

Portfolio Optimization with R/Rmetrics

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Portfolio Optimization Problem

... return, risk, performance ratio

For a given set of financial assets let us find the composition

- 1) which minimizes the risk for a given return (reward),
- 2) which maximizes the return for a given risk,
- 3) which optimizes a reward/risk performance ratio,
- 4) which finds the global minimum risk,

subject to certain constraints and preferences.

Stone 1973

$$R_S[Y_0, k, A](f) = \left(\int_{-\infty}^A |y - Y_0|^k f(y) dy \right)^{1/k}$$

y are the financial returns,
 $f(\cdot)$ their multivariate distribution
 A , Y_0 , and k parameters

$$R_{SD}(f) = R_S[\mu_y, 2, \infty](f) \quad R_{SSD}(f) = R_S[\mu_y, 2, 0](f)$$

$$R_{SVM}(f) = R_S[\mu_y, 2, 0]^2(f) \quad R_{\alpha-t}(f) = R_S[t, \alpha, t]^\alpha(f)$$

Pederson and Satchell 1998

$$R[A, b, \alpha, \theta, W(\cdot)] = \left[\int_{-\infty}^A |y - b|^\alpha W[F(y)] f(y) dy \right]^\theta$$

for some bounded function $W(\cdot)$

(BP1) (Nonnegativity): $R[\tilde{y}] \geq 0$.

(BP2) (Homogeneity): $R[\lambda \tilde{y}] = |\lambda| R[\tilde{y}]$ for $\lambda \geq 0$.

(BP3) (Subadditivity): $R[\tilde{y}_1 + \tilde{y}_2] \leq R[\tilde{y}_1] + R[\tilde{y}_2]$.

(BP4) (Shift-invariance): $R[\tilde{y} + \lambda] \leq R[\tilde{y}]$ for all λ .

Artzner, Delbaen, Eber, Heath 1999

(ADEH 3) (translation invariance) $R(X + c) = R(X) - c$ for all c

... this makes a coherent risk measure

(ADEH 4) (monotonicity) $X \leq Y \Rightarrow R(Y) \leq R(X)$.

- (a) *Stone's Class for $k > 1$ and $Y_0 = \mu_y$ and $A = \mu_y$ or $A = \infty$*
- *Standard deviation*
 - *Mean absolute deviation*
 - *Fishburn's $\alpha - t$ measures for $t = \mu_y$ raised to power $\frac{1}{k}$*
 - *Semistandard deviation (3)*
 - *The first Kijima-Ohnishi measure*
 - *Generalized lower partial moment*
- (b) *The range*
- (c) *The piecewise linear measures*
- *The Gini coefficient*
 - *The L-moments for $r + s < 2$*
- (d) *Kijima and Ohnishi's second measure*

Pederson and Satchell 1998

... note

<i>Covariance Risk Measure:</i>	<i>(Standard deviation)²</i>
<i>CVaR Measure:</i>	<i>$k = 1, A = \text{VaR}, Y_0 = 0$</i>
<i>new Developments:</i>	<i>Spectral Risk Measures</i>

Markowitz 1952, QP1:

Minimize Risk for a given Return:

$$\begin{aligned} \min \quad & w^\top \hat{\Sigma} w \\ \text{s.t.} \quad & \\ & w^\top \hat{\mu} = \bar{r} \\ & w^\top \mathbf{1} = 1 \\ & Aw \leq b \end{aligned}$$

QP2:

Maximize Return for a given Risk:

$$\begin{aligned} \max_{\mathbf{w}} \quad & w^\top \hat{\mu} \\ \text{s.t.} \quad & w^\top \mathbf{1} = 1 \\ & Aw \leq b \\ & w^\top \hat{\Sigma} w \leq \sigma \\ & w^\top \mathbf{B} w \leq c \end{aligned}$$

QP1 Solution:

„Quadratic Programming Solvers“
Goldfarb and Idnani, 1982

QP2 Solution:

„Second Order Cone Programming Solver“
Nesterov and Nemirovski, 1994

... do not forget the critical line algorithms

Nawrocki, 1992:

$$LPM = E[\{\max(0, \tau - y)\}^a]$$

τ *Benchmark*
 $0 < a < 1$ *Risk seeking behavior*
 $a = 1$ *Risk neutrality*
 $a > 1$ *Risk aversion*

$$\begin{array}{ll}
 \min_w & w^\top L w \\
 \text{s.t.} & \\
 & Aw \leq b
 \end{array}$$

Quadratic Lower Partial Moments:

Co-Lower Partial Moments

$$CLPM_{ij} = \frac{1}{k} \sum_{t=1}^k [MAX\{0, (\tau_t - x_{it})\}]^{a-1} (\tau_t - x_{jt}), \text{ for } a > 1$$

$$CLPM_{ij} = \frac{1}{k} \sum_{t=1}^k I_{\{MAX[0, (\tau_t - x_{it})]\}} \cdot (\tau_t - x_{jt}), \text{ for } a = 1$$

$$L = \begin{pmatrix} CLPM_{11} & \cdots & CLPM_{1n} \\ \vdots & \ddots & \vdots \\ CLPM_{n1} & \cdots & CLPM_{nn} \end{pmatrix}$$

Mean – QLPM Solution: For $a > 1$ formally equivalent to QP1

... note there is also a symmetrized QLPM version

Rockafeller and Uryasev 1992:

CVAR:

$$e_s = \max \left[0, VaR - \sum_{i=1}^n w_i r_{i,s} \right]$$

$$CVaR = VaR - \left(\frac{1}{m} \sum_{s=1}^m e_s \right) / \alpha$$

*Note if the assets are elliptically distributed,
we will get the same set of weights as for the
Mean-Variance Markowitz Portfolio!*

$$\max_{w_i, e_s, VaR} VaR - \left(\frac{1}{m} \sum_{s=1}^m e_s \right) / \alpha$$

$$\sum_{i=1}^n w_i \mu_i \geq \bar{\mu}$$

$$e_s \geq VaR - \sum_{i=1}^n w_i r_{i,s}$$

$$e_s \geq 0$$

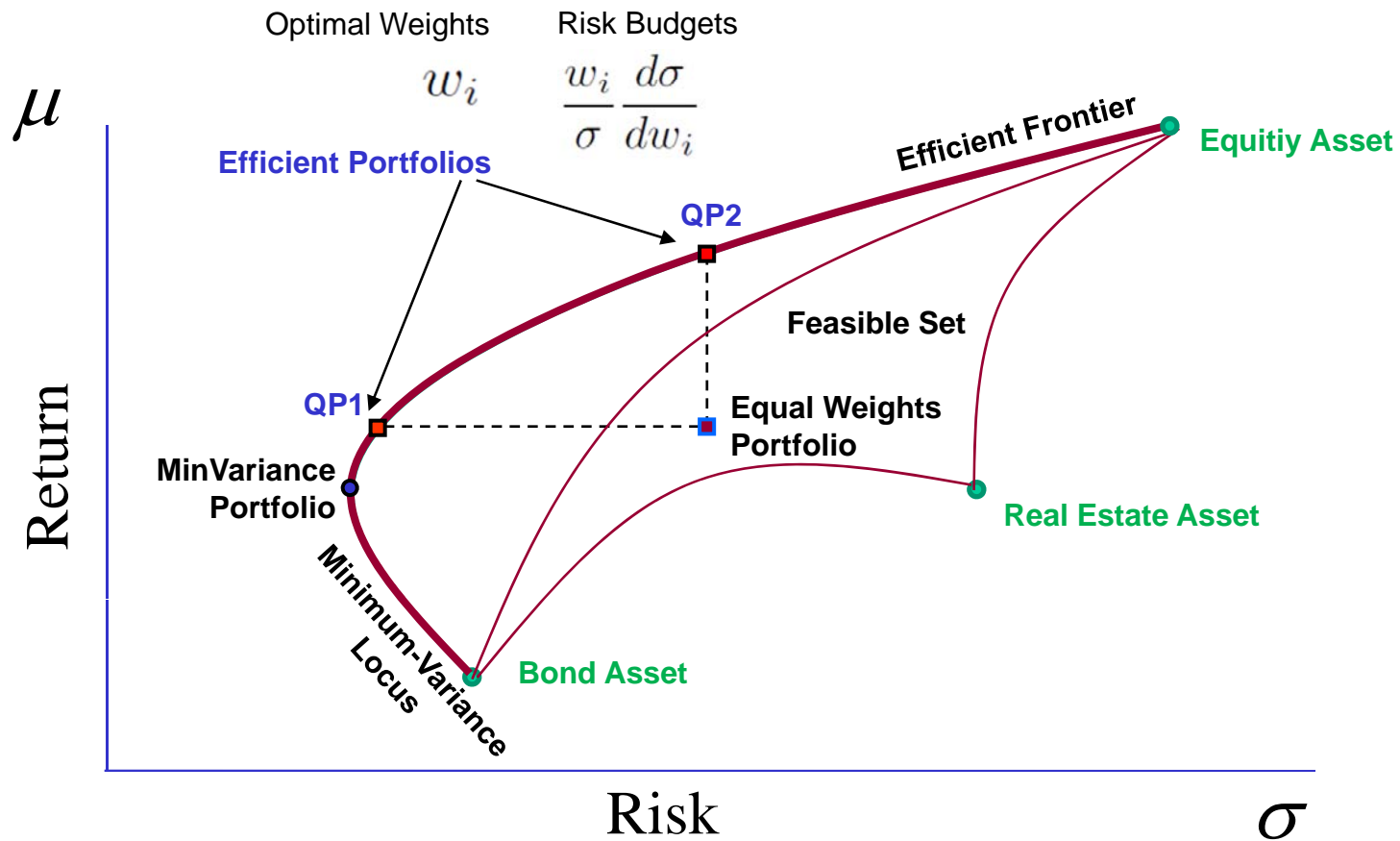
$$w_i \geq 0$$

...

Mean - CVaR Solution: Linear Programming Problem

... note Conditional Drawdown at Risk Portfolios can be solved in the same way

Risk vs. Return

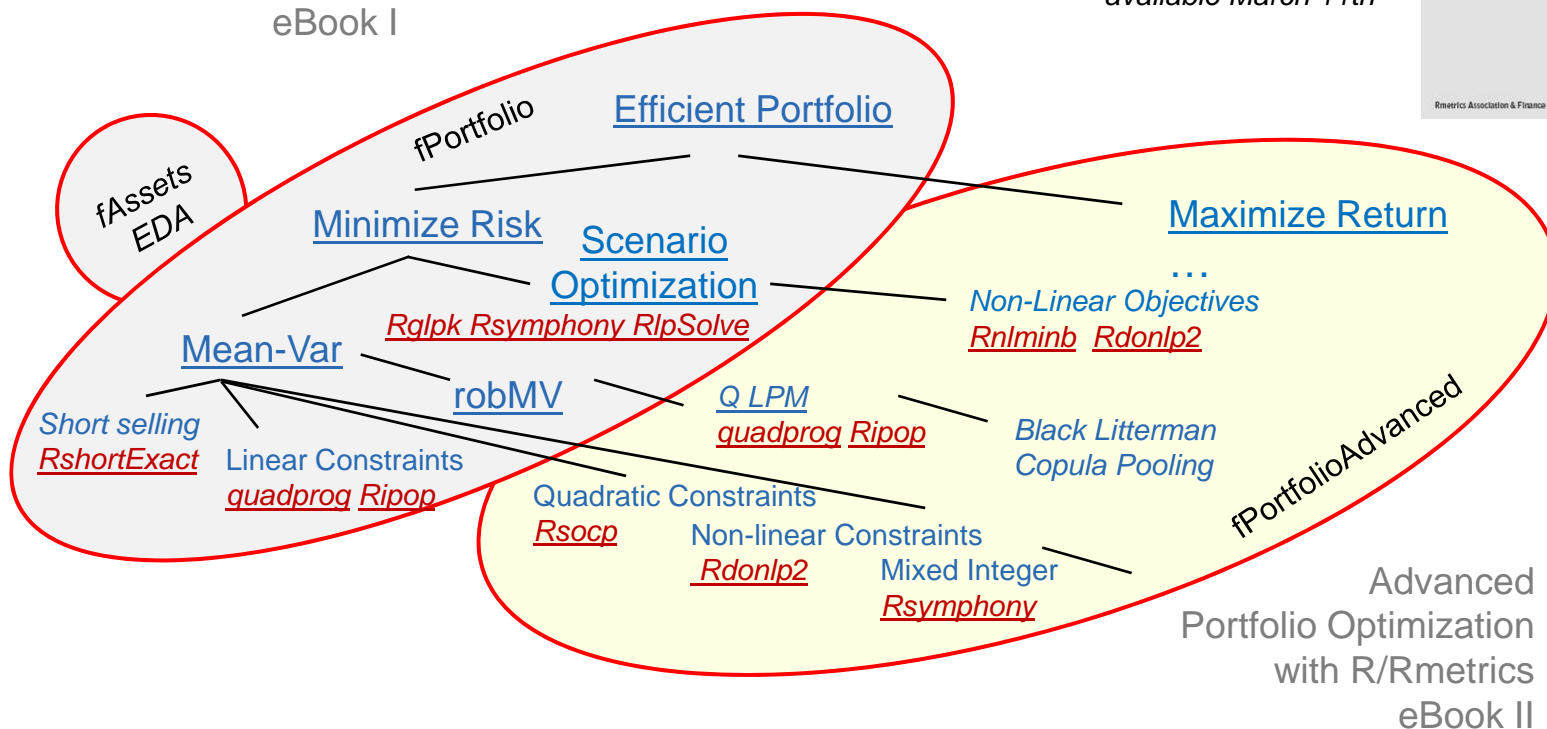
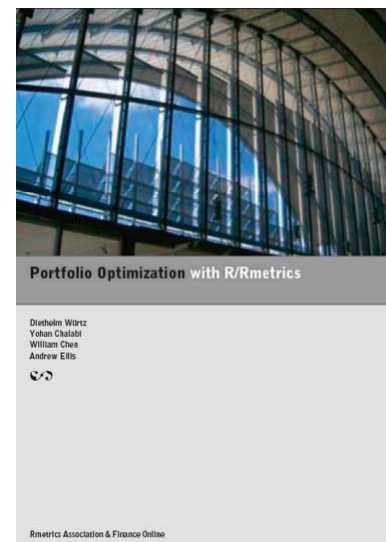


fPortfolio Zoo:
Rmetrics SoftwarePortfolio Optimization
with R/Rmetrics
eBook I

Topics

- Managing Data Sets of Assets
- Exploratory Data Analysis of Assets
- Portfolio Framework
- Mean-Variance Portfolios
- Mean-CVaR Portfolios
- Portfolio Backtesting

462 p 88 CHF
see Example Text on
www.rmetrics.org
available March 11th



Chronological Objects
in R/Rmetrics

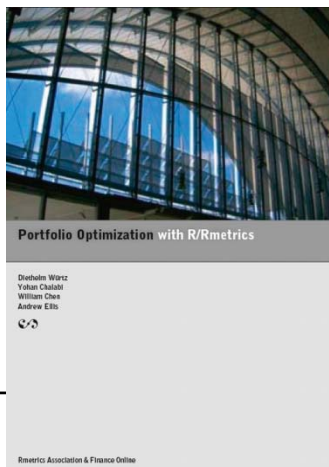
eBook, available in July

timeDate*^①
timeSeries*^①datafeed*^③

- ① CRAN Repository
- ② r-forge Repository
- ③ Rmetrics Repository

* Rmetrics Packages
and/or Interfaces

fPortfolio*^{① ②}
 quadprog^①
 Rglpk^①
 Rsymphony^①
 fAssets*^{① ②}
 robustbase^①
 corpcor^①
 fPortfolioBacktest*^{① ②}
 fPortfolioPerformance*^③



fPortfolioAdvanced*^③
 fPortfolioSolver*^②
 Ripop*^③
 Rnlminb*^③
 RlpSolve*^②
 RlpSolveAPI*^②
 Rsocp*^②
 Rdonlp2^②
 ... commercial solvers^③
 BLCOP^{① ②}

Rmetrics Packages: fEcofin, fBasics, timeDate, timeSeries, fImport, datafeed, fArma, fArmaOx, fGarch, fGarchOx, fNonlinear, fMultivar, fUnitRoots, fTrading, fOptions, fExoticOptions, fAsianOptions, fTrading, fAssets, fPortfolio, fPortfolioSolver, fPortfolioBacktesting, fPortfolioPerformance, Rquadprog, Ripop, Rsimplex, Rsocp, RlpSolve, RlpSolveAPI, Rnlminb, Rsoplex, Rcplex, ...

Portfolio Model**Portfolio Functions****Portfolio Data****Portfolio Specification****Portfolio Constraints**

Default Portfolio:

Constrained MV Portfolio
with LongOnly constraints

```
portfolioFrontier()  
  efficientPortfolio()  
  minriskPortfolio()  
  maxratioPortfolio()  
  feasiblePortfolio()
```

```
portfolioData()  
  timeSeries
```

```
portfolioSpec()  
  setType() = "MV"  
  setEstimator() = "covEstimator"  
  setOptimize() = "minRisk"  
  setSolver() = "solveRquadprog"  
  ...
```

```
portfolioConstraints()  
  "LongOnly"
```

CVaR Example:

Mean-CVaR Portfolio
with alternative constraints

```
portfolioFrontier()  
  efficientPortfolio()  
  minriskPortfolio()  
  maxratioPortfolio()  
  feasiblePortfolio()
```

```
portfolioData()  
  timeSeries
```

```
portfolioSpec()  
  setType() = "CVaR"  
  setAlpha() = 0.05  
  setOptimize() = "minRisk"  
  setSolver() = "solveRsymphony"  
  ...
```

```
portfolioConstraints()  
  "LongOnly", "Short", "Partial",  
  minW, maxW,  
  minsumW, maxSumW, eqsumW,  
  minsumB, maxSumB, eqsumB,  
  listFun, minFun, maxFun, ...
```

MSCI
WorldSwiss Performance
IndexS&P
500

SX5T

UKX

TPX

MXEF

SENSEX

CECEEUR

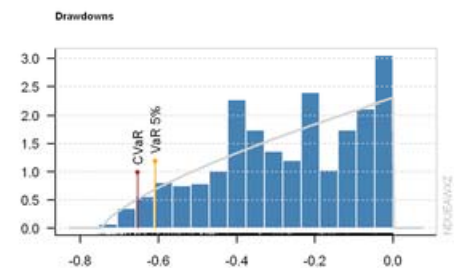
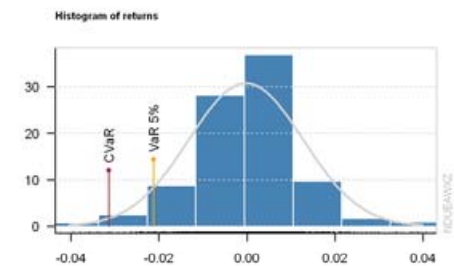
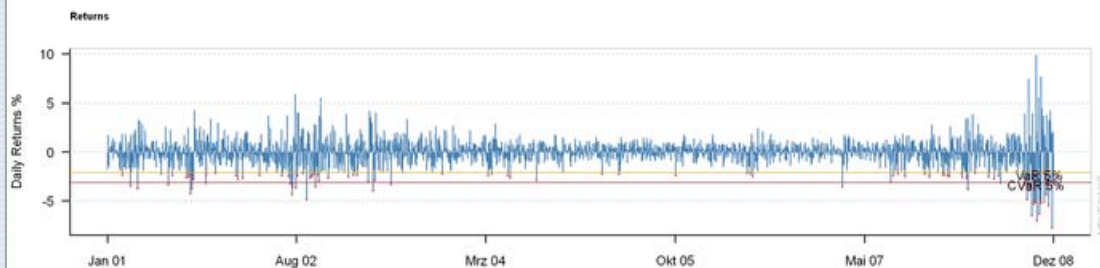
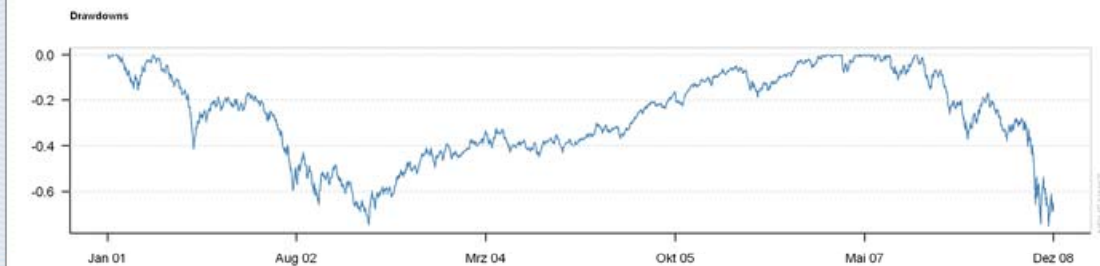
IBOV

MEXBOL

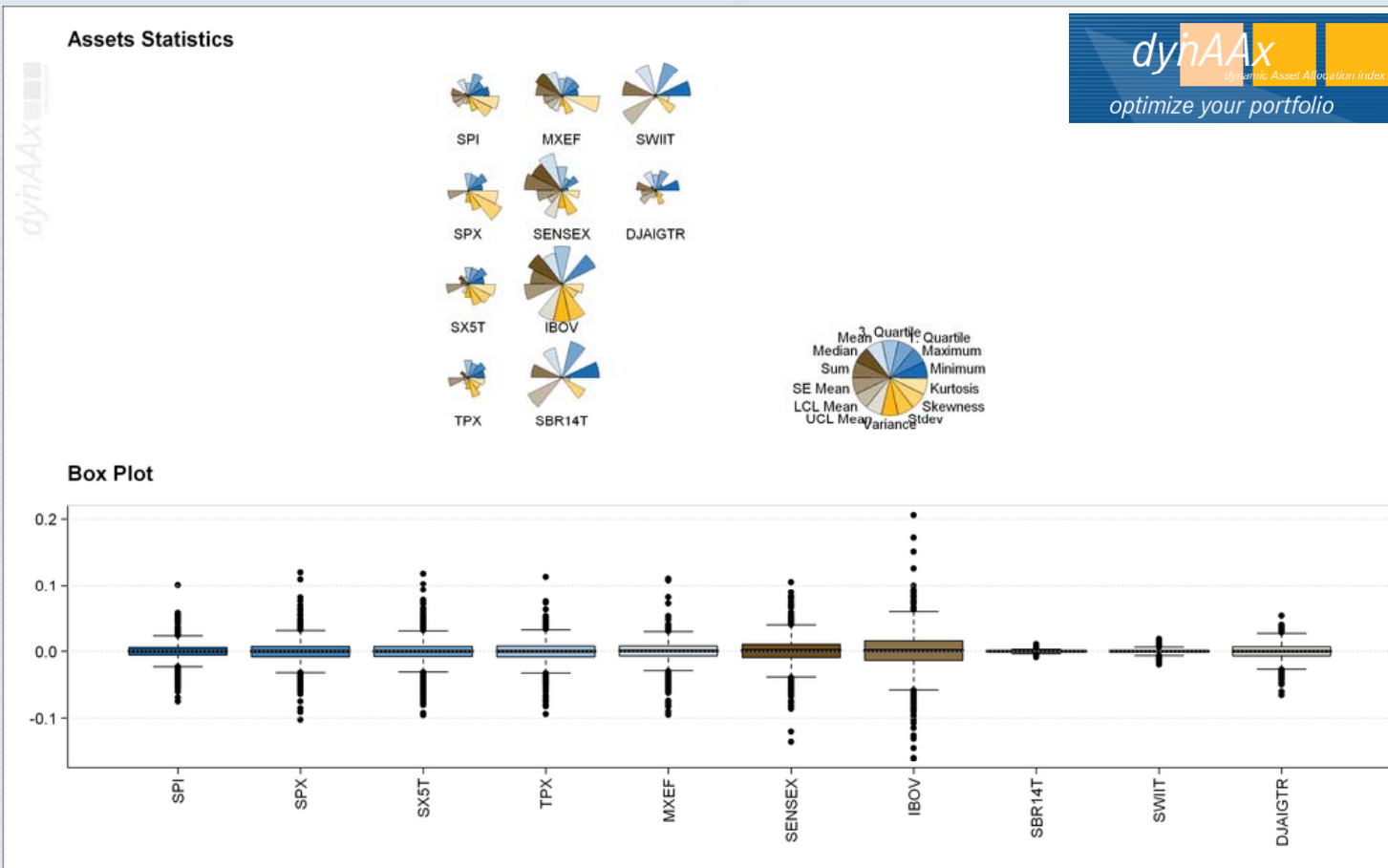
AS51

Swiss Bond
IndexSwiss Real
EstateDJ AIG
Commodity

Family: dynAax MSCI World | View: Single Asset View | Function: Series



Family: dynAAx MSCI World | View: Multi Asset View | Function: Distribution



>>> Close window <<<

Load Data Set, Specification and Constraints
Pictet Swiss Pension Fund Benchmark
LPP2005

Compute the efficient frontier

Output:

The portfolio weights

The covariance risk budgets

The target returns and target risks

LPP Portfolio Example:

```
> Data = LPP2005.RET[, 1:6]
```

```
> Spec = portfolioSpec()
```

```
> Cons = "LongOnly"
```

Portfolio Frontier:

```
> portfolioFrontier(Data, Spec, Cons)
```

Title:

MV Portfolio Frontier:

Estimator: covEstimator

Solver: solveRquadprog

Optimize: minRisk

Constraints: LongOnly

Portfolio Points: 5 of 50

Portfolio Weights:

	SBI	SPI	SII	LMI	MPI	ALT	LPP25	LPP40	LPP60
1	1.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
13	0.0327	0.0000	0.1458	0.6594	0.0000	0.1621	0.0000	0.0000	0.0000
25	0.0000	0.0081	0.2492	0.3528	0.0000	0.3899	0.0000	0.0000	0.0000
37	0.0000	0.0197	0.3516	0.0120	0.0000	0.6168	0.0000	0.0000	0.0000
50	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	0.0000	0.0000	0.0000

Covariance Risk Budgets:

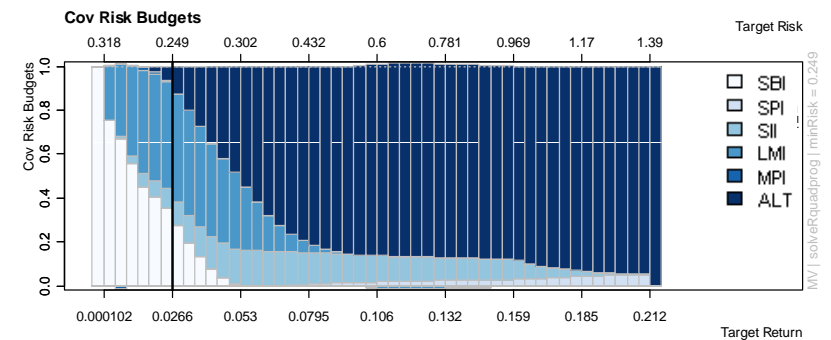
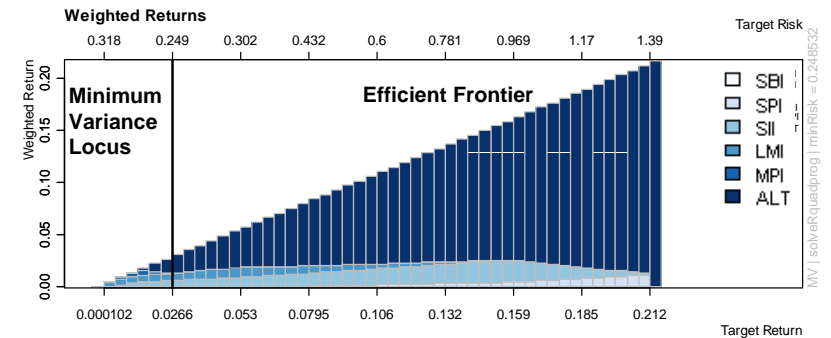
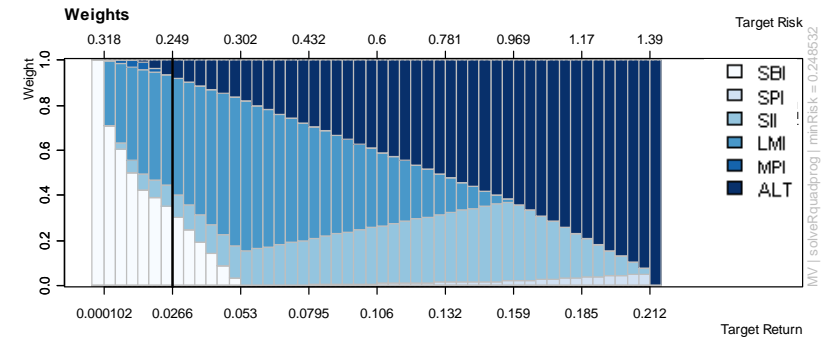
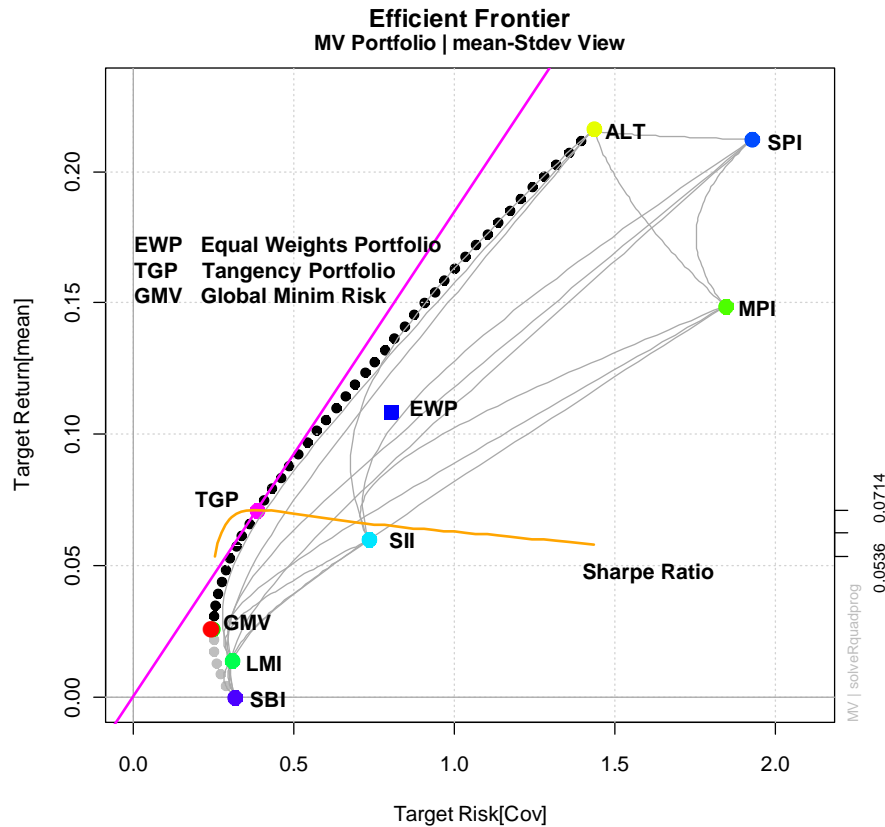
	SBI	SPI	SII	LMI	MPI	ALT	LPP25	LPP40	LPP60
1	1.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
13	0.0116	0.0000	0.1586	0.3456	0.0000	0.4841	0.0000	0.0000	0.0000
25	0.0000	0.0176	0.1225	-0.0083	0.0000	0.8683	0.0000	0.0000	0.0000
37	0.0000	0.0274	0.0954	-0.0008	0.0000	0.8780	0.0000	0.0000	0.0000
50	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	0.0000	0.0000	0.0000

Target Return and Risks:

	mean	mu	Cov	Sigma	CVaR	VaR
1	0.0000	0.0000	0.1261	0.1261	0.2758	0.2177
13	0.0210	0.0210	0.1198	0.1198	0.2329	0.1708
25	0.0420	0.0420	0.2381	0.2381	0.5135	0.3348
37	0.0630	0.0630	0.3845	0.3845	0.8577	0.5714
50	0.0858	0.0858	0.5684	0.5684	1.3343	0.8978

Plotting Frontiers and Weights

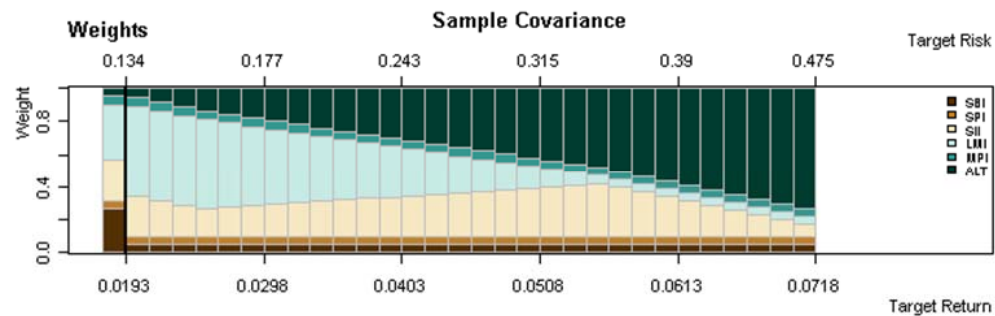
LPP 2005 Benchmark Portfolio



```
# Example:
Cons = c(
  "minW[1:nAssets] = 0.05",
  "maxsumW[c('SBI','LMI')] = 0.6")

# Mean-Variance:
frontier = portfolioFrontier(Data,Spec,Cons)

# Weights Plot:
weightsPlot(frontier)
```



Reducing Estimation Errors ...

Functions:

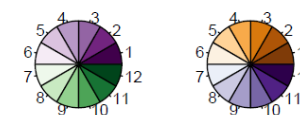
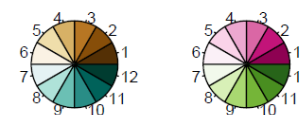
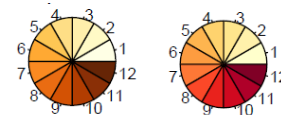
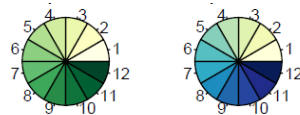
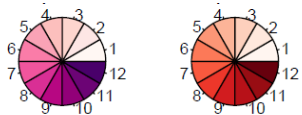
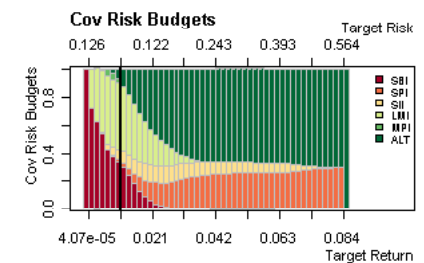
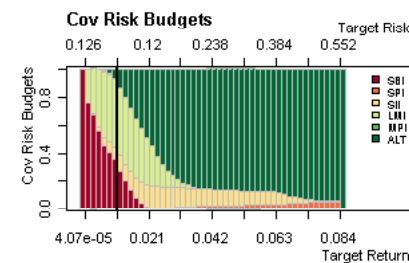
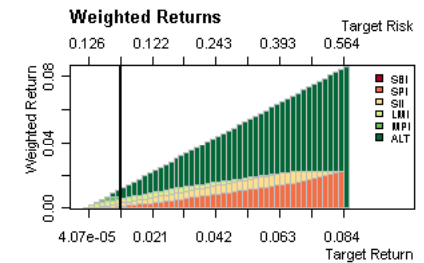
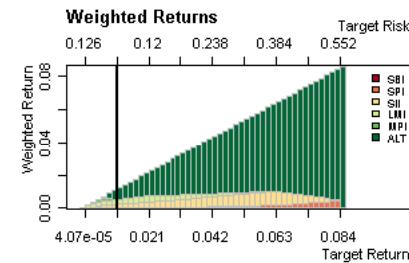
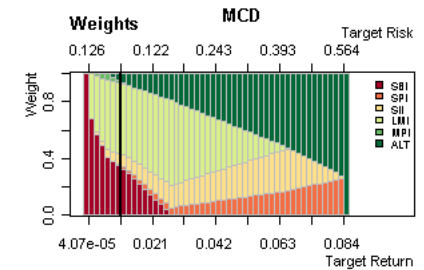
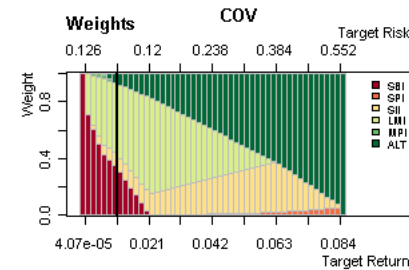
```
covEstimator
kendallEstimator
spearmanEstimator
mcdEstimator
mveEstimator
covMcdEstimator
covOGKEstimator
shrinkEstimator
baggedEstimator
```

```
# MV Sample Estimator:
covFrontier = portfolioFrontier(Data, Spec)

# MV MCD Estimator:
setEstimator(Spec) <- "covMcdEstimator"
mcdFrontier <- portfolioFrontier(Data, Spec)

# Weights Plot:
weightsPlot(covFrontier)
weightsPlot(mcdFrontier)

...
```

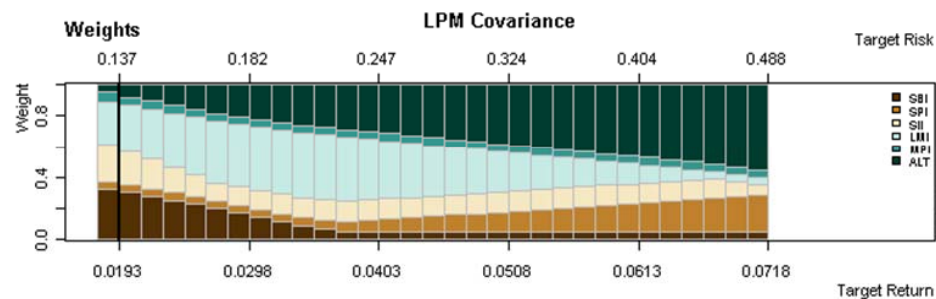


Q Lower Partial Moments ...

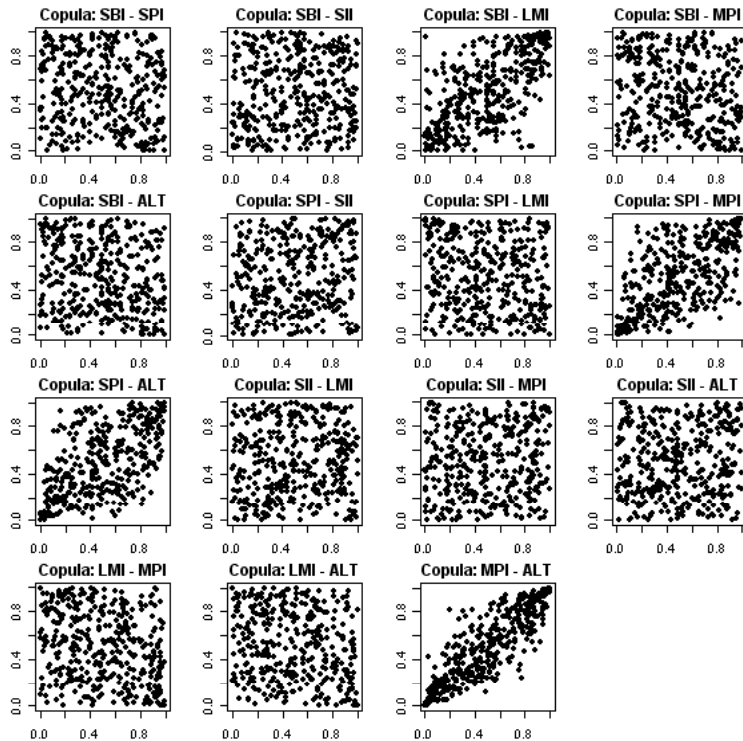
```
# Example:
Cons = c(
  "minW[1:nAssets] = 0.05",
  "maxsumW[c('SBI','LMI')] = 0.60")

# Quadratic Lower Partial Moments:
setEstimator(Spec) <- "lpmEstimator"
Spec@model$param$a <- 1.25
Spec@model$param$tau <- "colMeans"
frontier <- portfolioFrontier(Data,Spec,Cons)

# Weights Plot:
weightsPlot(frontier)
```



Copulae Lower Tail Risk Dependence Budgets



SBI CH Bonds
SPI CH Stocks
SII CH Immo
LMI World Bonds
MPI World Stocks
ALT World AltInvest

Tail Dependence:
Lower

SBI SPI	0
SBI SII	0.055
SBI LMI	0.064
SBI MPI	0
SBI ALT	0
SPI SII	0
SPI LMI	0
SPI MPI	0.352
SPI ALT	0.273
SII LMI	0.075
SII MPI	0
LMI MPI	0
LMI ALT	0
MPI ALT	0.124

$$\lambda_{lower} = \lim_{u \rightarrow 0} \left[\Pr \left(Y \leq F_Y^{-1}(u) \mid X \leq F_X^{-1}(u) \right) \right]$$

$$= \lim_{u \rightarrow 0} \left[\frac{C(u, u)}{u} \right]$$

$$\min w^\top \hat{\Sigma} w$$

s. t.

$$w^\top \hat{\mu} = \bar{r}$$

$$w^\top 1 = 1$$

$$\mathcal{L}_i^{lower} \leq \frac{w_i}{\lambda} \frac{d\lambda}{dw_i} \leq \mathcal{L}_i^{upper}$$

...

... Quadratic Constraints use Rsocp
(not yet fully implemented)

```

# Specification:
spec <- portfolioSpec()
setTargetReturn(spec) <- 4*mean(data) # 17.2%
setObjective(spec) = c("Objective", "Return", "Risk")
Return <- function(weights)
  (getMu(Data) %*% weights)
Risk <- function(weights)
  (sqrt(weights %*% getSigma(Data) %*% weights))
Objective <- function(weights) Risk(weights)
setSolver(spec) <- "solveRdonlp2"

# 130/30 Extension Constraints:
lowerExtension <- function(w) sum(w[w<0])
upperExtension <- function(w) sum(w[w>0])
cons <- c(
  "minW[1:nAssets] = rep(-0.30, times = nAssets)",
  "maxW[1:nAssets] = rep( 1.30, times = nAssets)",
  "minsumW[1:nAssets] = -0.30",
  "maxsumW[1:nAssets] = 1.30",
  "listF = list(lowerExtension, upperExtension),
  "minF = c(-0.30, 0.00)",
  "maxF = c( 0.00, 1.30)")

# Portfolio:
efficientPortfolio(data, spec, cons)

```

```

Title:
MV Efficient Portfolio
Estimator:      covEstimator
Solver:         solveRdonlp2
Optimize:       minRisk
Constraints:     minW maxW minsumW maxsumW

Portfolio Weights:
      SBI      SPI      SII      LMI      MPI      ALT
-0.293  0.001 -0.000 -0.006  0.000  1.243

Covariance Risk Budgets:
      SBI      SPI      SII      LMI      MPI      ALT
0.0121 0.0009 0.0000 0.0003 0.0003 0.9864

Target Return and Risks:
      mean      mu      Cov      Sigma      CVaR      VaR
0.1067 0.1067 0.7157 0.7157 1.6843 1.1471

```

Other non-linear Constraints:
Value at Risk, Tracking Error, Drawdowns, ...

Buy-In Threshold Constraints:

These constraints define the minimum level at which an asset can be purchased. Its eliminates the problem of unrealistically small trades.

Cardinality Constraints:

These constraints restrict the number of stocks allowed in the portfolio

Roundlot Constraints:

Roundlots are used to define the basic unit of investment. Investors are allowed only to make transactions in multiples of the roundlots.

...

```
setSolver(spec) <- "solveRsymphony"
```

```
cons <- ...
```

is currently under implementation in Package
fPortfolioAdvanced.

BLCOP

BLCOP

is a contributed Package written by Francisco Gochez for Black-Litterman and Copula Opinion Pooling in Portfolio Optimization.

Black-Litterman

Fisher Black and Robert Litterman's 1992 goal was to create a systematic method of specifying and then incorporating analyst/portfolio manager views into the estimation of market parameters for portfolio optimization.

Copula Opinion Pooling

is an alternative way with several advantages compared with Black-Litterman, Attilio Meucci 2005.

...

```
setType(spec) <- "BLCOP"
```

```
setViews(spec) <- ...
```

an interface is currently under implementation in Package
fPortfolioAdvanced .

fPortfolioBacktest

Portfolio Model

*Example: Rolling Tangency CVaR Portfolio
with box/group constraints*

*Specification the Backtest
Settings*

```
backtestSpec <-  
portfolioBacktest(  
  windows,  
  strategy,  
  smoother, ... )
```

Run the Backtests

```
rollingBacktest <-  
portfolioBacktesting(  
  formula,  
  data, spec, constraints,  
  backtest = backtestSpec, ...)
```

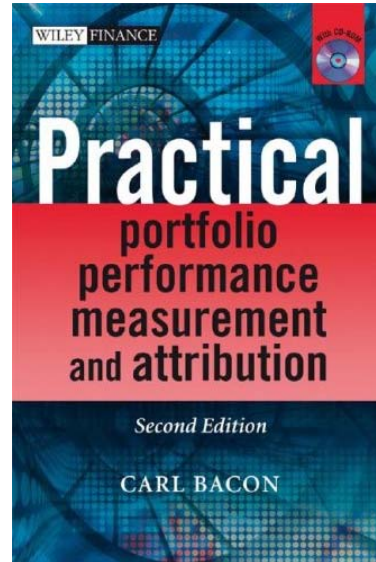
Smooth the Weights

```
portfolioSmoothing(  
  object = rollingBacktest,  
  backtest = backtestSpec, ...)
```

Analyze the Performance

```
portfolioPerformance(...)
```


fPortfolioPerformance



Implements more than 100 traditional portfolio risk and performance measures from Carl Bacon's book, plus some more, e.g. robust risk measures, extreme value measures, copulae measures, ...

Preliminary version (without documentation) is available on demand.

MSCI GCC Gulf Cooperation Council Countries Indices

Rolling Windows:

Horizon 12m

Shift 1m

Portfolio Strategy:

MV Tangency Portfolio

Dynamic Horizon < 12M

Optimal Shrinkage Estimator

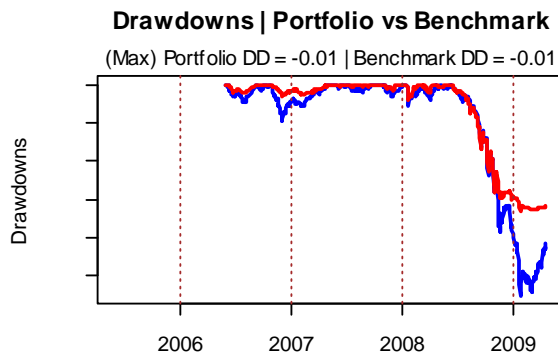
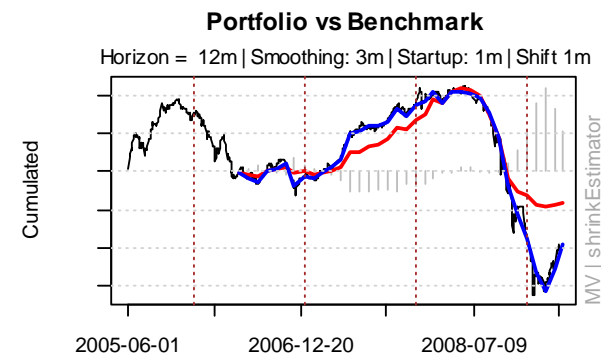
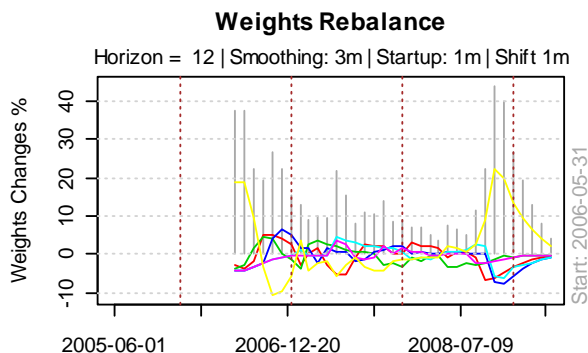
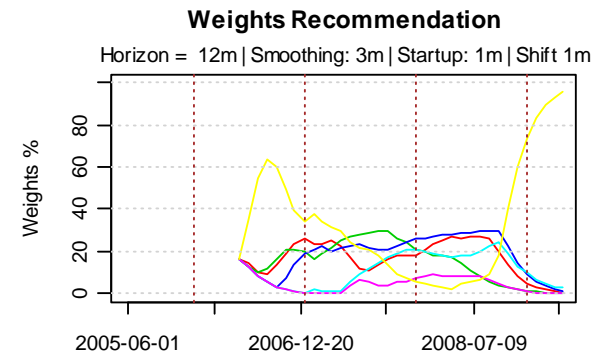
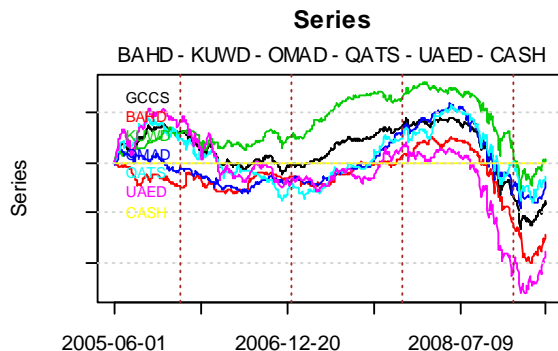
best of $\lambda = 0 \dots 1$

Partial Cash Position

Max 30% Box Constraints

Weights Smoothing:

3m Double EMA



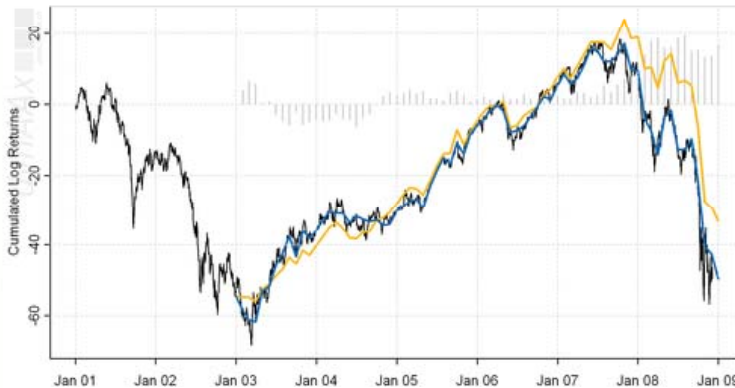
Backtesting Results ...

Tangency Plus Strategy Markowitz

Family: dynAAx MSCI World | View: Index View | Function: Index

dynAAx
optimize your portfolio

Cumulated Log Return | dynAAx versus Benchmark



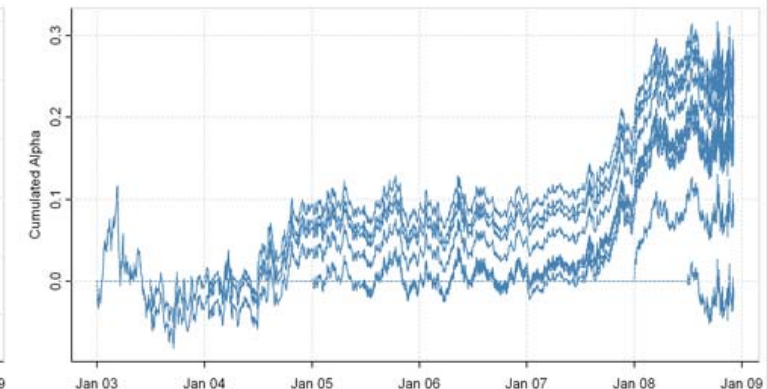
Cumulated Log Returns | Series



Drawdowns | dynAAx versus Benchmark



Cumulated Alpha with different starting points

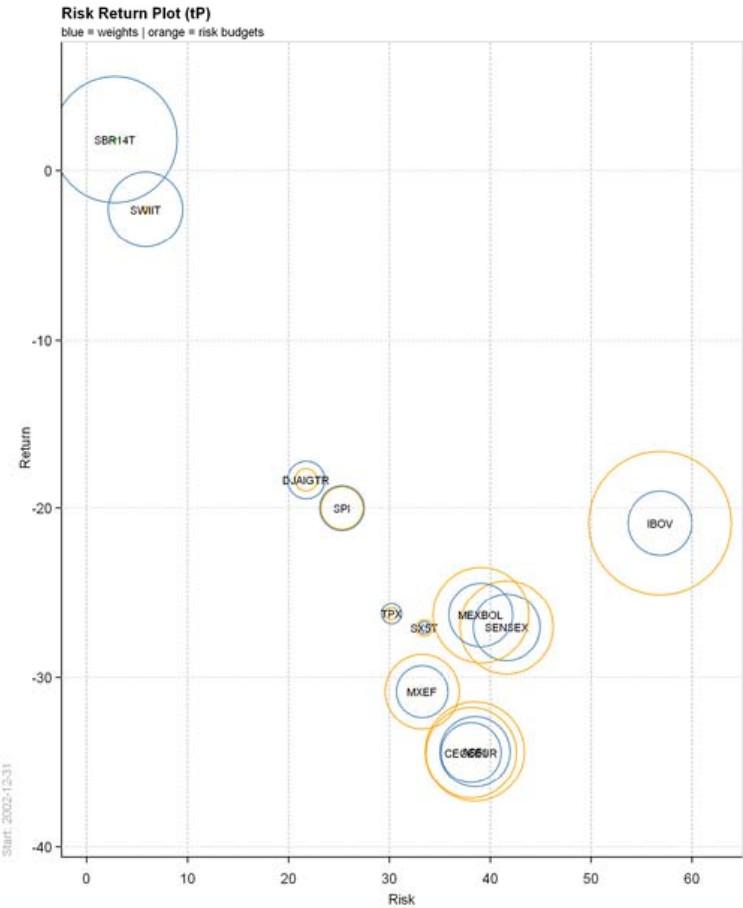
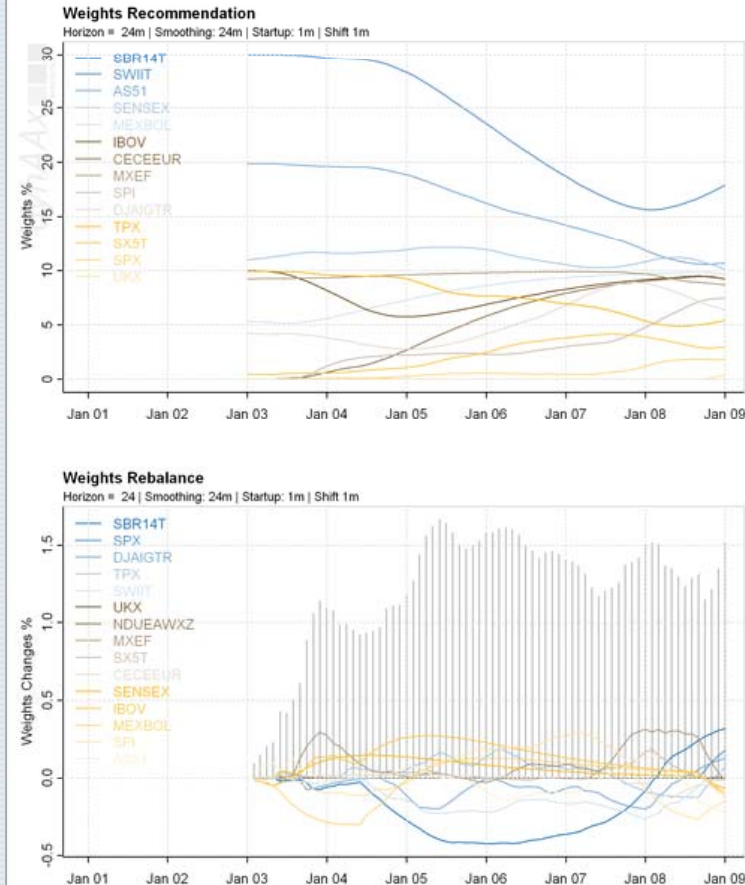


>>> Close window <<<

Backtesting Results

Tangency Plus Strategy Markowitz

Family: dynAAx MSCI World | View: Index View | Function: Allocation

dynAAx
optimize your portfolio

>>> Close window <<<

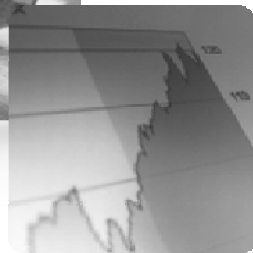
open source software for computational finance and financial engineering



Rapid



Model



Prototyping



Teaching



Training



Business

Thank you

wuertz@phys.ethz.ch

Rmetrics Packages: fEcofin, fBasics, timeDate, timeSeries, fImport, datafeed, fArma, fArmaOx, fGarch, fGarchOx, fNonlinear, fMultivar, fUnitRoots, fTrading, fOptions, fExoticOptions, fAsianOptions, fTrading, fAssets, fPortfolio, fPortfolioSolver, fPortfolioBacktesting, fPortfolioPerformance, Rquadprog, Ripop, Rsimplex, Rsocp, RlpSolve, RlpSolveAPI, Rnlminb, Rsoplex, Rcplex, ...

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open source software for computational finance and financial engineering



Rapid



Model



Prototyping



Teaching



Training



Business

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Rmetrics

is a collection of R packages for computational finance and financial engineering.
It is based on the R language and the R run-time environment.



Rmetrics

is designed

- as an Open Source Environment – you can look at any piece of the code
- as a Rapid Model Prototyping System – do in one day where others need one week
- as a Teaching Tool for “Computational Finance and Financial Engineering”,
- but also a Code Archive for business use – copy and paste for free what you need



Rmetrics

tries to cover all major aspects of computational finance and financial engineering

- Time and Date Management of Financial Time Series

- Pricing and Valuation of Financial Instruments and Derivatives

- Volatility Modeling and Forecasting including GARCH Processes

- Risk Management including Extreme Value Theory and Copulae

- Asset Management and Portfolio Optimization together with Performance Analysis

...



1997 Starting with a Collection of SPlus Functions

1999 Moving to R

2001 Creating Rmetrics Packages

2002 Adding to CRAN Packages



2003 Introducing R-sig-Finance / Private Repository – Martin Mächler

2004 Providing Debian Packages – Dirk Eddelbüttel

2007 Organizing the 1st Rmetrics User and Developer Workshop

2008 Founding the Rmetrics Association / Offering Student Internships

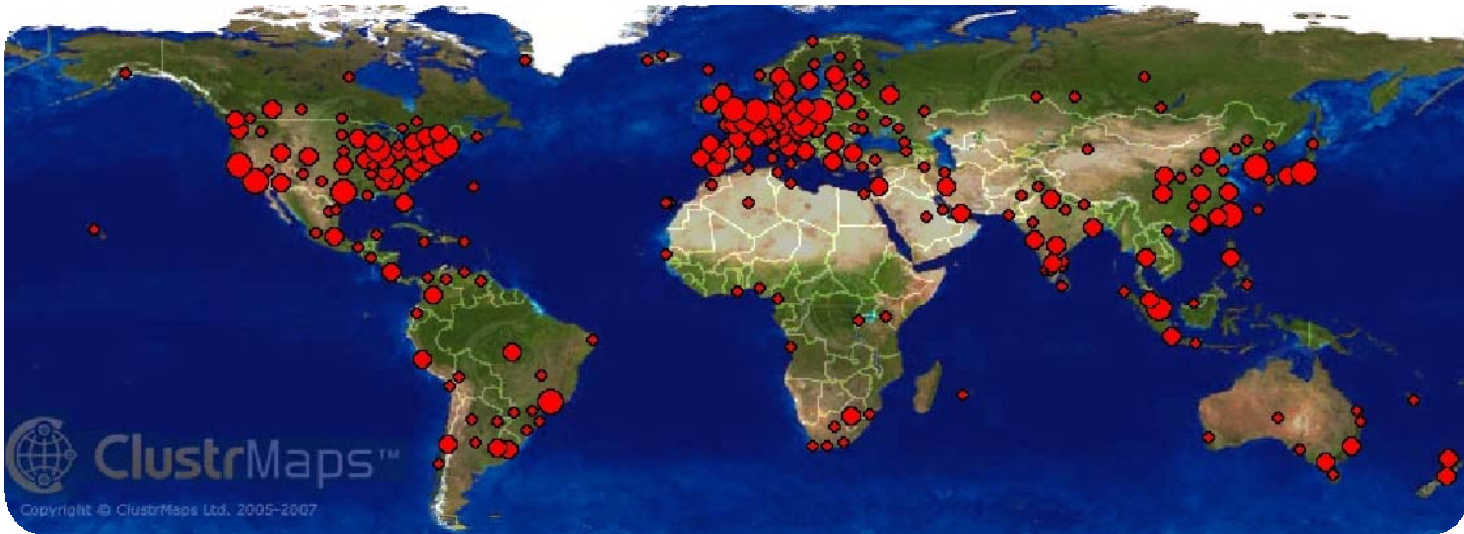
2008 2nd Rmetrics Developer Workshop

2008 Joining R-forge / Rmetrics Repository



2009 3rd Rmetrics User and Developer Workshop

2009 First Rmetrics eBook “Portfolio Optimization with R/Rmetrics”



People use it in Education

Chicago Business School, University of Chicago
University of Economics, Vienna
Swiss Federal Administration, Berne
Institute for Advanced Studies, Vienna
Swiss Economic Institute, KOF ETH Zurich
Swiss Banking Institute, University of Zurich

...

and in Business ...

Bank Clariden, Zurich
Bank of America, Chicago
Credit Suisse, Madrid,
European Central Bank, Frankfurt
Government Investment Corp,
Singapore
Lippers – Reuters, Dallas

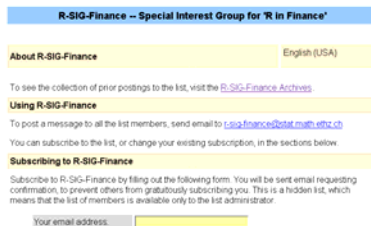
...



Download R Run-Time Environment and Rmetrics Packages:
www.r-project.org



Get most recent updates from the Rmetrics Repository:
<https://r-forge.r-project.org>



Find help from the Special Interest Group of R in Finance:
<https://stat.ethz.ch/mailman/listinfo/rmetrics-core>
<https://stat.ethz.ch/mailman/listinfo/r-sig-finance>



Visit the home of Rmetrics Association for Financial Computing:
www.rmetrics.org



The “Rmetrics Association” is a not-for-profit organization working in the public interest. It was founded May, 2008 as an association under Swiss law and has its seat in Zurich.

Rmetrics was born 1997 in the econphysics group of Dr. Diethelm Würtz at the Institute of Theoretical Physics. When Rmetrics was introduced it served as a teaching environment in computational finance and financial engineering.

Diethelm Würtz is Senior Scientist and Private Lecturer at the Physics Department and at the Curriculum for Computational Science at the Swiss Federal Institute of Technology in Zurich.

The Rmetrics Association ...

- ❑ supports the Rmetrics project and other innovations in financial computing,
- ❑ ensures the continued development of the Rmetrics software packages,
- ❑ provides a reference point for individuals, institutions or commercial enterprises, that want to support or interact with the Rmetrics development community,
- ❑ encourages students to participate in internships,
- ❑ publishes eBooks covering user and programming guides,
- ❑ offers traineeships, and organizes meetings and workshops.

Open Source Software ...



Rmetrics ...
... is a collection of 5
functions embedded in
the



Statistical Environment
offering a "Rapid Model
Prototyping" platform for
"Financial Engineering"
and "Computational
Finance".

Coverage:
Rmetrics covers Time
Series Econometrics,
Hypothesis Testing,
GARCH Modeling and
Volatility Forecasting,
Extreme Value Theory
and Copulas, Pricing of
Derivatives, Portfolio
Analysis, Design and
Optimization and much
more.

Software ...

• Install all Rmetrics Packages from CRAN

Install all Rmetrics packages from CRAN using the Rmetrics.R installation script.
[More information at wiki.rmetrics.org ...](#)

• Download Rmetrics Packages from CRAN

Major Rmetrics packages and many contributed R packages related to finance and econometrics can be downloaded from the CRAN server.
[Go to CRAN's contributed packages list ...](#)

• Rmetrics Development Packages

The Rmetrics development repository is hosted by RForge. There you can download development versions of Rmetrics and contributed Rmetrics packages.
[Go to Rmetrics Project on RForge ...](#)

• Download the R Environment from CRAN

Here you can download and install the R environment from the CRAN server. Follow the links for Linux, Mac OS X, or Windows on CRAN's home page.
[Go to CRAN's home page ...](#)

• Download Packages from the Portfolio Project

Here you can download all packages used in the Rmetrics Portfolio Project. The versions of the packages offered in the download area are exactly those which we use.
[Coming soon ...](#)

Site Map

Documentation, eBooks, Wiki, ...



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Documentation ...

• Rmetrics eBooks

The Rmetrics Association and Finance Online have started a collaboration in writing and publishing a series of eBooks. We aim to provide first class documentation of the Rmetrics software environment.
The first book on "Portfolio Optimization with R/Rmetrics" will be available by the middle of March. Please bookmark this page and come back later.

• Rmetrics Wiki

The topics which are covered in this wiki are for R/Rmetrics users and developers who want to install the development version of Rmetrics.
[Click here ...](#)



Conferences, Workshops, Lectures, Seminars ...



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Conferences
Workshop
Lectures
Seminars ...

• Meielisalp Workshop 2009

Third international workshop on "Computational Finance and Financial Engineering" together with the third Rmetrics user and developer meeting.
June 28th to July 2nd, Lake Thun, Switzerland.
[Read more ...](#)

• ETH Lecture FS 2009

"Computational Finance and Econophysics" Lecture given by Dietrich Würlt at ETH Zurich.
[Go to the Course Catalogue ...](#)

• ETH Seminar FS 2009

"Seminar in Financial Engineering for CSE. CSE is the 'Interdisciplinary Curriculum in Computational Science and Engineering' at ETH Zurich.
[Go to the Course Catalogue ...](#)



Workshop Center at Meielisalp,
photos above show PG-Online in
the vicinity of Meielisalp.

Other Events:

useR! 2009

Previous Events:

Meielisalp 2008

Rmetrics Lectures 2008

Rmetrics Lectures 2007

Meielisalp User and Developer Workshop



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Meielisalp Workshop 2009

• Workshop 2009

The workshop will take place from June 28th - July 2nd, 2009 at Meielisalp, Lake Thun, Switzerland. It will be organized by the "Rmetrics Association for Financial Computing" and co-organized by the Swiss Federal Institute of Technology in Zurich, by the University of Economics and Business Administration in Vienna, and by the University of Auckland.
[Go to Registration ...](#)

• The Workshop Focuses on ...

- using R and Rmetrics as the premier open source solution for financial market analysis, valuation of financial instruments, and insurance tasks
- providing a platform for R users to discuss and exchange ideas on how R and Rmetrics can be used to do computations, data analysis, and visualization in finance and insurance
- giving an overview of the new features of the rapidly evolving R in Finance project and discussing future developments

• The Program Consists of ...

- presentations of new R/Rmetrics directions and developments through keynote lectures
- user-contributed presentations reflecting the wide range of fields in which R and Rmetrics are used in finance and insurance to analyze and model data
- bringing together developers, practitioners, and users from finance and insurance providing a platform for common discussions and exchange of ideas

• The Call for Papers Invites ...

- all Rmetrics users and developers to submit abstracts presenting innovations or existing applications of R and Rmetrics on topics such as:
 - Econometrics, Finance and Insurance
 - Portfolio Selection and Optimization
 - Valuation of Financial Derivatives
 - Extreme Value Theory and Copulas
 - High Frequency and TimesSeries Data
 - Robust Statistics

Register Online ...



on a "first come first serve" basis starts in January 2009. Please note that the workshop is limited to 50 participants including the speakers.
[Go to registration ...](#)

Submission of Abstracts ...

by end of May 2009

Organization ...

Dietrich Würlt, Swiss Federal Institute of Technology, Zurich, David Scott, University of Auckland, Auckland.

Local Organization ...
Vahan Choudhry, ETH Zurich, choudh@ethz.ch
Dietrich Würlt, ETH Zurich, wuerl@ethz.ch

Download ...

Short Announcement
Poster
First Announcement



Donations ...

The non-profit Rmetrics Association supports the open source Rmetrics Software in the public interest. Rmetrics has expenses and it is hoped that businesses that use it and make money through it will contribute back to help make Rmetrics the best open source software in computational finance and financial engineering.

Donate



<https://www.rmetrics.org>