX T VZ   
## 0.022934605 0.008884657 0.034015824 0.012252247 0.012960855

p\_load(ShrinkCovMat)  
cov.shrink <- shrinkcovmat.equal(t(big5))  
  
w\_mv = solve(Smat, rep(1, 5))/sum(solve(Smat, rep(1, 5)))  
w\_mv

## PZZA BBBY NFLX T VZ   
## 0.1203822 0.1455698 0.0537738 0.4219927 0.2582814

w\_mv.sh = solve(cov.shrink$Sigmahat, rep(1, 5))/sum(solve(cov.shrink$Sigmahat, rep(1, 5)))  
w\_mv.sh

## PZZA BBBY NFLX T VZ   
## 0.14060608 0.16285892 0.05720927 0.35087718 0.28844854

w\_tan = solve(Smat, Rbar)/sum(solve(Smat, Rbar))  
w\_tan

## PZZA BBBY NFLX T VZ   
## 0.41738563 -0.06679238 0.10860677 0.26771485 0.27308513

w\_tan.sh <- solve(cov.shrink$Sigmahat, muhat)/sum(solve(cov.shrink$Sigmahat, muhat))  
w\_tan.sh

## PZZA BBBY NFLX T VZ   
## 0.27672821 0.06377318 0.08775110 0.29794089 0.27380662

#QUESTION 6.11

p\_load(quadprog)  
lambda = 8 # subjective call  
mu5 = apply(big5, 2, mean) + mean(rfree1)  
A1 = cbind(rep(1, 5))  
ra5.8 = solve.QP(Dmat = lambda \* Smat, dvec = mu5, Amat = A1, bvec = 1, meq = 1)  
  
ra5.8$solution

## [1] 0.6163886 -0.2090827 0.1453468 0.1643431 0.2830041

#We might want to restrict short positions. Then  
  
lambda <- 8 # subjective call  
mu5 = apply(big5, 2, mean) + mean(rfree1)  
  
A2 = cbind(rep(1, 5), diag(5))  
b2 = c(1, rep(0, 5))  
ra5.8.nn = solve.QP(Dmat = lambda \* Smat, dvec = mu5, Amat = A2, bvec = b2, meq = 1)  
  
round(ra5.8.nn$solution, 3)

## [1] 0.540 0.000 0.143 0.070 0.247

#Thus, with the non-negativity constraint, four stocks are represented in the risk-averse portfolio with