INTERMEDIATE PORTFOLIO ANALYSIS IN R

Application

Real World Example

- Solve a portfolio optimization problem similar to the types of problems in the industry
- Apply techniques learned throughout the course
  - Specify a portfolio with constraints and objectives
  - Run the optimization with period rebalancing on historical data
  - Analyze the results
  - Refine constraints, objectives, and moment estimates
- Data
  - EDHEC-Risk Alternative Indexes monthly returns
  - Jan 1997 - March 2016

Benchmark

```
> data(indexes)
> returns <- indexes[,1:4]

# Equal weight benchmark
> n <- ncol(returns)
> equal_weights <- rep(1 / n, n)

> benchmark_returns <- Return.portfolio(R = returns,
                weights = equal_weights, rebalance_on = "years")

> colnames(benchmark_returns) <- "benchmark"

# Benchmark performance
> table.AnnualizedReturns(benchmark_returns)
                           benchmark
Annualized Return             0.0775
Annualized Std Dev            0.1032
Annualized Sharpe (Rf=0%)     0.7509
```

Base Portfolio Definition

- Define a portfolio specification to be used as the base case
- The base portfolio specification is meant to be a simple approach with relaxed constraints and basic objectives
  - Do not overcomplicate or over-constrain

```
# Base portfolio specification
> base_port_spec <- portfolio.spec(assets = colnames(returns))
> base_port_spec <- add.constraint(portfolio = base_port_spec,
                                   type = "full_investment")
> base_port_spec <- add.constraint(portfolio = base_port_spec,
                                   type = "long_only")
> base_port_spec <- add.objective(portfolio = base_port_spec,
                                  type = "risk", name = "StdDev")
```

INTERMEDIATE PORTFOLIO ANALYSIS IN R

Let’s practice!

INTERMEDIATE PORTFOLIO ANALYSIS IN R

Optimization Backtest

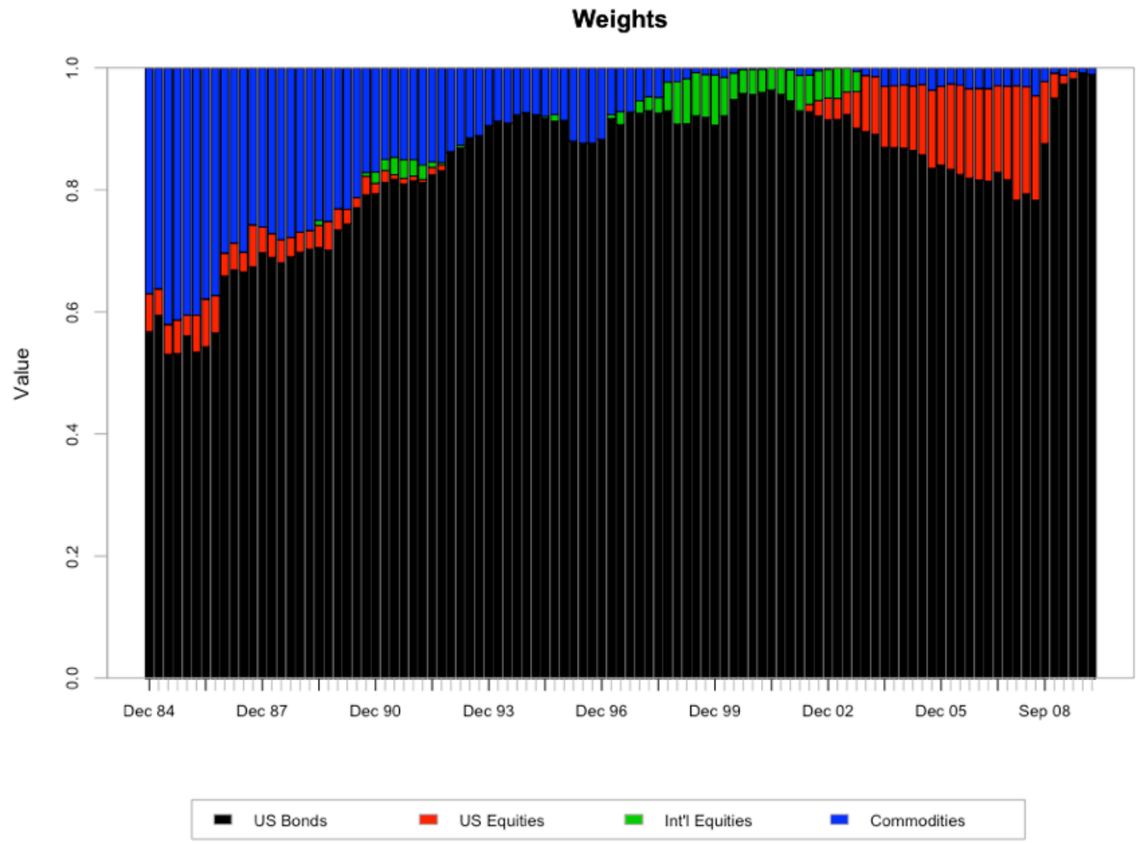
Optimization Backtest: Execution

Run the optimization with periodic rebalancing

```
> opt_base <- optimize.portfolio.rebalancing(R = returns,
                      optimize_method = "ROI",
                      portfolio = base_port_spec,
                      rebalance_on = "quarters",
                      training_period = 60,
                      rolling_window = 60)

> # Calculate portfolio returns
> base_returns <- Return.portfolio(returns,
                                   extractWeights(opt_base))
> colnames(base_returns) <- "base"
```

Optimization Backtest: Analysis

```
> # Chart the optimal weights
> chart.Weights(opt_base)
```



Optimization Backtest: Analysis

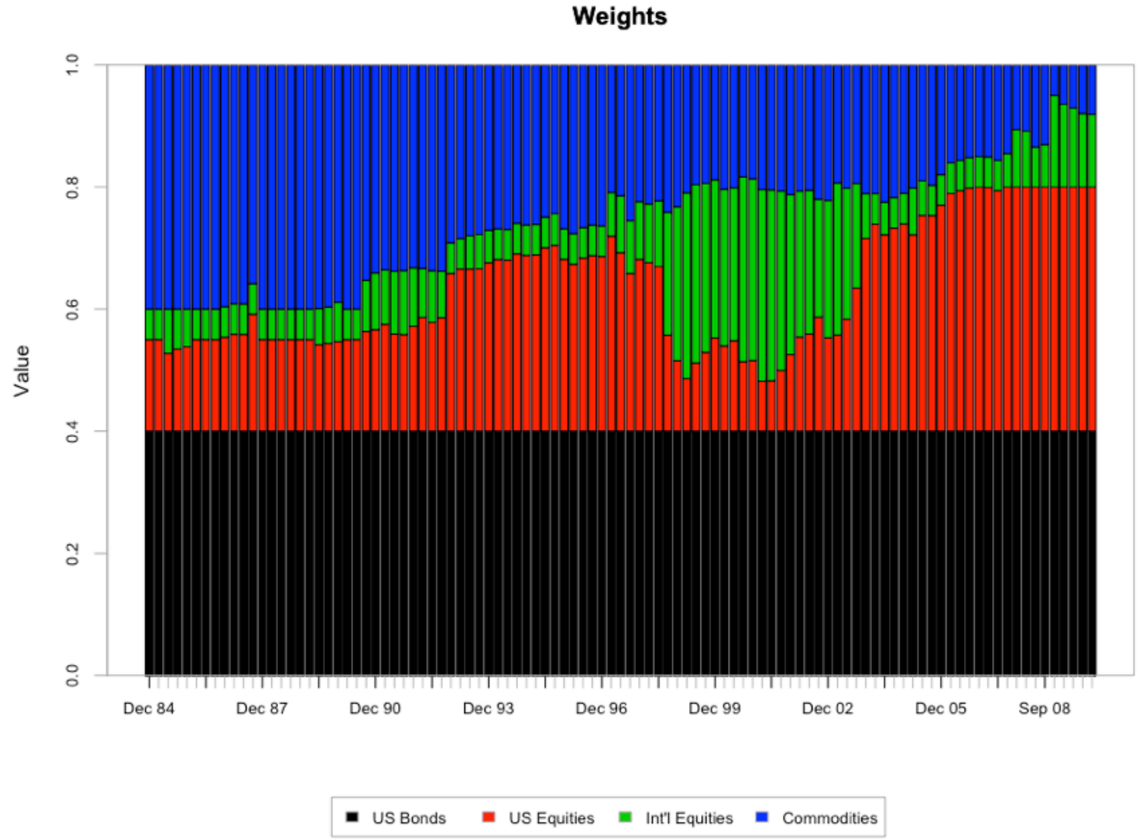
```
> # Merge benchmark and portfolio returns
> ret <- cbind(benchmark_returns, base_returns)

> # Annualized performance
> table.AnnualizedReturns(ret)
                           benchmark   base
Annualized Return             0.0775 0.0772
Annualized Std Dev            0.1032 0.0436
Annualized Sharpe (Rf=0%)     0.7509 1.7714
```

Optimization Backtest: Refine Constraints

```
> # Make a copy of the portfolio specification
> box_port_spec <- base_port_spec

> # Update the constraint
> box_port_spec <- add.constraint(portfolio = box_port_spec,
                                  type = "box", min = 0.05, max = 0.4,
                                  indexnum = 2)

> # Backtest
> opt_box <- optimize.portfolio.rebalancing(R = returns,
                                            optimize_method = "ROI",
                                            portfolio = box_port_spec,
                                            rebalance_on = "quarters",
                                            training_period = 60,
                                            rolling_window = 60)

> # Calculate portfolio returns
> box_returns <- Return.portfolio(returns, extractWeights(opt_box))
> colnames(box_returns) <- "box"
```

Optimization Backtest: Analysis Refined Constraints

```
> # Chart the optimal weights
> chart.Weights(opt_box)
```



Optimization Backtest: Analysis Refined Constraints

```
> # Merge box portfolio returns
> ret <- cbind(ret, box_returns)

> # Annualized performance
> table.AnnualizedReturns(ret)
                           benchmark   base    box
Annualized Return             0.0775 0.0772 0.0760
Annualized Std Dev            0.1032 0.0436 0.0819
Annualized Sharpe (Rf=0%)     0.7509 1.7714 0.9282
```

INTERMEDIATE PORTFOLIO ANALYSIS IN R

Let’s practice!

INTERMEDIATE PORTFOLIO ANALYSIS IN R

Congratulations!