Project 5

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tinytex::install_tinytex()

a.

```
hw <- read.csv("/Users/user/Desktop/Yonsei/Junior/3-2/Statistical Models in Finance/stockData.csv",sep=

r_hw5 <- (hw[-1, 3:ncol(hw)]-hw[-nrow(hw),3:ncol(hw)])/hw[-nrow(hw),3:ncol(hw)]

covmat_hw5 <- var(r_hw5)
beta_hw5 <- covmat_hw5[1,-1] / covmat_hw5[1,1]
```

$\beta < 0$ would be eliminated.

```
rrr_hw5 <- r_hw5[,-c(1,which(beta_hw5<0)+1)]

beta_new_hw5 <- rep(0,ncol(rrr_hw5))
alpha_hw5 <- rep(0,ncol(rrr_hw5))
mse_hw5 <- rep(0,ncol(rrr_hw5))
Ribar_hw5 <- rep(0,ncol(rrr_hw5))
Ratio_hw5 <- rep(0,ncol(rrr_hw5))
stock_hw5 <- rep(0,ncol(rrr_hw5))
```

Setting $R_f = 0.001$.

```
rf_hw5 <- 0.001

for(i in 1:ncol(rrr_hw5)) {
  q_hw5 <- lm(data=rrr_hw5, formula=rrr_hw5[,i]~r_hw5[,1])
  beta_new_hw5[i] <- q_hw5$coefficients[2]
  alpha_hw5[i] <- q_hw5$coefficients[1]
  mse_hw5[i] <- summary(q_hw5)$sigma^2
  Ribar_hw5[i] <- q_hw5$coefficients[1] + q_hw5$coefficients[2] * mean(r_hw5[,1])
  Ratio_hw5[i] <- (Ribar_hw5[i] - rf_hw5) / beta_new_hw5[i]
  stock_hw5[i] <- i
}

xx_hw5 <- (cbind(stock_hw5, alpha_hw5, beta_new_hw5, Ribar_hw5, mse_hw5, Ratio_hw5))

head(xx_hw5)
```

```
##      stock_hw5    alpha_hw5 beta_new_hw5   Ribar_hw5     mse_hw5  Ratio_hw5
## [1,]         1  0.008655390     1.292956 0.020022021 0.003900176 0.01471204
## [2,]         2 -0.008402523     1.329101 0.003281867 0.002299243 0.00171685
## [3,]         3  0.008128193     1.039393 0.017265705 0.002303044 0.01564923
```

```
## [4,]         4  0.010120116     1.053093 0.019378066 0.003794271 0.01745151
## [5,]         5  0.021888991     1.466752 0.034783501 0.012180070 0.02303286
## [6,]         6  0.017501358     1.602233 0.031586905 0.003738721 0.01909017
```

Order with C_i, descending.

```
A_hw5 <- xx_hw5[order(-xx_hw5[,6]),]

col1_hw5 <- rep(0,nrow(A_hw5))
col2_hw5 <- rep(0,nrow(A_hw5))
col3_hw5 <- rep(0,nrow(A_hw5))
col4_hw5 <- rep(0,nrow(A_hw5))
col5_hw5 <- rep(0,nrow(A_hw5))

col1_hw5 <- (A_hw5[,4]-rf_hw5)*A_hw5[,3]/A_hw5[,5]
col3_hw5 <- A_hw5[,3]^2 / A_hw5[,5]
for(i in 1:nrow(A_hw5)) {
  col2_hw5[i] <- sum(col1_hw5[1:i])
  col4_hw5[i] <- sum(col3_hw5[1:i])
}

head(cbind(A_hw5, col1_hw5, col2_hw5, col3_hw5, col4_hw5))
```

```
##      stock_hw5   alpha_hw5 beta_new_hw5   Ribar_hw5     mse_hw5  Ratio_hw5
## [1,]        10 0.012302336    0.4415913 0.016184453 0.001534396 0.03438576
## [2,]         7 0.014207885    0.6063894 0.019538775 0.014905473 0.03057239
## [3,]         5 0.021888991    1.4667521 0.034783501 0.012180070 0.02303286
## [4,]        21 0.014978015    1.0119216 0.023874019 0.001159385 0.02260454
## [5,]        11 0.005838142    0.3725544 0.009113341 0.002604566 0.02177760
## [6,]        19 0.011967695    0.9192540 0.020049039 0.000981385 0.02072228
##        col1_hw5  col2_hw5  col3_hw5  col4_hw5
## [1,]  4.3700073  4.370007 127.08771  127.0877
## [2,]  0.7542006  5.124208  24.66934  151.7570
## [3,]  4.0682871  9.192495 176.62967  328.3867
## [4,] 19.9646503 29.157145 883.21434 1211.6011
## [5,]  1.1605237 30.317669  53.28979 1264.8908
## [6,] 17.8430528 48.160722 861.05639 2125.9472
```

```
for(i in 1:nrow(A_hw5)) {
  col5_hw5[i] <- var(r_hw5[,1])*col2_hw5[i]/(1+var(r_hw5[,1])*col4_hw5[i])
}
```

1. Short Sales are Allowed

```
z_short_hw5 <- (A_hw5[,3]/A_hw5[,5])*(A_hw5[,6]-col5_hw5[nrow(A_hw5)])
x_short_hw5 <- z_short_hw5/sum(z_short_hw5)

Weights_with_short_hw5 <- cbind(A_hw5, col1_hw5, col2_hw5, col3_hw5, col4_hw5, col5_hw5, z_short_hw5, x

Weights_with_short_hw5
```

```
##       stock_hw5     alpha_hw5 beta_new_hw5    Ribar_hw5      mse_hw5
##  [1,]        10  0.0123023356    0.4415913  0.016184453 0.0015343962
##  [2,]         7  0.0142078854    0.6063894  0.019538775 0.0149054735
##  [3,]         5  0.0218889914    1.4667521  0.034783501 0.0121800699
##  [4,]        21  0.0149780146    1.0119216  0.023874019 0.0011593849
##  [5,]        11  0.0058381415    0.3725544  0.009113341 0.0026045662
```

```
##  [6,]        19  0.0119676949    0.9192540  0.020049039 0.0009813850
##  [7,]         6  0.0175013580    1.6022329  0.031586905 0.0037387208
##  [8,]         9  0.0087282627    0.8325653  0.016047510 0.0025530829
##  [9,]        22  0.0034927433    0.2703064  0.005869061 0.0004154065
## [10,]        12  0.0047991903    0.4144258  0.008442489 0.0010992542
## [11,]         4  0.0101201161    1.0530930  0.019378066 0.0037942714
## [12,]        20  0.0097526759    1.1652413  0.019996544 0.0018201982
## [13,]        13  0.0047973438    0.5458007  0.009595586 0.0012944845
## [14,]         3  0.0081281929    1.0393931  0.017265705 0.0023030445
## [15,]         1  0.0086553902    1.2929557  0.020022021 0.0039001757
## [16,]        25  0.0077748368    1.2715311  0.018953119 0.0043443846
## [17,]        27  0.0034913903    0.6918690  0.009573748 0.0011392389
## [18,]        28  0.0023034128    0.6549028  0.008060794 0.0018692960
## [19,]        18  0.0012257745    0.8254525  0.008482492 0.0007699461
## [20,]        17  0.0011692396    0.8307181  0.008472248 0.0007589588
## [21,]         8  0.0008588360    2.2070856  0.020261764 0.0060171497
## [22,]        23 -0.0003583592    1.3342432  0.011371238 0.0029731850
## [23,]        15 -0.0008562845    0.9826892  0.007782731 0.0021138563
## [24,]        16 -0.0007152736    0.8343952  0.006620060 0.0028848995
## [25,]        24 -0.0019388661    0.7124890  0.004324766 0.0031221621
## [26,]         2 -0.0084025226    1.3291008  0.003281867 0.0022992429
## [27,]        29 -0.0090743876    1.1615438  0.001136975 0.0056590552
## [28,]        14 -0.0078580236    0.9869324  0.000818295 0.0015995332
## [29,]        30 -0.0195785627    1.7986942 -0.003765884 0.0072581265
## [30,]        26 -0.0166063667    1.1917612 -0.006129357 0.0063462533
##           Ratio_hw5    col1_hw5   col2_hw5  col3_hw5   col4_hw5    col5_hw5
##  [1,]  0.0343857582  4.37000725   4.370007 127.08771   127.0877 0.004509034
##  [2,]  0.0305723920  0.75420063   5.124208  24.66934   151.7570 0.005155987
##  [3,]  0.0230328633  4.06828705   9.192495 176.62967   328.3867 0.007853704
##  [4,]  0.0226045359 19.96465033  29.157145 883.21434  1211.6011 0.014197508
##  [5,]  0.0217776019  1.16052373  30.317669  53.28979  1264.8908 0.014389225
##  [6,]  0.0207222813 17.84305280  48.160722 861.05639  2125.9472 0.016226513
##  [7,]  0.0190901749 13.10805163  61.268773 686.63863  2812.5859 0.016764537
##  [8,]  0.0180736690  4.90702222  66.175796 271.50117  3084.0870 0.016855066
##  [9,]  0.0180131145  3.16831482  69.344110 175.88934  3259.9764 0.016904721
## [10,]  0.0179585592  2.80586522  72.149976 156.24111  3416.2175 0.016943388
## [11,]  0.0174515124  5.10079848  77.250774 292.28404  3708.5015 0.016976025
## [12,]  0.0163026696 12.16106973  89.411844 745.95573  4454.4572 0.016881190
## [13,]  0.0157485802  3.62420510  93.036049 230.12901  4684.5863 0.016834029
## [14,]  0.0156492321  7.34091861 100.376968 469.09130  5153.6776 0.016741334
## [15,]  0.0147120436  6.30603143 106.682999 428.63056  5582.3081 0.016605941
## [16,]  0.0141192925  5.25458758 111.937587 372.15658  5954.4647 0.016469780
## [17,]  0.0123921556  5.20690624 117.144493 420.17760  6374.6423 0.016232369
## [18,]  0.0107814372  2.47372988 119.618223 229.44342  6604.0857 0.016064406
## [19,]  0.0090647148  8.02191428 127.640137 884.96047  7489.0462 0.015320875
## [20,]  0.0089949256  8.17874657 135.818884 909.26228  8398.3085 0.014698396
## [21,]  0.0087272393  7.06519929 142.884083 809.55719  9207.8657 0.014217399
## [22,]  0.0077731241  4.65418562 147.538268 598.75355  9806.6192 0.013855052
## [23,]  0.0069022143  3.15315499 150.691423 456.83238 10263.4516 0.013569043
## [24,]  0.0067354898  1.62548152 152.316905 241.33086 10504.7824 0.013423703
## [25,]  0.0046664107  0.75872404 153.075629 162.59264 10667.3751 0.013299990
## [26,]  0.0017168500  1.31905635 154.394685 768.30027 11435.6754 0.012575156
## [27,]  0.0001179246  0.02811458 154.422800 238.41152 11674.0869 0.012337867
## [28,] -0.0001841109 -0.11211431 154.310686 608.94987 12283.0368 0.011756901
```

```
## [29,] -0.0026496357 -1.18107181 153.129614 445.74876 12728.7855 0.011283703
## [30,] -0.0059822030 -1.33882007 151.790794 223.80051 12952.5860 0.011003586
##       z_short_hw5  x_short_hw5
##  [1,]  6.72926855  0.297016862
##  [2,]  0.79610466  0.035138516
##  [3,]  1.44859325  0.063938097
##  [4,] 10.12541359  0.446916117
##  [5,]  1.54110377  0.068021331
##  [6,]  9.10340862  0.401806800
##  [7,]  3.46551629  0.152961167
##  [8,]  2.30556770  0.101763286
##  [9,]  4.56112412  0.201319172
## [10,]  2.62206839  0.115733013
## [11,]  1.78961000  0.078989914
## [12,]  3.39232869  0.149730809
## [13,]  2.00065822  0.088305173
## [14,]  2.09663875  0.092541568
## [15,]  1.22939868  0.054263273
## [16,]  0.91191674  0.040250236
## [17,]  0.84328925  0.037221152
## [18,] -0.07782938 -0.003435238
## [19,] -2.07864748 -0.091747468
## [20,] -2.19857918 -0.097041021
## [21,] -0.83496229 -0.036853616
## [22,] -1.44969876 -0.063986891
## [23,] -1.90664521 -0.084155621
## [24,] -1.23445518 -0.054486457
## [25,] -1.44616708 -0.063831010
## [26,] -5.36829265 -0.236946025
## [27,] -2.23432577 -0.098618806
## [28,] -6.90295208 -0.304682916
## [29,] -3.38351386 -0.149341739
## [30,] -3.18975678 -0.140789677
```

Thus, the last column is the percentage of each stock.
2. Short Sales are NOT Allowed

```
table1_hw5 <- cbind(A_hw5, col1_hw5, col2_hw5, col3_hw5, col4_hw5, col5_hw5)
table2_hw5 <- table1_hw5[1:which(col5_hw5==max(col5_hw5)),]

z_no_short_hw5 <- (table2_hw5[,3]/table2_hw5[,5]) * (table2_hw5[,6] - max(col5_hw5))

x_no_short_hw5 <- z_no_short_hw5 / sum(z_no_short_hw5)

Weights_no_short_hw5 <- cbind(table2_hw5, z_no_short_hw5, x_no_short_hw5)

Weights_no_short_hw5
```

```
##       stock_hw5   alpha_hw5 beta_new_hw5   Ribar_hw5      mse_hw5  Ratio_hw5
##  [1,]        10 0.012302336    0.4415913 0.016184453 0.0015343962 0.03438576
##  [2,]         7 0.014207885    0.6063894 0.019538775 0.0149054735 0.03057239
##  [3,]         5 0.021888991    1.4667521 0.034783501 0.0121800699 0.02303286
##  [4,]        21 0.014978015    1.0119216 0.023874019 0.0011593849 0.02260454
##  [5,]        11 0.005838142    0.3725544 0.009113341 0.0026045662 0.02177760
##  [6,]        19 0.011967695    0.9192540 0.020049039 0.0009813850 0.02072228
```

```
##  [7,]         6 0.017501358    1.6022329 0.031586905 0.0037387208 0.01909017
##  [8,]         9 0.008728263    0.8325653 0.016047510 0.0025530829 0.01807367
##  [9,]        22 0.003492743    0.2703064 0.005869061 0.0004154065 0.01801311
## [10,]        12 0.004799190    0.4144258 0.008442489 0.0010992542 0.01795856
## [11,]         4 0.010120116    1.0530930 0.019378066 0.0037942714 0.01745151
##         col1_hw5  col2_hw5  col3_hw5  col4_hw5    col5_hw5 z_no_short_hw5
##  [1,]  4.3700073  4.370007 127.08771  127.0877 0.004509034      5.0104316
##  [2,]  0.7542006  5.124208  24.66934  151.7570 0.005155987      0.5531319
##  [3,]  4.0682871  9.192495 176.62967  328.3867 0.007853704      0.7293785
##  [4,] 19.9646503 29.157145 883.21434 1211.6011 0.014197508      4.9126156
##  [5,]  1.1605237 30.317669  53.28979 1264.8908 0.014389225      0.6868125
##  [6,] 17.8430528 48.160722 861.05639 2125.9472 0.016226513      3.5090829
##  [7,] 13.1080516 61.268773 686.63863 2812.5859 0.016764537      0.9060214
##  [8,]  4.9070222 66.175796 271.50117 3084.0870 0.016855066      0.3579440
##  [9,]  3.1683148 69.344110 175.88934 3259.9764 0.016904721      0.6748380
## [10,]  2.8058652 72.149976 156.24111 3416.2175 0.016943388      0.3704217
## [11,]  5.1007985 77.250774 292.28404 3708.5015 0.016976025      0.1319708
##       x_no_short_hw5
##  [1,]    0.280812095
##  [2,]    0.031000551
##  [3,]    0.040878374
##  [4,]    0.275329947
##  [5,]    0.038492745
##  [6,]    0.196668269
##  [7,]    0.050778414
##  [8,]    0.020061146
##  [9,]    0.037821624
## [10,]    0.020760467
## [11,]    0.007396367
```

b.

```r
blume1_hw5 <- read.csv("/Users/user/Desktop/Yonsei/Junior/3-2/Statistical Models in Finance/stockData_hw
blume2_hw5 <- read.csv("/Users/user/Desktop/Yonsei/Junior/3-2/Statistical Models in Finance/stockData_hw

vasicek_hw5 <- read.csv("/Users/user/Desktop/Yonsei/Junior/3-2/Statistical Models in Finance/stockData_h

blume1_adj_hw5 <- (blume1_hw5[-1, 3:ncol(blume1_hw5)]-blume1_hw5[-nrow(blume1_hw5),3:ncol(blume1_hw5)])/
blume2_adj_hw5 <- (blume2_hw5[-1, 3:ncol(blume2_hw5)]-blume2_hw5[-nrow(blume2_hw5),3:ncol(blume2_hw5)])/

vasicek_adj_hw5 <- (vasicek_hw5[-1, 3:ncol(vasicek_hw5)]-vasicek_hw5[-nrow(vasicek_hw5),3:ncol(vasicek_h

covmat_vasicek_hw5 <- cov(vasicek_adj_hw5)

beta_vasicek_hw5 <- covmat_vasicek_hw5[1,-1] / covmat_vasicek_hw5[1,1]

var_beta_vasicek_hw5 <- rep(0,29)

for (i in 1:29) {
  q_vasicek_hw5 <- lm(data=vasicek_adj_hw5, formula=vasicek_adj_hw5[,i+1]~vasicek_adj_hw5[,1])
  var_beta_vasicek_hw5[i] <- vcov(q_vasicek_hw5)[2,2]
}

beta_adj_vasicek_hw5 <- var_beta_vasicek_hw5*mean(beta_vasicek_hw5)/(var(beta_vasicek_hw5)+var_beta_vasi
```

```
                        + var(beta_vasicek_hw5)*beta_vasicek_hw5/(var(beta_vasicek_hw5)+var_beta_vasicek
```

```
##      AAPL       IBM     GOOGL      META      NFLX      AMZN      TSLA       NKE
## 0.6853000 0.7587961 0.7564781 0.4403143 0.3200798 0.8936009 0.2161433 0.4357601
##       MCD       WMT        KO       PEP       XOM       CVX      SHEL     BRK.A
## 0.4356265 0.2152959 0.4750701 0.5615389 0.6651619 0.7009526 0.5436994 0.7578331
##     BRK.B         V       JPM        MA      C.PJ        MS      HSBC        BA
## 0.7618083 0.8738200 0.8660196 0.8835770 0.3138952 0.8158667 0.4417706 0.7621666
##        GE       JNJ       PFE       PKX      BIDU
## 0.3925367 0.5680888 0.6943486 0.5381654 0.6942291
```

```
beta_adj_vasicek_hw5
```

```
##  [1] 0.36845126 0.26943304 0.26492260 0.33569204 0.66831869 0.40924025
##  [7] 0.63646220 0.28401303 0.17951606 0.30202968 0.14894242 0.15644440
## [13] 0.18939160 0.27380531 0.31493018 0.10891350 0.10705420 0.15104667
## [19] 0.23116284 0.17225626 0.06057136 0.31118376 0.30671126 0.32321459
## [25] 0.35527820 0.14932560 0.16545571 0.45484034 0.50542767
```

c.

```
PRESS_vasicek_hw5 <- sum((beta_adj_vasicek_hw5-beta_vasicek_hw5)^2) / 29

PRESS_vasicek_hw5
```

```
## [1] 0.4693639
```