Constrained Portfolio Optimisation

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The following R code is for solving the unconstrained portfolio optimisation using quadratic programming techniques.

```r
library(zoo)
library(PerformanceAnalytics)
library(PortfolioAnalytics)
library(quadprog)
library(quantmod)
# Assets tickers
portfolioprices <- NULL
for (ticker in tickers) {
  portfolioprices <- cbind(portfolioprices,
    getSymbols(yahoo(ticker, from = '2016-01-03', to = '2020-10-05', periodicity = 'daily', auto.assign = FALSE))[,4])
}
# portfolio prices
portfolioprices2 <- data.matrix(as.data.frame(portfolioprices))
# The return matrix.
retnatrix <- data.frame(matrix(NA, nrow = nrow(portfolioprices) - 1, ncol = ncol(portfolioprices)))
for (i in 1:(nrow(portfolioprices2) - 1)) {
  for (j in 1:ncol(portfolioprices2)){
    retnatrix[i,j]<-(portfolioprices2[i+1,j] -
      portfolioprices2[i,j])/portfolioprices2[i,j]
  }
}
covariance <- cov(retnatrix) # The co-variance matrix.
print(covariance)
n <- ncol(retnatrix)
# Matrix defining the constraints.
Amat <- cbind(1, colMeans(retnatrix), diag(n))
# Vector appearing in the quadratic function to be minimised.
bvec <- c(1, rep(0, n))

# Create the objective matrix
Dmat <- 2*covariance

# Specify the number of equality constraints
```

1
meq <- 1
risk.Vector <- rep(0,100)
count <- 1
minret <- 0 # set min return
# setting max return to be max of average returns
maxret <- max(colMeans(retmatrix)) - 10^-10
number_points <- 100
return_vals <- seq(from = minret,
   to = maxret,length.out = number_points)

# Sets of weights
weights_list <- matrix(0, number_points, n)

for ( return_val in return_vals ) {
  dvec <- colMeans(retmatrix) * return_val
  dvec <- rep(0,n)*return_val
  b.Vector <- c(1, return_val, rep(0,n))
  out <- solve.QP( Dmat, dvec, Amat, bvec = b.Vector, meq )
  risk.Vector[count] <- out$value
  weights_list[count,] <- out$solution
  count <- count + 1
}

# Plotting the efficient frontier.
plot(risk.Vector, return_vals,
   xlab="Risk",ylab="Return",col='red')