

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

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

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

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

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

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

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

... this makes a coherent risk measure

- (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

Covariance Risk Measure: (Standard deviation)²
CVaR Measure: $k = 1, A = VaR, Y_0 = 0$
new Developments: Spectral Risk Measures

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:

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

QP1 Solution:

„Quadratic Programming Solvers“
Goldfarb and Idrnani, 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*

$$\begin{array}{l} \min_w \quad w^\top L w \\ s.t. \quad Aw \leq b \end{array}$$

Quadratic Lower Partial Moments:

Co-Lower Partial Moments

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

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

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

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

... note there is also a symmetrized QLPM version

Rockafeller and Uryasev 1992:

CVAR:

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

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

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

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

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

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

$$e_s \geq 0$$

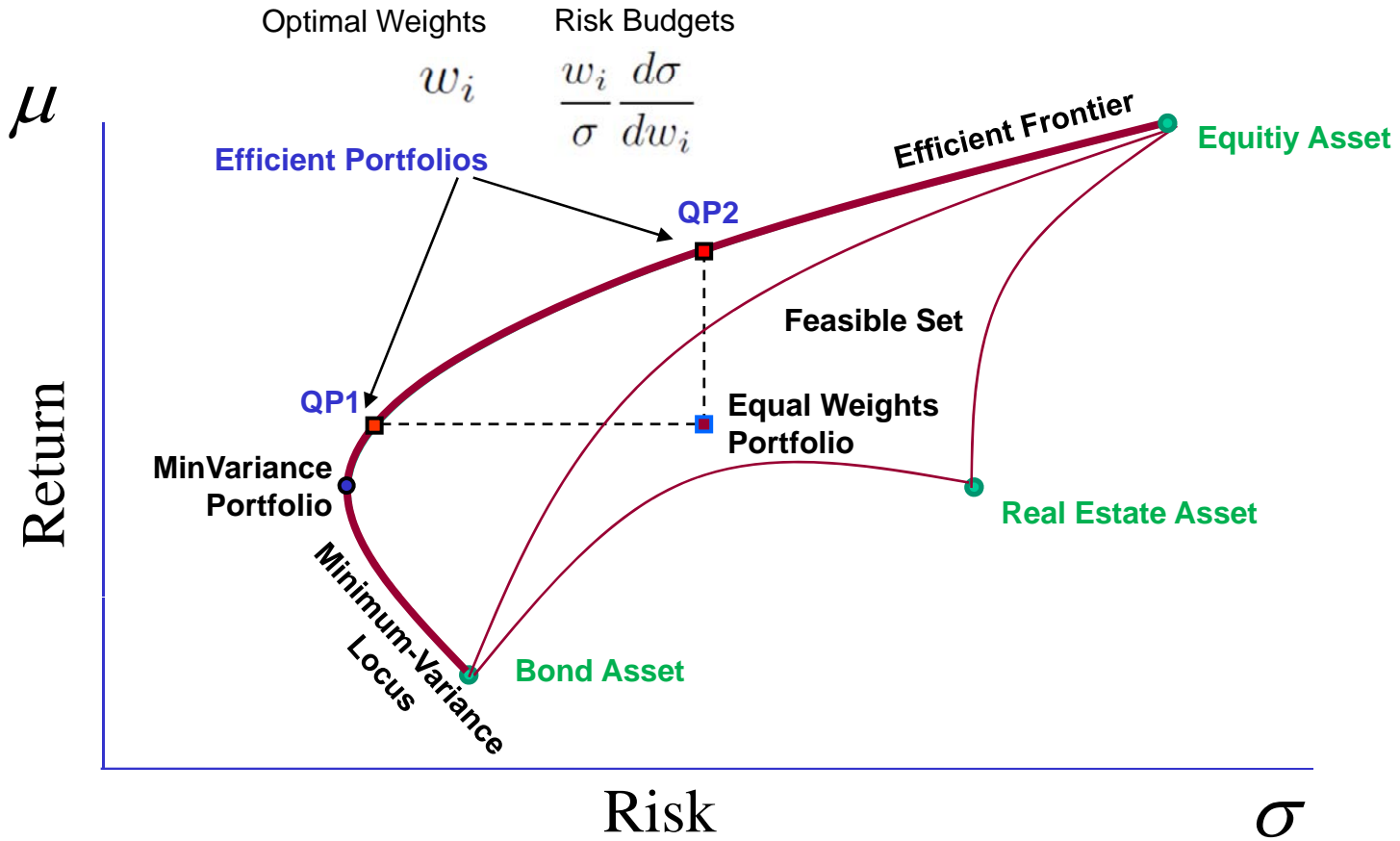
$$w_i \geq 0$$

...

Mean - CVaR Solution: Linear Programming Problem

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

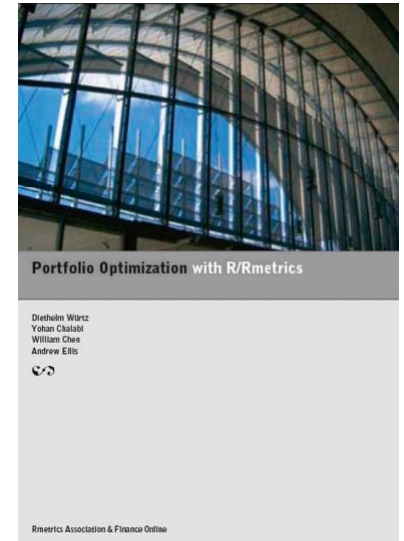
Risk vs. Return



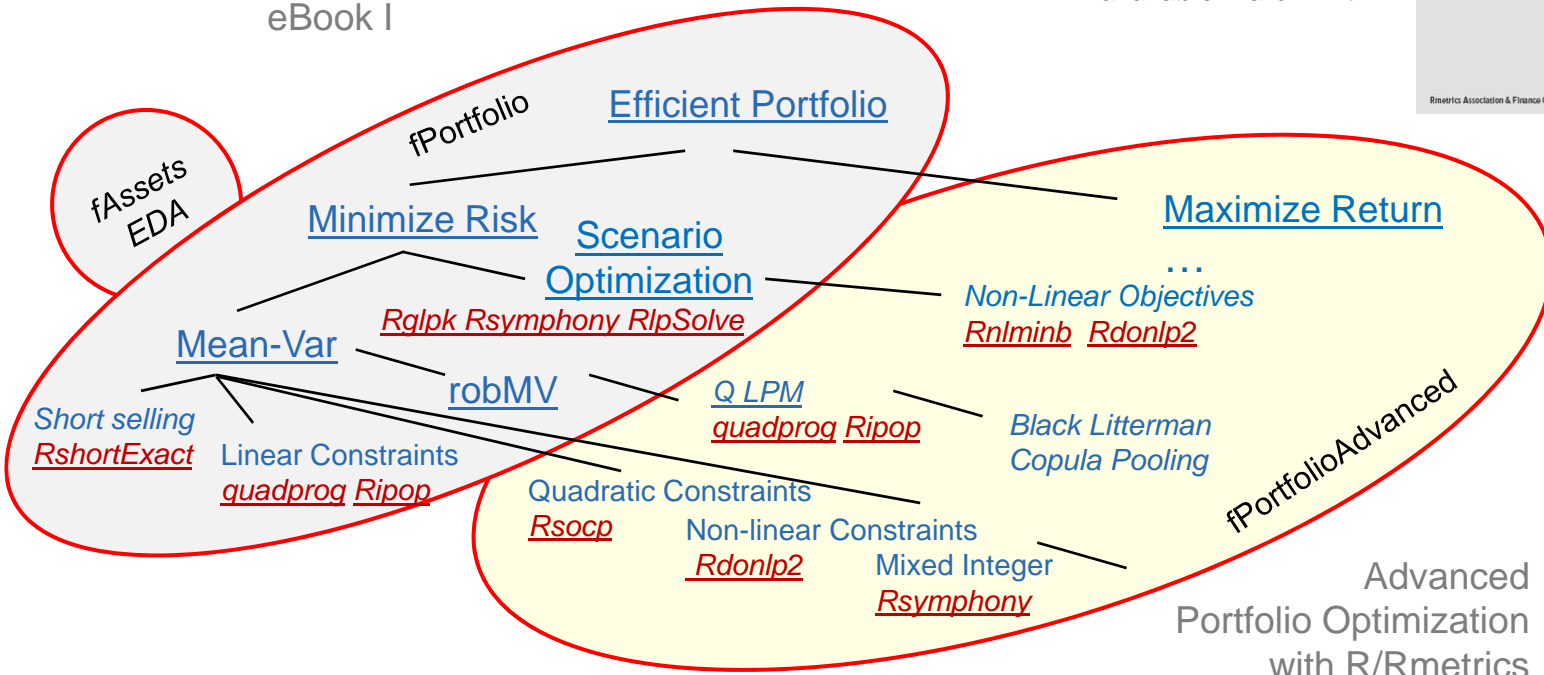
fPortfolio Zoo: Rmetrics Software

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



Portfolio Optimization
 with R/Rmetrics
 eBook I



Advanced
 Portfolio Optimization
 with R/Rmetrics
 eBook II

Chronological Objects in R/Rmetrics

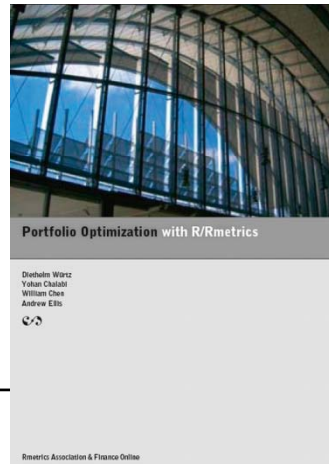
eBook, available in July

timeDate* ①
timeSeries* ①
datafeed* 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



www.rmetrics.org
- limited to 50 participants -

View from Meielisalp on Lake Thune

Computational Finance and Financial Engineering
Third R/Rmetrics User and Developer Workshop
June 28th – July 2nd, 2009, Meielisalp, Lake Thune, Switzerland

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 World

Swiss Performance Index

S&P 500

SX5T

UKX

TPX

MXF

SENSEX

CECEUR

IBOV

MEXBOL

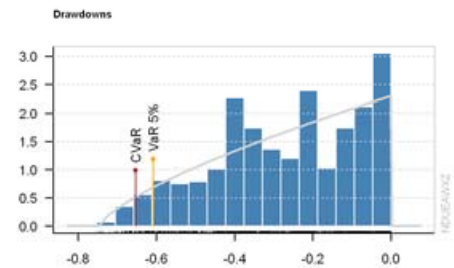
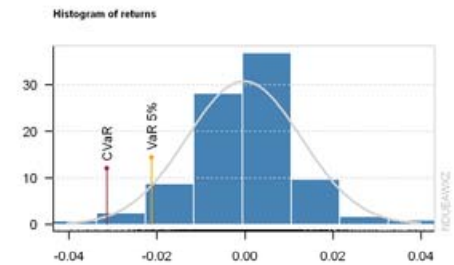
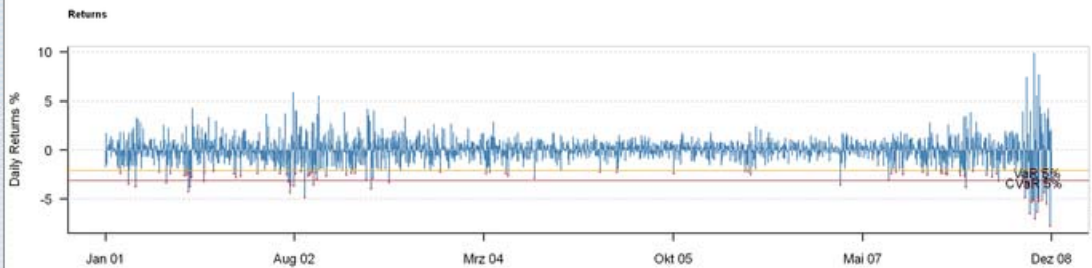
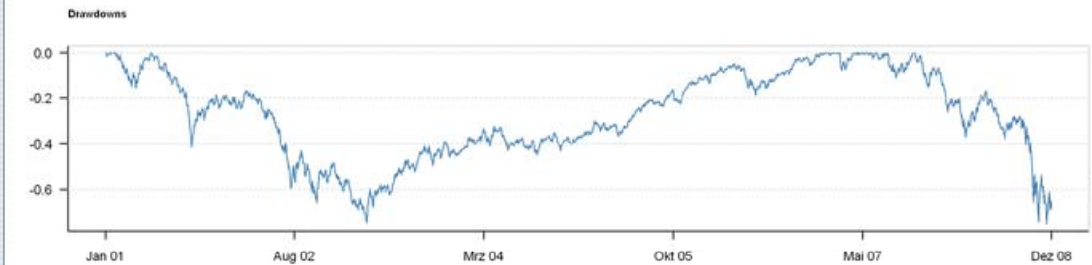
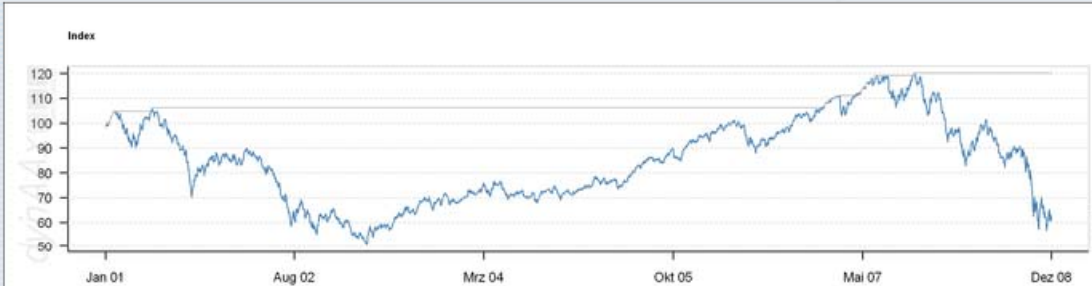
AS51

Swiss Bond Index

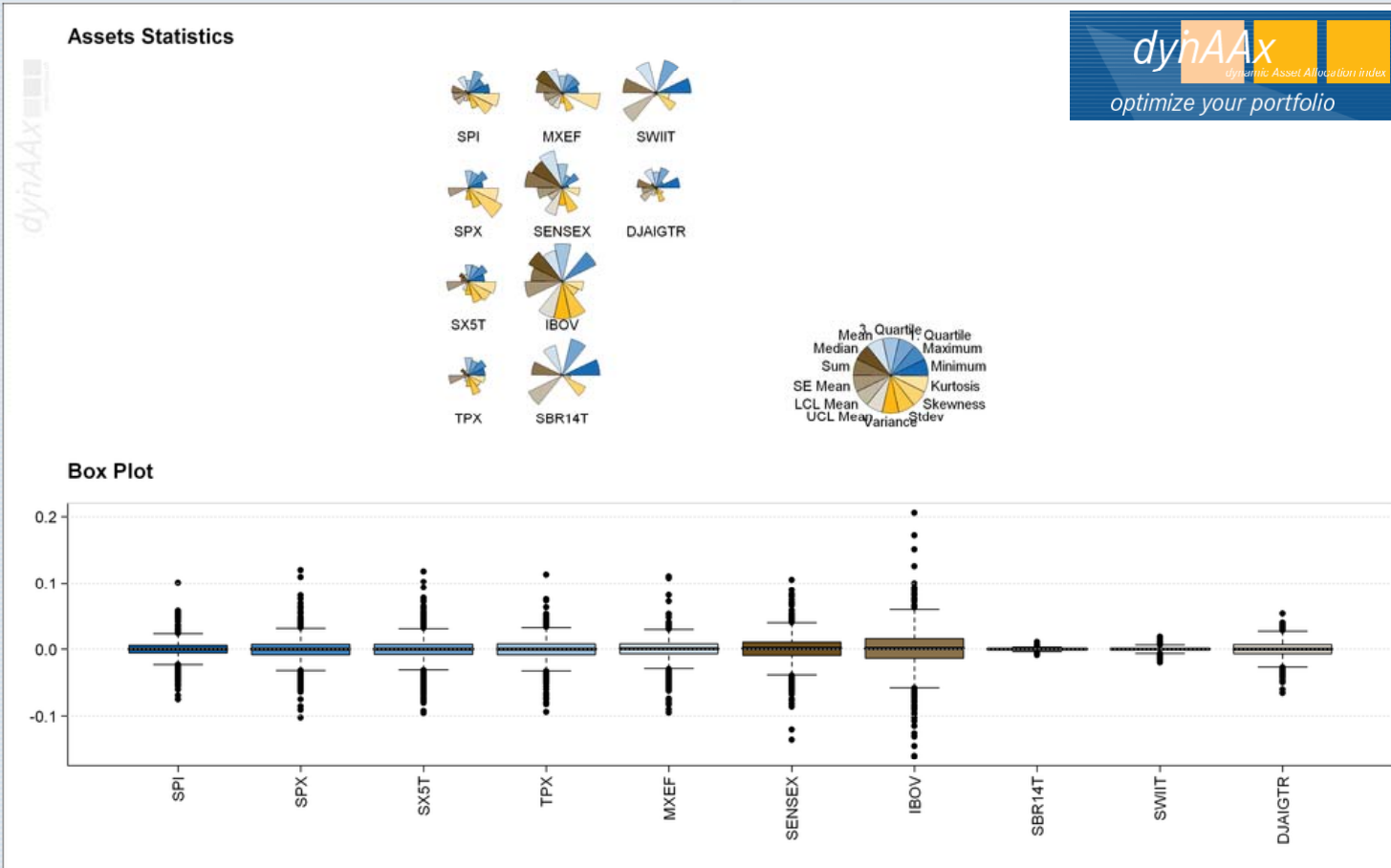
Swiss Real Estate

DJ 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

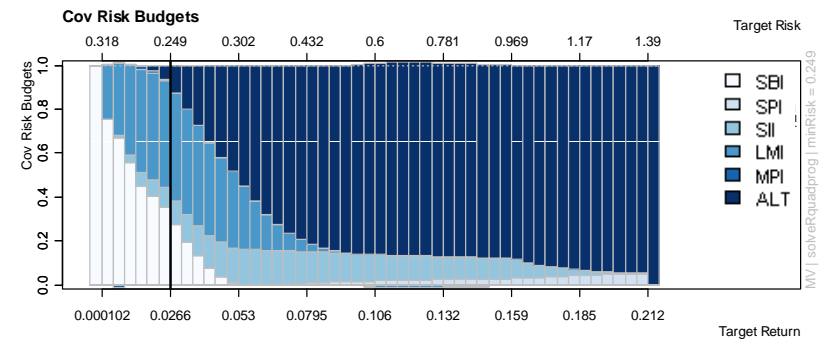
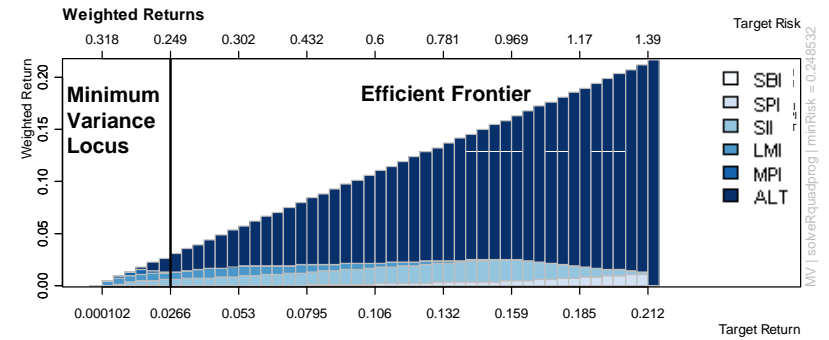
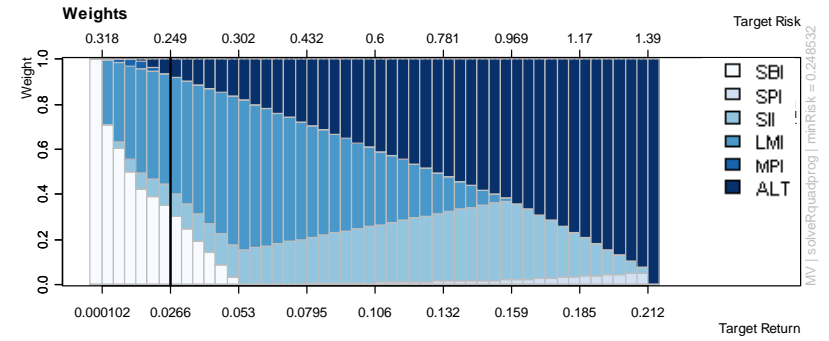
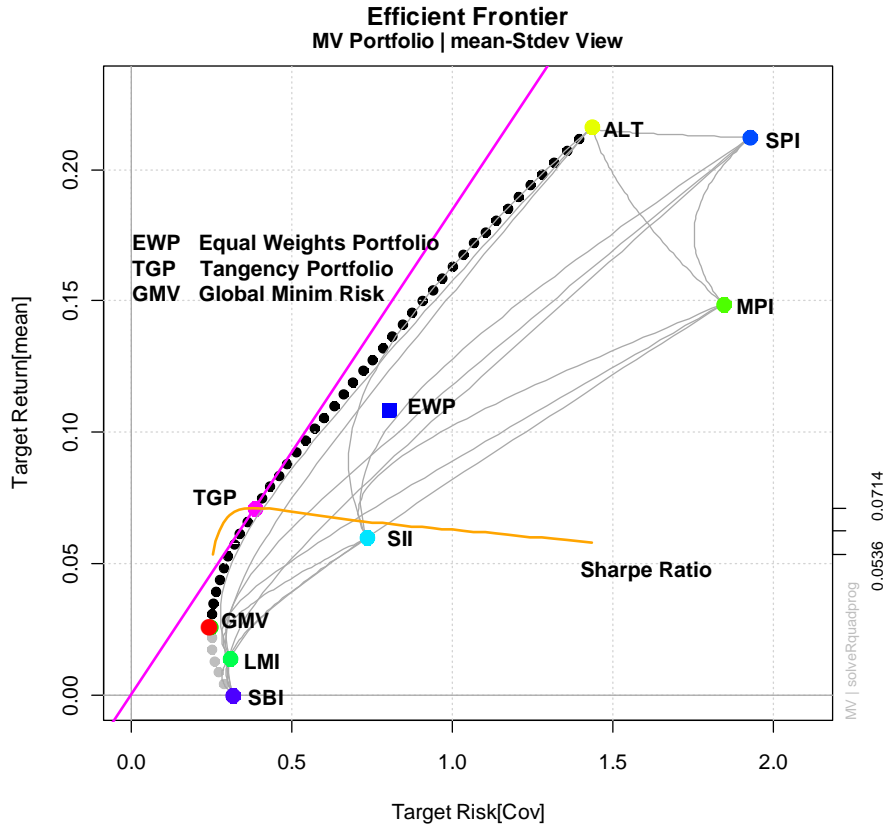
```
Covariance Risk Budgets:
```

	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

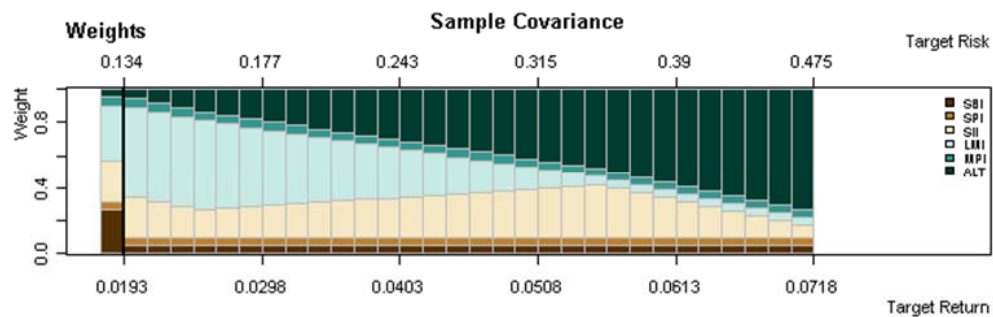
LPP 2005 Benchmark Portfolio



```
# 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)
```



Functions:

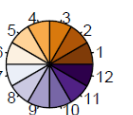
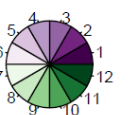
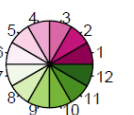
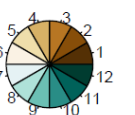
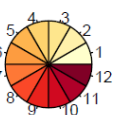
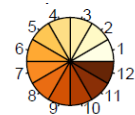
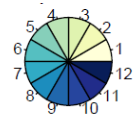
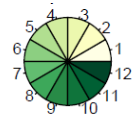
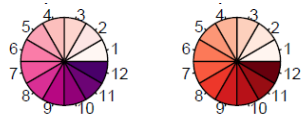
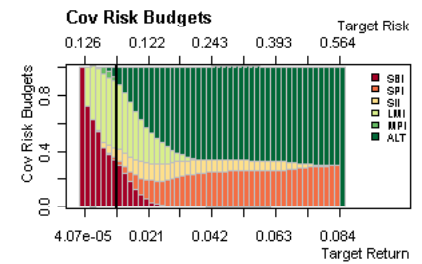
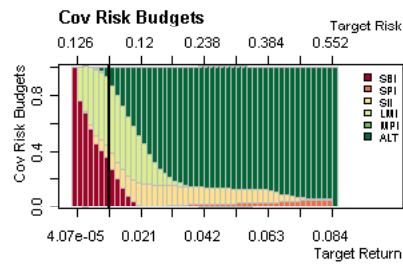
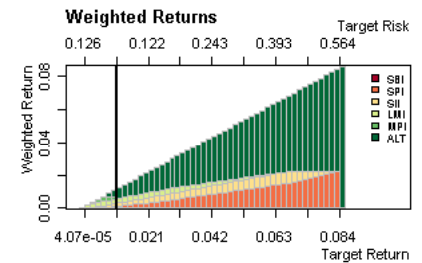
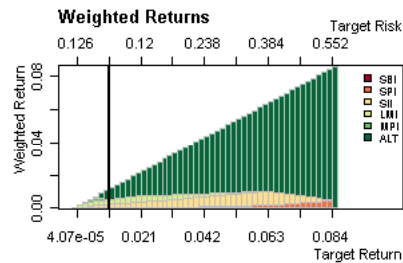
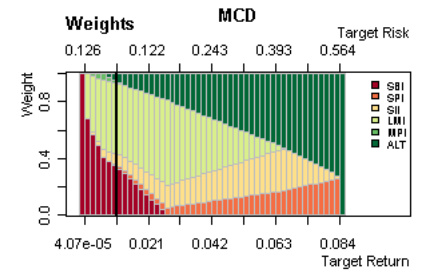
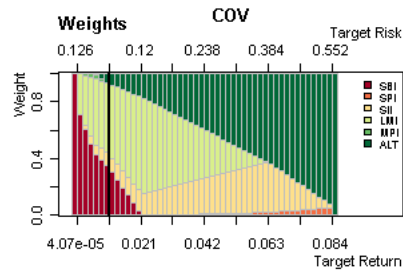
```
covEstimator
kendallEstimator
spearmanEstimator
mcdEstimator
mveEstimator
covMcdEstimator
covOGKEstimator
shrinkEstimator
baggedEstimator
```

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

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

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

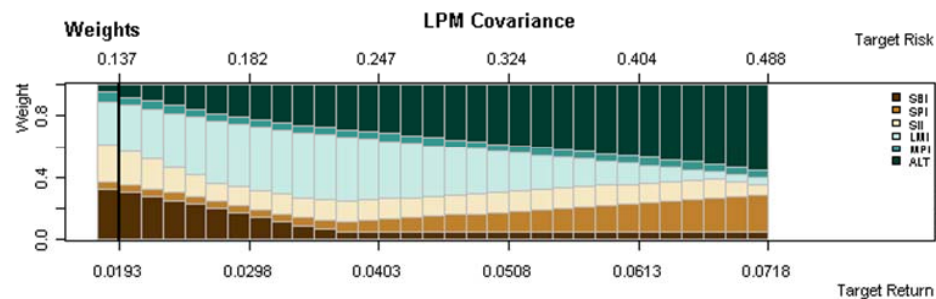
... 
```



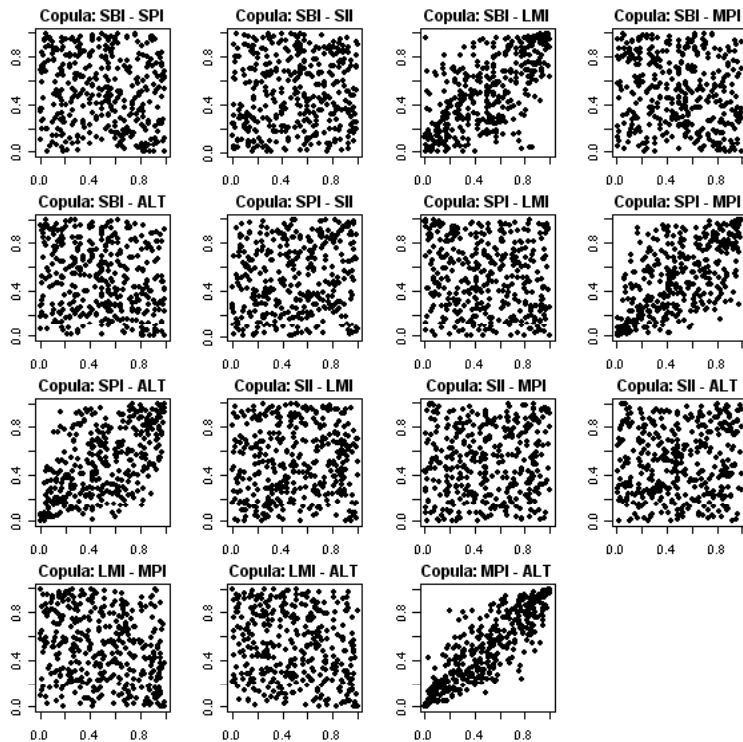
```
# Example:
Cons = c(
  "minW[1:nAssets] = 0.05",
  "maxsumW[c('SBI','LMI')] = 0.60")

# 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
SII CH Stocks
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.

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

$$w^\top \mathbf{1} = 1$$

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

...

... Quadratic Constraints use Rscop
(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, ...)
```

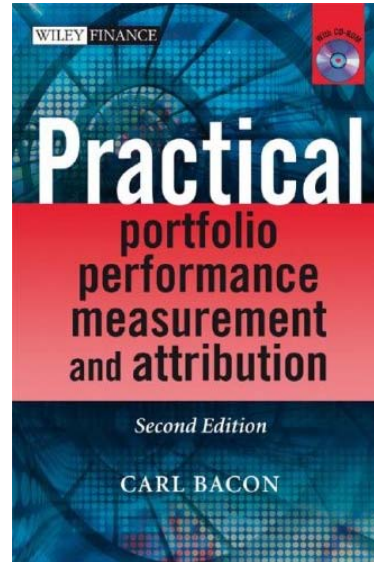
Smooth the Weights

```
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:

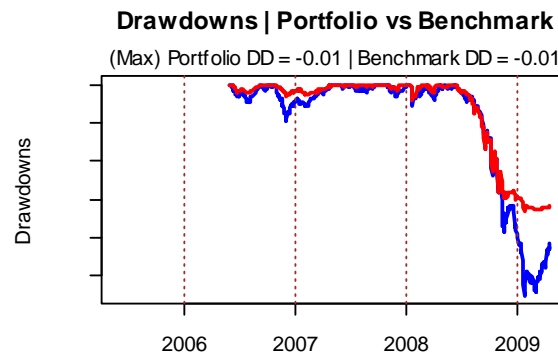
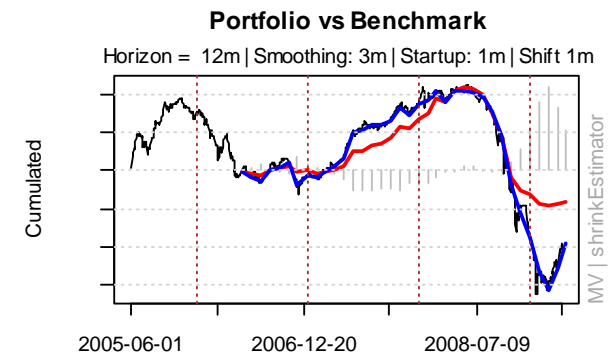
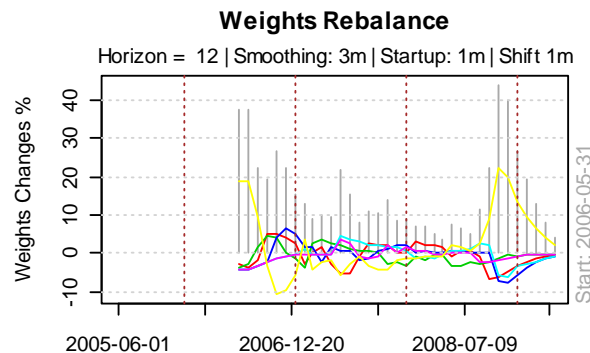
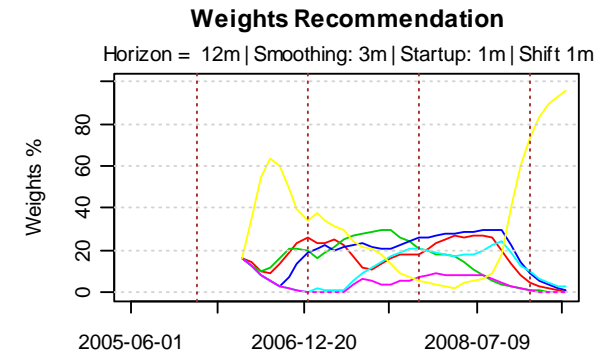
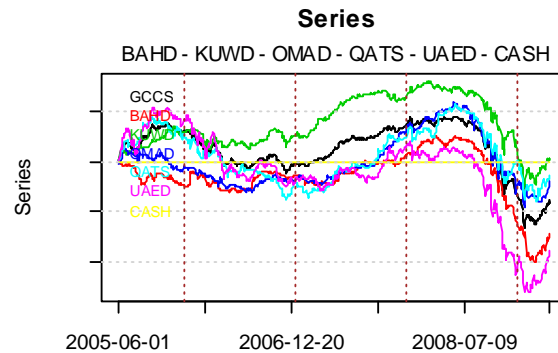
Horizon 12m
Shift 1m

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

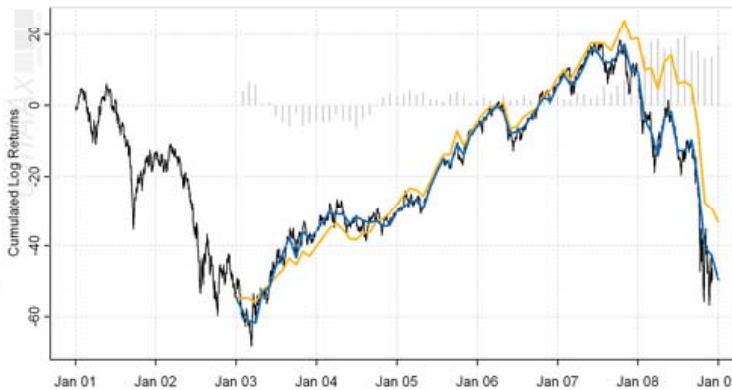


Tangency Plus Strategy Markowitz

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

dynAAx
optimize your portfolio

Cumulated Log Return | dynAAx versus Benchmark



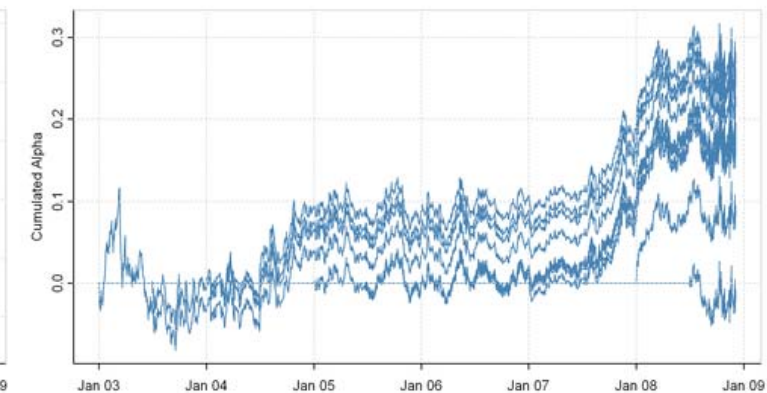
Cumulated Log Returns | Series



Drawdowns | dynAAx versus Benchmark



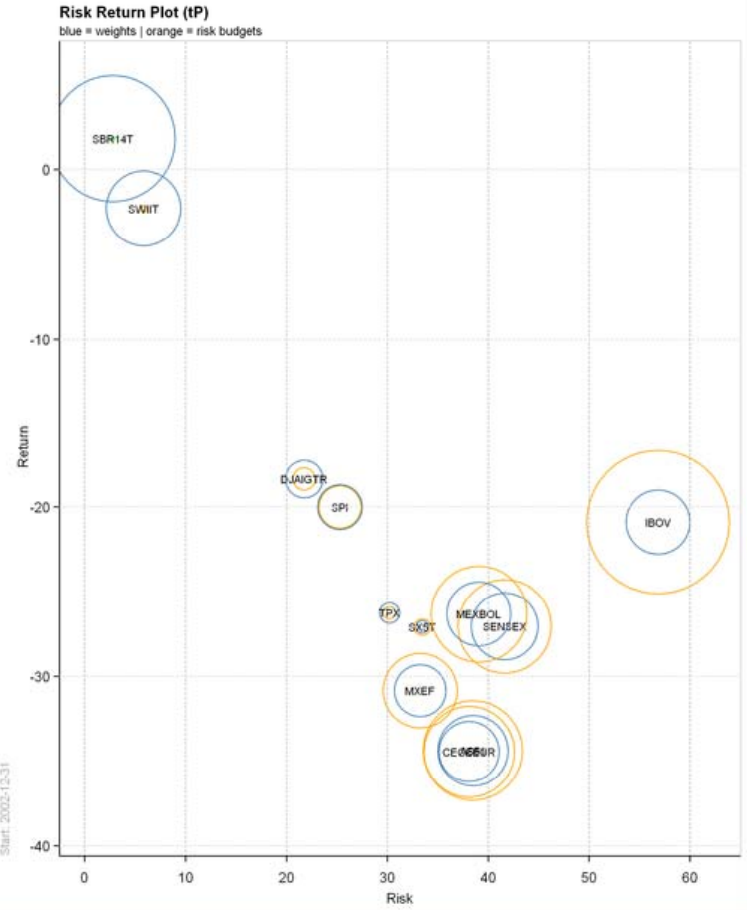
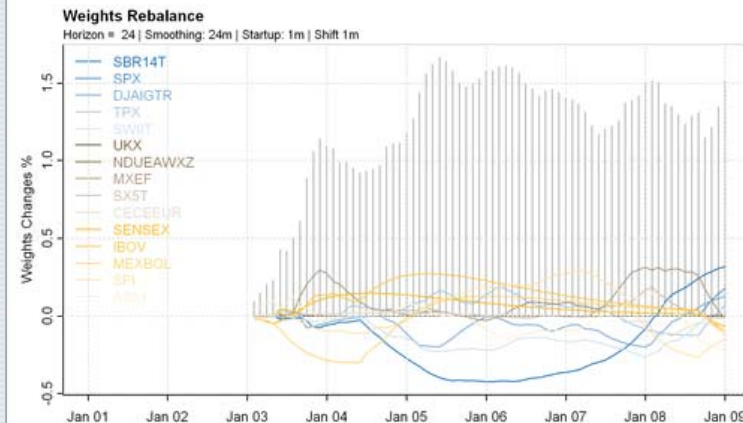
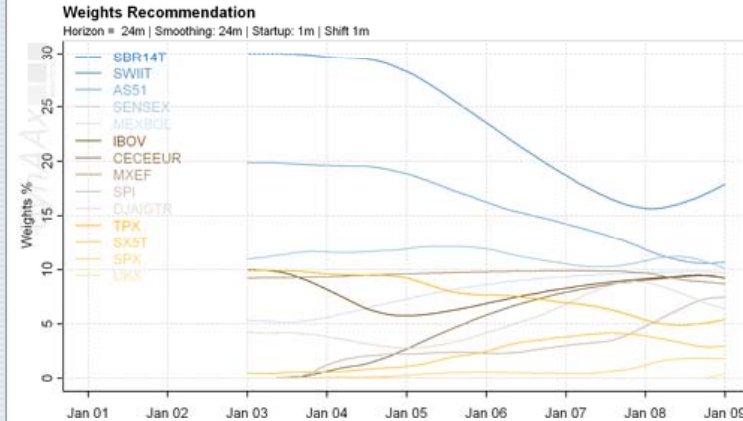
Cumulated Alpha with different starting points



>>> Close window <<<

Tangency Plus Strategy Markowitz

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



>>> Close window <<<

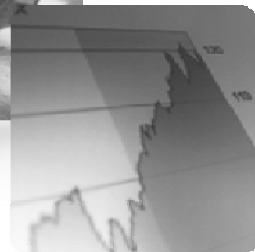
open source software for computational finance and financial engineering



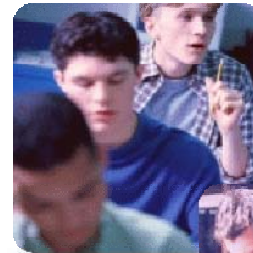
Rapid



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, Rsocplex, Rreplex, ...

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, Rplex, ...

open source software for computational finance and financial engineering



Rapid



Model



Prototyping



Teaching



Training



Business

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, Rsocplex, Rreplex, ...



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

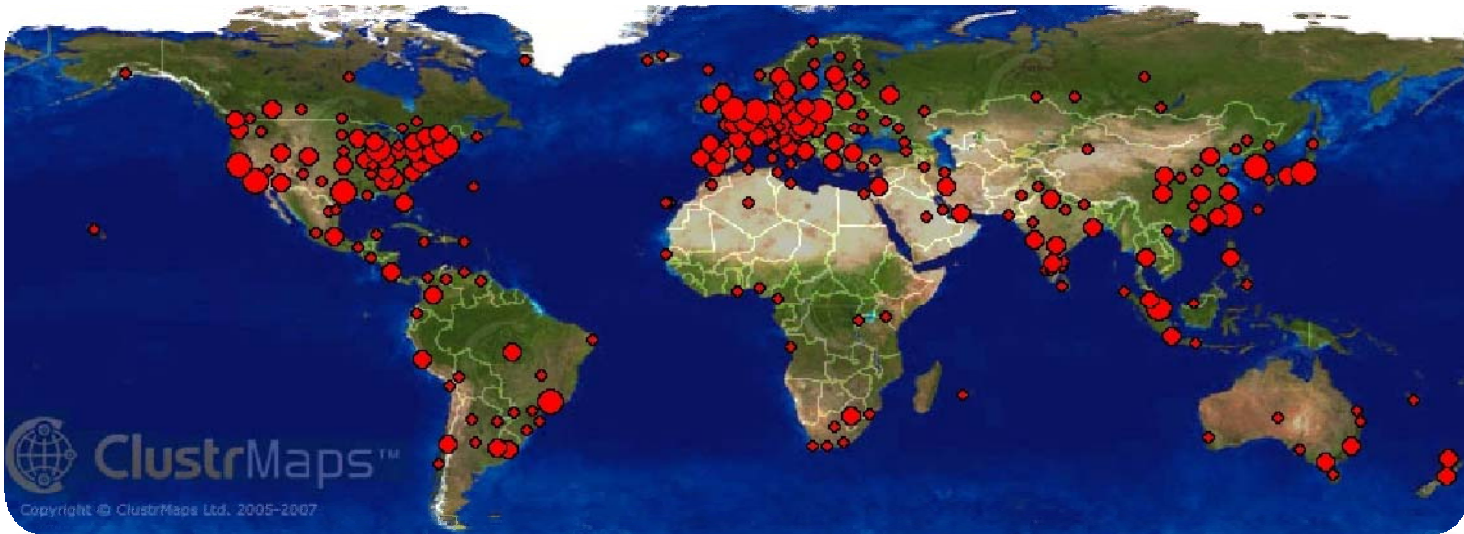
2008 2nd Rmetrics Developer Workshop



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

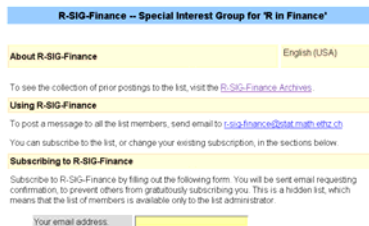
...



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 R-Forge ...](#)
- **Download the R Environment from CRAN**
Windows, Linux, and Mac OS X users 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 ...](#)

Documentation, eBooks, Wiki, ...



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

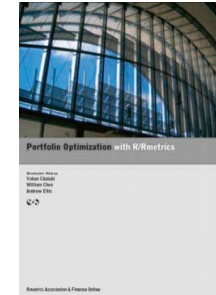


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Documentation ...

- **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 R/Rmetrics user and developer meeting. June 28th to July 2nd, Lake Thun, Switzerland.
[Read more ...](#)
- **ETH Lecture FS 2009**
"Economics and Econophysics" Lecture given by Diethelm Wüzt at ETH Zurich.
[Go to the Course Catalogue ...](#)
- **ETH Seminar FS 2009**
"Seminar in Financial Engineering for CSE, CSE in the Interdisciplinary Curriculum in Computational Science and Engineering" at ETH Zurich.
[Go to the Course Catalogue ...](#)



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

Previous Events:
Meielisalp 2008
Meielisalp 2007
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 R/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
- FX and High Frequency and TimeSeries Data
- Robust Statistics

Register Online ...



is 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 ...
Diethelm Wüzt, Swiss Federal Institute of Technology, Zurich, David Scott, University of Auckland, Auckland.

Local Organization ...
Yohan Chalabi, ETH Zurich, chalabi@fhnw.ch, Diethelm Wüzt, ETH Zurich, wuertz@fhnw.ethz.ch

Download ...
Short Announcement
Full 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>