Finance Project Report

BT2201 Business Concepts and Metrics for Analytics
Semester 1, Academic Year 2022/2023

Group #Group number
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Introduction

Need to check with prof There are 252 trading days in one year. Need to ask Thomas about hedging and conversion..... Market premium = 6%? http://www.market-risk-premia.com/jp.html https://pages.stern.nyu.edu/~adamodar/New_Home_Page/datafile/ctryprem.html

```
##          mkt          rf AGG US Equity SCHP US Equity VCSH US Equity
## 1 0.06482698 0.001171951    0.03641951     0.04817965     0.03425126
##   BNDX US Equity VWOB US Equity 1306 JT Equity VOO US Equity VO US Equity
## 1     0.03620082     0.07251365     0.04701504     0.0906777     0.106077
##   VSS US Equity VGK US Equity VWO US Equity 1343 JT Equity VNQ US Equity
## 1    0.08455045    0.05738451     0.0961492     0.07586042     0.1007644
##   VNQI US Equity IAU US Equity BCI US Equity
## 1     0.07711911    0.09040527    0.02267546
```

```
##          mkt          rf AGG US Equity SCHP US Equity VCSH US Equity
## 1 0.02171798 1.44247e-08   0.008683369    0.008833578    0.008418671
##   BNDX US Equity VWOB US Equity 1306 JT Equity VOO US Equity VO US Equity
## 1      0.0083668     0.01511547     0.04234143    0.05687401   0.06354008
##   VSS US Equity VGK US Equity VWO US Equity 1343 JT Equity VNQ US Equity
## 1    0.04384086    0.07043416    0.08867709      0.0423807    0.09916497
##   VNQI US Equity IAU US Equity BCI US Equity
## 1     0.04230302    0.03006542    0.03706263
```

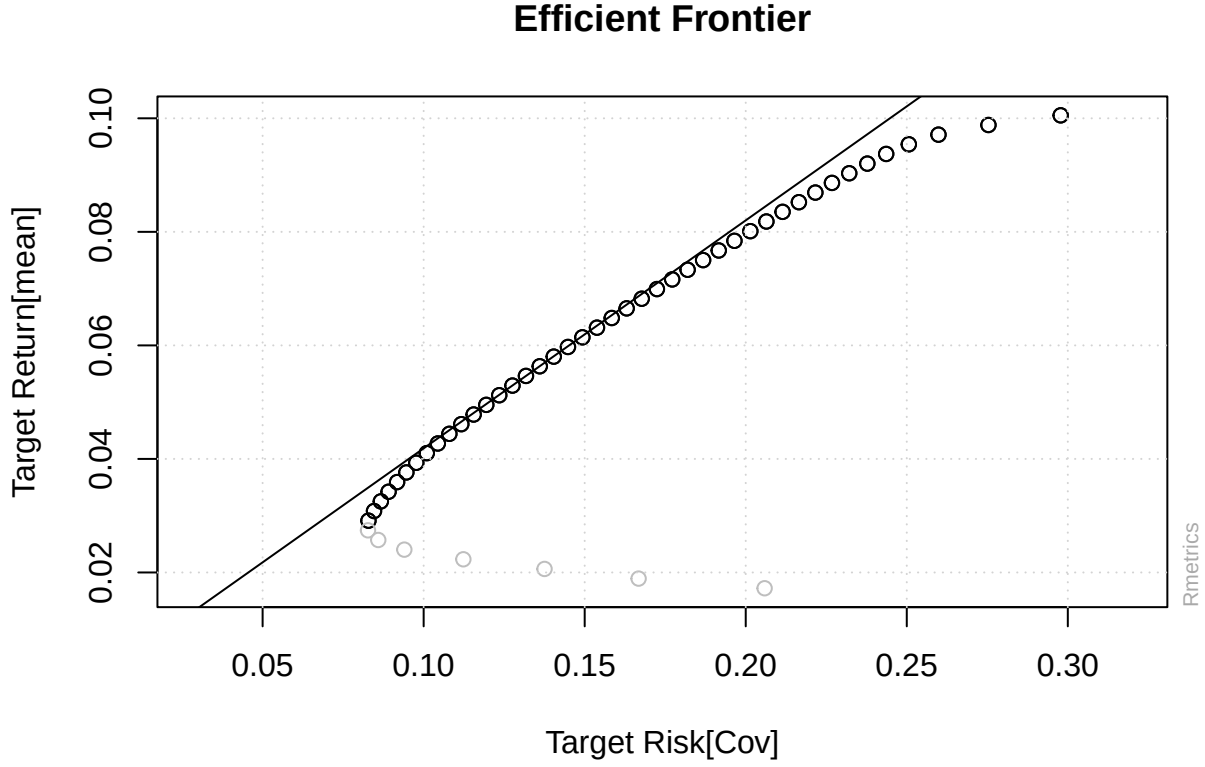
```
##         mkt          rf AGG US Equity SCHP US Equity VCSH US Equity
## 1 0.1473702 0.0001201029    0.09318459     0.09398711     0.09175331
##   BNDX US Equity VWOB US Equity 1306 JT Equity VOO US Equity VO US Equity
## 1     0.09147021       0.122945      0.2057703     0.2384827    0.2520716
##   VSS US Equity VGK US Equity VWO US Equity 1343 JT Equity VNQ US Equity
## 1     0.2093821     0.2653943      0.297787      0.2058657     0.3149047
##   VNQI US Equity IAU US Equity BCI US Equity
## 1       0.205677     0.1733938     0.1925166
```

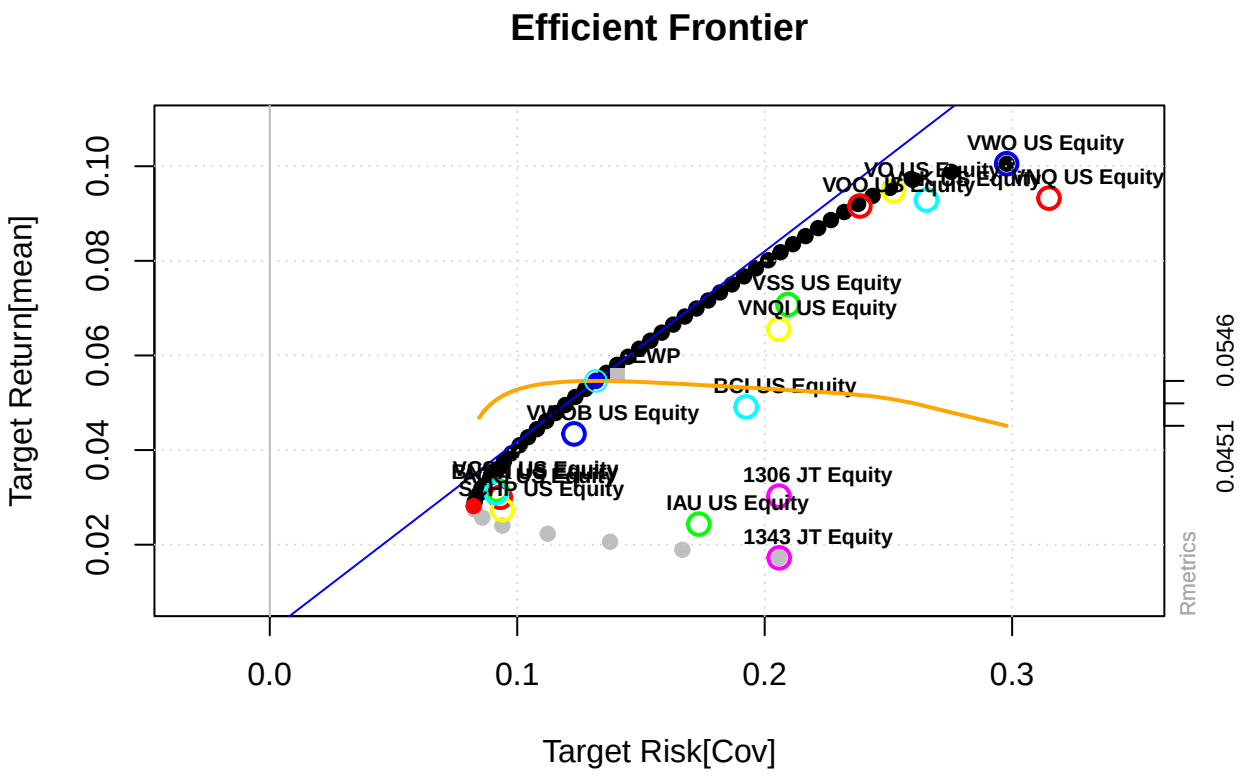
mkt	rf	AGG US Equity	SCHP US Equity	VCSH US Equity	BNDX US Equity	VWOB US Equity	1306 JT Equity	VOO US Equity	VO US Equity	VSS US Equity	VGK US Equity	VWO US Equity	1343 JT Equity	VNQ US Equity	VNQI US Equity	IAU US Equity	BCI US Equity
0.06	48	20	11	72	64	19	54	81	79	63	42	51	36	20	08	72	50	37	47	00	59	06	77	70	77	84	56	05	73	84	59	61	49	27	58	60	40	07	64	47	71	09	90	40	52	26755

mkt	rf	AGG US Equity	SCHP US Equity	VCSH US Equity	BNDX US Equity	VWOB US Equity	1306 JT Equity	VOO US Equity	VO US Equity	VSS US Equity	VGK US Equity	VWO US Equity	1343 JT Equity	VNQ US Equity	VNQI US Equity	IAU US Equity	BCI US Equity
0.02	17	18	0.00	86	83	08	88	33	08	41	08	70	83	68	15	10	56	42	34	01	05	68	74	06	35	04	01	38	40	07	04	04	42	88	67	70	42	38	07	99	16	54	23	03	03	00	65	37	06	26

		AGG US Equity	SCHP US Equity	VCSH US Equity	BNDX US Equity	VWOB US Equity	1306 JT Equity	VOO US Equity	VO US Equity	VSS US Equity	VGK US Equity	VWO US Equity	1343 JT Equity	VNQ US Equity	VNQI US Equity	IAU US Equity	BCI US Equity
mkt	rf																
0.14	7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

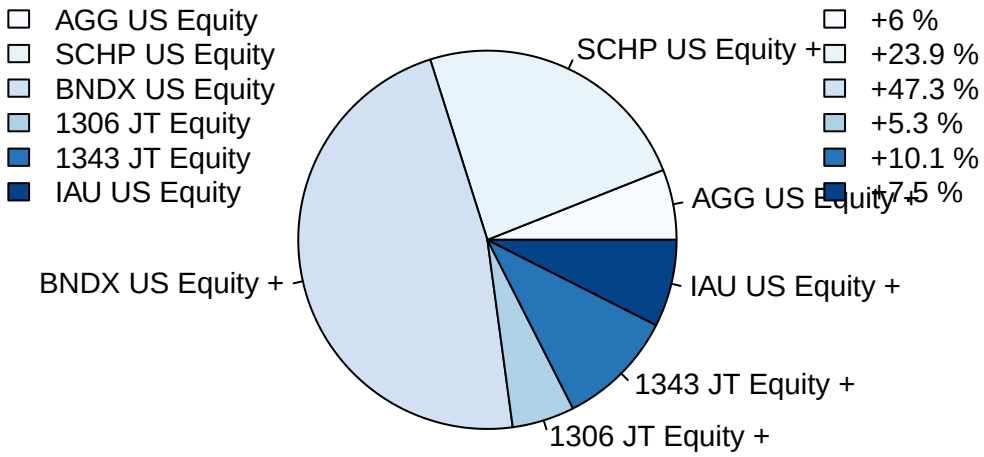
```
##
## Call:
## lm(formula = (`AGG US Equity`) ~ (mkt), data = ETFfxReturns)
##
## Coefficients:
## (Intercept)          mkt
##   2.112e-05    4.721e-01

##
## Call:
## lm(formula = (`VSS US Equity`) ~ (mkt), data = ETFfxReturns)
##
## Coefficients:
## (Intercept)          mkt
##   7.322e-05    1.151e+00

## [1] TRUE

## [1] TRUE
```

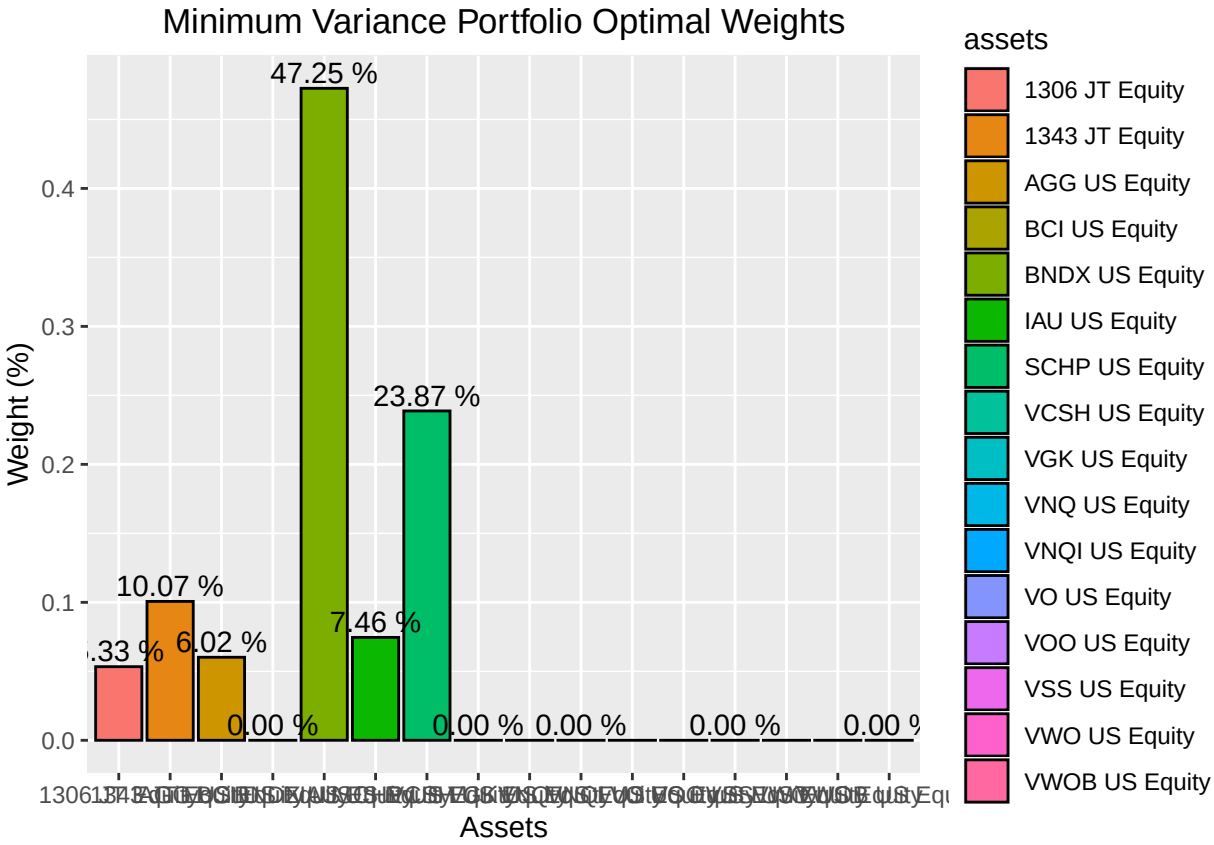




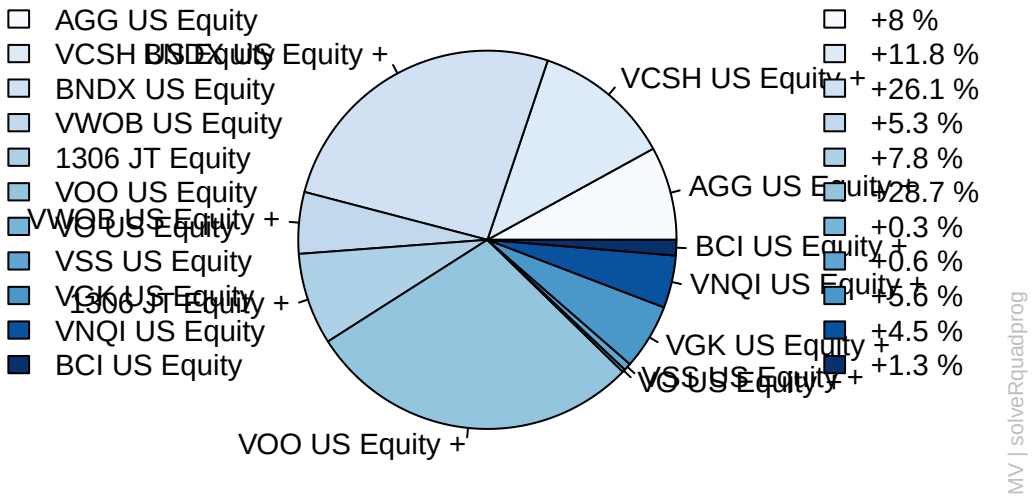
We have modified the weights to create 3 different portfolios to cater to investors with different risk appetites. ### The first portfolio will be the Global Minimum Variance Portfolio(GVMP) the portfolio with the lowest Risk. ### It is weighted to give the least risk out of our holdings, catering to investors whose preferences lie in safe investments with minimal risk.

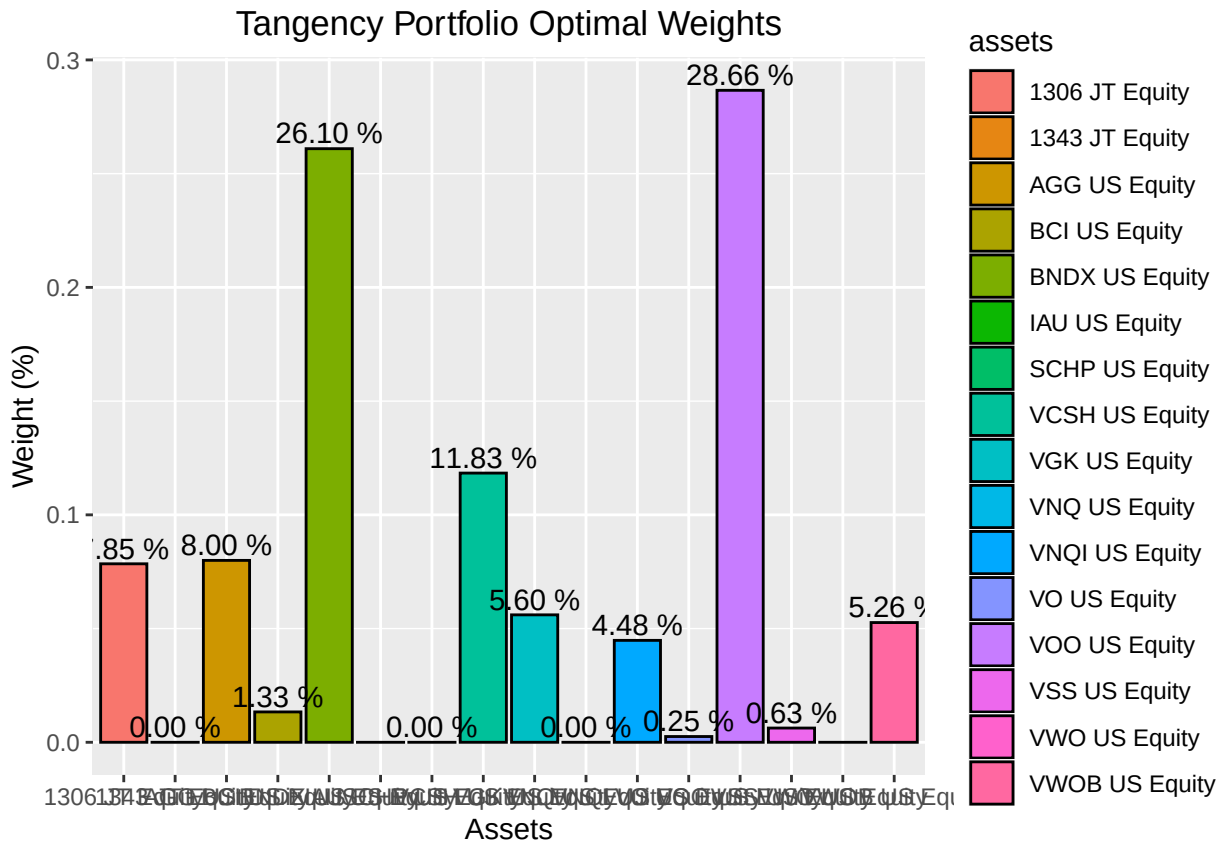
Weights




Minimum Variance Portfolio Optimal Weights
assets
1306 JT Equity
1343 JT Equity
AGG US Equity
BCI US Equity
BNDX US Equity
IAU US Equity
SCHP US Equity
VCSH US Equity
VGK US Equity
VNQ US Equity
VNQI US Equity
VO US Equity
VOO US Equity
VSS US Equity
VWO US Equity
VWOB US Equity
Weight (%)
0.0
0.1
0.2
0.3
0.4
.33 %
10.07 %
6.02 %
0.00 %
47.25 %
7.46 %
23.87 %
0.00 %
0.00 %
0.00 %
0.00 %
Assets

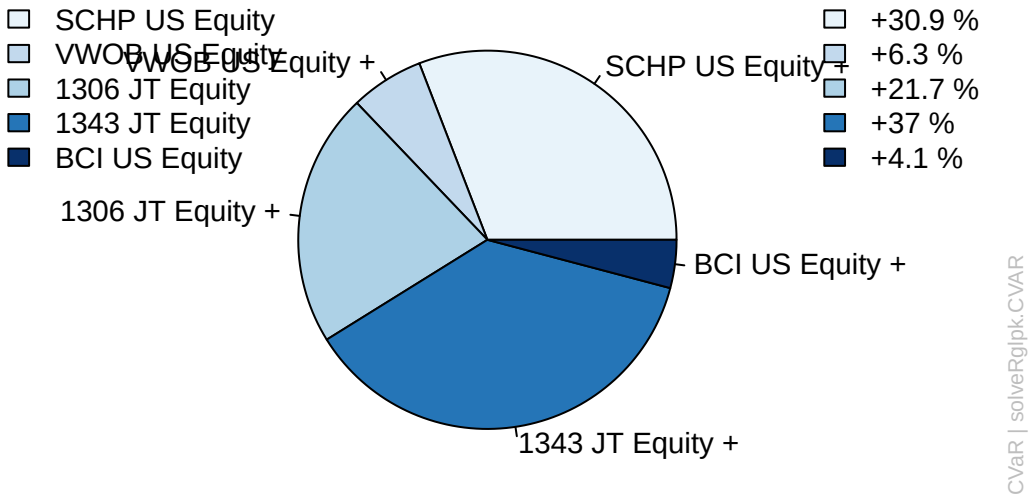
Weights

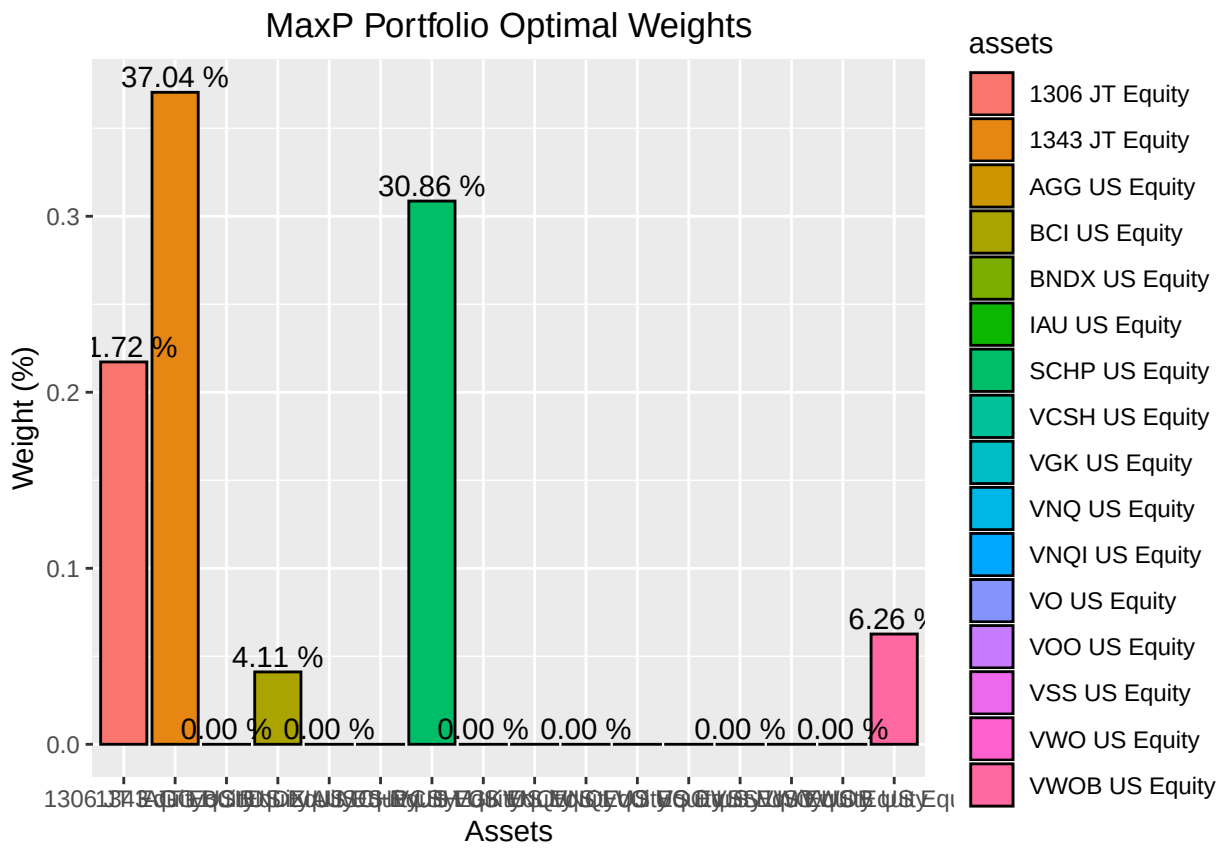

AGG US Equity
VCSH US Equity
BNDX US Equity
VWOB US Equity
1306 JT Equity
VOO US Equity
VO US Equity
VSS US Equity
VGK US Equity
VNQI US Equity
BCI US Equity
+8 %
+11.8 %
+26.1 %
+5.3 %
+7.8 %
+28.7 %
+0.3 %
+0.6 %
+5.6 %
+4.5 %
+1.3 %
MV | solveRquadprog




```
## Solver set to solveRquadprog

## setSolver: solveRglpk
```

Weights





Trying to get the different weighted porfolios

first up ewP

```
ewSpec <- Spec
setWeights(ewSpec) <- rep(1/(ncol.rets - 3), times = (ncol.rets-3))
ewP <- feasiblePortfolio(myret, spec = ewSpec, constraints = "LongOnly")
getTargetReturn(ewP)
```

```
##      mean        mu
## 0.0558525 0.0558525
```

```
getTargetRisk(ewP)
```

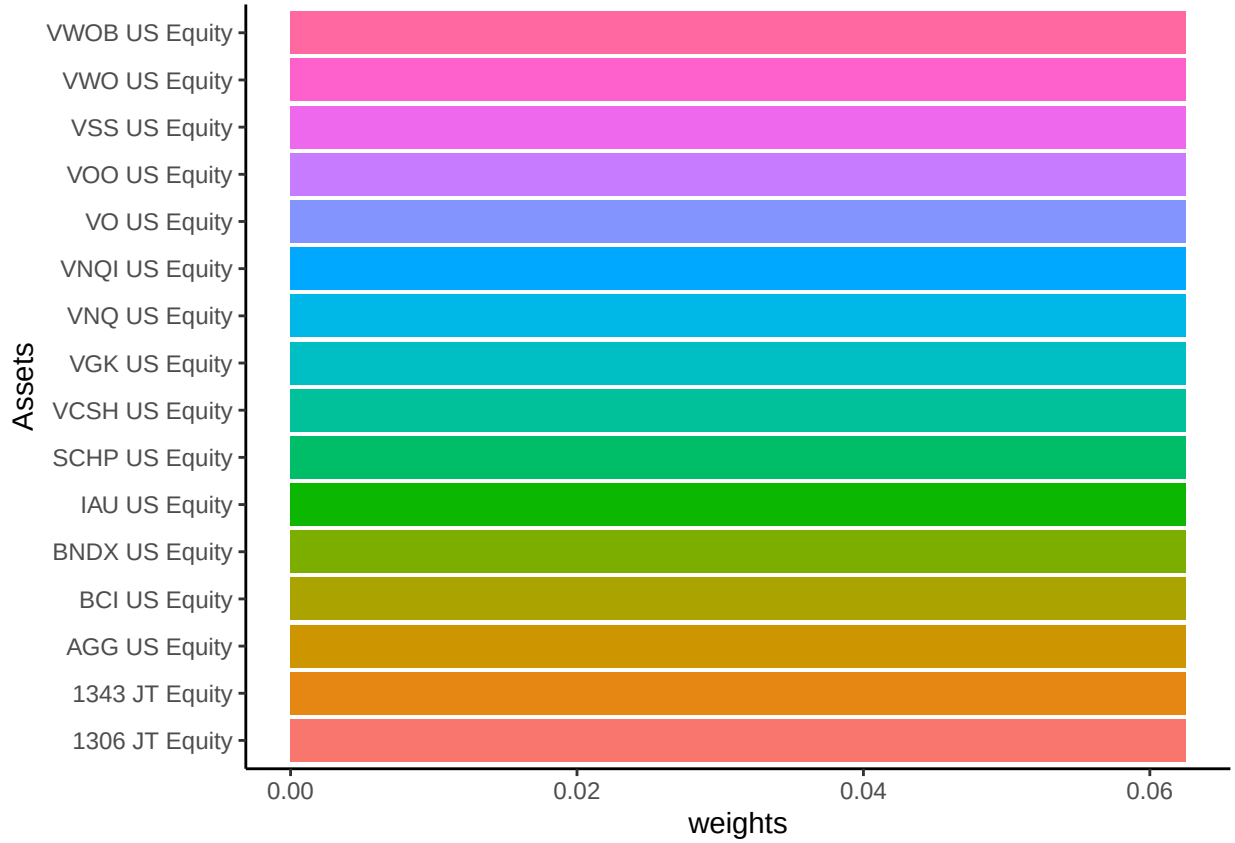
```
##       Cov     Sigma      CVaR       VaR
## 0.1404847 0.1404847 0.3146521 0.3146521
```

```
ewP@portfolio@portfolio$weights
```

```
##  AGG US Equity SCHP US Equity VCSH US Equity BNDX US Equity VWOB US Equity
##         0.0625         0.0625         0.0625         0.0625         0.0625
## 1306 JT Equity  VOO US Equity   VO US Equity  VSS US Equity  VGK US Equity
##         0.0625         0.0625         0.0625         0.0625         0.0625
##  VWO US Equity 1343 JT Equity  VNQ US Equity VNQI US Equity  IAU US Equity
##         0.0625         0.0625         0.0625         0.0625         0.0625
```

```
##  BCI US Equity
##         0.0625
```

```
ewPdf <- as.data.frame(ewP@portfolio@portfolio$weights) %>% rename(weights = `ewP@portfolio@portfolio$w
ewPdf <- ewPdf %>% mutate(Assets = rownames(ewPdf))
ggplot(ewPdf, aes(x = Assets, y = weights, fill = Assets))  + geom_bar(stat = "identity")+ theme_classi
```



next min variance portfolio

```
# this is if we didnt force the min to 1.5. Also i realsied ryan alr did this oops

mvP <- minvariancePortfolio(myret, spec = Spec, constraints = "minW[1:16] = 0.015")
getTargetReturn(mvP)
```

```
##       mean         mu
## 0.03447323 0.03447323
```

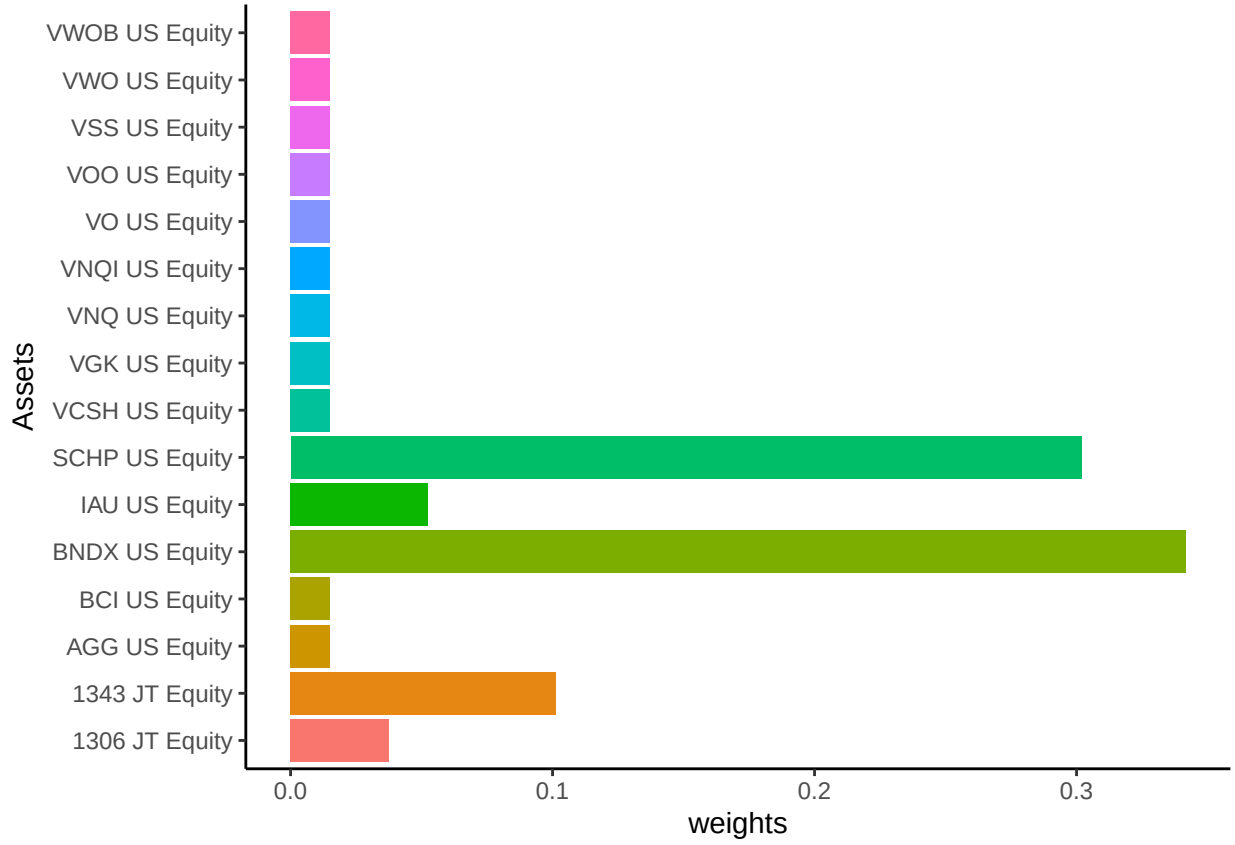
```
getTargetRisk(mvP)
```

```
##        Cov      Sigma       CVaR        VaR
## 0.09132431 0.09132431 0.15455165 0.15455165
```

```
mvP@portfolio@portfolio$weights
```

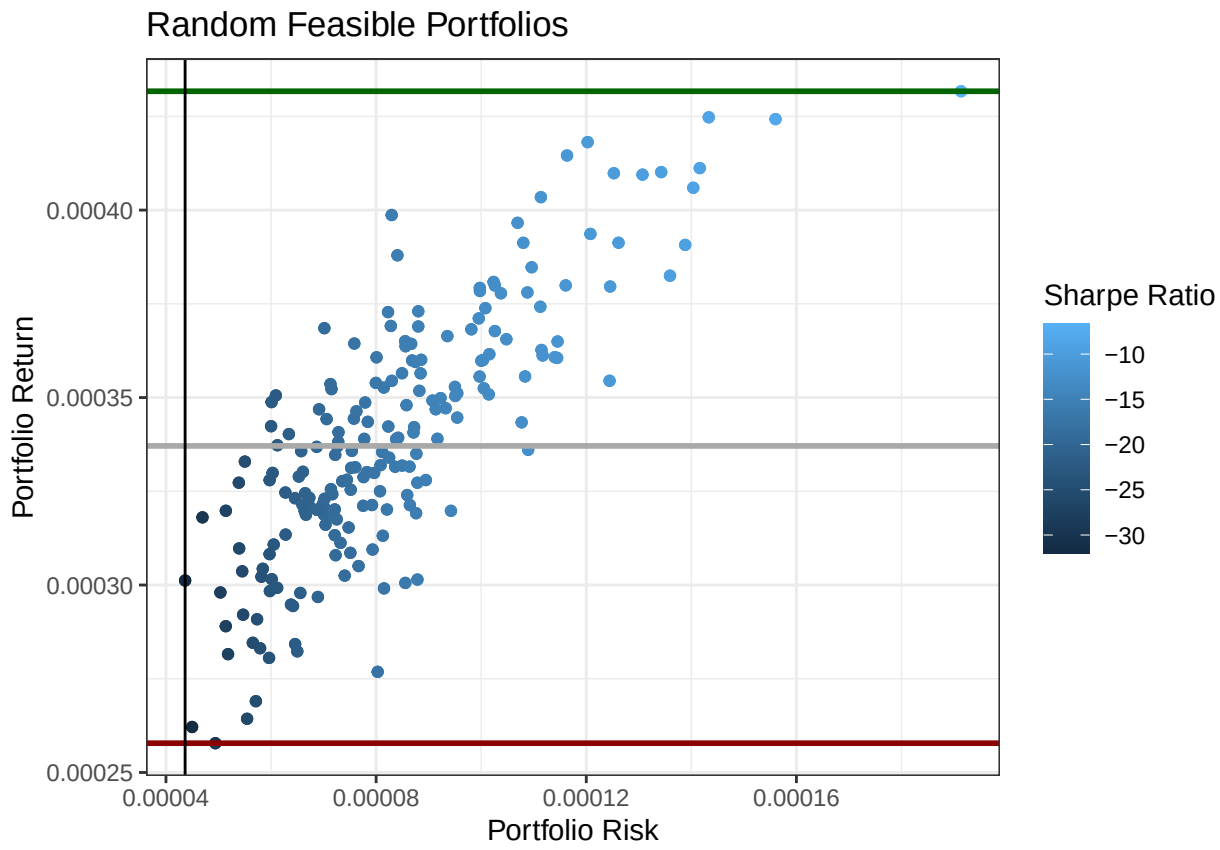
```
##  AGG US Equity SCHP US Equity VCSH US Equity BNDX US Equity VWOB US Equity
##     0.01500000     0.30186235     0.01500000     0.34163867     0.01500000
## 1306 JT Equity  VOO US Equity   VO US Equity  VSS US Equity  VGK US Equity
##     0.03770718     0.01500000     0.01500000     0.01500000     0.01500000
##  VWO US Equity 1343 JT Equity  VNQ US Equity VNQI US Equity  IAU US Equity
##     0.01500000     0.10140450     0.01500000     0.01500000     0.05238731
##  BCI US Equity
##     0.01500000
```

```
mvPdf <- as.data.frame(mvP@portfolio@portfolio$weights) %>% rename(weights = `mvP@portfolio@portfolio$w
mvPdf <- mvPdf %>% mutate(Assets = rownames(mvPdf))
ggplot(mvPdf, aes(x = Assets, y = weights, fill = Assets)) + geom_bar(stat = "identity") + theme_classi
```




```
np1 = 200  #number of portfolios
ret2 = ETFfxReturns[,-(1:3)]  #excluding dates
mu1 = colMeans(ret2)  #mean returns
na1 = ncol(ret2)  #number of assets
varc1 = cov(ret2)

riskp1 = NULL  #vector to store risk
retp1 = NULL  #vector to store returns
```

```r
for (i in 1:np1) {
    w = diff(c(0, sort(runif(na1 - 1)), 1))  # random weights
    r1 = t(w) %*% mu1  #matrix multiplication
    sd1 = t(w) %*% varc1 %*% w
    retp1 = rbind(retp1, r1)
    riskp1 = rbind(riskp1, sd1)
}

# create a data frame of risk and return
d_p1 = data.frame(Ret = retp1, Risk = riskp1)
d_p1 = d_p1 %>% mutate(SharpeRatio = (Ret - 0.001697914) / Risk)
p1 = ggplot(d_p1, aes(Risk, Ret, colour = SharpeRatio))
# scatter plot
p1 = p1 + geom_point()
# scatter plot with density and identified port risk return (highest
# lowest returns and min risk)
p1 + geom_point() + geom_hline(yintercept = c(max(d_p1$Ret), median(d_p1$Ret),
    min(d_p1$Ret)), colour = c("darkgreen", "darkgray", "darkred"), size = 1) +
    geom_vline(xintercept = d_p1[(d_p1$Risk == min(d_p1$Risk)), ][, 2]) +
    labs(colour = "Sharpe Ratio", x = "Portfolio Risk", y = "Portfolio Return",
        title = "Random Feasible Portfolios") + theme_bw()
```



Appendix