HW 7

Estimation

3/20/2021

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

## Question 5

data1 = read.table(file.choose(),header = T,sep = ",")  
data1

## TimePeriod Yield  
## 1 2015-01 0.03  
## 2 2015-02 0.02  
## 3 2015-03 0.03  
## 4 2015-04 0.02  
## 5 2015-05 0.02  
## 6 2015-06 0.02  
## 7 2015-07 0.03  
## 8 2015-08 0.07  
## 9 2015-09 0.02  
## 10 2015-10 0.02  
## 11 2015-11 0.11  
## 12 2015-12 0.22  
## 13 2016-01 0.23  
## 14 2016-02 0.30  
## 15 2016-03 0.28  
## 16 2016-04 0.23  
## 17 2016-05 0.26  
## 18 2016-06 0.27  
## 19 2016-07 0.29  
## 20 2016-08 0.30  
## 21 2016-09 0.28  
## 22 2016-10 0.32  
## 23 2016-11 0.41  
## 24 2016-12 0.49  
## 25 2017-01 0.47  
## 26 2017-02 0.50  
## 27 2017-03 0.75  
## 28 2017-04 0.77  
## 29 2017-05 0.86  
## 30 2017-06 1.00  
## 31 2017-07 1.03  
## 32 2017-08 1.01  
## 33 2017-09 1.00  
## 34 2017-10 1.04  
## 35 2017-11 1.19  
## 36 2017-12 1.28  
## 37 2018-01 1.31  
## 38 2018-02 1.51  
## 39 2018-03 1.65  
## 40 2018-04 1.79  
## 41 2018-05 1.82  
## 42 2018-06 1.94  
## 43 2018-07 1.90  
## 44 2018-08 2.07  
## 45 2018-09 2.06  
## 46 2018-10 2.19  
## 47 2018-11 2.16  
## 48 2018-12 2.18  
## 49 2019-01 2.21  
## 50 2019-02 2.32  
## 51 2019-03 2.45  
## 52 2019-04 2.32  
## 53 2019-05 2.30  
## 54 2019-06 2.22  
## 55 2019-07 2.05  
## 56 2019-08 1.99  
## 57 2019-09 1.84  
## 58 2019-10 1.61  
## 59 2019-11 1.42  
## 60 2019-12 1.49

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

##   
## FALSE   
## 60

rff1

## [1] 0.03 0.02 0.03 0.02 0.02 0.02 0.03 0.07 0.02 0.02 0.11 0.22 0.23 0.30 0.28  
## [16] 0.23 0.26 0.27 0.29 0.30 0.28 0.32 0.41 0.49 0.47 0.50 0.75 0.77 0.86 1.00  
## [31] 1.03 1.01 1.00 1.04 1.19 1.28 1.31 1.51 1.65 1.79 1.82 1.94 1.90 2.07 2.06  
## [46] 2.19 2.16 2.18 2.21 2.32 2.45 2.32 2.30 2.22 2.05 1.99 1.84 1.61 1.42 1.49

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

## [1] 2.499656e-05 1.666514e-05 2.499656e-05 1.666514e-05 1.666514e-05  
## [6] 1.666514e-05

length(rfree1)

## [1] 60

#b  
#DPZ  
x1 = get.hist.quote(instrument = "DPZ", start = "2014-12-01", end = "2019-12-31",   
 quote = "AdjClose", compression = "m") # monthly

## time series ends 2019-12-01

## time series ends 2019-12-01  
dpz\_m = as.vector(x1)  
n = length(dpz\_m)  
  
dpz\_m\_ret = (dpz\_m[-1] - dpz\_m[-n])/dpz\_m[-n]  
  
d1 = tibble(dpz\_m\_ret, rfree1)  
d1 = d1 %>% mutate(DPZ = dpz\_m\_ret - rfree1)  
d1

## # A tibble: 60 x 3  
## dpz\_m\_ret rfree1 DPZ  
## <dbl> <dbl> <dbl>  
## 1 0.0546 0.0000250 0.0546   
## 2 0.0250 0.0000167 0.0250   
## 3 -0.00965 0.0000250 -0.00968  
## 4 0.0760 0.0000167 0.0760   
## 5 0.00751 0.0000167 0.00749  
## 6 0.0436 0.0000167 0.0436   
## 7 0.00666 0.0000250 0.00663  
## 8 -0.0694 0.0000583 -0.0695   
## 9 0.0186 0.0000167 0.0186   
## 10 -0.00864 0.0000167 -0.00866  
## # ... with 50 more rows

#KMX  
x2 = get.hist.quote(instrument = "KMX", start = "2014-12-01", end = "2019-12-31",   
 quote = "AdjClose", compression = "m") # monthly

## time series ends 2019-12-01

## time series ends 2019-12-01  
kmx\_m = as.vector(x2)  
n = length(kmx\_m)  
  
kmx\_m\_ret = (kmx\_m[-1] - kmx\_m[-n])/kmx\_m[-n]  
  
d2 = tibble(kmx\_m\_ret, rfree1)  
d2 = d2 %>% mutate(KMX = kmx\_m\_ret - rfree1)  
d2

## # A tibble: 60 x 3  
## kmx\_m\_ret rfree1 KMX  
## <dbl> <dbl> <dbl>  
## 1 -0.0673 0.0000250 -0.0673   
## 2 0.0807 0.0000167 0.0807   
## 3 0.0283 0.0000250 0.0283   
## 4 -0.0130 0.0000167 -0.0131   
## 5 0.0430 0.0000167 0.0430   
## 6 -0.0680 0.0000167 -0.0680   
## 7 -0.0257 0.0000250 -0.0257   
## 8 -0.0544 0.0000583 -0.0545   
## 9 -0.0275 0.0000167 -0.0276   
## 10 -0.00523 0.0000167 -0.00524  
## # ... with 50 more rows

#DE  
  
x3 = get.hist.quote(instrument = "DE", start = "2014-12-01", end = "2019-12-31",   
 quote = "AdjClose", compression = "m") # monthly

## time series ends 2019-12-01

## time series ends 2019-12-01  
de\_m = as.vector(x3)  
n = length(de\_m)  
  
de\_m\_ret = (de\_m[-1] - de\_m[-n])/de\_m[-n]  
  
d3 = tibble(de\_m\_ret, rfree1)  
d3 = d3 %>% mutate(DE = de\_m\_ret - rfree1)  
d3

## # A tibble: 60 x 3  
## de\_m\_ret rfree1 DE  
## <dbl> <dbl> <dbl>  
## 1 -0.0306 0.0000250 -0.0307  
## 2 0.0635 0.0000167 0.0635  
## 3 -0.0321 0.0000250 -0.0321  
## 4 0.0394 0.0000167 0.0393  
## 5 0.0349 0.0000167 0.0349  
## 6 0.0360 0.0000167 0.0360  
## 7 -0.0193 0.0000250 -0.0193  
## 8 -0.135 0.0000583 -0.135   
## 9 -0.0951 0.0000167 -0.0951  
## 10 0.0625 0.0000167 0.0624  
## # ... with 50 more rows

#HD  
  
X4 = get.hist.quote(instrument = "HD", start = "2014-12-01", end = "2019-12-31",   
 quote = "AdjClose", compression = "m") # monthly

## time series ends 2019-12-01

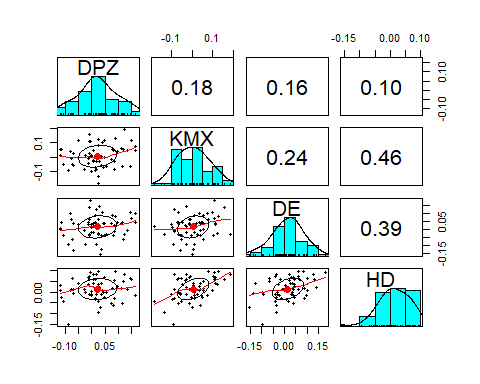
## time series ends 2019-12-01  
hd\_m = as.vector(X4)  
n = length(hd\_m)  
  
hd\_m\_ret = (hd\_m[-1] - hd\_m[-n])/hd\_m[-n]  
  
d4 = tibble(hd\_m\_ret, rfree1)  
d4 = d4 %>% mutate(HD = hd\_m\_ret - rfree1)  
d4

## # A tibble: 60 x 3  
## hd\_m\_ret rfree1 HD  
## <dbl> <dbl> <dbl>  
## 1 -0.000489 0.0000250 -0.000514  
## 2 0.0989 0.0000167 0.0989   
## 3 -0.00993 0.0000250 -0.00996   
## 4 -0.0535 0.0000167 -0.0535   
## 5 0.0415 0.0000167 0.0415   
## 6 -0.00260 0.0000167 -0.00262   
## 7 0.0587 0.0000250 0.0587   
## 8 -0.00487 0.0000583 -0.00493   
## 9 -0.00833 0.0000167 -0.00835   
## 10 0.0760 0.0000167 0.0760   
## # ... with 50 more rows

#BIG4  
big4 = tibble(DPZ = d1$DPZ, KMX = d2$KMX, DE = d3$DE, HD = d4$HD)  
  
big4

## # A tibble: 60 x 4  
## DPZ KMX DE HD  
## <dbl> <dbl> <dbl> <dbl>  
## 1 0.0546 -0.0673 -0.0307 -0.000514  
## 2 0.0250 0.0807 0.0635 0.0989   
## 3 -0.00968 0.0283 -0.0321 -0.00996   
## 4 0.0760 -0.0131 0.0393 -0.0535   
## 5 0.00749 0.0430 0.0349 0.0415   
## 6 0.0436 -0.0680 0.0360 -0.00262   
## 7 0.00663 -0.0257 -0.0193 0.0587   
## 8 -0.0695 -0.0545 -0.135 -0.00493   
## 9 0.0186 -0.0276 -0.0951 -0.00835   
## 10 -0.00866 -0.00524 0.0624 0.0760   
## # ... with 50 more rows

pairs.panels(big4)



#a  
RF1 = mean(rfree1)  
RF1

## [1] 0.0008540643

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

## [1] 0.02168727

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

## [1] 0.006560551

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

## [1] 0.01473077

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

## [1] 0.01457972

#c  
# Rbar <- colMeans(big4)  
Rbar = apply(big4, MARGIN = 2, FUN = mean)  
  
SDbar = apply(big4, 2, sd)  
  
tibble(Stocks = names(big4), Rbar, SDbar)

## # A tibble: 4 x 3  
## Stocks Rbar SDbar  
## <chr> <dbl> <dbl>  
## 1 DPZ 0.0217 0.0725  
## 2 KMX 0.00656 0.0759  
## 3 DE 0.0147 0.0695  
## 4 HD 0.0146 0.0506

#ALTERNATIVELY  
x = big4  
sapply(x, function(x) c(Mean = mean(x, na.rm = TRUE), `Stand dev` = sd(x), n = length(x)))

## DPZ KMX DE HD  
## Mean 0.02168727 0.006560551 0.01473077 0.01457972  
## Stand dev 0.07248046 0.075854795 0.06952991 0.05063022  
## n 60.00000000 60.000000000 60.00000000 60.00000000

#d  
#Covariance  
  
Smat = cov(big4)  
Smat

## DPZ KMX DE HD  
## DPZ 0.0052534164 0.0009638593 0.000812484 0.0003556754  
## KMX 0.0009638593 0.0057539499 0.001239931 0.0017717321  
## DE 0.0008124840 0.0012399306 0.004834409 0.0013581252  
## HD 0.0003556754 0.0017717321 0.001358125 0.0025634192

#e  
#Correlation  
cor(big4)

## DPZ KMX DE HD  
## DPZ 1.00000000 0.1753112 0.1612212 0.09692216  
## KMX 0.17531122 1.0000000 0.2350946 0.46132311  
## DE 0.16122123 0.2350946 1.0000000 0.38579653  
## HD 0.09692216 0.4613231 0.3857965 1.00000000

#f  
Rbar

## DPZ KMX DE HD   
## 0.021687273 0.006560551 0.014730772 0.014579717

S2 = apply(big4, 2, var)  
S2

## DPZ KMX DE HD   
## 0.005253416 0.005753950 0.004834409 0.002563419

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

## [1] 2.867565e-05

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

## [1] 0.727842

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

## DPZ KMX DE HD   
## 0.01637570 0.01225885 0.01448244 0.01444133

p\_load(ShrinkCovMat)  
cov.shrink = shrinkcovmat.equal(t(big4))  
  
w\_mv = solve(Smat, rep(1, 4))/sum(solve(Smat, rep(1, 4)))  
w\_mv

## DPZ KMX DE HD   
## 0.26116869 0.06738034 0.15503847 0.51641250

w\_mv.sh = solve(cov.shrink$Sigmahat, rep(1, 4))/sum(solve(cov.shrink$Sigmahat, rep(1, 4)))  
w\_mv.sh

## DPZ KMX DE HD   
## 0.2624339 0.1560439 0.2139336 0.3675886

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

## DPZ KMX DE HD   
## 0.4206119 -0.1608227 0.1348007 0.6054101

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

## DPZ KMX DE HD   
## 0.30823515 0.09903993 0.21323428 0.37949064

#g  
  
p\_load(quadprog)  
lambda = 4 # subjective call  
mu4 = apply(big4, 2, mean) + mean(rfree1)  
A1 = cbind(rep(1, 4))  
ra4.4 = solve.QP(Dmat = lambda \* Smat, dvec = mu4, Amat = A1, bvec = 1, meq = 1)  
  
ra4.4$solution

## [1] 0.6244698 -0.4525943 0.1089256 0.7191989

#We might want to restrict short positions. Then  
  
lambda = 4 # subjective call  
mu4 = apply(big4, 2, mean) + mean(rfree1)  
  
A2 = cbind(rep(1, 4), diag(4))  
b2 = c(1, rep(0, 4))  
ra4.4.nn = solve.QP(Dmat = lambda \* Smat, dvec = mu4, Amat = A2, bvec = b2, meq = 1)  
  
round(ra4.4.nn$solution, 3)

## [1] 0.544 0.000 0.072 0.384