

Portfolio Optimization

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A. Loading Data

```
data(edhec)
# Use the first 4 columns in edhec for a returns object
returns <- edhec[, 1:6]
colnames(returns) <- c("CA", "CTAG", "DS", "EM", "EQMN", "ED")
fund.names <- colnames(returns)
print(head(returns, 5))
```

##	CA	CTAG	DS	EM	EQMN	ED
## 1997-01-31	0.0119	0.0393	0.0178	0.0791	0.0189	0.0213
## 1997-02-28	0.0123	0.0298	0.0122	0.0525	0.0101	0.0084
## 1997-03-31	0.0078	-0.0021	-0.0012	-0.0120	0.0016	-0.0023
## 1997-04-30	0.0086	-0.0170	0.0030	0.0119	0.0119	-0.0005
## 1997-05-31	0.0156	-0.0015	0.0233	0.0315	0.0189	0.0346

```
colMeans(returns)
```

##	CA	CTAG	DS	EM	EQMN	ED
##	0.005500364	0.004158182	0.006621818	0.006245818	0.004356000	0.006216364

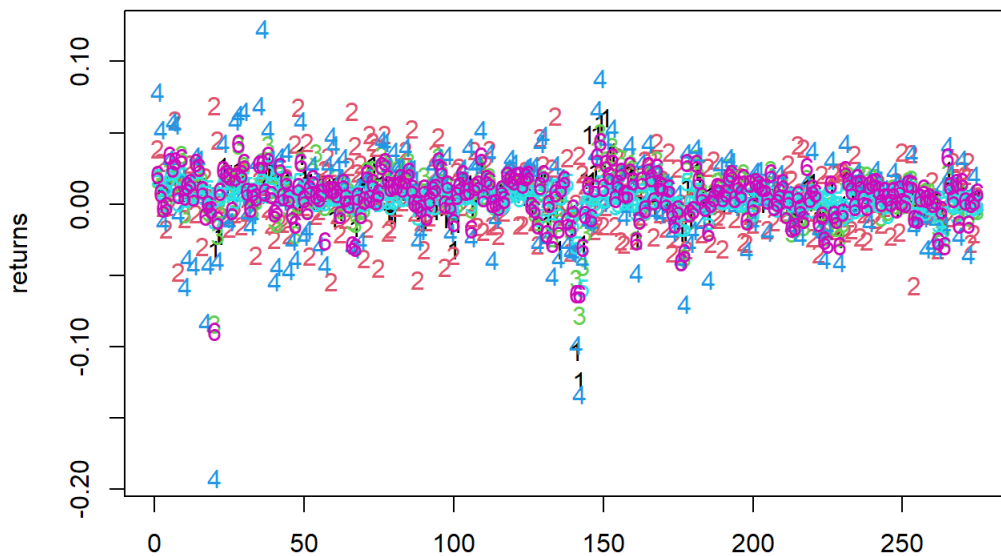
```
x = round(var(returns), 6)
print(x)
```

##	CA	CTAG	DS	EM	EQMN	ED
## CA	0.000266	-0.000008	0.000201	0.000312	0.000065	0.000198
## CTAG	-0.000008	0.000536	-0.000008	0.000030	0.000037	0.000005
## DS	0.000201	-0.000008	0.000285	0.000423	0.000080	0.000260
## EM	0.000312	0.000030	0.000423	0.001032	0.000133	0.000441
## EQMN	0.000065	0.000037	0.000080	0.000133	0.000064	0.000084
## ED	0.000198	0.000005	0.000260	0.000441	0.000084	0.000279

```
x = round(cor(returns), 6)
print(x)
```

##	CA	CTAG	DS	EM	EQMN	ED
## CA	1.000000	-0.020397	0.730564	0.595816	0.494521	0.727190
## CTAG	-0.020397	1.000000	-0.020666	0.040761	0.197965	0.012591
## DS	0.730564	-0.020666	1.000000	0.779393	0.590578	0.922729
## EM	0.595816	0.040761	0.779393	1.000000	0.514851	0.822511
## EQMN	0.494521	0.197965	0.590578	0.514851	1.000000	0.623350
## ED	0.727190	0.012591	0.922729	0.822511	0.623350	1.000000

```
matplot(returns)
```



B. Create the Portfolio Object

```
myport1 <- portfolio.spec(assets=fund.names)
print.default(myport1)
```

```
## $assets
##      CA      CTAG      DS      EM      EQMN      ED
## 0.1666667 0.1666667 0.1666667 0.1666667 0.1666667 0.1666667
##
## $category_labels
## NULL
##
## $weight_seq
## NULL
##
## $constraints
## list()
##
## $objectives
## list()
##
## $call
## portfolio.spec(assets = fund.names)
##
## attr(,"class")
## [1] "portfolio.spec" "portfolio"
```

C. Constraints

```
myport1 <- add.constraint(portfolio=myport1, type="weight_sum",
                          min_sum=1, max_sum=1)

myport1 <- add.constraint(portfolio=myport1, type="box",
                          min=0.05, max=0.4)
```

D. Objective

```
myport1 <- add.objective(myport1, type="risk", name="StdDev")
myport1
```

```
## *****
## PortfolioAnalytics Portfolio Specification
## *****
##
## Call:
## portfolio.spec(assets = fund.names)
##
## Number of assets: 6
## Asset Names
## [1] "CA" "CTAG" "DS" "EM" "EQMN" "ED"
##
## Constraints
## Enabled constraint types
##   - weight_sum
##   - box
##
## Objectives:
## Enabled objective names
##   - StdDev
```

E. Optimize

```
solution <- optimize.portfolio(returns, myport1,
                             optimize_method="ROI", trace=TRUE)

solution
```

```
## *****
## PortfolioAnalytics Optimization
## *****
##
## Call:
## optimize.portfolio(R = returns, portfolio = myport1, optimize_method = "ROI",
##   trace = TRUE)
##
## Optimal Weights:
##   CA   CTAG   DS   EM   EQMN   ED
## 0.2439 0.2061 0.0500 0.0500 0.4000 0.0500
##
## Objective Measure:
## StdDev
## 0.0103
```

Maximize mean return with ROI

```
base_port <- portfolio.spec(assets=fund.names)
base_port <- add.constraint(portfolio=base_port, type="leverage",
                           min_sum=0.99, max_sum=1.01)
base_port <- add.constraint(portfolio=base_port, type="box", min=0.05, max=0.65)

maxret <- add.objective(portfolio=base_port, type="return", name="mean")
opt_maxret <- optimize.portfolio(R=returns, portfolio=maxret,
                               optimize_method="ROI", trace=TRUE)

print(opt_maxret)
```

```
## *****
## PortfolioAnalytics Optimization
## *****
##
## Call:
## optimize.portfolio(R = returns, portfolio = maxret, optimize_method = "ROI",
##   trace = TRUE)
##
## Optimal Weights:
##   CA CTAG   DS   EM EQMN   ED
## 0.05 0.05 0.65 0.16 0.05 0.05
##
## Objective Measure:
##      mean
## 0.006315
```

```
colMeans(returns)
```

```
##           CA           CTAG           DS           EM           EQMN           ED
## 0.005500364 0.004158182 0.006621818 0.006245818 0.004356000 0.006216364
```

```
names(opt_maxret)
```

```
## [1] "weights"           "objective_measures" "opt_values"
## [4] "out"                 "call"               "portfolio"
## [7] "R"                   "data_summary"       "elapsed_time"
## [10] "end_t"
```

```
opt_maxret$weights
```

```
##   CA CTAG   DS   EM EQMN   ED
## 0.05 0.05 0.65 0.16 0.05 0.05
```

```
opt_maxret$objective_measures$mean
```

```
##           mean
## 0.006315058
```

```
sum(colMeans(returns)*opt_maxret$weights)
```

```
## [1] 0.006315058
```

Minimize variance with ROI

```
minvar <- add.objective(portfolio=base_port, type="risk", name="var")
opt_minvar <- optimize.portfolio(R=returns, portfolio=minvar,
                                optimize_method="ROI", trace=TRUE)
print(opt_minvar)
```

```
## *****
## PortfolioAnalytics Optimization
## *****
##
## Call:
## optimize.portfolio(R = returns, portfolio = minvar, optimize_method = "ROI",
##   trace = TRUE)
##
## Optimal Weights:
##      CA   CTAG    DS    EM   EQMN    ED
## 0.0623 0.1277 0.0500 0.0500 0.6500 0.0500
##
## Objective Measure:
##   StdDev
## 0.009046
```