Package 'fAssets'

October 13, 2022

Title Rmetrics - Analysing and Modelling Financial Assets

Date 2017-11-12

Version 3042.84

Author Diethelm Wuertz [aut],
Tobias Setz [cre],
Yohan Chalabi [ctb]

Maintainer Tobias Setz <tobias.setz@live.com>

Description Provides a collection of functions
to manage, to investigate and to analyze data sets of financial
assets from different points of view.

Depends R (>= 2.15.1), timeDate, timeSeries, fBasics

Imports fMultivar, robustbase, MASS, sn, ecodist, mvnormtest, energy,
grDevices, graphics, stats

Suggests methods, mnormt, RUnit

LazyData yes

License GPL (>= 2)

URL https://www.rmetrics.org

NeedsCompilation no

Repository CRAN

Date/Publication 2017-11-16 21:59:39 UTC

R topics documented:

`fAssets-package` *Analysing and Modelling Financial Assets*

Description

The Rmetrics `fAssets` package is a collection of functions to manage, to investigate and to analyze data sets of financial assets from different points of view.

Details

Package:	fAssets
Type:	Package
Date:	2014
License:	GPL Version 2 or later
Copyright:	(c) 1999-2014 Rmetrics Association
Repository:	R-FORGE
URL:	https://www.rmetrics.org

1 Introduction

The package `fAssets` was written to explore and investigate data sets of financial asssets

Included are functions to make the the asset selection process easier, to robustify return and covariances for modeling portfolios, to test financial returns for multivariate normality, and to measure in a simple way performance and risk of funds and portfolios.

Beside this many functions for graphs and plots, and for a more sophisticated explorative data analysis are provided. They range from simple time series plots to more elaborated statisitical chart tools: histogram, density, boxplots, and QQ plots; pairs,similaries, and covarinace ellipses plots; star plots, and risk/reward graphs.

2 Assets Selection

The assets selection chapter containts functions which arrange assets from a data set according to different measaures applying ideas from principal component analysis, from hierarchical clustering, or by a user defined statistical measure:

```
assetsArrange              Rearranges the columns in a data set of assets
 pcaArrange                 Returns PCA correlation ordered column names
 hclustArrange              Returns hierarchical clustered column names
 abcArrange                 Returns assets sorted by column names
 orderArrange               Returns assets ordered by column names
 sampleArrange              Returns a re-sampled set of assets
 statsArrange               Returns statistically rearranged column names
```

In addition we have summarized and bundle of distance measure functions to determine the similarity or dissimilarity of individual assets from a set of multivariate financial return series.

```
assetsDist                 Computes the distances between assets
 corDist                    Returns correlation distance measure
 kendallDist                Returns kendalls correlation distance measure
 spearmanDist               Returns spearmans correlation distance measure
 mutinfoDist                Returns mutual information distance measure
 euclideanDist              Returns Euclidean distance measure
 maximumDist                Returns maximum distance measure
 manhattanDist              Returns Manhattan distance measure
 canberraDist               Returns Canberra distance measure
 binaryDist                 Returns binary distance measure
 minkowskiDist              Returns Minkowsky distance measure
 braycurtisDist             Returns Bray Curtis distance measure
 mahalanobisDist            Returns Mahalanobis distance measure
 jaccardDist                Returns Jaccard distance mesaure
 sorensenDist               Returns Sorensen distance measure
```

A last group of functions allows to select assets by concepts from hierarchical or k-means clustering:

```
assetsSelect               Selects similar or dissimilar assets
.hclustSelect              Selects due to hierarchical clustering
.kmeansSelect              Selects due to k-means clustering
```

3 Assets Covariance Robustification

We provide several functions to compute robust measures for mean and/or covariance estimates which can be used for example in robustified Markowitz portfolio Optimization.

```
assetsMeanCov              Estimates mean and variance for a set of assets
.covMeanCov                 uses sample covariance estimation
```

```
.mveMeanCov                 uses "cov.mve" from [MASS]
.mcdMeanCov                 uses "cov.mcd" from [MASS]
.studentMeanCov             uses "cov.trob" from [MASS]
.MCDMeanCov                 requires "covMcd" from [robustbase]
.OGKMeanCov                 requires "covOGK" from [robustbase]
.nnveMeanCov                uses builtin from [covRobust]
.shrinkMeanCov              uses builtin from [corpcor]
.baggedMeanCov              uses builtin from [corpcor]
.arwMeanCov                 uses builtin from [mvoutlier]
.donostahMeanCov            uses builtin from [robust]
.bayesSteinMeanCov          uses builtin from Alexios Ghalanos
.ledoitWolfMeanCov          uses builtin from [tawny]
.rmtMeanCov                 uses builtin from [tawny]
```

An additional function allows to detect outliers from a PCA outlier analysis.

```
assetsOutliers              Detects outliers in multivariate assets sets
```

4 Testing Assets for Normality

The multivariate Shapiro test and the E-Statistic Energy Test allow to test multivariate Normality of financial returns.

```
assetsTest                  Tests for multivariate Normal Assets
mvshapiroTest               Multivariate Shapiro Test
mvenergyTest                Multivariate E-Statistic (Energy) Test
```

5 Lower Partial Moments Measures

The computation of Lower partial moments is done by the following two functions:

```
assetsLPM                   Computes asymmetric lower partial moments
assetsSLPM                  Computes symmetric lower partial moments
```

6 Assets Time Series and Density Plot Functions

Dozens of tailored plot functions are included in the `fAssets` package. This makes it very easy to visualize properties and to perform an explorative data analysis. Starting from simple time series functions.

```
assetsReturnPlot            Displays time series of individual assets
assetsCumulatedPlot         Displays time series of individual assets
assetsSeriesPlot            Displays time series of individual assets
```

we can also explore the distributional properties of the returns by histogram, density, boxplots, and QQ Plots:

```
assetsHistPlot              Displays a histograms of a single asset
assetsLogDensityPlot        Displays a pdf plot on logarithmic scale
assetsHistPairsPlot         Displays a bivariate histogram plot
assetsBoxPlot               Displays a standard box plot
assetsBoxPercentilePlot     Displays a side-by-side box-percentile plot
assetsQQNormPlot            Displays normal qq-plots of individual assets
```

7 Assets Dependency and Structure Plot Functions

Corellation and similarities are another source of information about the dependence structure of individual financial returns. The functions which help us to detect those properties in data sets of financial assets include:

```
assetsPairsPlot             Displays pairs of scatterplots of assets
assetsCorgramPlot           Displays pairwise correlations between assets
assetsCorTestPlot           Displays and tests pairwise correlations
assetsCorImagePlot          Displays an image plot of a correlations
covEllipsesPlot             Displays a covariance ellipses plot
assetsDendrogramPlot        Displays hierarchical clustering dendrogram
assetsCorEigenPlot          Displays ratio of the largest two eigenvalues
```

Beside correlations und dependencies also risk/reward graphs give additional insight into the structure of assets.

```
assetsRiskReturnPlot        Displays risk-return diagram of assets
assetsNIGShapeTrianglePlot  Displays NIG Shape Triangle
assetsTreePlot              Displays a minimum spanning tree of assets
```

Statistic visualized by star plots is a very appealing tool for characterization and classification of assets by eye:

```
assetsStarsPlot             Draws segment/star diagrams of asset sets
assetsBasicStatsPlot        Displays a segment plot of basic return stats
assetsMomentsPlot           Displays a segment plot of distribution moments
assetsBoxStatsPlot          Displays a segment plot of box plot statistics
assetsNIGFitPlot            Displays a segment plot NIG parameter estimates
```

About Rmetrics:

The `fAssets` Rmetrics package is written for educational support in teaching "Computational Finance and Financial Engineering" and licensed under the GPL.

assets-arrange *Rearranging Assets Columnwise*

Description

Allows to rearrange a set of assets columnwise.

Usage

```
assetsArrange(x, method = c("pca", "hclust", "abc"), ...)

pcaArrange(x, robust = FALSE, ...)
hclustArrange(x, method = c("euclidean", "complete"), ...)
abcArrange(x, ...)
orderArrange(x, ...)
sampleArrange(x, ...)
statsArrange(x, FUN = colMeans, ...)
```

Arguments

x	any rectangular time series object which can be converted by the function `as.matrix()` into a matrix object, e.g. like an object of class `timeSeries`, `data.frame`, or `mts`.
method	a character string, which method should be applied to reaarnage the assests? Either `"pca"` which arranges the columns by an eigenvalue decomposition, `"hclust"` which arrangtes the columns by hierarchical clustering, `"abc"` which arrangtes the columns alphabetically, `"order"` which arrangtes the columns by the order function, `"sample"` which arranges the columns randomly, or `"stats"` which arranges by an statistical strategy.
robust	a logical flag. Should robust statistics applied?
FUN	function anme of the statistical function to be applied.
...	optional arguments to be passed.

Value

a character vector with the rearranged assets names.

Author(s)

Diethelm Wuertz for the Rmetrics port.

References

Wuertz, D., Chalabi, Y., Chen W., Ellis A. (2009); *Portfolio Optimization with R/Rmetrics*, Rmetrics eBook, Rmetrics Association and Finance Online, Zurich.

Examples

```
## LPP -
   # Load Swiss Pension Fund Data:
   LPP <- LPP2005REC[, 1:3]
   head(LPP)

## assetsArrange -
   # Arrange Assets Columns:
   assetsArrange(x=LPP, "pca")
   assetsArrange(x=LPP, "hclust")
   assetsArrange(x=LPP, "abc")

## Alternative Usage -
   pcaArrange(x=LPP, robust=FALSE)
   pcaArrange(x=LPP, robust=TRUE)
   hclustArrange(x=LPP, method = c("euclidean", "complete"))
   abcArrange(x=LPP)
   orderArrange(x=LPP)
   sampleArrange(x=LPP)
   statsArrange(x=LPP, FUN=colMeans)
```

---

assets-distance *Distance Measures*

Description

Allows to measure the distance or similarity between assets.

Usage

```
assetsDist(x, method="cor", ...)

corDist(x)
kendallDist(x)
spearmanDist(x)

mutinfoDist(x, nbin=10)

euclideanDist(x)
maximumDist(x)
manhattanDist(x)
canberraDist(x)
binaryDist(x)
minkowskiDist(x)

braycurtisDist(x)
mahalanobisDist(x)
```

```
jaccardDist(x)
sorensenDist(x)
```

Arguments

x	any rectangular time series object which can be converted by the function dist() into a distance object.
method	a character string, the method from which to compute the distances. Allowed methods include cor, kendall, spearman, mutinfo, euclidean, maximum, manhattan, canberra, binary, minkowski, braycurtis, mahalanobis, jaccard, difference, or sorensen.
nbin	an integer value, the number of bins, by default 10.
...	optional argument to be passed the distance function.

Details

corDist, kendallDist, and spearmanDist call the base cov function from R.

mutinfoDist calls the function mutinfo from the contributed R package bioDist.

euclideanDist, maximumDist, manhattanDist, canberraDist, binaryDist, and minkowskiDist are functions build on top of R's base package.

braycurtisDist, mahalanobisDist, jaccardDist, and sorensenDist call functions from the contributed R package ecodist.

Value

an object of class dist.

References

Wuertz, D., Chalabi, Y., Chen W., Ellis A. (2009); *Portfolio Optimization with R/Rmetrics*, Rmetrics eBook, Rmetrics Association and Finance Online, Zurich.

Examples

```
## LPP -
   # Load Swiss Pension Fund Data:
   LPP <- LPP2005REC[, 1:6]
   head(LPP)

## Returns correlation distance measure
   corDist(LPP)

## Returns kendalls correlation distance measure
   kendallDist(LPP)

## Returns spearmans correlation distance measure
   spearmanDist(LPP)
```

```
## Return mutual information distance measure
   mutinfoDist(LPP)

## Return Euclidean distance measure
   euclideanDist(LPP)

## Return maximum distance measure
   maximumDist(LPP)

## Return Manhattan distance measure
   manhattanDist(LPP)

## Return Canberra distance measure
   canberraDist(LPP)

## Return binary distance measure
   binaryDist(LPP)

## Return Minkowsky distance measure
   minkowskiDist(LPP)

## Return Bray Curtis distance measure
   braycurtisDist(LPP)

## Return Mahalanobis distance measure
   # mahalanobisDist(LPP)

## Return Jaccard distance mesaure
   jaccardDist(LPP)

## Return Sorensen distance measure
   sorensenDist(LPP)
```

`assets-lpm` *Computation of Lower Partial Moments of Asset Sets*

Description

Computes lower partial moments from a time series of assets.

Usage

```
assetsLPM(x, tau, a, ...)
assetsSLPM(x, tau, a, ...)
```

Arguments

`x`	any rectangular time series object which can be converted by the function `as.matrix()` into a matrix object, e.g. like an object of class `timeSeries`, `data.frame`, or `mts`.

tau	the target return.
a	the value of the moment.
...	optional arguments to be passed.

Value

returns a list with two entries named mu and Sigma. The first denotes the vector of lower partial moments, and the second the co-LPM matrix. Note, that the output of this function can be used as data input for the portfolio functions to compute the LPM efficient frontier.

Author(s)

Diethelm Wuertz for the Rmetrics port.

References

Wuertz, D., Chalabi, Y., Chen W., Ellis A. (2009); *Portfolio Optimization with R/Rmetrics*, Rmetrics eBook, Rmetrics Association and Finance Online, Zurich.

Examples

```
## LPP -
   # Percentual Returns:
   LPP <- 100 * as.timeSeries(data(LPP2005REC))[, 1:6]
   colnames(LPP)
```

---

assets-meancov *Estimation of Mean and Covariances of Asset Sets*

Description

Estimates the mean and/or covariance matrix of a time series of assets by traditional and robust methods.

Usage

```
assetsMeanCov(x,
    method = c("cov", "mve", "mcd", "MCD", "OGK", "nnve", "shrink", "bagged"),
    check = TRUE, force = TRUE, baggedR = 100, sigmamu = scaleTau2,
    alpha = 1/2, ...)

getCenterRob(object)
getCovRob(object)
```

Arguments

x	any rectangular time series object which can be converted by the function as.matrix() into a matrix object, e.g. like an object of class timeSeries, data.frame, or mts.
method	a character string, whicht determines how to compute the covariance matix. If method="cov" is selected then the standard covariance will be computed by R's base function cov, if method="shrink" is selected then the covariance will be computed using the shrinkage approach as suggested in Schaefer and Strimmer [2005], if method="bagged" is selected then the covariance will be calculated from the bootstrap aggregated (bagged) version of the covariance estimator.
check	a logical flag. Should the covariance matrix be tested to be positive definite? By default TRUE.
force	a logical flag. Should the covariance matrix be forced to be positive definite? By default TRUE.
baggedR	when methode="bagged", an integer value, the number of bootstrap replicates, by default 100.
sigmamu	when methode="OGK", a function that computes univariate robust location and scale estimates. By default it should return a single numeric value containing the robust scale (standard deviation) estimate. When mu.too is true (the default), sigmamu() should return a numeric vector of length 2 containing robust location and scale estimates. See scaleTau2, s_Qn, s_Sn, s_mad or s_IQR for examples to be used as sigmamu argument. For details we refer to the help pages of the R-package robustbase.
object	a list as returned by the function assetsMeanCov.
alpha	when methode="MCD", a numeric parameter controlling the size of the subsets over which the determinant is minimized, i.e., alpha*n observations are used for computing the determinant. Allowed values are between 0.5 and 1 and the default is 0.5. For details we refer to the help pages of the R-package robustbase.
...	optional arguments to be passed to the underlying estimators. For details we refer to the manual pages of the functions cov.rob for arguments "mve" and "mcd" in the R package MASS, to the functions covMcd and covOGK in the R package robustbase.

Value

assetsMeanCov returns a list with for entries named center cov, mu and Sigma. The list may have a character vector attributed with additional control parameters.

getCenterRob extracts the center from an object as returned by the function assetsMeanCov.

getCovRob extracts the covariance from an object as returned by the function assetsMeanCov.

Author(s)

Juliane Schaefer and Korbinian Strimmer for R's corpcov package,
Diethelm Wuertz for the Rmetrics port.

References

Breiman L. (1996); *Bagging Predictors*, Machine Learning 24, 123–140.

Ledoit O., Wolf. M. (2003); *ImprovedEestimation of the Covariance Matrix of Stock Returns with an Application to Portfolio Selection*, Journal of Empirical Finance 10, 503–621.

Schaefer J., Strimmer K. (2005); *A Shrinkage Approach to Large-Scale Covariance Estimation and Implications for Functional Genomics*, Statist. Appl. Genet. Mol. Biol. 4, 32.

Wuertz, D., Chalabi, Y., Chen W., Ellis A. (2009); *Portfolio Optimization with R/Rmetrics*, Rmetrics eBook, Rmetrics Association and Finance Online, Zurich.

Examples

```
## LPP -
   LPP <- as.timeSeries(data(LPP2005REC))[, 1:6]
   colnames(LPP)

## Sample Covariance Estimation:
   assetsMeanCov(LPP)

## Shrinked Estimation:
   shrink <- assetsMeanCov(LPP, "shrink")
   shrink

## Extract Covariance Matrix:
   getCovRob(shrink)
```

`assets-modeling` *Modeling Multivariate Asset Sets*

Description

Fitting and Simulatingassets from multivariate asset sets based on modeling skew normal and related distributions.

Usage

```
assetsFit(x, method = c("st", "sn", "sc"),
  title=NULL, description=NULL, fixed.df=NA, ...)

assetsSim(n, method=c("st", "sn", "sc"),
    model=list(beta=rep(0, 2), Omega=diag(2), alpha=rep(0, 2), nu=4),
    assetNames=NULL)
```

Arguments

`x`	any rectangular time series object which can be converted by the function `as.matrix()` into a matrix object, e.g. like an object of class `timeSeries`, `data.frame`, or `mts`.

n	a numeric value which represents the number of random vectors to be drawn.
method	a character string with the names of the supported distributions: sn skew normal, st skew Student-t, and sc skew Cauchy
model	a list with the model parameters. beta a numeric vector, representing the location, Omega a symmetric positive-definite matrix (covariance matrix), alpha a numeric vector which regulates the skew of the density, nu a positive value representing the degrees of freedom.
fixed.df	a logical value, should the degreess of freedom fitted or held fixed?
title	an optional project title.
description	an option project desctiption.
assetNames	a character vector with optional asset names.
...	optional arguments passed to the underlying functions.

Value

assetsFit returns the fitted parameters, assetsSim returns a simulated (return) series.

Author(s)

Diethelm Wuertz for the Rmetrics port.

References

Wuertz, D., Chalabi, Y., Chen W., Ellis A. (2009); *Portfolio Optimization with R/Rmetrics*, Rmetrics eBook, Rmetrics Association and Finance Online, Zurich.

Examples

```
## LPP2005REC -
   # Load Swiss Pension Fund Data as Percentual Returns:
   LPP <- 100 * LPP2005REC[, 1:3]
   head(LPP)

## assetsFit -
   # Fit a Skew-Student-t Distribution:
   fit <- assetsFit(LPP)
   # Extract the Model:
   model <- fit@fit$dp
   # Show Model Slot:
   print(model)

## assetsSim -
   # Simulate set with same statistical properties:
   set.seed(1953)
   LPP.SIM <- assetsSim(n=nrow(LPP), model=model)
   colnames(LPP.SIM) <- colnames(LPP)
   head(LPP.SIM)
```

assets-outliers *Detection of Outliers in Asset Sets*

Description

Detects multivariate outliers in asset sets.

Usage

```
assetsOutliers(x, center, cov, ...)
```

Arguments

x	an object of class timeSeries.
center	a numeric vector, a (robust) estimate of the vector of means of the multivariate time series x.
cov	a numeric matrix, a (robust) estimate of the covariance matrix of the multivariate time series x.
...	optional arguments to be passed.

Value

returns a list with the following entries: the estimate for the location named center, the estimate for the covariance matrix named cov, the estimate for the correlation matrix named cor, the quantile named quantile, the outliers named outliers, and the time series named series.

Author(s)

Moritz Gschwandtner and Peter Filzmoser for the original R code from package "mvoutliers", Diethelm Wuertz for the Rmetrics port.

References

Wuertz, D., Chalabi, Y., Chen W., Ellis A. (2009); *Portfolio Optimization with R/Rmetrics*, Rmetrics eBook, Rmetrics Association and Finance Online, Zurich.

Examples

```
## LPP -
   LPP <- as.timeSeries(data(LPP2005REC))[, 1:6]
   colnames(LPP)

## assetsOutliers -
   assetsOutliers(LPP, colMeans(LPP), cov(LPP))
```

assets-selection *Selecting Assets from Multivariate Asset Sets*

Description

Selet assets from Multivariate Asset Sets based on clustering.

Usage

```
assetsSelect(x, method = c("hclust", "kmeans"), control = NULL, ...)
```

Arguments

x	any rectangular time series object which can be converted by the function as.matrix() into a matrix object, e.g. like an object of class timeSeries, data.frame, or mts.
method	a character string, which clustering method should be used? Either hclust for hierarchical clustering of dissimilarities, or kmeans for k-means clustering.
control	a character string with two entries controlling the parameters used in the underlying cluster algorithms. If set to NULL, then default settings are taken: For hierarchical clustering this is method=c(measure="euclidean", method="complete"), and for kmeans clustering this is method=c(centers=3, algorithm="Hartigan-Wong").
...	optional arguments to be passed. Note, for the k-means algorithm the number of centers has to be specified!

Details

The function assetsSelect calls the functions hclust or kmeans from R's "stats" package. hclust performs a hierarchical cluster analysis on the set of dissimilarities hclust(dist(t(x))) and kmeans performs a k-means clustering on the data matrix itself.

Note, the hierarchical clustering method has in addition a plot method.

Value

if use="hclust" was selected then the function returns a S3 object of class "hclust", otherwise if use="kmeans" was selected then the function returns an object of class "kmeans".

For details we refer to the help pages of hclust and kmeans.

Author(s)

Diethelm Wuertz for the Rmetrics port.

References

Wuertz, D., Chalabi, Y., Chen W., Ellis A. (2009); *Portfolio Optimization with R/Rmetrics*, Rmetrics eBook, Rmetrics Association and Finance Online, Zurich.

Examples

```
## LPP -
   # Load Swiss Pension Fund Data:
   LPP <- LPP2005REC
   colnames(LPP)

## assetsSelect -
   # Hierarchical Clustering:
   hclust <- assetsSelect(LPP, "hclust")
   plot(hclust)

## assetsSelect -
   # kmeans Clustering:
   assetsSelect(LPP, "kmeans", control =
     c(centers = 3, algorithm = "Hartigan-Wong"))
```

`assets-testing` *Testing Normality of Multivariate Asset Sets*

Description

Tests if the returns of a set of assets are normally distributed.

Usage

```
assetsTest(x, method = c("shapiro", "energy"), Replicates = 99)

mvshapiroTest(x)
mvenergyTest(x, Replicates = 99)
```

Arguments

`x`	any rectangular time series object which can be converted by the function `as.matrix()` into a matrix object, e.g. like an object of class `timeSeries`, `data.frame`, or `mts`.
`method`	a character string, which allows to select the test. If `method="shapiro"` then Shapiro's multivariate Normality test will be applied as implemented in R's contributed package `mvnormtest`. If `method="energy"` then the E-statistic (energy) for testing multivariate Normality will be used as proposed and implemented by Szekely and Rizzo [2005] using parametric bootstrap.
`Replicates`	an integer value, the number of bootstrap replicates, by default 100. This value is only used if `method="energy"`.

Value

returns an object of class `htest`.

Author(s)

Diethelm Wuertz for this Rmetrics port.

References

Rizzo M.L. (2002); *A New Rotation Invariant Goodness-of-Fit Test*, PhD dissertation, Bowling Green State University.

Szekely G.J., Rizzo, M.L. (2005); *A New Test for Multivariate Normality*, Journal of Multivariate Analysis 93, 58–80.

Szekely G.J. (1989); *Potential and Kinetic Energy in Statistics*, Lecture Notes, Budapest Institute of Technology, TechnicalUniversity.

Wuertz, D., Chalabi, Y., Chen W., Ellis A. (2009); *Portfolio Optimization with R/Rmetrics*, Rmetrics eBook, Rmetrics Association and Finance Online, Zurich.

Examples

```
## LPP -
   # Load Swiss Pension Fund Data:
   LPP <- LPP2005REC[, 1:6]
   head(LPP)

## assetsTest -
   # Multivariate Shapiro Test -
   assetsTest(LPP, "shapiro")

## assetsTest -
   # Multivariate Energy Test -
   assetsTest(LPP, "energy")
```

---

plot-binning *Bivariate Histogram Plots of Assets*

Description

Displays bivariate histogram plots of assets returns.

Usage

```
assetsHistPairsPlot(x, bins = 30, method = c("square", "hex"), ...)
```

Arguments

x	any rectangular time series object which can be converted by the function `as.matrix()` into a matrix object, e.g. like an object of class `timeSeries`, `data.frame`, or `mts`.
bins	an integer value, the number of bins used for the biariate histogram.

method	a character string denoting whic h type of binning should be used, either "squared" or "hexagonal".
...	optional arguments to be passed.

Author(s)

Diethelm Wuertz for the Rmetrics port.

References

Wuertz, D., Chalabi, Y., Chen W., Ellis A. (2009); *Portfolio Optimization with R/Rmetrics*, Rmetrics eBook, Rmetrics Association and Finance Online, Zurich.

Examples

```
## LPP2005REC -
   # Load Swiss Pension Fund Data:
   LPP <- LPP2005REC
   head(LPP)

## assetsHistPairsPlot -
   # Create a bivariate Binning Plot: assetsHistPairsPlot -
   assetsHistPairsPlot(LPP[, c("LMI", "ALT")])

## assetsHistPairsPlot -
   # Now with hexagonal Bins:
   assetsHistPairsPlot(LPP[, c("LMI", "ALT")], method = "hex")
   grid(col="red")
```

---

plot-boxplot *Displays a Box Plot of Assets*

Description

Displays standard box and box-percentile plots of assets.

Usage

```
assetsBoxPlot(x, col = "bisque", ...)
assetsBoxPercentilePlot(x, col = "bisque", ...)
```

Arguments

x	any rectangular time series object which can be converted by the function as.matrix() into a matrix object, e.g. like an object of class timeSeries, data.frame, or mts.
col	a character string, defining the color to fill the boxes.
...	optional arguments to be passed.

Author(s)

Diethelm Wuertz for the Rmetrics port.

References

Wuertz, D., Chalabi, Y., Chen W., Ellis A. (2009); *Portfolio Optimization with R/Rmetrics*, Rmetrics eBook, Rmetrics Association and Finance Online, Zurich.

Examples

```
## LPP -
   # Load Swiss Pension Fund Data:
   LPP <- LPP2005REC[, 1:6]
   head(LPP)

## assetsBoxPlot -
   # Create a Boxplot: assetsBoxPlot -
   assetsBoxPlot(LPP)

## assetsBoxPercentilePlot -
   # Create a Box Percentile Plot: assetsBoxPercentilePlot -
   assetsBoxPercentilePlot(LPP)
   grid(NA, NULL, col="red")
```

---

plot-ellipses *Displays a Covariance Ellipses Plot*

Description

Displays a covariance ellipses plot.

Usage

```
covEllipsesPlot(x = list(), ...)
```

Arguments

x	a list of at least two covariance matrices.
...	optional arguments to be passed.

Details

This plot visualizes the difference between two or more covariance matrices. It is meant to compare different methods of covariance estimation.

References

Wuertz, D., Chalabi, Y., Chen W., Ellis A. (2009); *Portfolio Optimization with R/Rmetrics*, Rmetrics eBook, Rmetrics Association and Finance Online, Zurich.

Examples

```
## LPP -
   # Load Swiss Pension Fund Data:
   LPP <- LPP2005REC[, 1:6]
   head(LPP)

## assetsMeanCov -
   # Compute Robust Covariance Matrix: assetsMeanCov -
   Cov <- cov(LPP)
   robustCov <- assetsMeanCov(LPP, "MCD")$Sigma

## covEllipsesPlot -
   # Create Covariance Ellipse Plot:
   covEllipsesPlot(list(Cov, robustCov))
```

---

plot-hist *Histogram Plots of Assets*

Description

Displays density of assets returns as a histogram and/or as log density plot.

Usage

```
assetsHistPlot(x, col = "steelblue", skipZeros = FALSE, ...)

assetsLogDensityPlot(x, estimator = c("hubers", "sample", "both"),
    labels = TRUE, ...)
```

Arguments

x	any rectangular time series object which can be converted by the function `as.matrix()` into a matrix object, e.g. like an object of class `timeSeries`, `data.frame`, or `mts`.
skipZeros	a logical, should zeros be skipped in the histogram plot of the return series ?
col	a character string, defining the color to fill the boxes.
estimator	a character string naming the type of estimator to fit the mean and variance of the normal density. This may be either `"huber"`, `"sample"`, or `"both"`.
labels	a logical flag, if `TRUE` then default labels will be used, otherwise the plots will be displayed without labels and the user can add his own labels.
...	optional arguments to be passed.

Author(s)

Diethelm Wuertz for the Rmetrics port.

References

Wuertz, D., Chalabi, Y., Chen W., Ellis A. (2009); *Portfolio Optimization with R/Rmetrics*, Rmetrics eBook, Rmetrics Association and Finance Online, Zurich.

Examples

```
## LPP2005REC -
   # Load Swiss Pension Fund Data:
   x <- LPP2005REC
   head(x)

## assetsHistPlot -
   # Create Histogram Plot: assetsHistPlot -
   # par(mfrow = c(2, 2))
   assetsHistPlot(x[, 1:4])

## assetsLogDensityPlot -
   #Create Log Density Plot: assetsLogDensityPlot -
   # par(mfrow = c(1, 1))
   assetsLogDensityPlot(x[, "ALT"], estimator = "both")
```

---

plot-mst *Assets Tree Plot*

Description

Creates and displays a minimum spanning tree of assets.

Usage

```
assetsTreePlot(x, labels = TRUE, title = TRUE, box = TRUE,
    method = "euclidian", seed = NULL, ...)
```

Arguments

x	a multivariate `timeSeries` object.
labels	a logical flag, if `TRUE` then default labels will be used, otherwise the plots will be displayed without labels and the user can add his own labels.
title	a logical flag, should a default title be added? By default `TRUE`.
box	a logical flag, should a box be added around the plot? By default `TRUE`.
method	a character string, the method used to compute the distance matrix, see function `dist`.
seed	an integer value setting the seed in the computation of the sample ranks.
...	optional arguments to be passed.

Author(s)

Diethelm Wuertz for the Rmetrics port.

References

Wuertz, D., Chalabi, Y., Chen W., Ellis A. (2009); *Portfolio Optimization with R/Rmetrics*, Rmetrics eBook, Rmetrics Association and Finance Online, Zurich.

Examples

```
## LPP2005REC -
   # Load Swiss Pension Fund Data:
   LPP <- LPP2005REC[, 1:6]
   head(LPP)

## assetsTreePlot(LPP) -
   # Create Minimum Spanning Tree Graph: assetsTreePlot -
   # par(mfrow = c(2, 2))
   assetsTreePlot(LPP)
   # new seeds ...
   for (i in 1:3) assetsTreePlot(LPP)
```

---

plot-pairs *Assets Pairs Plot*

Description

Display several aspects of correlation bettween pairs of assets.

Usage

```
assetsPairsPlot(x, ...)
assetsCorgramPlot(x,
    method = c("pie", "shade"), ...)
assetsCorTestPlot(x, ...)
assetsCorImagePlot(x, labels = TRUE, show = c("cor", "test"),
    use = c("pearson", "kendall", "spearman"), abbreviate = 3, ...)
```

Arguments

x	any rectangular time series object which can be converted by the function `as.matrix()` into a matrix object, e.g. like an object of class `timeSeries`, `data.frame`, or `mts`.
labels	a logical flag, if `TRUE` then default labels will be used, otherwise the plots will be displayed without labels and the user can add his own labels.
method	a character string, the type of graph used in the lower panel.

show	a character string, what should be pressented, correlations or results from correlation tests?
use	a character string indicating which correlation coefficient or covariance is to be computed. One of "pearson", the default, "kendall", or "spearman".
abbreviate	allows to abbreviate strings to at least abbreviate characters, such that they remain unique, if they were.
...	optional arguments to be passed.

Details

assetsPairsPlot
displays pairs of scatterplots of individual assets,

assetsCorgramPlot
displays correlations between assets,

assetsCorTestPlot
displays and tests pairwise correlations,

assetsCorImagePlot
displays an image plot of a correlations.

Author(s)

Diethelm Wuertz for the Rmetrics port.

References

Wuertz, D., Chalabi, Y., Chen W., Ellis A. (2009); *Portfolio Optimization with R/Rmetrics*, Rmetrics eBook, Rmetrics Association and Finance Online, Zurich.

Examples

```
## LPP2005REC -
   # Load Swiss Pension Fund Data:
   LPP <- LPP2005REC[, 1:6]
   head(LPP)

## assetsPairsPlot -
   # Create Pairs Plot:
   assetsPairsPlot(LPP)

## assetsCorgramPlot -
   # Create Corellogram Plot:
   assetsCorgramPlot(LPP, method = "pie")
   assetsCorgramPlot(LPP, method = "shade")

## assetsCorTestPlot -
   # Create Correlation Test Plot:
   assetsCorTestPlot(LPP)

## assetsCorImagePlot -
```

```
   # Create Correlation Image Plot:
   assetsCorImagePlot(LPP)
```

---

plot-qqplot *Normal Quantile-Quantile Plots*

Description

Displays a normal quantile-quantile plot

Usage

```
assetsQQNormPlot(x, col = "steelblue", skipZeros = FALSE, ...)
```

Arguments

x	any rectangular time series object which can be converted by the function `as.matrix()` into a matrix object, e.g. like an object of class `timeSeries`, `data.frame`, or `mts`.
col	a character string, defining the color to fill the boxes.
skipZeros	a logical, should zeros be skipped in the histogram plot of the return series?
...	optional arguments to be passed.

Author(s)

Diethelm Wuertz for the Rmetrics port.

References

Wuertz, D., Chalabi, Y., Chen W., Ellis A. (2009); *Portfolio Optimization with R/Rmetrics*, Rmetrics eBook, Rmetrics Association and Finance Online, Zurich.

Examples

```
## LPP2005REC -
   # Load Swiss Pension Fund Data:
   LPP <- LPP2005REC
   head(LPP)

## assetsQQNormPlot -
   # Create normal Quantile-Quantile Plot:
   # par(mfrow = c(2, 2))
   assetsQQNormPlot(LPP[, 1:3])
```

plot-risk *Assets Risk Plots*

Description

Displays risk plot from asseets.

Usage

```
assetsRiskReturnPlot(x, col = "steelblue", percentage = FALSE, scale = 252,
    labels = TRUE, add = TRUE, ...)

assetsNIGShapeTrianglePlot(x, labels, col = "steelblue", ...)
```

Arguments

x	any rectangular time series object which can be converted by the function `as.matrix()` into a matrix object, e.g. like an object of class `timeSeries`, `data.frame`, or `mts`.
col	a character string, defining the color to fill the boxes.
percentage	a logical flag. Are the returns given by log or percentual log returns?
scale	an integer value, the scale, i..e number of days, in a year. Used by daily data sets.
labels	a logical flag, if `TRUE` then default labels will be used, otherwise the plots will be displayed without labels and the user can add his own labels.
add	a logical flag, defining the color to fill the boxes.
...	optional arguments to be passed.

Author(s)

Diethelm Wuertz for the Rmetrics port.

References

Wuertz, D., Chalabi, Y., Chen W., Ellis A. (2009); *Portfolio Optimization with R/Rmetrics*, Rmetrics eBook, Rmetrics Association and Finance Online, Zurich.

Examples

```
## LPP2005REC -
   # Load Swiss Pension Fund Data:
   LPP <- LPP2005REC
   head(LPP)

## assetsRiskReturnPlot -
```

```
   # Create Risk/Return Plot:
   # par(mfrow = c(2, 2))
   assetsRiskReturnPlot(LPP)

## assetsNIGShapeTrianglePlot -
   # Create NIG Shape Triangle Plot:
   assetsNIGShapeTrianglePlot(LPP)
```

---

plot-series *Displays Series Plots of Assets.*

Description

Displays series from sets of assets.

Usage

```
assetsReturnPlot(x, col = "steelblue", ...)
assetsCumulatedPlot(x, col = "steelblue", ...)
assetsSeriesPlot(x, col = "steelblue", ...)
```

Arguments

x	an object of class `timeSeries`.
col	a character string, defining the color to fill the boxes.
...	optional arguments to be passed.

Author(s)

Diethelm Wuertz for the Rmetrics port.

References

Wuertz, D., Chalabi, Y., Chen W., Ellis A. (2009); *Portfolio Optimization with R/Rmetrics*, Rmetrics eBook, Rmetrics Association and Finance Online, Zurich.

Examples

```
## LPP2005REC -
   # Load Swiss Pension Fund Data:
   LPP <- LPP2005REC
   head(LPP)

## assetsReturnPlot -
   # Create Return Series Plot:
   # par(mfrow = c(3, 2))
   assetsReturnPlot(LPP[, 1:3])

## assetsCumulatedPlot -
```

```
   # Create Cumulated Price/Index Plot:
   assetsCumulatedPlot(LPP[, "LPP40"], col = "red")

## assetsSeriesPlot
   # Crete Time Series Plot:
   assetsSeriesPlot(LPP[, c("LMI", "ALT")],
     col = c("orange", "brown"))
```

---

plot-similarity *Assets Similarity Plots*

Description

Displays plots of similariaies and dissimilarities between data sets of assets.

Usage

```
assetsDendrogramPlot(x, labels = TRUE, title = TRUE, box = TRUE,
    method = c(dist = "euclidian", clust = "complete"), ...)

assetsCorEigenPlot(x, labels = TRUE, title = TRUE, box = TRUE,
    method = c("pearson", "kendall", "spearman"), ...)
```

Arguments

box	a logical flag, should a box be added around the plot? By default TRUE.
labels	a logical flag, if TRUE then default labels will be used, otherwise the plots will be displayed without labels and the user can add his own labels.
method	[assetsCorgramPlot] - for the function assetsCorgramPlot a character string, the type of graph used in the lower panel, for the function assetsCorEigenPlot a character string, the method used to compute the correlation matrix. [assetsTreePlot] - a character string, the method used to compute the distance matrix, see function dist.
title	a logical flag, should a default title be added? By default TRUE.
x	any rectangular time series object which can be converted by the function as.matrix() into a matrix object, e.g. like an object of class timeSeries, data.frame, or mts.
...	optional arguments to be passed.

Details

assetsDendrogramPlot
displays a hierarchical clustering dendrogram,

assetsCorEigenPlot
displays ratio plot of the largest two eigenvalues.

Author(s)

Diethelm Wuertz for the Rmetrics port.

References

Wuertz, D., Chalabi, Y., Chen W., Ellis A. (2009); *Portfolio Optimization with R/Rmetrics*, Rmetrics eBook, Rmetrics Association and Finance Online, Zurich.

Examples

```
## LPP2005REC -
   # Load Swiss Pension Fund Data:
   LPP <- LPP2005REC
   head(LPP)

## assetsDendrogramPlot -
   # Display a Dendrogram Plot:
   assetsDendrogramPlot(LPP)

## assetsCorEigenPlot -
   # Display a Correlation Eigenvalue Ratio  Plot:
   assetsCorEigenPlot(LPP)
```

---

plot-stars *Stars Plots of Assets.*

Description

Displays star plots to compare assets sets.

Usage

```
assetsStarsPlot(x, method = c("segments", "stars"), locOffset = c(0, 0),
    keyOffset = c(0, 0), ...)

assetsBoxStatsPlot(x, par = TRUE, oma = c(0,0,0,0), mar = c(4, 4, 4, 4),
    keyOffset = c(-0.65, -0.50), main = "Assets Statistics",
    title = "Assets", titlePosition = c(3, 3.65),
    description = "Box Plot Statistics", descriptionPosition = c(3, 3.50), ...)

assetsBasicStatsPlot(x, par = TRUE, oma = c(0,0,0,0), mar = c(4, 4, 4, 4),
    keyOffset = c(-0.65, -0.50), main = "Assets Statistics",
    title = "Assets", titlePosition = c(3, 3.65),
   description = "Basic Returns Statistics", descriptionPosition = c(3, 3.50), ...)

assetsMomentsPlot(x, par = TRUE, oma = c(0,0,0,0), mar = c(4, 4, 4, 4),
    keyOffset = c(-0.65, -0.50), main = "Assets Statistics",
    title = "Assets", titlePosition = c(3, 3.65),
```

```
    description = "Moments Statistics", descriptionPosition = c(3, 3.50), ...)

assetsNIGFitPlot(x, par = TRUE, oma = c(0,0,0,0), mar = c(4, 4, 4, 4),
    keyOffset = c(-0.65, -0.50), main = "Assets Statistics",
    title = "Assets", titlePosition = c(3, 3.65),
    description = "NIG  Parameters", descriptionPosition = c(3, 3.50), ...)
```

Arguments

description	a destription string.
descriptionPosition	the position of the description string.
method	a character string from to select the plot method. Eiter a "star" or a "segment" plot.
keyOffset	a numeric vector of lenght two, specifying an offset in the legend with respect to x and y direction.
locOffset	a numeric vector of lenght two, specifying an offset in the location of the stars/circles with respect to x and y direction.
main	to set the main title.
mar	to set the number of lines of margin to be specified on the four sides of the plot. The default is c(5,4,4,2)+0.1.
oma	to set the size of the outer margins in lines of text.
par	a logical flag. Should be internal par() setting be used?
title	a character string, the plot title.
titlePosition	the position of the title string.
x	any rectangular time series object which can be converted by the function as.matrix() into a matrix object, e.g. like an object of class timeSeries, data.frame, or mts.
...	optional arguments to be passed.

Details

assetsStarsPlot
draws segment or star diagrams of data sets,

assetsBasicStatsPlot
displays a segment plot of box plot statistics,

assetsMomentsPlot
displays a segment plot of distribution moments,

assetsBoxStatsPlot
displays a segment plot of box plot statistics,

assetsNIGFitPlot
displays a segment plot NIG parameter estimates.

Author(s)

Diethelm Wuertz for the Rmetrics port.

References

Wuertz, D., Chalabi, Y., Chen W., Ellis A. (2009); *Portfolio Optimization with R/Rmetrics*, Rmetrics eBook, Rmetrics Association and Finance Online, Zurich.

Examples

```
## LPP2005REC -
   # Load Swiss Pension Fund Data:
   LPP <- LPP2005REC
   head(LPP)

## assetsBasicStatsPlot -
   # Create a basic Stats Plot: assetsBasicStatsPlot -
   # par(mfrow = c(1, 1))
   assetsBasicStatsPlot(LPP, title = "", description = "")

## assetsMomentsPlot -
   # Create a Moments Plot: assetsMomentsPlot -
   assetsMomentsPlot(LPP, title = "", description = "")

## assetsBoxStatsPlot -
   # Create a Box Stats Plot: assetsBoxStatsPlot -
   assetsBoxStatsPlot(LPP, title = "", description = "")

## assetsNIGFitPlot -
   # Create a NIG Fit Plot: assetsNIGFitPlot -
   assetsNIGFitPlot(LPP[, 7:9], title = "", description = "")
```

Index