Project - STATS 183

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1. Allocation

Stock	Markowitz	Equal	SIM	SIMSS	CCM	CCMSS	MGMSS
ATVI	0.0846	0.0400	0.0874	0.1258	0.0266	0.4196	0.1485
TTWO	-0.0472	0.0400	0.0000	-0.0006	0.0000	-0.2019	-0.0129
WMT	-0.7060	0.0400	0.0713	0.1796	0.0000	0.2914	-0.0331
KNM	-0.0865	0.0400	0.0000	-0.0098	0.0000	-0.2742	-0.0144
NTDOY	0.3539	0.0400	0.1308	0.1553	0.1144	0.6339	0.1948
EXPO	0.5696	0.0400	0.2934	0.3407	0.4416	1.6466	0.4825
JCP	-0.0726	0.0400	0.0000	-0.0875	0.0000	-0.4536	-0.1710
TW	0.4951	0.0400	0.1215	0.1687	0.0786	0.6269	0.2737
HURN	0.1303	0.0400	0.0000	0.0330	0.0000	-0.0860	0.0770
KSS	-0.2697	0.0400	0.0000	0.0143	0.0000	-0.1277	-0.1054
JNJ	0.4553	0.0400	0.0000	0.0752	0.0000	0.1723	0.1783
TJX	0.3056	0.0400	0.1903	0.2784	0.2519	1.2017	0.2687
NVS	0.5268	0.0400	0.0000	0.0690	0.0000	-0.0706	0.0736
RMTI	0.0386	0.0400	0.0640	0.0814	0.0073	0.2501	0.1107
GSK	-0.1602	0.0400	0.0000	-0.2417	0.0000	-1.4430	-0.3367
AEL	0.0495	0.0400	0.0000	-0.0092	0.0000	-0.1616	-0.0276
PRU	0.0941	0.0400	0.0000	-0.0458	0.0000	-0.1151	-0.0060
SLF	-0.5253	0.0400	0.0000	-0.2416	0.0000	-0.5367	-0.2409
MFC	0.0047	0.0400	0.0000	-0.1036	0.0000	-0.3977	-0.1811
MET	-0.5651	0.0400	0.0000	-0.1489	0.0000	-0.2816	-0.0861
F	0.2277	0.0400	0.0083	0.0572	0.0185	0.2080	0.0731
HMC	-0.1020	0.0400	0.0000	0.1178	0.0000	0.3320	0.1457
ZAAP	0.0650	0.0400	0.0328	0.0371	0.0229	0.1434	0.0473
DDS	0.2282	0.0400	0.0000	0.0623	0.0065	0.2109	0.0317
TTM	-0.0945	0.0400	0.0000	0.0928	0.0318	0.3149	0.1096

2. Expected Returns

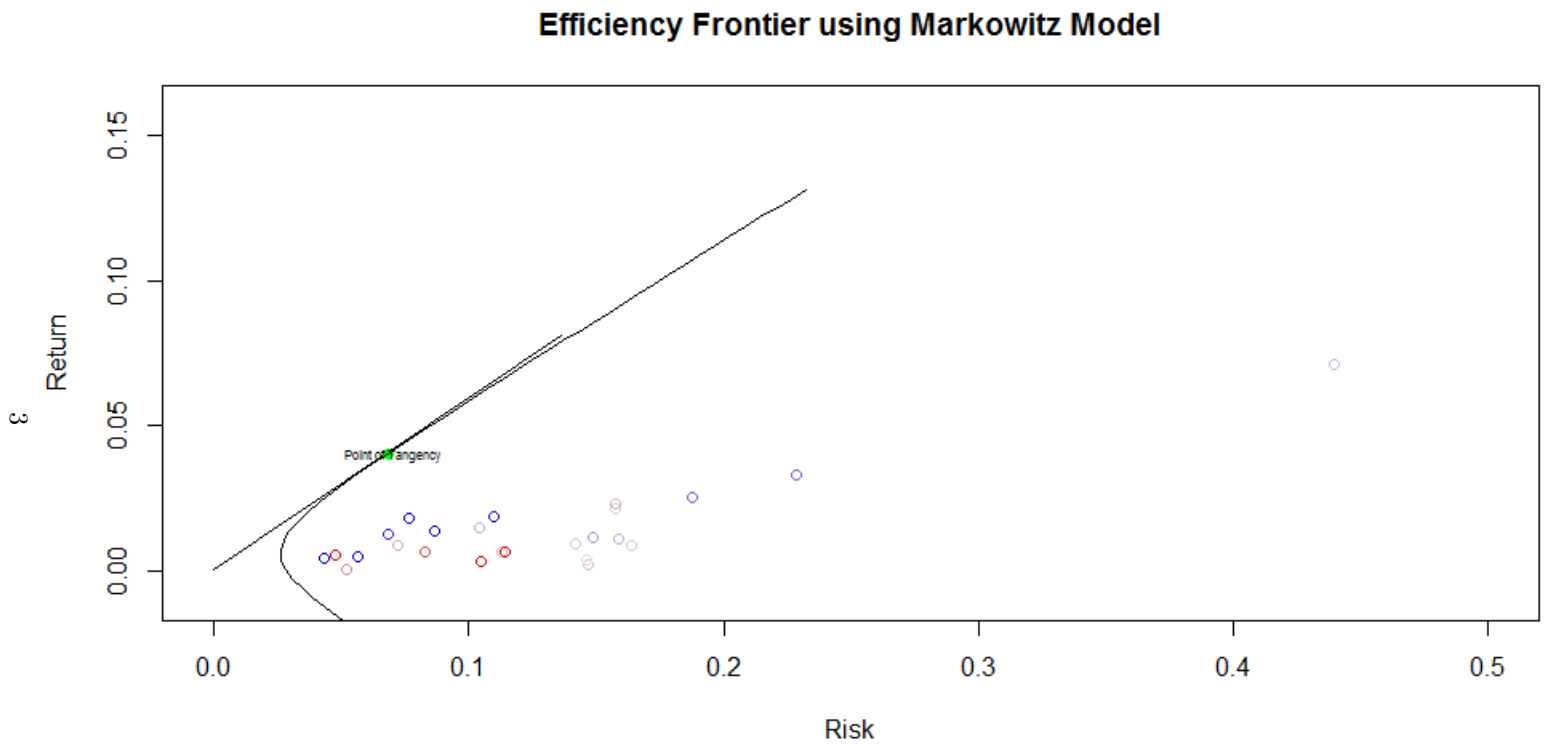
Markowitz	Equal	SIM	SIMSS	CCM	CCMSS	MGMSS
0.0404	0.0139	0.0176	0.0270	0.0182	0.0956	0.0327

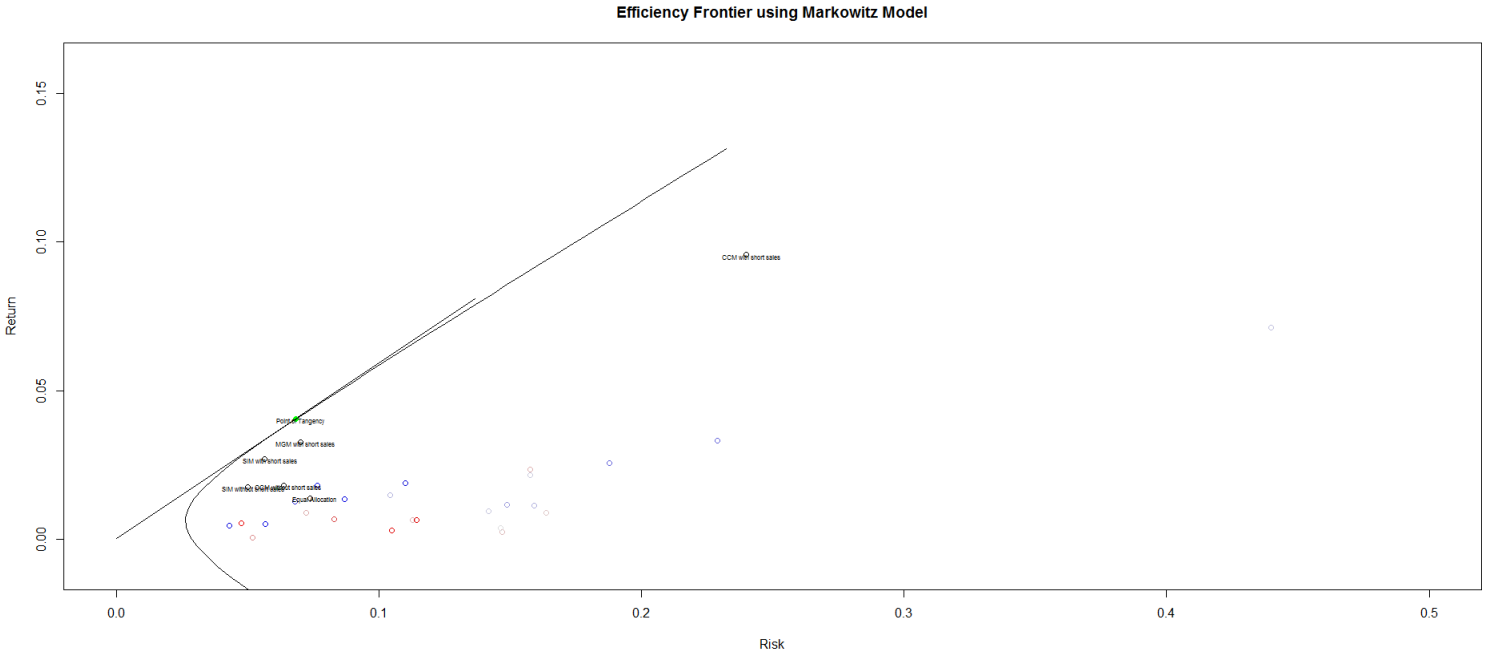
3. Risk

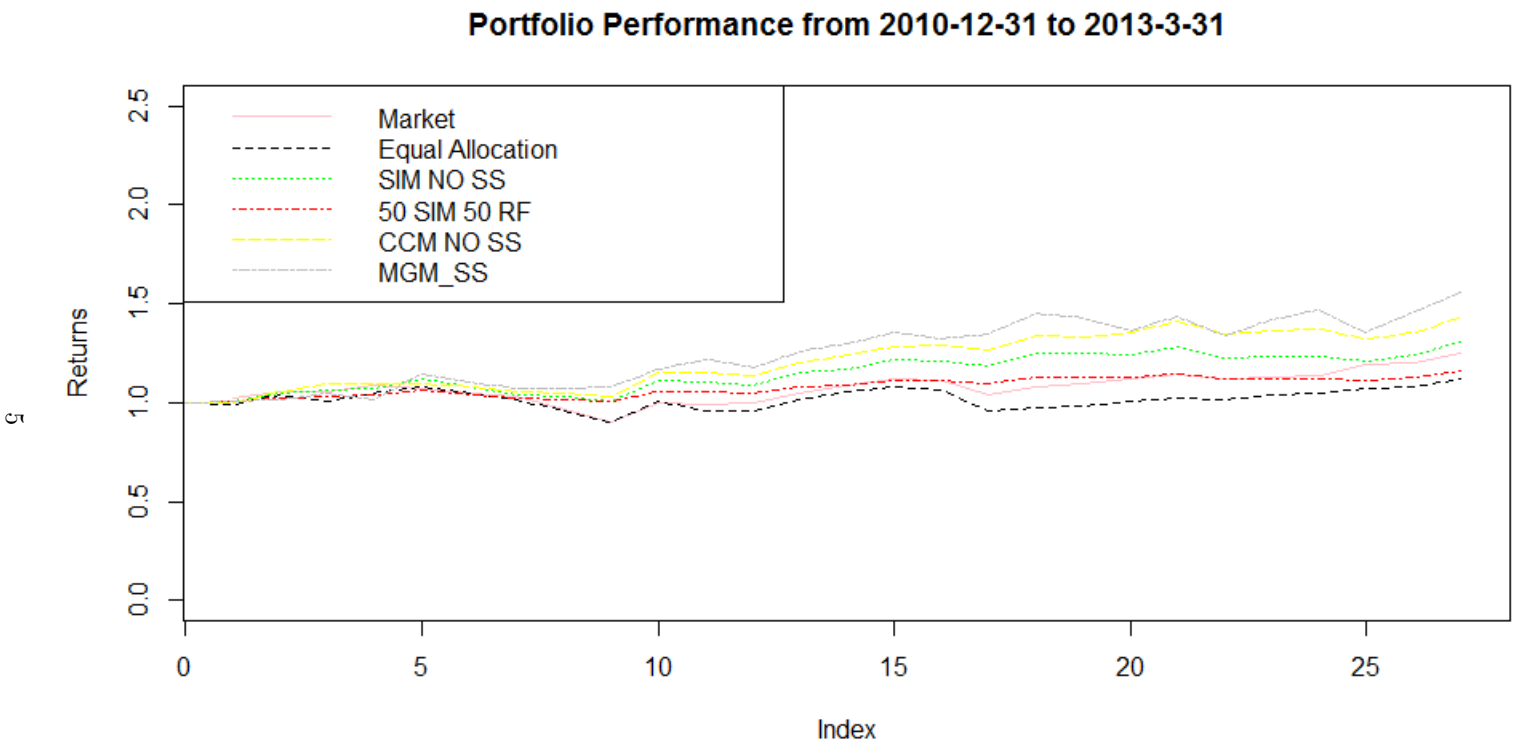
Markowitz	Equal	SIM	SIMSS	CCM	CCMSS	MGMSS
0.0682	0.0054	0.0500	0.0564	0.0637	0.2399	0.0700

4. Alphas and Betas for SIM and SIMSS

	Alpha	Beta (Unadjusted)
SIM	0.0168	0.6894
SIMSS	0.02668	0.2766


Efficiency Frontier using Markowitz Model
Return
Risk
0.00
0.05
0.10
0.15
0.0
0.1
0.2
0.3
0.4
0.5


Efficiency Frontier using Markowitz Model
Return
Risk
0.00
0.05
0.10
0.15
0.0
0.1
0.2
0.3
0.4
0.5
CCM with short sales
Point of Tangency
MGM with short sales
SIM with short sales
Equal Allocation


Portfolio Performance from 2010-12-31 to 2013-3-31
Market
Equal Allocation
SIM NO SS
50 SIM 50 RF
CCM NO SS
MGM_SS
Returns
0.0
0.5
1.0
1.5
2.0
2.5
0
5
10
15
20
25
Index

5. Discussion

   The Multigroup Model portfolio did the best overall, while the Equal Allocation portfolio did the worst. The average returns for the period are as follows: Equal Allocation = 11.8%, SIM = 30.3%, 50% SIM and 50% Risk-Free = 15.7%, CCM = 42.6%, and MGM = 55.6%.The MGM, CCM, and SIM porfolios overall, did better than the S&P500. The 50% SIM and 50% Risk-Free portfolio did as much/less than the S&P500 initially, but eventually performed worse over time. The Equal Allocation portfolio did worse than the S&P500 overall. For all my portfolios, I used Rf= 0.0004, which was the 3 month bond rate last month.

   I initially thought that the stocks I chose were good enough data, but it turns out that some of the stocks I chose didn't have data before 2007. I saw this mistake by the time I was done coding everything so it was not too much trouble, but I had to look at several other stocks in other industries because for some porfolios, my risk-free rate was not low enough. I figured that this was because I picked some stocks at random; they simply didn't perform well during the initial period. The code discussed in class definitely helped, especially the stockPortfolio package.

Code:

```
> #######project1 is for Exercise A#######
> #######test is for Exercise B#######
>
> ####Load up data
> library(stockPortfolio)
> ticker <- c("ATVI", "TTWO", "WMT", "KNM", "NTDOY", "EXPO",
"JCP", "TW", "HURN", "KSS", "JNJ", "TJX", "NVS",
"RMTI", "GSK", "AEL", "PRU", "SLF", "MFC", "MET", "F", "HMC",
"ZAAP", "DDS", "TTM", "^GSPC")
>
> project1 <- getReturns(ticker, start='2005-12-31', end = '2010-12-31')
> ####3 month Risk-free rate & 6 month Risk-free rate
> Rf1 = 0.0004
> Rf2 = 0.0008
> ####
>
> #Exercise A
> #1
> cmarko <- stockModel(project1, Rf = Rf1, model = "none", drop=26)
> opcmarko <- optimalPort(cmarko)
> opcmarko
Model: no model specified.
Expected return: 0.04195728
Risk estimate:   0.06923724

Portfolio allocation:
       ATVI        TTWO         WMT         KNM       NTDOY        EXPO
 0.08932939 -0.05174448 -0.71062257 -0.09865849  0.39684528  0.55538032
        JCP          TW        HURN         KSS         JNJ         TJX
-0.06485910  0.51209696  0.13958392 -0.28002219  0.43653257  0.30906819
        NVS        RMTI         GSK         AEL         PRU         SLF
 0.53379832  0.04147533 -0.14117198  0.06196067  0.10575409 -0.58036425
        MFC         MET           F         HMC        ZAAP         DDS
 0.04351393 -0.59984452  0.22638246 -0.12691103  0.06396188  0.22040490
        TTM
-0.08188959
> plot(opcmarko, xlim=c(0,0.5), ylim=c(-0.01,0.16), main="Efficiency Frontier using Markowitz Model")
> slope <- (opcmarko$risk-Rf1)/opcmarko$risk
> segments(0,Rf1,2*opcmarko$risk,Rf1+slope*2*opcmarko$R)
> points(opcmarko$risk, opcmarko$R, pch=19, col="green") #Point of tangency
> text(opcmarko$risk+0.002, opcmarko$R-0.0005, "Point of Tangency", cex = 0.5)
> opcmarko$R #Expected return at point
[1] 0.04195728
> opcmarko$risk #risk at point
[1] 0.06923724
>
> #2
> portPossCurve(cmarko,add=TRUE, riskRange = 9)
>
> #3 equal allocation
> x3 = rep(1/25, times = 25)
> rbar3 =  cmarko$R %*% x3
> sd3 = (t(x3) %*% cmarko$COV %*% x3)^0.5
> points(sd3, rbar3)
> text(sd3+0.002, rbar3-0.0005, "Equal Allocation", cex = 0.5)
>
> #4 assume SIM holds, Rf borrowing & lending exists, use excess return to beta ratio
> csim <- stockModel(project1, model = "SIM", Rf= Rf1, index=26, shortSelling = FALSE)
> opcsim <- optimalPort(csim, Rf = Rf1, shortSell = FALSE)
> opcsim$X
      ATVI       TTWO        WMT        KNM      NTDOY       EXPO        JCP
0.08529009 0.00000000 0.06754295 0.00000000 0.15298270 0.28836934 0.00000000
       TW       HURN        KSS        JNJ        TJX        NVS       RMTI
0.11868766 0.00000000 0.00000000 0.00000000 0.18519110 0.00000000 0.06275569
      GSK        AEL        PRU        SLF        MFC        MET          F
0.00000000 0.00000000 0.00000000 0.00000000 0.00000000 0.00000000 0.00693531
      HMC       ZAAP        DDS        TTM
0.00000000 0.03224515 0.00000000 0.00000000
> opcsim$R
[1] 0.01799278
> opcsim$risk
[1] 0.05043353
> opcsimA <- csim$alpha %*% opcsim$X
> opcsimB <- csim$beta %*% opcsim$X
> points(opcsim$risk, opcsim$R)
> text(opcsim$risk+0.002, opcsim$R-0.0005, "SIM without short sales", cex = 0.5)
>
> csimss <- stockModel(project1, Rf = Rf1, model = "SIM", index=26, shortSelling = TRUE)
> opcsimss <- optimalPort(csimss, Rf=Rf1, shortSell = TRUE)
> opcsimss$X
         ATVI          TTWO           WMT           KNM         NTDOY
 0.1247371305 -0.0007980814  0.1778681765 -0.0100927758  0.1746790188
         EXPO           JCP            TW          HURN           KSS
 0.3378997026 -0.0873127093  0.1672156520  0.0325909614  0.0135574573
          JNJ           TJX           NVS          RMTI           GSK
 0.0731676154  0.2756212460  0.0678243813  0.0807532463 -0.2410656776
          AEL           PRU           SLF           MFC           MET
-0.0094566912 -0.0461608270 -0.2412079578 -0.1034158570 -0.1490927615
            F           HMC          ZAAP           DDS           TTM
```

```
 0.0566352133  0.1163246969  0.0367686685  0.0613958504  0.0915643213
> opcsimss$R
[1] 0.02747013
> opcsimss$risk
[1] 0.05675291
> opcsimssA <- csimss$alpha %*% opcsimss$X
> opcsimssB <- csimss$beta %*% opcsimss$X
> points(opcsimss$risk, opcsimss$R)
> text(opcsimss$risk+0.002, opcsimss$R-0.0005, "SIM with short sales", cex = 0.5)
>
> #5 constant correlation model
> ccm <- stockModel(project1, model = "CCM", Rf= Rf1, shortSelling = FALSE)
> opccm <- optimalPort(ccm, Rf = Rf1, shortSell = FALSE)
> opccm$X
       ATVI        TTWO         WMT         KNM       NTDOY        EXPO
0.021142442 0.000000000 0.000000000 0.000000000 0.164215361 0.429725066
        JCP          TW        HURN         KSS         JNJ         TJX
0.000000000 0.071558496 0.000000000 0.000000000 0.000000000 0.240516024
        NVS        RMTI         GSK         AEL         PRU         SLF
0.000000000 0.003857114 0.000000000 0.000000000 0.000000000 0.000000000
        MFC         MET           F         HMC        ZAAP         DDS
0.000000000 0.000000000 0.015948118 0.000000000 0.021431629 0.003571348
        TTM       ^GSPC
0.028034403 0.000000000
> opccm$R
[1] 0.01855626
> opccm$risk
[1] 0.06395478
> points(opccm$risk, opccm$R)
> text(opccm$risk+0.002, opccm$R-0.0005, "CCM without short sales", cex = 0.5)
>
> ccmss <- stockModel(project1, model = "CCM", Rf= Rf1, shortSelling = TRUE)
> opccmss <- optimalPort(ccmss, Rf = Rf1, shortSell = TRUE)
> opccmss$X
       ATVI        TTWO         WMT         KNM       NTDOY        EXPO
 0.42441743 -0.21102379  0.28573114 -0.28684831  0.79394745  1.68106424
        JCP          TW        HURN         KSS         JNJ         TJX
-0.46967878  0.63591715 -0.09246743 -0.13859398  0.16258926  1.22179156
        NVS        RMTI         GSK         AEL         PRU         SLF
-0.08355655  0.25258954 -1.49255990 -0.17027203 -0.12188150 -0.55665946
        MFC         MET           F         HMC        ZAAP         DDS
-0.41261950 -0.29438841  0.21061012  0.33193082  0.14572272  0.21304431
        TTM       ^GSPC
 0.31911385 -1.34791995
> opccmss$R
[1] 0.1011361
> opccmss$risk
[1] 0.2498319
> points(opccmss$risk, opccmss$R)
> text(opccmss$risk+0.002, opccmss$R-0.0005, "CCM with short sales", cex = 0.5)
>
> #6 multigroup model
> ind <- c('Multimedia & Graphics Software','Multimedia & Graphics Software',
'Department Stores','Multimedia & Graphics Software','Multimedia & Graphics Software',
'Management Services','Department Stores','Management Services','Management Services','Department Stores',
'Drug Manufacturers','Department Stores','Drug Manufacturers','Drug Manufacturers','Drug Manufacturers',
'Life Insurance','Life Insurance','Life Insurance','Life Insurance','Life Insurance','Auto Manufacturers','Auto Manufacturers',
'Auto Manufacturers','Department Stores','Auto Manufacturers','Index')
> data <- as.data.frame(cbind(ticker, ind))
> ticker <- data$ticker
> ind <- data$ind
>
> cmgmss <- stockModel(project1, model = "MGM", Rf= Rf1, industry = ind, drop=26)
> opcmgmss <- optimalPort(cmgmss, Rf = Rf1)
> opcmgmss$X
       ATVI        TTWO         WMT         KNM       NTDOY        EXPO
 0.14422025 -0.01534025 -0.03470378 -0.01788193  0.22321740  0.47989176
        JCP          TW        HURN         KSS         JNJ         TJX
-0.17063374  0.27230089  0.07659623 -0.10581209  0.17567345  0.26548505
        NVS        RMTI         GSK         AEL         PRU         SLF
 0.07187226  0.10956065 -0.33625980 -0.02838278 -0.00672602 -0.24077772
        MFC         MET           F         HMC        ZAAP         DDS
-0.18109748 -0.08679255  0.07285765  0.14539446  0.04711306  0.03105951
        TTM
 0.10916553
> opcmgmss$R
[1] 0.03342752
> opcmgmss$risk
[1] 0.07056614
> points(opcmgmss$risk, opcmgmss$R)
> text(opcmgmss$risk+0.002, opcmgmss$R-0.0005, "MGM with short sales", cex = 0.5)
>
> #7 Graph
> plot(opcmarko, xlim=c(0,0.5), ylim=c(-0.01,0.16), main="Risk and Returns of Portfolios")
> slope <- (opcmarko$risk-Rf1)/opcmarko$risk
> segments(0,Rf1,2*opcmarko$risk,Rf1+slope*2*opcmarko$R)
> points(opcmarko$risk, opcmarko$R, pch=19, col="green") #Point of tangency
> text(opcmarko$risk+0.002, opcmarko$R-0.0005, "Point of Tangency", cex = 0.5)
> points(sd3, rbar3)
> text(sd3+0.002, rbar3-0.0005, "Equal Allocation", cex = 0.5)
> points(opcsim$risk, opcsim$R)
```

```
> text(opcsim$risk+0.002, opcsim$R-0.0005, "SIM without short sales", cex = 0.5)
> points(opcsimss$risk, opcsimss$R)
> text(opcsimss$risk+0.002, opcsimss$R-0.0005, "SIM with short sales", cex = 0.5)
> points(opccmss$risk, opccmss$R)
> text(opccmss$risk+0.002, opccmss$R-0.0005, "CCM with short sales", cex = 0.5)
> points(opcmgmss$risk, opcmgmss$R)
> text(opcmgmss$risk+0.002, opcmgmss$R-0.0005, "MGM with short sales", cex = 0.5)
>
> #Exercise B
> #Test Period
> #504a50riskfree
> opcsim50 <- opcsim
> opcsim50$X <- opcsim50$X/2
> opcsim50$X[26] <- as.numeric(0.5)
> opcsim50$R <- (opcsim50$R)/2+(0.5*Rf1)
> opcsim50$risk <- (opcsim50$risk)/2
>
> test <- getReturns(ticker, start='2010-12-31', end = '2013-03-31')
> test1 <- test
> test1$R <- cbind(test1$R, rep(Rf1, times=27))
>
> tpEqu <- testPort(test$R[,-26], X=rep(1/25,25))
Warning message:
In testPort(test$R[, -26], X = rep(1/25, 25)) :
  Allocation X was standardized
> tpopsim1 <- testPort(test, opcsim)
Warning message:
In testPort(test, opcsim) : Allocation X was standardized
> tpopsim50<- testPort(test1, opcsim50)
Warning message:
In testPort(test1, opcsim50) : Allocation X was standardized
> tpopccm1 <- testPort(test, opccm)
Warning message:
In testPort(test, opccm) : Allocation X was standardized
> tpopmgm1 <- testPort(test, opcmgmss)
Warning message:
In testPort(test, opcmgmss) : Allocation X was standardized
>
> #Fixing tpopsim50
> tpopsim50$sumRet[26] <- 1
>
> #Generate the time plots:
> plot(cumprod(1+rev(test$R[,26])),ylim=c(0,2.5),ylab = "Returns", lty=1, col="pink", type="l", main="Portfolio Performance from 2010-12-31 to 2013-3-31")
> lines(tpEqu, lty=2, col="black")
> lines(tpopsim1, lty=3, col="green")
> lines(tpopsim50, lty=4, col="red")
> lines(tpopccm1, lty=5, col="yellow")
> lines(tpopmgm1, lty=6, col="grey")
>
> #Add a legend:
> legend('topleft', lty=1:6, c('Market', 'Equal Allocation', 'SIM NO SS', '50 SIM 50 RF', 'CCM NO SS', 'MGM_SS'), col=c("pink", "black", "green", "red", "yellow", "grey"))
>
>
> #RESULTS AND DISCUSSION
>
> opcmarko$X
       ATVI        TTWO         WMT         KNM       NTDOY        EXPO
 0.08932939 -0.05174448 -0.71062257 -0.09865849  0.39684528  0.55538032
        JCP          TW        HURN         KSS         JNJ         TJX
-0.06485910  0.51209696  0.13958392 -0.28002219  0.43653257  0.30906819
        NVS        RMTI         GSK         AEL         PRU         SLF
 0.53379832  0.04147533 -0.14117198  0.06196067  0.10575409 -0.58036425
        MFC         MET           F         HMC        ZAAP         DDS
 0.04351393 -0.59984452  0.22638246 -0.12691103  0.06396188  0.22040490
        TTM
-0.08188959
> opcmarko$R
[1] 0.04195728
> opcmarko$risk
[1] 0.06923724
>
> x3
 [1] 0.04 0.04 0.04 0.04 0.04 0.04 0.04 0.04 0.04 0.04 0.04 0.04 0.04 0.04 0.04 0.04
[16] 0.04 0.04 0.04 0.04 0.04 0.04 0.04 0.04 0.04 0.04 0.04 0.04 0.04
> rbar3
           [,1]
[1,] 0.01402497
> sd3
           [,1]
[1,] 0.07373374
>
> opcsim$X
      ATVI       TTWO        WMT        KNM      NTDOY       EXPO        JCP
0.08529009 0.00000000 0.06754295 0.00000000 0.15298270 0.28836934 0.00000000
       TW       HURN        KSS        JNJ        TJX        NVS       RMTI
0.11868766 0.00000000 0.00000000 0.00000000 0.18519110 0.00000000 0.06275569
       GSK        AEL        PRU        SLF        MFC        MET          F
0.00000000 0.00000000 0.00000000 0.00000000 0.00000000 0.00000000 0.00693531
       HMC       ZAAP        DDS        TTM
0.00000000 0.03224515 0.00000000 0.00000000
> opcsim$R
```

```
[1] 0.01799278
> opcsim$risk
[1] 0.05043353
> opcsimA
           [,1]
[1,] 0.01725803
> opcsimB
          [,1]
[1,] 0.6914522
>
> opcsimss$X
         ATVI          TTWO           WMT           KNM         NTDOY
 0.1247371305 -0.0007980814  0.1778681765 -0.0100927758  0.1746790188
         EXPO           JCP            TW          HURN           KSS
 0.3378997026 -0.0873127093  0.1672156520  0.0325909614  0.0135574573
          JNJ           TJX           NVS          RMTI           GSK
 0.0731676154  0.2756212460  0.0678243813  0.0807532463 -0.2410656776
          AEL           PRU           SLF           MFC           MET
-0.0094566912 -0.0461608270 -0.2412079578 -0.1034158570 -0.1490927615
            F           HMC          ZAAP           DDS           TTM
 0.0566352133  0.1163246969  0.0367686685  0.0613958504  0.0915643213
> opcsimss$R
[1] 0.02747013
> opcsimss$risk
[1] 0.05675291
> opcsimssA
           [,1]
[1,] 0.02717715
> opcsimssB
          [,1]
[1,] 0.2757168
>
> opccm$X
       ATVI        TTWO         WMT         KNM       NTDOY        EXPO
0.021142442 0.000000000 0.000000000 0.000000000 0.164215361 0.429725066
       JCP          TW        HURN         KSS         JNJ         TJX
0.000000000 0.071558496 0.000000000 0.000000000 0.000000000 0.240516024
       NVS        RMTI         GSK         AEL         PRU         SLF
0.000000000 0.003857114 0.000000000 0.000000000 0.000000000 0.000000000
       MFC         MET           F         HMC        ZAAP         DDS
0.000000000 0.000000000 0.015948118 0.000000000 0.021431629 0.003571348
       TTM       ^GSPC
0.028034403 0.000000000
> opccm$R
[1] 0.01855626
> opccm$risk
[1] 0.06395478
>
> opccmss$X
       ATVI        TTWO         WMT         KNM       NTDOY        EXPO
 0.42441743 -0.21102379  0.28573114 -0.28684831  0.79394745  1.68106424
       JCP          TW        HURN         KSS         JNJ         TJX
-0.46967878  0.63591715 -0.09246743 -0.13859398  0.16258926  1.22179156
       NVS        RMTI         GSK         AEL         PRU         SLF
-0.08355655  0.25258954 -1.49255990 -0.17027203 -0.12188150 -0.55665946
       MFC         MET           F         HMC        ZAAP         DDS
-0.41261950 -0.29438841  0.21061012  0.33193082  0.14572272  0.21304431
       TTM       ^GSPC
 0.31911385 -1.34791995
> opccmss$R
[1] 0.1011361
> opccmss$risk
[1] 0.2498319
>
> opcmgmss$X
       ATVI        TTWO         WMT         KNM       NTDOY        EXPO
 0.14422025 -0.01534025 -0.03470378 -0.01788193  0.22321740  0.47989176
       JCP          TW        HURN         KSS         JNJ         TJX
-0.17063374  0.27230089  0.07659623 -0.10581209  0.17567345  0.26548505
       NVS        RMTI         GSK         AEL         PRU         SLF
 0.07187226  0.10956065 -0.33625980 -0.02838278 -0.00672602 -0.24077772
       MFC         MET           F         HMC        ZAAP         DDS
-0.18109748 -0.08679255  0.07285765  0.14539446  0.04711306  0.03105951
       TTM
 0.10916553
> opcmgmss$R
[1] 0.03342752
> opcmgmss$risk
[1] 0.07056614
```