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Statistics C183/C283 **Instructor: Nicolas Christou**

Introduction to the package `stockPortfolio`

As short introduction of the package `stockPortfolio`.

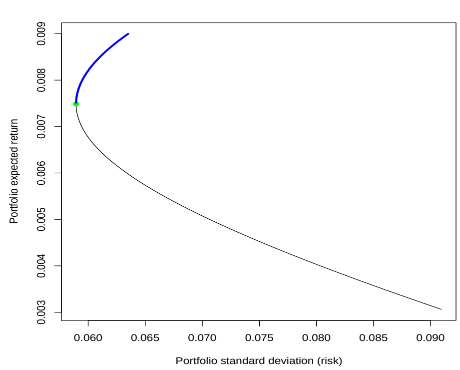
```
#########################
#===> ((((( 1 ))))) <===#
#===> quick example <===#
#########################
# load package
library(stockPortfolio)

# select stocks
#IBM: International Business Machines Copr.
#WFC: Wells Fargo & Compnay
#JPM: JPMorgan Chase & Company
#LUV: Southwest Airlines Co.
#XOM: Exxon Mobil Corporation

ticker <- c("IBM", "WFC", "JPM", "LUV", "XOM")

#Get stock data
gr <- getReturns(ticker, start="2005-03-31", end="2010-03-31")

#gr is a "list" object and we find what it contains by typing the following:
names(gr)

#We can access each component of gr by typing:
gr$R
gr$ticker
etc.

#Obtain the variance-covariance matrix of the returns:
> cov(gr$R)
             IBM          WFC           JPM           LUV           XOM
IBM 0.0040317283 0.0011198635  0.0019111776  0.0018376731  0.0005219823
WFC 0.0011198635 0.0140009223  0.0090748082  0.0045614185  0.0002158645
JPM 0.0019111776 0.0090748082  0.0087172088  0.0040831109 -0.0001559581
LUV 0.0018376731 0.0045614185  0.0040831109  0.0082593478 -0.0004506132
XOM 0.0005219823 0.0002158645 -0.0001559581 -0.0004506132  0.0026259464

#Obtain the correlation matrix of the returns:
cor(gr$R)

#We can find summary statistics as follows:
summary(gr$R)

#To find the mean, variance, and standard deviation of a particular stock
mean(gr$R[,4])
var(gr$R[,4])
sd(gr$R[,4])
```

```
#To find the means of all five stocks:
xx <- as.data.frame(gr$R)
mean(xx)

#To find the covariance and correlation between two stocks:
cov(gr$R[,4], gr$R[,5])
cor(gr$R[,4], gr$R[,5])
```

===

Use two stocks to find the minimum risk portfolio (its composition, expected return, and standard deviation). Note: The following lines until the end of this page can be done outside the package! Let's work with two stocks: IBM and LUV.

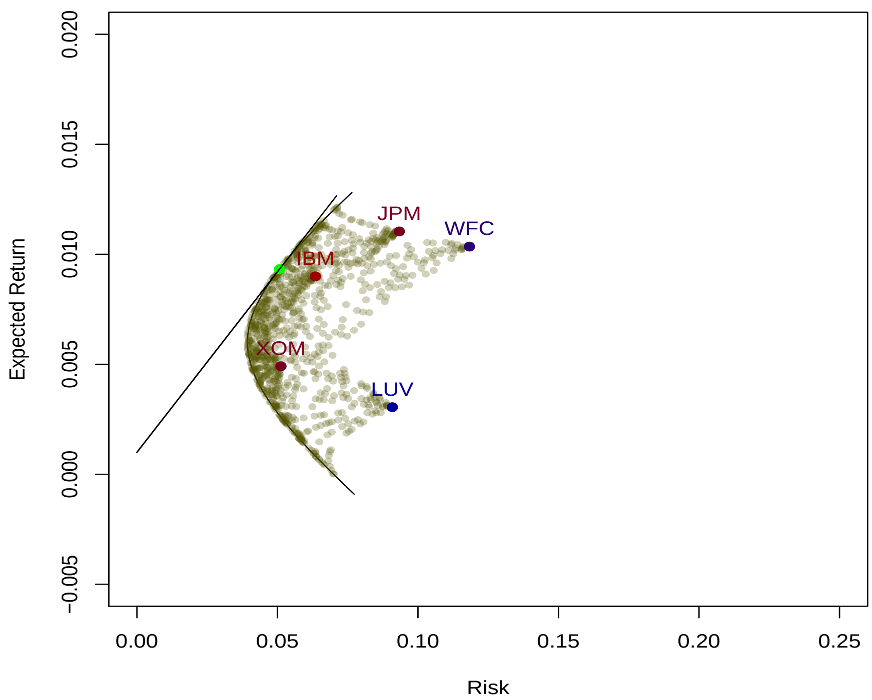
```
#Find the composition of the minimum risk portfolio:
x_IBM <- (var(gr$R[,4]) - cov(gr$R[,1], gr$R[,4])) /
(var(gr$R[,1]) + var(gr$R[,4]) - 2*cov(gr$R[,1], gr$R[,4]))
x_LUV <- 1-x_IBM

# Find the mean and sd of the minimum risk portfolio:
mean_min <-  x_IBM*mean(gr$R[,1]) + x_LUV*mean(gr$R[,4])

var_min <-  x_IBM^2*var(gr$R[,1]) + x_LUV^2*var(gr$R[,4]) +
          2*x_IBM*x_LUV*cov(gr$R[,1], gr$R[,4])

sd_min <- var_min^0.5

# Construct the portfolio possibilities curve and identify the efficient frontier:
a <- seq(0,1,.01)
b <- 1-a
mean_p <- a*mean(gr$R[,1]) + b*mean(gr$R[,4])
var_p <- a^2*var(gr$R[,1]) + b^2*var(gr$R[,4]) +
         2*a*b*cov(gr$R[,1], gr$R[,4])
sd_p <- var_p^0.5

plot(sd_p,mean_p, type="l", xlab="Portfolio standard deviation (risk)",
     ylab="Portfolio expected return")
points(sd_min, mean_min, pch=19, col="green")

# Identify the efficient frontier:
xx <- cbind(sd_p,mean_p)
xxx <- xx[which(xx[,2]>mean_min),]
points(xxx, type="l", col="blue", lwd=3)
```



We will use now the `stockPortfolio` package to find the point of tangency (point `G`):

```
#Step 1:  Select a model.  At this point we only know one model (short sales +
risk free rate).  We call this no model, denoted with "none".

port_model <- stockModel(gr, model="none", Rf=0.001)

#Step 2:  Optimize, i.e. find the composition of the point of tangency.
op <- optimalPort(port_model)

#Note:  op is a class of "optimalPortfolio" and contains the following:
#model:  The model used (here "none").
#X:  The composition of the point of tangency.
#R:  The expected return of the point of tangency.
$risk:  The standard deviation of the point of tangency.

#All the above information can be accessed using op$name, where name is one
of (model, X, R, risk).

#For example:
> op$X
        IBM          WFC          JPM          LUV          XOM
 0.489511049  0.001947768  0.337708840 -0.181017319  0.351849663

> op$R
[1] 0.009327074

> op$risk
[1] 0.05073789

#Visualization!
#Add the portfolio possibilities curve:
portPossCurve(port_model, xlim=c(0,0.25), ylim=c(-0.005,0.02))

#Add a cloud of many portfolios:
portCloud(port_model, add=TRUE)

#Add the five stocks plus the point of tangency:
points(op, pch=19, add=TRUE)

points(op$risk, op$R, pch=19, col="green")

#Add the tangent (the following will draw the line only up to G):
Rf <- 0.001
segments(0, Rf, op$risk, op$R)

#If you want to extend the tangent beyond G:
slope <- (op$R-Rf)/op$risk

segments(0, Rf, 1.4*op$risk, Rf+slope*1.4*op$risk)
```

The graph of the commands above is shown below:



So far we have use the following functions of the `stockPortfolio` package:

```
getReturns
stockModel
optimalPort
portPossCurve
PortCloud
```