

Real world example

INTERMEDIATE PORTFOLIO ANALYSIS IN R



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Instructor

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 {6}
 - Jan 1997 - March 2016

```

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

```
# 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")
```

Let's practice!

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Optimization backtest

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Optimization backtest: execution

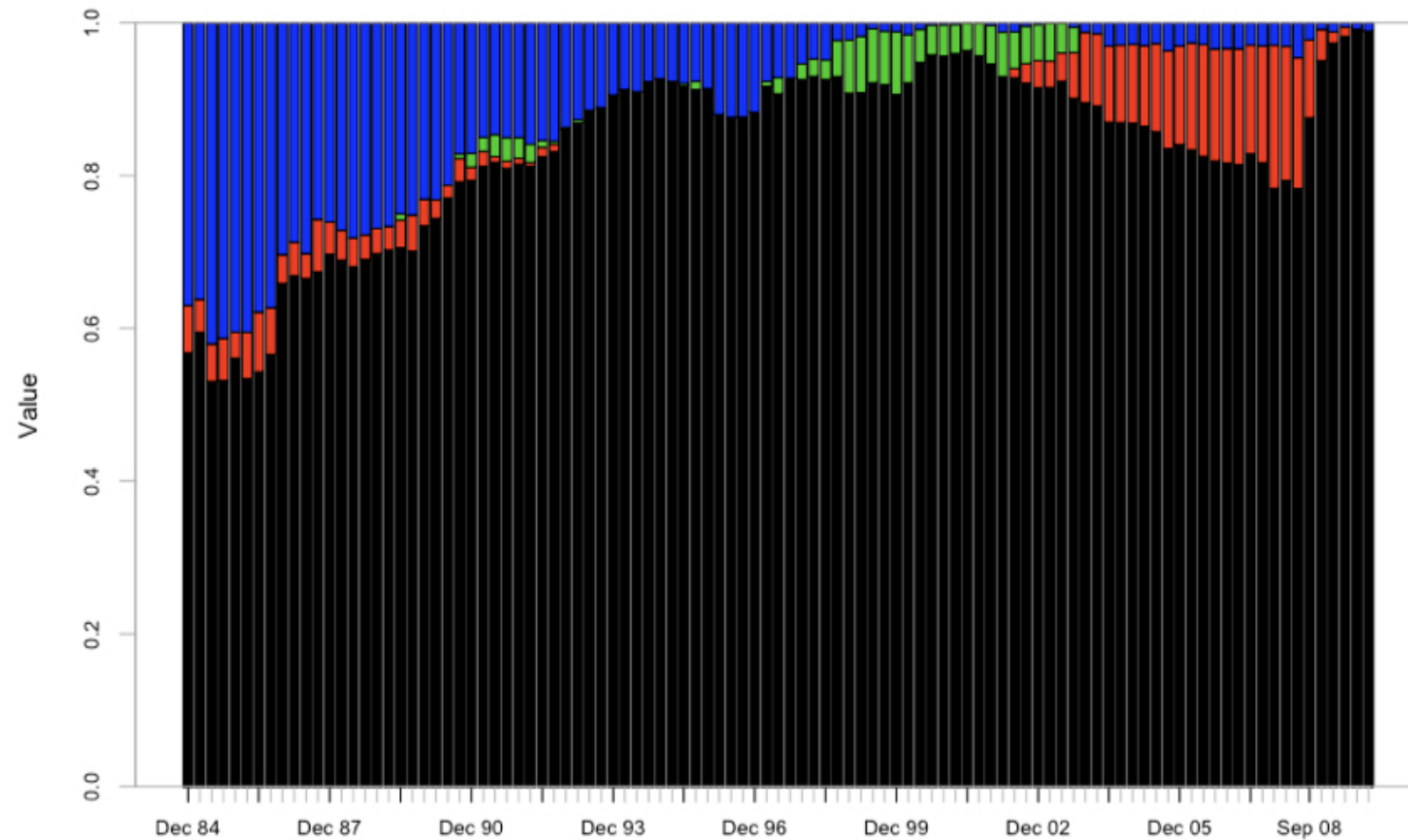
```
# Run the optimization with periodic rebalancing
opt_base <- optimize.portfolio.rebalancing(R = returns,
                                         optimize_method = "ROI",
                                         portfolio = base_port_spec,
                                         rebalance_on = "quarters",
                                         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)
```



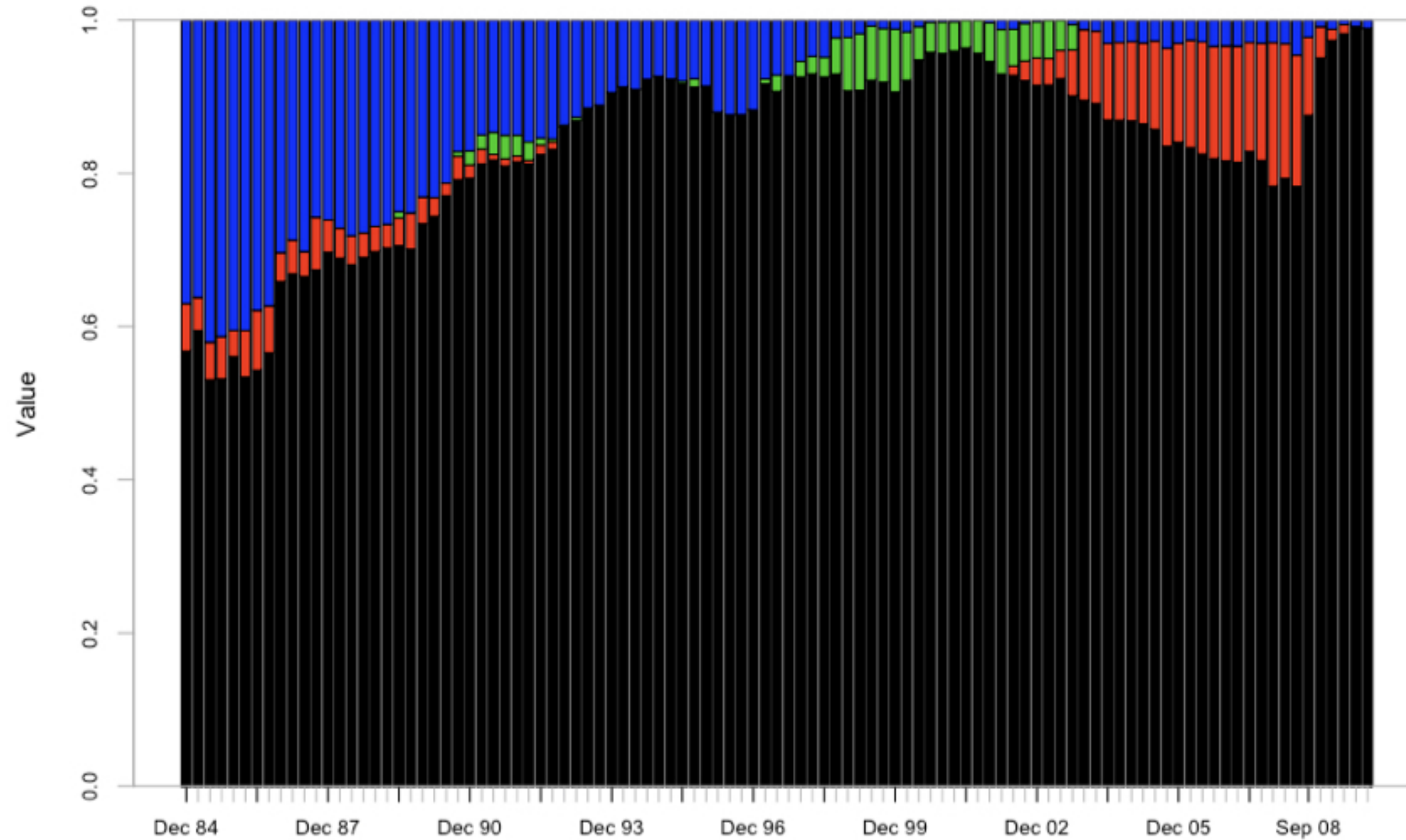
Optimization backtest: analysis

```
# 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

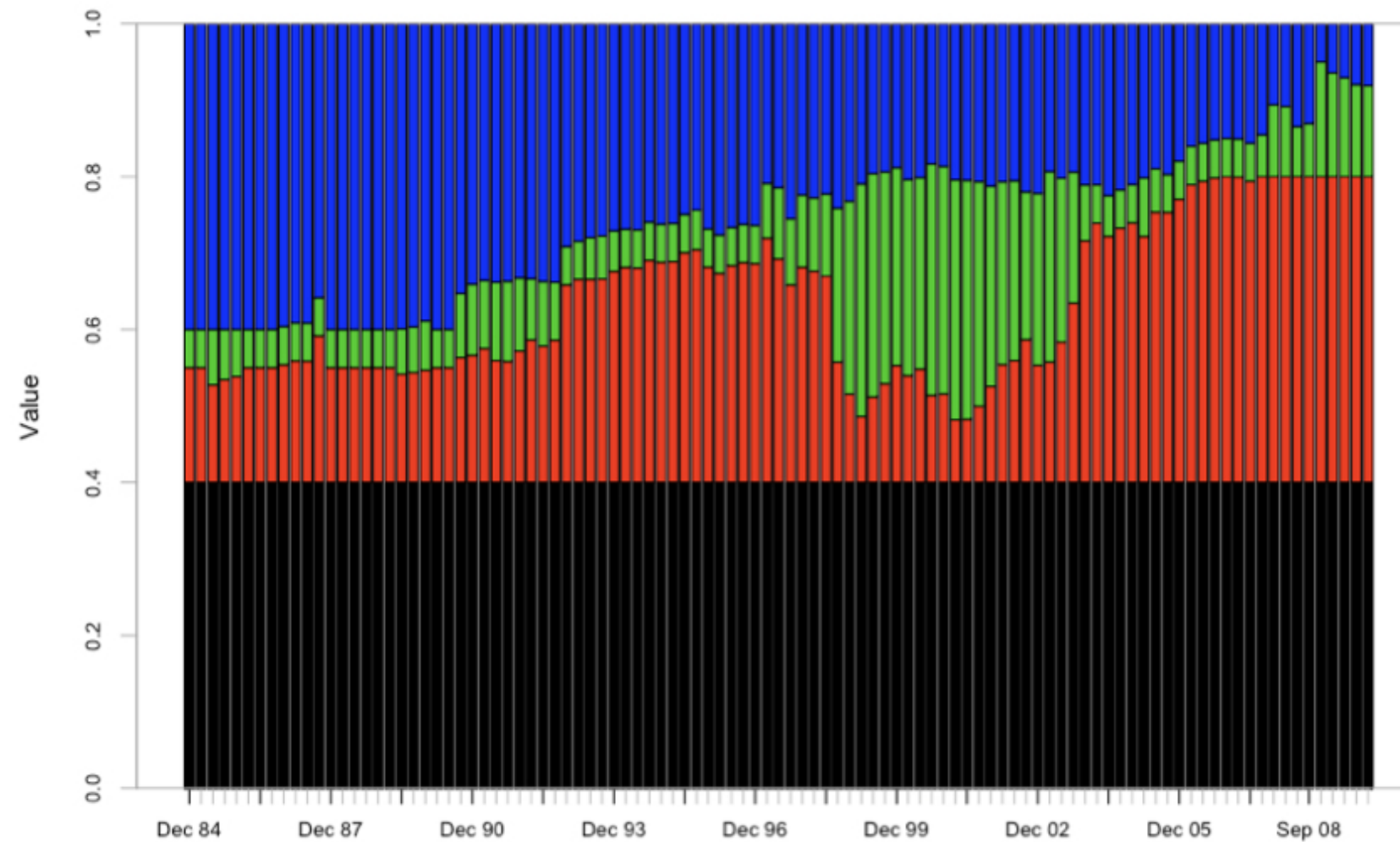
# Update the constraint
box_port_spec <- add.constraint(portfolio = box_port_spec,
                                type = "box",
                                min = 0.05, max = 0.4,
                                indexnum = 2)

# 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

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Congratulations!

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