Package 'fAssets'

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Depends R (>= 2.6.0), methods, sn, MASS, robustbase, timeDate,timeSeries, fBasics, fCopulae (>= 2100.77)

Suggests RUnit

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Description Environment for teaching ''Financial Engineering and Computational Finance''

NOTE SEVERAL PARTS ARE STILL PRELIMINARY AND MAY BE CHANGED IN THE FUTURE. THIS TYPICALLY INCLUDES FUNCTION AND ARGUMENT NAMES, AS WELL AS DEFAULTS FOR ARGUMENTS AND RETURN VALUES.

LazyLoad yes

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R topics documented:

`fAssets-package` *Assets Modelling*

Description

The Rmetrics "fAssets" package is a very powerful collection of functions to investigate and analyze data sets of financial assets from different points ov view.

Details

Package:	fAssets
Type:	Package
Date:	2009
License:	GPL Version 2 or later
Copyright:	(c) 1999-2008 Diethelm Wuertz and Rmetrics Association
URL:	http://www.rmetrics.org

assetsArrange *Rearranging Assets Columnwise*

Description

Allows to rearrange a set of assets columnwise.

Usage

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

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, or `"abc"` which arrangtes the columns alphabetically.
...	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

```
## lppData -
   lppData = as.timeSeries(data(LPP2005REC))

## assetsArrange -
   assetsArrange(lppData, "pca")
   assetsArrange(lppData, "hclust")
   assetsArrange(lppData, "abc")
```

assetsFit *Fitting of Multivariate Asset Sets*

Description

Fits the parameters to a multivariate normal, skew normal, or (skew) Student-t distribution.

Usage

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

Arguments

x	a numeric matrix of returns or any other rectangular object like a data.frame or a multivariate time series object which can be transformed by the function as.matrix to an object of class matrix.
method	a character string, which type of distribution should be fitted? method="st" denotes a multivariate skew-Student-t distribution, method="snorm" a multivariate skew-Normal distribution, and method="norm" a multivariate Normel distribution. By default a multivariate normal distribution will be fitted to the empirical market data.
title	a character string, assigning a title to an "fASSETS" object.
description	a character string, assigning a brief description to an "fASSETS" object.
fixed.df	either NA, the default, or a numeric value assigning the number of degrees of freedom to the model. In the case that fixed.df=NA the value of df will be included in the optimization process, otherwise not.
...	optional arguments to be passed.

Details

The function assetsFit for the parameter estimation uses code based on functions from the contributed packages "mtvnorm" and "sn" for fitting data to a multivariate Normal, skew-Normal, or skew-Student-t distribution.

Value

assetsFit()
returns a S4 object class of class "fASSETS", with the following slots:

@call	the matched function call.
@data	the input data in form of a data.frame.
@description	allows for a brief project description.
@fit	the results as a list returned from the underlying fitting function.

@method	the selected method to fit the distribution, one of "norm", "snorm", "st".
@model	the model parameters describing the fitted parameters in form of a list, model=list(mu, Omega, alpha, df.
@title	a title string.

The @fit slot is a list with the following compontents: (Note, not all are documented here).

@fit$dp	a list containing the direct parameters beta, Omega, alpha. Here, beta is a matrix of regression coefficients with dim(beta)=c(nrow(X), ncol(y)), Omega is a covariance matrix of order dim, alpha is a vector of shape parameters of length dim.
@fit$se	a list containing the components beta, alpha, info. Here, beta and alpha are the standard errors for the corresponding point estimates; info is the observed information matrix for the working parameter, as explained below.
fit@optim	the list returned by the optimizer optim; see the documentation of this function for explanation of its components.

Note that the @fit$model slot can be used as input to the function assetsSim for simulating a similar portfolio of assets compared with the original portfolio data, usually market assets.

Author(s)

Adelchi Azzalini for R's sn package,
Torsten Hothorn for R's mtvnorm package,
Diethelm Wuertz for the Rmetrics port.

References

Azzalini A. (1985); *A Class of Distributions Which Includes the Normal Ones*, Scandinavian Journal of Statistics 12, 171–178.

Azzalini A. (1986); *Further Results on a Class of Distributions Which Includes the Normal Ones*, Statistica 46, 199–208.

Azzalini A., Dalla Valle A. (1996); *The Multivariate Skew-normal Distribution*, Biometrika 83, 715–726.

Azzalini A., Capitanio A. (1999); *Statistical Applications of the Multivariate Skew-normal Distribution*, Journal Roy. Statist. Soc. B61, 579–602.

Azzalini A., Capitanio A. (2003); *Distributions Generated by Perturbation of Symmetry with Emphasis on a Multivariate Skew-t Distribution*, Journal Roy. Statist. Soc. B65, 367–389.

Genz A., Bretz F. (1999); *Numerical Computation of Multivariate t-Probabilities with Application to Power Calculation of Multiple Contrasts*, Journal of Statistical Computation and Simulation 63, 361–378.

Genz A. (1992); *Numerical Computation of Multivariate Normal Probabilities*, Journal of Computational and Graphical Statistics 1, 141–149.

Genz A. (1993); *Comparison of Methods for the Computation of Multivariate Normal Probabilities*, Computing Science and Statistics 25, 400–405.

Hothorn T., Bretz F., Genz A. (2001); *On Multivariate t and Gauss Probabilities in R*, R News 1/2, 27–29.

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)

## assetsFit -
   # Fit a Skew-Student-t Distribution:
   fit = assetsFit(LPP)
   print(fit)
   # Show Model Slot:
   print(fit@model)

## assetsSim -
   # Simulate set with same statistical properties:
   set.seed(1953)
   lppSim = assetsSim(n = nrow(LPP), dim = ncol(LPP), model = fit@model)
   colnames(lppSim) <- colnames(LPP)
   rownames(lppSim) <- rownames(LPP)
   head(lppSim)
```

`assetsLPM` *Computation of Lower Partial Moments of Asset Sets*

Description

Computes assymmetric lower partial moments from a time series of assets.

Usage

```
assetsLPM(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 -
   LPP = as.timeSeries(data(LPP2005REC))[, 1:6]

   # Lower Partial Moments:
   assetsLPM(LPP)
```

`assetsMeanCov` *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)
```

---

assetsOutliers *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]

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

---

assetsPfolio *Risk and Related Measures for Portfolios*

Description

Computes Value-at-Risk and related measures for a portfolio of assets.

The functions are:

`pfolioVaR`	computes Value-at-Risk for a portfolio of assets,
`pfolioCVaRplus`	computes Value-at-Risk+ for a portfolio of assets,
`pfolioCVaR`	computes Conditional Value-at-Risk for a PF of assets,
`lambdaCVaR`	computes CVaR's atomic split value lambda,
`pfolioMaxLoss`	computes Maximum Loss for a portfolio of assets,
`pfolioReturn`	computes return values of a portfolio,
`pfolioTargetReturn`	computes the target return of a portfolio,
`pfolioTargetRisk`	computes the target risk of a portfolio,
`pfolioHist`	plots a histogram of the returns of a portfolio.

Usage

```
pfolioVaR(x, weights = NULL, alpha = 0.05)
pfolioCVaRplus(x, weights = NULL, alpha = 0.05)
pfolioCVaR(x, weights = NULL, alpha = 0.05)
lambdaCVaR(n, alpha = 0.05)

pfolioMaxLoss(x, weights = NULL)
pfolioReturn(x, weights = NULL)
pfolioTargetReturn(x, weights = NULL)
pfolioTargetRisk(x, weights = NULL)
pfolioHist(x, weights = NULL, alpha = 0.05, range = NULL, details = TRUE, ...)
```

Arguments

x	a 'timeSeries' object, data frame or any other rectangular object which can be expressed as a matrix. The first dimension is the number of observations, we call it n, and the second is the number of assets in the data set, we call it dim.
weights	usually a numeric vector which has the length of the number of assets. The weights measures the normalized weights of the individual assets. By default NULL, then an equally weighted set of assets is assumed.
alpha	a numeric value, the confidence interval, by default 0.05.
details	a logical value, should details be printed?
n	the number of observation from which the CVaR's atomic split value lambda=1-floor(alpha*n)/(alpha*n) will be evaluated.
range	a numeric vector of two elements limiting the plot range of the histogram. This is quite useful if one likes to compare several plots on the same scale. If range=NULL, the default value, then the range will be selected automatically.
...	optional arguments to be passet to the function hist.

Details

The percentile measures of loss (or reward) are defined in the following way: Let $f(x, y)$ be a loss functions depending upon a decision vector $x = (x_1, ..., x_n)$ and a random vector $y = (y_1, ..., y_m)$, then

pfolioVaR is the alpha-percentile of the loss distribution, a smallest value such that the probability that losses exceed or are equal to this value is greater or equal to alpha.

pfolioCVaRplus or "CVaR+" or the "upper CVaR" are the expected losses strictly exceeding VaR. This is also also called "Mean Excess Loss" and "Expected Shortfall".

pfolioCVaR is a weighted average of VaR and CVaRplus defined as $CVaR = lambda * VaR + (1 - lambda)$ CVaRplus, for $0 <= lambda <= 1$.

Note, CVaR is convex, but VaR and CVaRplus may be non-convex. The following inequalities are valid: $VaR <= CVaR <= CVaRplus$.

Value

pfolioVaR
returns the value of risk, VaR, for a portfolio of assets, a numeric value.

pfolioCVaRplus
returns the conditional value of risk plus, CVaRplus, for a portfolio of assets, a numeric value.

pfolioCVaR
returns the conditional value of risk, CVaR, for a portfolio of assets, a numeric value.

lambdaCVaR
returns CVaR's atomic split value lambda, a numeric value.

`pfolioMaxLoss`
returns the maximum loss value of the portfolio, a numeric value.

`pfolioReturn`
returns the total portfolio return computed from the set of assets `x`, a numeric vector.

`pfolioTargetReturn`
returns the total return or target return computed from the set of assets `x` and weights `weights`, a numeric value.

`pfolioTargetRisk`
returns the total risk (Sigma) or target risk computed from the set of assets `x` and `weights` via the formual `sqrt(weights %*% cov(x) %*% weights)`, a numeric value.

`pfolioHist`
plots a histogram of portfolio returns and adds the values for the VaR (blue), for the CVaRplus (red), and for the maximum loss (green) to the histogram plot. The function invisibly returns a list with the following elements: VaR, VaRplus, maxLoss, mean, and sd. If `details` is `TRUE`, then the result is printed.

References

Uryasev S. (2000); *Conditional Value-at-Risk (CVaR): Algorithms and Applications*, Risk Management and Financial Engineering Lab, University of Florida

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

Examples

```
## assetsSim -
   myAssets = 100/12 * assetsSim(n = 120, dim = 4)
   # Plot Cumulated Returns of the Assets:
   prices = apply(myAssets, 2, FUN = cumsum)
   par(mfrow = c(2, 1), cex = 0.7)
   ts.plot(prices, col = 1:4, ylim = c(-300, 300))
   legend(0, 300, legend = colnames(myAssets), pch = "----", col = 1:4)
   title(main = "Cumulated Returns", ylab = "Cumulated Returns")
   abline(h = 0, lty = 3)

## pfolioCVaR -
   equalWeights = rep(1/4, 4)
   alpha = 0.10
   # Value at Risk:
   pfolioVaR(myAssets, equalWeights, alpha)
   # Conditional Value at Risk Plus:
   pfolioCVaRplus(myAssets, equalWeights, alpha)
   # Conditional Value at Risk Plus:
   pfolioCVaR(myAssets, equalWeights, alpha)
   # Lambda - Atomic Split Value:
```

```
   lambdaCVaR(120, alpha)

## pfolioHist -
   # Maximum Loss Value of the Portfolio
   pfolioMaxLoss(myAssets, equalWeights)
   # Compute Portfolio Returns:
   r = pfolioReturn(myAssets, equalWeights)
   head(r)
   # Target Return and Target Risk:
   pfolioTargetReturn(myAssets, equalWeights)
   pfolioTargetRisk(myAssets, equalWeights)
   # Plot:
   pfolioHist(myAssets, equalWeights, alpha, n = 20)
```

`assetsQQNormPlot` *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 -
   LPP = as.timeSeries(data(LPP2005REC))

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

`assetsSelect` *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 -
   LPP = as.timeSeries(data(LPP2005REC))
   colnames(LPP)

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

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

---

assetsSim *Simulating Multivariate Asset Sets*

Description

Simulates multivariate artificial data sets of assets, from a multivariate normal, skew normal, or (skew) Student-t distribution.

Usage

```
assetsSim(n, dim = 2, model = list(mu = rep(0, dim), Omega = diag(dim),
    alpha = rep(0, dim), df = Inf), assetNames = NULL)
```

Arguments

`n`	integer value, the number of data records to be simulated.
`dim`	integer value, the dimension (number of columns) of the assets set.
`model`	a list of model parameters: `mu` a vector of mean values, one for each asset series, `Omega` the covariance matrix of assets, `alpha` the skewness vector, and `df` the number of degrees of freedom which is a measure for the fatness of the tails (excess kurtosis).

For a symmetric distribution `alpha` is a vector of zeros. For the normal distributions `df` is not used and set to infinity, `Inf`. Note that all assets have the same value for `df`.

`assetNames` [assetsSim] -
a vector of character strings of length `dim` allowing for modifying the names of the individual assets.

Value

`assetsSim()`
returns a data.frame of simulated assets.

Author(s)

Adelchi Azzalini for R's `sn` package,
Torsten Hothorn for R's `mtvnorm` package,
Diethelm Wuertz for the Rmetrics port.

References

Azzalini A. (1985); *A Class of Distributions Which Includes the Normal Ones*, Scandinavian Journal of Statistics 12, 171–178.

Azzalini A. (1986); *Further Results on a Class of Distributions Which Includes the Normal Ones*, Statistica 46, 199–208.

Azzalini A., Dalla Valle A. (1996); *The Multivariate Skew-normal Distribution*, Biometrika 83, 715–726.

Azzalini A., Capitanio A. (1999); *Statistical Applications of the Multivariate Skew-normal Distribution*, Journal Roy. Statist. Soc. B61, 579–602.

Azzalini A., Capitanio A. (2003); *Distributions Generated by Perturbation of Symmetry with Emphasis on a Multivariate Skew-t Distribution*, Journal Roy. Statist. Soc. B65, 367–389.

Genz A., Bretz F. (1999); *Numerical Computation of Multivariate t-Probabilities with Application to Power Calculation of Multiple Contrasts*, Journal of Statistical Computation and Simulation 63, 361–378.

Genz A. (1992); *Numerical Computation of Multivariate Normal Probabilities*, Journal of Computational and Graphical Statistics 1, 141–149.

Genz A. (1993); *Comparison of Methods for the Computation of Multivariate Normal Probabilities*, Computing Science and Statistics 25, 400–405.

Hothorn T., Bretz F., Genz A. (2001); *On Multivariate t and Gauss Probabilities in R*, R News 1/2, 27–29.

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

See Also

`MultivariateDistribution`.

Examples

```
## LPP -
   # Percentual Returns:
   LPP = 100 * as.timeSeries(data(LPP2005REC))[, 1:3]
   colnames(LPP)

## assetsFit -
   # Fit a Skew-Student-t Distribution:
   fit = assetsFit(LPP)
   print(fit)
   # Show Model Slot:
   print(fit@model)

## assetsSim -
   # Simulate set with same statistical properties:
   set.seed(1953)
   lppSim = assetsSim(n = nrow(LPP), dim = ncol(LPP), model = fit@model)
   colnames(lppSim) <- colnames(LPP)
   rownames(lppSim) <- rownames(LPP)
   head(lppSim)
   head(as.timeSeries(lppSim))
```

---

assetsTest *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 = 100,
    title = NULL, description = 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 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"`.
title	a character string, assigning a title to an `"fASSETS"` object.
description	a character string, assigning a brief description to the returned object.

Value

returns an object of class `fHTEST`.

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

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

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

`binningPlot` *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 -
   LPP = as.timeSeries(data(LPP2005REC))

## assetsHistPairsPlot -
   assetsHistPairsPlot(LPP[, c("LMI", "ALT")])
   assetsHistPairsPlot(LPP[, c("LMI", "ALT")], method = "hex")
```

---

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 -
   LPP = as.timeSeries(data(LPP2005REC))
   head(LPP)

## assetsBoxPlot -
   assetsBoxPlot(LPP)

## assetsBoxPercentilePlot -
   assetsBoxPercentilePlot(LPP)
```

---

covEllipsesPlot *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 -
   LPP = as.timeSeries(data(LPP2005REC))[, 1:6]
   head(LPP)

## cov -
   Cov = cov(LPP)
   robustCov = assetsMeanCov(LPP, "MCD")$Sigma

## covEllipsesPlot -
   covEllipsesPlot(list(Cov, robustCov))
```

---

fAssets *fAssets class and methods*

Description

fAssets class and methods.

Usage

```
## S4 method for signature 'fASSETS'
show(object)
## S3 method for class 'fASSETS'
plot(x, which = "ask", ...)
## S3 method for class 'fASSETS'
summary(object, which = "all", ...)
```

Arguments

object	An object of class fASSETS.
x	a numeric matrix of returns or any other rectangular object like a data.frame or a multivariate time series object which can be transformed by the function as.matrix to an object of class matrix.
which	which of the five plots should be displayed? which can be either a character string, "all" (displays all plots) or "ask" (interactively asks which one to display), or a vector of 5 logical values, for those elements which are set TRUE the correponding plot will be displayed.
...	arguments to be passed.

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))[, 1:3]
   colnames(LPP)

## assetsFit -
   # Fit a Skew-Student-t Distribution:
   fit = assetsFit(LPP)

## fASSETS -
   class(fit)
   print(fit)
   plot(fit, 1)

## @model
   # Show Model Slot:
   print(fit@model)
```

`histPlot` *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 -
   x = as.timeSeries(data(LPP2005REC))


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

## assetsLogDensityPlot -
   # par(mfrow = c(1, 1))
   assetsLogDensityPlot(x[, "ALT"], estimator = "both")
```

---

pairsPlot *Assets Pairs Plot*

Description

Display several aspects of correlation bettween pairs of assets.

Usage

```
assetsPairsPlot(x, labels = TRUE, ...)
assetsCorgramPlot(x, labels = TRUE,
    method = c("pie", "shade"), ...)
assetsCorTestPlot(x, labels = TRUE, ...)
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 -
   LPP = as.timeSeries(data(LPP2005REC))

## assetsPairsPlot -
   assetsPairsPlot(LPP[, 1:6])

## assetsCorgramPlot -
   assetsCorgramPlot(LPP[, 1:6], method = "pie")
   assetsCorgramPlot(LPP[, 1:6], method = "shade")

## assetsCorTestPlot -
   assetsCorTestPlot(LPP[, 1:6])

## assetsCorImagePlot -
   assetsCorImagePlot(LPP[, 1:6])
```

riskPlots *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 -
   LPP = as.timeSeries(data(LPP2005REC))

## assetsRiskReturnPlot -
   # par(mfrow = c(2, 2))
   assetsRiskReturnPlot(LPP)
```

```
## assetsNIGShapeTrianglePlot -
   assetsNIGShapeTrianglePlot(LPP)
```

`seriesPlot` *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 -
   LPP = as.timeSeries(data(LPP2005REC))

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

## assetsCumulatedPlot -
   assetsCumulatedPlot(LPP[, "LPP40"],
     col = "red")

## assetsSeriesPlot
   assetsSeriesPlot(LPP[, c("LMI", "ALT")],
     col =c("orange", "brown"))
```

similarityPlot *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 -
   LPP = as.timeSeries(data(LPP2005REC))

## assetsDendrogramPlot -
   assetsDendrogramPlot(LPP)

## assetsCorEigenPlot -
   assetsCorEigenPlot(LPP)
```

`starsPlot` *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 -
   LPP = as.timeSeries(data(LPP2005REC))

## assetsBasicStatsPlot -
   # par(mfrow = c(1, 1))
   assetsBasicStatsPlot(LPP,
     title = "", description = "")

## assetsMomentsPlot -
   assetsMomentsPlot(LPP,
     title = "", description = "")

## assetsBoxStatsPlot -
   assetsBoxStatsPlot(LPP,
     title = "", description = "")

## assetsNIGFitPlot -
   assetsNIGFitPlot(LPP[, 7:9],
     title = "", description = "")
```

---

treePlot *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 -
   LPP = as.timeSeries(data(LPP2005REC))

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

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