

Portfolio Analysis in R

Econ 424/Amath 540

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R Functions for Portfolio Analysis

- Eric Zivot's R functions (on class webpage in `portfolio.r`)
- R package `tseries`
 - `portfolio.optim()`
- Rmetrics package `fPortfolio`
 - Extensive collection of functions
- R package `quadprog`
 - `solve.QP()` for quadratic programming.

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R functions in portfolio.r

Function	Description
getPortfolio	Create portfolio object
efficient.portfolio	Compute minimum variance portfolio subject to target return
globalMin.portfolio	Compute global minimum variance portfolio
tangency.portfolio	Compute tangency portfolio
efficient.frontier	Compute efficient frontier of risky asset only portfolios

Note: these functions are based on matrix algebra solutions to portfolio calculations that allow short sales

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3 Firm Example Data

```
> er
      MSFT      NORD      SBUX
0.0427 0.0015 0.0285

> covmat
      MSFT      NORD      SBUX
MSFT 0.0100 0.0018 0.0011
NORD 0.0018 0.0109 0.0026
SBUX 0.0011 0.0026 0.0199

> r.free
[1] 0.005
```

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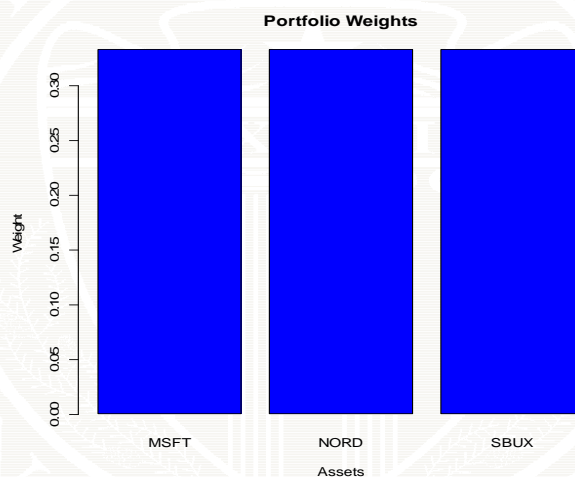
Create Arbitrary Portfolio

```
# compute equally weighted portfolio
> ew = rep(1,3)/3
> equalWeight.portfolio =
+ getPortfolio(er=er,cov.mat=covmat,weights=ew)

> equalWeight.portfolio
Call:
getPortfolio(er = er, cov.mat = covmat,
weights = ew)

Portfolio expected return:      0.02423
Portfolio standard deviation:   0.07587
Portfolio weights:
      MSFT      NORD      SBUX
0.3333 0.3333 0.3333
```

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```
> plot(equalWeight.portfolio, col="blue")
```

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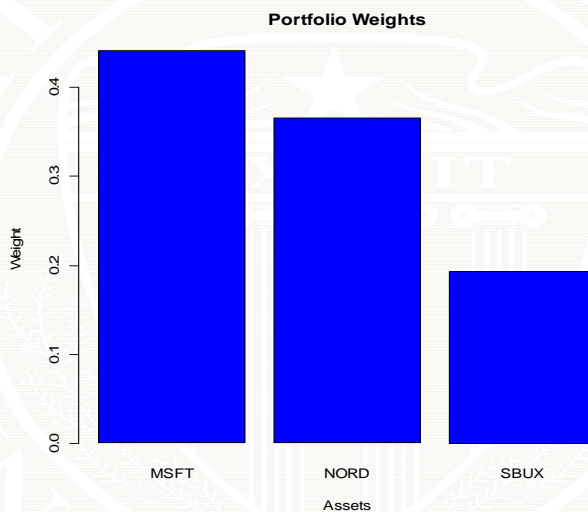
Compute Global Minimum Variance Portfolio

```
> gmin.port <- globalMin.portfolio(er, covmat)
> attributes(gmin.port)
$names
[1] "call"      "er"        "sd"        "weights"
$class
[1] "portfolio"

> print(gmin.port)
Call:
globalMin.portfolio(er = er, cov.mat = covmat)

Portfolio expected return:      0.02489
Portfolio standard deviation:   0.07268
Portfolio weights:
    MSFT    NORD    SBUX
0.4411  0.3656  0.1933
```

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```
> plot(gmin.port, col="blue")
```

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Compute Efficient Portfolio

```
# compute efficient portfolio subject to
# target return equal to  $E[R_{msft}] = 0.0427$ 
> target.return = er["MSFT"]
> e.port.msft = efficient.portfolio(er, covmat,
                                   target.return)
```

```
> e.port.msft
```

```
Call:
```

```
efficient.portfolio(er = er, cov.mat = covmat,
target.return = target.return)
```

```
Portfolio expected return:      0.0427
```

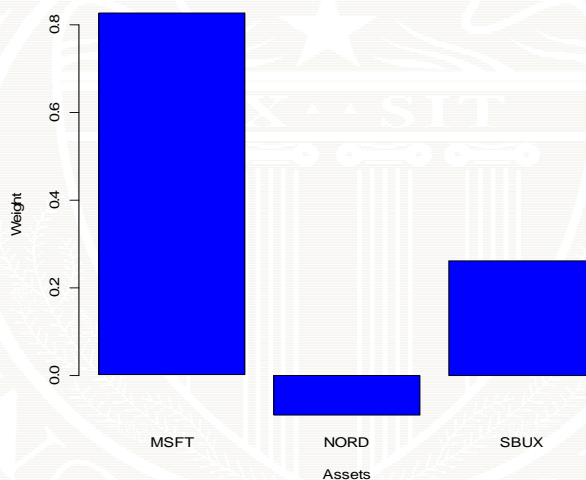
```
Portfolio standard deviation:   0.09166
```

```
Portfolio weights:
```

MSFT	NORD	SBUX
0.8275	-0.0907	0.2633

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Portfolio Weights



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Compute Tangency Portfolio

```
> tan.port <- tangency.portfolio(er, covmat,  
+                               r.free)  
> print(tan.port)
```

Call:

```
tangency.portfolio(er = er, cov.mat = covmat,  
risk.free = r.free)
```

Portfolio expected return: 0.05189

Portfolio standard deviation: 0.1116

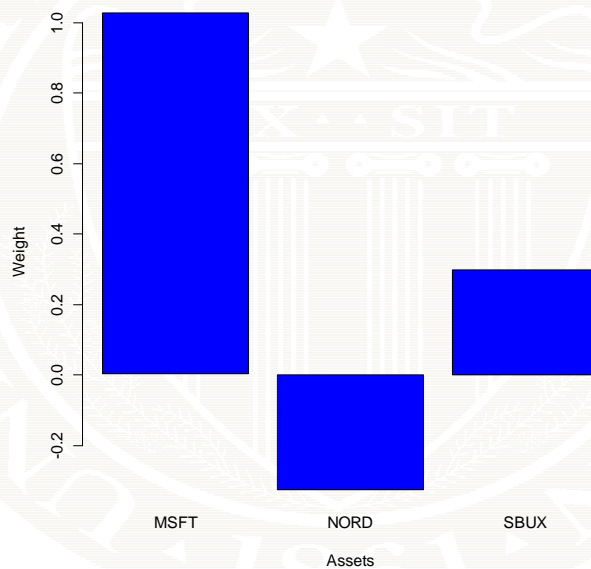
Portfolio Sharpe Ratio: 0.4202

Portfolio weights:

MSFT	NORD	SBUX
1.0268	-0.3263	0.2994

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Portfolio Weights



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Compute Efficient Frontier

```
> ef = efficient.frontier(er, covmat,
+   alpha.min=-2, alpha.max=1.5,
+   nport=20)
> attributes(ef)
$names
[1] "call"      "er"        "sd"        "weights"

$class
[1] "Markowitz"
```

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Frontier portfolios

```
> summary(ef)
Frontier portfolios' expected returns and standard
deviations
```

	port 1	port 2	port 3	port 4	port 5	port 6
ER	0.0783	0.0750	0.0718	0.0685	0.0652	0.0619
SD	0.1826	0.1732	0.1640	0.1548	0.1458	0.1370

	port 7	port 8	port 9	port 10	port 11	port 12
ER	0.0586	0.0554	0.0521	0.0488	0.0455	0.0422
SD	0.1284	0.1200	0.1120	0.1044	0.0973	0.0908

	port 13	port 14	port 15	port 16	port 17
ER	0.039	0.0357	0.0324	0.0291	0.0258
SD	0.085	0.0802	0.0764	0.0739	0.0727

	port 18	port 19	port 20
ER	0.0225	0.0193	0.0160
SD	0.0730	0.0748	0.0779

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Frontier portfolios

Portfolio weights:

	MSFT	NORD	SBUX
port 1	1.6001	-1.0035	0.4033
port 2	1.5290	-0.9194	0.3904
port 3	1.4578	-0.8354	0.3775
port 4	1.3866	-0.7513	0.3646
port 5	1.3155	-0.6672	0.3517
	...		
	...		
port 18	0.3903	0.4257	0.1841
port 19	0.3191	0.5097	0.1712
port 20	0.2479	0.5938	0.1583

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Plot efficient frontier

```

> plot(ef, plot.assets=T, col="blue", pch=16)
> points(gmin.port$sd, gmin.port$er,
+        col="green", pch=16, cex=2)
> points(tan.port$sd, tan.port$er, col="red",
+        pch=16, cex=2)
> text(gmin.port$sd, gmin.port$er,
+       labels="GLOBAL MIN", pos=2)
> text(tan.port$sd, tan.port$er,
+       labels="TANGENCY", pos=2)
> sr.tan = (tan.port$er - r.free)/tan.port$sd
> abline(a=r.free, b=sr.tan, col="green",
+        lwd=2)

```

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