Package 'LIHNPSD'

February 19, 2015

Type Package

Title Poisson Subordinated Distribution

Version 0.2.1

Date 2012-04-12

Author Stephen Horng-Twu Lihn <stevelihn@gmail.com>

Maintainer Stephen Horng-Twu Lihn <stevelihn@gmail.com>

Description A Poisson Subordinated Distribution to capture major leptokurtic features in log-return time series of financial data.

License GPL-2

Depends R (>= 2.14.1), sn, moments, BB, Bolstad2, optimx, Rmpfr

URL http://papers.ssrn.com/sol3/papers.cfm?abstract_id=2032762

Repository CRAN

Date/Publication 2012-04-13 05:19:27

NeedsCompilation no

R topics documented:

LIHNPSD-package *Poisson Subordinated Distribution*

Description

A new Poisson subordinated distribution is proposed to capture major leptokurtic features in log-return time series of financial data. This distribution is intuitive, easy to calculate, and converge quickly. It fits well to the historical daily log-return distributions of currencies, commodities, Treasury yields, VIX, and, most difficult of all, DJIA. It serves as a viable alternative to the more sophisticated truncated stable distribution.

Author(s)

Stephen Horng-Twu Lihn <stevelihn@gmail.com>

References

On a Poisson Subordinated Distribution for Precise Statistical Measurement of Leptokurtic Financial Data, SSRN 2032762, http://papers.ssrn.com/sol3/papers.cfm?abstract_id=2032762.

See Also

dji_logr, rawmean, rawdensity, LIHNPSD_prepare_data, LIHNPSD_theoretical_result, LIHNPSD_plot_std4gr

Examples

```
# Load the daily log-return data of DJIA
data(dji_logr)

# Construct the S3 object for PSD
dist <- list( sigma= 0.004625, alpha= 0.292645, gamma= 0.482744, beta= -0.154049, location= 0.002968 )
class(dist) <- "LIHNPSD"
dist <- rawmean(dist)

# A simple graph of the distribution's log PDF
x <- seq(-0.1,0.1,by=0.1/1000)
plot( x, log(rawdensity(dist,x)), pch=".")

# The more sophisticated fit and graphs
dt <- LIHNPSD_prepare_data(dji_logr, breaks=160, merge_tails=c(4,2))
th <- LIHNPSD_theoretical_result(dist, dt)
LIHNPSD_plot_std4gr(th, dt)
```

.N *Simple MPFR constructor*

Description

Construct an MPFR object with provided precision for further use in constructing PSD object in MPFR mode

Usage

```
.N(x,p=128)
```

Arguments

x	The number
p	The precision, typically one of 64, 96, 128.

Value

Return an MPFR object

Examples

```
# Convert the number 0.5 to 128-digit precision in MPFR
.N( 0.5, 128 )
```

calcqq *Calculate quantile-to-quantile object from PSD and histogram*

Description

Calculate quantile-to-quantile object from PSD and histogram

Usage

```
calcqq(d, hq, step = 5, debug = 0)
```

Arguments

d	The PSD S3 object
hq	`list( qhx = h$mids, qhy = h$counts )` where h is the histogram
step	The steps of PSD movement
debug	0/1: Print debug (mostly timing) message or not

Value

x	Data's x values
xq	Data's CDF(x)
y	PSD fit's x values
yq	PSD fit's CDF(x)

`density` *The probability density function of PSD with location parameter.*

Description

The probability density function of PSD with location parameter. Since location parameter is included, the mean of the PDF is always adjusted to reflect the location parameter.

Usage

```
density(d, x)
```

Arguments

d	A fully specified PSD S3 object
x	x of PDF

Value

Return PDF(x)

See Also

`rawdensity`

`dji_logr` *Log-return of DJIA*

Description

Log-return data of DJIA from 1930 to 2011

Usage

```
data(dji_logr)
```

References

See Yahoo Finance ^DJI for more details.

generatepdf *Internal utility to generate (raw) PDF*

Description

Internal utility to generate (raw) PDF

Usage

```
generatepdf(d, NS, NT, raw=1)
```

Arguments

d	A fully specified PSD S3 object
NS	Extend x-axis to number of sigma
NT	Number of tick samples per unit of sigma
raw	1: Use rawdensity; 0: Use density

Value

N	Number of data points
x	Array of x
dx	delta x
pb	Array of PDF(x)

See Also

density, rawdensity

gold_logr *Log-return of spot gold*

Description

Log-return data of spot gold (London PM fixing) from 1972 to 2009

Usage

```
data(gold_logr)
```

References

See LBMA website for more details.

LihnBetaPoly *The beta polynomial*

Description

The beta polynomial in the general form of the N-th moment

Usage

```
LihnBetaPoly(N, b)
```

Arguments

N	The N-th polynomial
b	Beta

Value

The numeric value of the polynomial

References

See Section "General Form of the N-th Moment" in the PSD paper

Examples

```
# g_1(b) = b
LihnBetaPoly(1, 0.5)
```

LihnFunctionAnalytic *Analytic form of Lihn function*

Description

Analytic form of Lihn function for integer alpha

Usage

```
LihnFunctionAnalytic(alpha, x)
```

Arguments

alpha	The order of Lihn function. Must be an integer from -1 to 4
x	The x parameter

Value

The numeric value of Lihn function

References

Appendix A of the PSD paper.

See Also

LihnFunctionSum

Examples

```
# L_1(x) = x+1
LihnFunctionAnalytic(1,1)
```

LihnFunctionKth *The k-th term in the sum of Lihn function*

Description

The k-th term in the sum of Lihn function. This is used internally by LihnFunctionSum.

See Also

LihnFunctionSum

LihnFunctionSum *The summation form of Lihn function*

Description

The summation form of Lihn function

Usage

```
LihnFunctionSum(alpha, x, epsilon = 1e-10)
```

Arguments

alpha	The order of Lihn function
x	The x parameter
epsilon	tolerance of error

Value

The numeric value of Lihn function

References

Appendix A of the PSD paper.

See Also

LihnFunctionAnalytic

Examples

```
# L_1(x) = x+1
LihnFunctionSum(1,1)
```

LihnFunctionValidate *Validation of Lihn function implementations*

Description

Validation of Lihn function implementations

Usage

```
LihnFunctionValidate()
```

Examples

```
LihnFunctionValidate()
```

LIHNPSD_plotcdf *Internal utility to plot cdf chart*

Description

Internal utility to plot cdf chart used by LIHNPSD_plot_std4gr

Usage

```
LIHNPSD_plotcdf(dist, h, data_st, tx, tcdf, xlab = "log(r)", main = "PSD CDF")
```

Arguments

dist	the PSD S3 object
h	The histogram
data_st	The descriptive statistics of the data
tx	The x axis for theoretical plot, usually it is tx from LIHNPSD_theoretical_result
tcdf	The CDF for theoretical plot
xlab	The x-axis label
main	The main label

Value

N/A

See Also

LIHNPSD_plot_std4gr, LIHNPSD_theoretical_result

LIHNPSD_plotlogpdf *Internal utility to plot log-pdf chart*

Description

Internal utility to plot cdf chart used by LIHNPSD_plot_std4gr

Usage

```
LIHNPSD_plotlogpdf(dist, h, tx, tpdf, xlab = "log(r)", main = "PSD Log PDF")
```

Arguments

dist	The PSD S3 object
h	The histogram
tx	The x axis for theoretical plot, usually it is tx from LIHNPSD_theoretical_result
tpdf	The PDF for theoretical plot
xlab	The x-axis label
main	The main label

Value

N/A

See Also

LIHNPSD_plot_std4gr, LIHNPSD_theoretical_result

LIHNPSD_plotpdf *Internal utility to plot pdf chart*

Description

Internal utility to plot pdf chart used by LIHNPSD_plot_std4gr

Usage

```
LIHNPSD_plotpdf(dist, h, tx, tpdf, xlab = "log(r)", main = "PSD PDF")
```

Arguments

dist	the PSD S3 object
h	The histogram
tx	The x axis for theoretical plot, usually it is tx from LIHNPSD_theoretical_result
tpdf	The PDF for theoretical plot
xlab	The x-axis label
main	The main label

Value

N/A

See Also

LIHNPSD_plot_std4gr, LIHNPSD_theoretical_result

LIHNPSD_plotqq *Internal utility to plot qq chart*

Description

Internal utility to plot qq chart used by LIHNPSD_plot_std4gr

Usage

```
LIHNPSD_plotqq(dist, qqp, merge_tails, main = "PSD QQ-Plot")
```

Arguments

dist	the PSD S3 object
qqp	The qq-plot data set, usually output of calcqq
merge_tails	Specify the numbers of data points to merge in both tails when processing histogram
main	The main label

Value

N/A

See Also

LIHNPSD_plot_std4gr, calcqq

LIHNPSD_plot_std4gr *Standard utility to plot a 4-chart graph on a given data set and PSD fit*

Description

Standard utility to plot a 4-chart graph on a given data set and PSD fit.

Usage

```
LIHNPSD_plot_std4gr(th, dt, EPS, file = NA)
```

Arguments

th	The theoretical object from LIHNPSD_theoretical_result
dt	The data set object from LIHNPSD_prepare_data
EPS	TRUE: plot for eps file; FALSE: plot to screen
file	File name of the eps output

Value

No output value

LIHNPSD_prepare_data *Prepare the data set object from log-return series*

Description

Prepare the data set object from log-return series

Usage

```
LIHNPSD_prepare_data(logr, breaks, merge_tails)
```

Arguments

logr	The log-return series
breaks	Breaks for histogram
merge_tails	Specify the numbers of data points to merge in both tails when processing histogram

Value

logr	The log-return series from the input
N	The length of logr
breaks	Breaks specified from the input
merge_tails	merge_tails from the input
stats	The descriptive statistics of logr: c(mean(logr), sqrt(var(logr)), skewness(logr), kurtosis(l
h	The histogram of logr
hq	The tail-merged histogram

See Also

standardfit

LIHNPSD_standardfit_fn

Internal utility to perform nonlinear fit using spg

Description

Internal utility to perform nonlinear fit using spg

Usage

```
LIHNPSD_standardfit_fn(psd, data_stats, hist, plotqq = 1, weights = list(), merge_tails = c(0, 0), deb
```

Arguments

psd	An internal array representing a guess of the PSD parameters
data_stats	The descriptive statistics of the input data
hist	Input histogram
plotqq	TRUE/FALSE: Plot intermediate charts oor not
weights	Specify the weights of each component in the nonlinear fit, defaults are 1.
merge_tails	Specify the numbers of data points to merge in both tails when processing histogram
debug	TRUE/FALSE: print debug messages or not

Value

A numeric value representing the error of the fit

See Also

standardfit

LIHNPSD_standardfit_test

Internal utility to test the stability of LIHNPSD_standardfit_fn

---

Description

Internal utility to test the stability of LIHNPSD_standardfit_fn

Usage

```
LIHNPSD_standardfit_test(d, r, hist, plotqq = 1, weights = list(), merge_tails = c(0, 0))
```

Arguments

d	A PSD S3 object representing initial guess of the PSD parameters
r	Input log-return series
hist	Input histogram
plotqq	TRUE/FALSE: Plot intermediate charts oor not
weights	Specify the weights of each component in the nonlinear fit, defaults are 1.
merge_tails	Specify the numbers of data points to merge in both tails when processing histogram

Value

The debug output of LIHNPSD_standardfit_fn

See Also

LIHNPSD_standardfit_fn

LIHNPSD_theoretical_result *Prepare the theoretical result on a given data set and PSD fit*

Description

Prepare the theoretical result on a given data set and PSD fit

Usage

```
LIHNPSD_theoretical_result(dist, dt, N=5000)
```

Arguments

dist	A PSD S3 object to evaluate theoretical result. Location parameter is included.
dt	The data set output from LIHNPSD_prepare_data
N	The number of data points when calculating PDF / CDF

Value

dist	the PSD S3 object from the input
N	N from the input
qqp	Output from calcqq
merge_tails	Copied from dt
tx	x by seq(min(dt$logr), max(dt$logr), length=N+1)
dx	dx on tx
tpdf	Theoretical PDF calculated on tx
tcdf	Theoretical CDF calculated on tx

See Also

calcqq, density, rawcdf

LIHNPSD_UnitTest *Perform major unit tests on the package*

Description

Perform major unit tests on the package

Usage

```
LIHNPSD_UnitTest(mpfr = 0)
```

Arguments

mpfr	If non-zero value is specified, MPFR will be used.

Value

Error if not passed

See Also

psdunittest

LihnTildeFunction *The tilde Lihn function*

Description

The tilde Lihn function

Usage

```
LihnTildeFunction(x, alpha, p, epsilon = 1e-10)
```

Arguments

x	The x parameter
alpha	The alpha parameter
p	The p parameter
epsilon	the tolerance of error

Value

The numeric value of the tilde Lihn function

References

Section "Pareto Tail" of the PSD paper.

Examples

```
LihnTildeFunction(0,0,0)
# should equal to 1/sqrt(2*pi)
```

`MergeTailHistogram` *Utility function to merge tails in the histogram*

Description

Utility function to merge data points in the tails of the histogram.

Usage

```
MergeTailHistogram(q, merge_tails)
```

Arguments

`q`	In the form of `list( qhx = h$mids, qhy = h$counts )` where `h` is a histogram
`merge_tails`	Number of data points to merge on each side, in the form of `c(left, right)`

Value

Modified `q` after the merge

Examples

```
# Load the daily log-return data of DJIA
data(dji_logr)
h <- hist(dji_logr, breaks = 60, plot = FALSE)
# Merge two data points from the left tail, and one data points from the right tail
q2 <- MergeTailHistogram( list(qhx=h$mids, qhy=h$counts), c(2,1) )
```

`MergeTailHistogramOneSide` *Internal utility function to merge the left tail in the histogram*

Description

Internal utility function to merge the left tail in the histogram

Usage

```
MergeTailHistogramOneSide(q, allowed_merge)
```

Arguments

`q`	In the form of `list( qhx = h$mids, qhy = h$counts )` where `h` is a histogram
`allowed_merge`	Number of data points that should be merged in the left tail

Value

Modified `q` after the merge

See Also

`MergeTailHistogram`

`mu1_analytic` *Calculate the analytic form of the first moment (mean) of PSD without location parameter*

Description

Calculate the analytic form of the first moment (mean) of PSD without location parameter. The analytic form uses Lihn function.

Usage

```
mu1_analytic(d)
```

Arguments

`d`	A fully specified PSD S3 object

Value

Numeric value of the mean

References

See Section "The Mean" in the PSD paper

See Also

rawmean, rawmu1

`mu2_analytic` *Calculate the analytic form of the second moment of PSD without location parameter*

Description

Calculate the analytic form of the second moment of PSD without location parameter. The analytic form uses Lihn function.

Usage

```
mu2_analytic(d)
```

Arguments

d	A fully specified PSD S3 object

Value

Numeric value of the second moment

References

See Section "The Variance" in the PSD paper

See Also

rawmu2

`mu3_analytic` *Calculate the analytic form of the third moment of PSD without location parameter*

Description

Calculate the analytic form of the third moment of PSD without location parameter. The analytic form uses Lihn function.

Usage

```
mu3_analytic(d)
```

Arguments

`d`	A fully specified PSD S3 object

Value

Numeric value of the third moment

References

See Section "The Skewness" in the PSD paper

See Also

`rawmu3`

`mu4_analytic` *Calculate the analytic form of the fourth moment of PSD without location parameter*

Description

Calculate the analytic form of the fourth moment of PSD without location parameter. The analytic form uses Lihn function.

Usage

```
mu4_analytic(d)
```

Arguments

`d`	A fully specified PSD S3 object

Value

Numeric value of the fourth moment

References

See Section "The Kurtosis" in the PSD paper

See Also

rawmu4

`mu_n_core` *Calculate the analytic core part of N-th moment of PSD without location parameter*

Description

Calculate the analytic core part of N-th moment of PSD without location parameter. The analytic form uses Lihn function. The core part does not include the the beta polynomial (LihnBetaPoly) since it does not have a general analytic form.

Usage

```
mu_n_core(d, n)
```

Arguments

d	A fully specified PSD S3 object
n	The N-th moment

Value

Numeric value of the core part of the N-th moment

References

See Section "General Form of the N-th Moment" in the PSD paper

See Also

LihnBetaPoly

poisson_sum *Utility to calculate the Poisson sum*

Description

Utility to calculate the Poisson sum

Usage

```
poisson_sum(d, fn)
```

Arguments

d	A fully specified PSD S3 object
fn	The input function

Value

The numeric value of the sum on `fn`

poisson_sum_kth *Internal utility to calculate the k-th item of the Poisson sum*

Description

Internal utility to calculate the k-th item of the Poisson sum

Usage

```
poisson_sum_kth(d, fn, k)
```

Arguments

d	A fully specified PSD S3 object
fn	The input function
k	Specify the k-th item

Value

The numeric value of the k-th item on `fn`

See Also

`poisson_sum`

prepare *Internal utility to construct a PSD S3 object*

Description

Internal utility to construct a PSD S3 object. This utility makes sure unspecified parameters are set to zero. If MPFR precision is set, all the parameters will be converted to MPFR. Several standard numbers are also stored within the object for easy access, such as pi, e. This utility is for internal use most of time, which is wrapped by rawmean.

Usage

```
prepare(d)
```

Arguments

d	A primitive PSD S3 object

Value

A fully specified PSD S3 object

See Also

rawmean

Examples

```
# Construct the S3 object for PSD
dist <- list( sigma= 0.004625, alpha= 0.292645, gamma= 0.482744, beta= -0.154049, location= 0.002968 )
class(dist) <- "LIHNPSD"
dist <- prepare(dist)
```

psdkernel *Calculate the ratio of the actual volatility vs the unit volatility*

Description

Calculate the ratio of the actual volatility vs the unit volatility

Usage

```
psdkernel(d, k)
```

Arguments

d	A fully specified PSD S3 object
k	The k in the Poisson distribution

Value

The numeric value of the kernel

---

psdkurtosis *Calculate the kurtosis based on Poisson sum of moments*

Description

Calculate the kurtosis based on Poisson sum of moments.

Usage

```
psdkurtosis(d)
```

Arguments

d	A fully specified PSD S3 object

Value

Numeric value of the kurtosis

References

See Section "The Kurtosis" in the PSD paper

See Also

rawmu4

psdmagnitude *A simplistic algorithm of estimating magnitude of shock*

Description

A simplistic algorithm of estimating magnitude of shock

Usage

```
psdmagnitude(d, r, step=0.1)
```

Arguments

d	A fully specified PSD S3 object
r	Log-return of the day
step	Fractional k step for the precision of the estimate, default is 0.1.

Value

Estimated k magnitude

psdskewness *Calculate the skewness based on Poisson sum of moments*

Description

Calculate the skewness based on Poisson sum of moments.

Usage

```
psdskewness(d)
```

Arguments

d	A fully specified PSD S3 object

Value

Numeric value of the skewness

References

See Section "The Skewness" in the PSD paper

See Also

rawmu3

psdunittest *Perform unit tests on the specified PSD S3 object*

Description

Perform unit tests on the specified PSD S3 object

Usage

```
psdunittest(d)
```

Arguments

d	A PSD S3 object

Value

Error if not passed

See Also

LIHNPSD_UnitTest

psdvariance *Calculate the variance based on Poisson sum of moments*

Description

Calculate the variance based on Poisson sum of moments.

Usage

```
psdvariance(d)
```

Arguments

d	A fully specified PSD S3 object

Value

Numeric value of the variance

References

See Section "The Variance" in the PSD paper

See Also

rawmu2

r10y_logr *Log-return of R10Y*

Description

Log-return data of R10Y (10-Year Treasury yield) from 1962 to 2011

Usage

```
data(r10y_logr)
```

References

See Federal Reserve Board website for more details.

rawcdf *Calculate the raw CDF*

Description

Calculate the raw CDF

Usage

```
rawcdf(d, x)
```

Arguments

d	A fully specified PSD S3 object
x	x of CDF

Value

Return CDF(x)

References

See Section "Development of PSD" in the PSD paper

See Also

rawcdfinv

rawcdfinv *Calculate Inverse of CDF using Newton's method*

Description

Calculate Inverse of CDF using Newton's method

Usage

```
rawcdfinv(d, c, xinit)
```

Arguments

d	A fully specified PSD S3 object
c	CDF
xinit	Initial guess of x. Use 0 if not sure.

Value

Return x where CDF(x)=c

References

See Section "Development of PSD" in the PSD paper

See Also

rawcdf

rawdensity *The probability density function of PSD without location parameter*

Description

The probability density function of PSD without location parameter. Since there is no additional location parameter, the PDF is exactly the same as what is described in the PSD paper. We use "raw" to differentiate such PDF from the more complicated (yet more complete) PDF with location parameter.

Usage

```
rawdensity(d, x)
```

Arguments

d	A fully specified PSD S3 object
x	x of PDF

Value

Return PDF(x)

References

See Section "Development of PSD" in the PSD paper

See Also

SPSD, density

---

rawdensity0 *The raw PDF at x=0*

Description

The raw PDF at x=0. It is implemented from the analytic result primarily for internal validation purpose.

Usage

```
rawdensity0(d)
```

Arguments

d	A fully specified PSD S3 object

Value

Return PDF(x)

References

See Section "Development of PSD" in the PSD paper

See Also

rawdensity

rawdensityslope *Calculate the slope of the PDF (dP/dx)*

Description

Calculate the slope of the PDF (dP/dx)

Usage

```
rawdensityslope(d, x)
```

Arguments

d	A fully specified PSD S3 object
x	x of dP/dx

Value

Return dP/dx

References

See Section "Tail Index" in the PSD paper

See Also

rawdensity

rawdensity_kth *The k-th item of the raw PDF*

Description

The k-th item of the raw PDF. This is used primarily to understand the internal structure of the subordination.

Usage

```
rawdensity_kth(d, x, k)
```

Arguments

d	A fully specified PSD S3 object
x	x of PDF
k	The k-th item in the Poisson sum

Value

Return PDF(x)

References

See Section "Development of PSD" in the PSD paper

See Also

rawdensity

---

rawmean *Utility to construct a PSD S3 object with calculated mean*

Description

Utility to construct a PSD S3 object with calculated mean. Mean of a PSD distribution is required in many calculations. So it makes sense to calculate it and store it in the S3 object once for all. The word "raw" means the calculation is performed without considering the location parameter.

Usage

```
rawmean(d)
```

Arguments

d	A PSD S3 object

Value

A fully specified PSD S3 object with calculated mean

References

See Section "The Mean" in the PSD paper

Examples

```
# Construct the S3 object for PSD
dist <- list( sigma= 0.004625, alpha= 0.292645, gamma= 0.482744, beta= -0.154049, location= 0.002968 )
class(dist) <- "LIHNPSD"
dist <- rawmean(dist)
```

rawmu1 — *Calculate the Poisson sum of the first moment (mean) of PSD without location parameter*

Description

Calculate the Poisson sum of the first moment (mean) of PSD without location parameter.

Usage

```
rawmu1(d)
```

Arguments

d	A fully specified PSD S3 object

Value

Numeric value of the mean

References

See Section "The Mean" in the PSD paper

See Also

rawmean, mu1_analytic

rawmu2 — *Calculate the Poisson sum of the second moment of PSD without location parameter*

Description

Calculate the Poisson sum of the second moment of PSD without location parameter.

Usage

```
rawmu2(d)
```

Arguments

d	A fully specified PSD S3 object

Value

Numeric value of the second moment

References

See Section "The Variance" in the PSD paper

See Also

psdvariance, mu2_analytic

`rawmu3` *Calculate the Poisson sum of the third moment of PSD without location parameter*

Description

Calculate the Poisson sum of the third moment of PSD without location parameter.

Usage

```
rawmu3(d)
```

Arguments

`d`	A fully specified PSD S3 object

Value

Numeric value of the third moment

References

See Section "The Skewness" in the PSD paper

See Also

psdskewness, mu3_analytic

rawmu4 *Calculate the Poisson sum of the fourth moment of PSD without location parameter*

Description

Calculate the Poisson sum of the fourth moment of PSD without location parameter.

Usage

```
rawmu4(d)
```

Arguments

d	A fully specified PSD S3 object

Value

Numeric value of the fourth moment

References

See Section "The Kurtosis" in the PSD paper

See Also

psdkurtosis, mu4_analytic

rawsn *Internal utility for SN related function*

Description

Internal utility for SN related function

Usage

```
rawsn(d, type, x, k)
```

Arguments

d	A fully specified PSD S3 object
type	1: for PDF, 2: for 2nd term of dP/dx
x	x of SN
k	The k-th item in the Poisson sum

Value

A numeric value

See Also

rawdensity, rawdensityslope

SPSD *Simple PSD constructor*

Description

Construct an S3 object for PSD in double-precision or MPFR

Usage

```
SPSD(sigma, alpha, gamma, beta=0, mpfr=0)
```

Arguments

sigma	sigma value of PSD
alpha	alpha value of PSD
gamma	gamma value of PSD
beta	optional beta value of PSD for skewness
mpfr	optional mpfr precision. Default is 0, which sets all calculations in double precision. For MPFR, set it to an integer, typically one of 64, 96, 128.

Value

Return an S3 object of LIHNPSD class that can be used for subsequent calculation.

Note

This constructor doesn't include the location parameter.

See Also

See also package's example for the DJIA parameters.

Examples

```
# Normal distribution
SPSD( 1,0,0 )
# PSD that approximate DJIA
SPSD(0.004625, 0.292645, 0.482744, -0.154049)
```

`standardfit` *Standard utility to perform nonlinear PSD fit*

Description

Standard utility to perform nonlinear PSD fit

Usage

```
standardfit(d, r, hist, trace, iter, plotqq, weights, merge_tails)
```

Arguments

`d`	A PSD S3 object representing initial guess of the PSD parameters
`r`	Input log-return series
`hist`	Input histogram
`trace`	TRUE/FALSE: turn trace on/off
`iter`	Maximum number of iterations
`plotqq`	TRUE/FALSE: Plot intermediate charts oor not
`weights`	Specify the weights of each component in the nonlinear fit, defaults are 1.
`merge_tails`	Specify the numbers of data points to merge in both tails when processing histogram

Value

`dist`	A PSD S3 object representing best nonlinear fit
`psdout`	The output of optmix/psg function. This is for debugging purpose only.

See Also

`LIHNPSD_standardfit_fn`

Examples

```
# Load the daily log-return data of DJIA
data(szd_logr)

# Prepare the input data set
merge_tails <- c(1,3)
dt <- LIHNPSD_prepare_data(szd_logr, breaks=68, merge_tails=merge_tails)

# Prepare the input PSD
dist <- list( sigma= 0.0036, alpha= 0.9, gamma= 0.0, beta= -0.014 )
class(dist) <- "LIHNPSD"
dist <- rawmean(dist)
dist$location <- 0.00014
```

```
# Invoke the nonlinear fit (This will take some time!)
#fit <- standardfit(dist, dt$logr, dt$h, trace=1, iter=10,
#       plotqq=1, weights=list(m3=5,m4=1,qq_df=4), merge_tails=merge_tails )

# The final PSD
#dist <- fit$dist
```

`szd_logr` *Log-return of SZD/USD*

Description

Log-return data of SZD/USD exchange rate from 1975 to 2008

Usage

```
data(szd_logr)
```

References

See Federal Reserve Board website for more details.

`tailindex` *Calculate the tail index*

Description

Calculate the tail index

Usage

```
tailindex(d, x)
```

Arguments

`d`	A fully specified PSD S3 object
`x`	x where the tail index is evaluated

Value

Return the tail index

References

See Section "Tail Index" in the PSD paper

tailindex_plot *Generate the plot of tail index for the specified PSD*

Description

Generate the plot of tail index for the specified PSD

Usage

```
tailindex_plot(d, xmin, xmax, ymax=0.4)
```

Arguments

d	A fully specified PSD S3 object
xmin	Minimum of x-axis
xmax	Maximum of x-axis
ymax	Maximum of y-axis, default is 0.4

Value

N/A

References

See Section "Tail Index" in the PSD paper

See Also

tailindex

TimeSeriesLogReturn *Convert price series to log-return series*

Description

Convert daily price series to log-return series by a specified time interval

Usage

```
TimeSeriesLogReturn(pr, days)
```

Arguments

pr	Array of daily prices
days	Time interval, typically 1 for one day

Value

Array of log-return series

Examples

```
pr <- c( 100.0, 102.0, 106.0, 105.0 )
logr <- TimeSeriesLogReturn(pr,1)
```

---

vix_logr *Log-return of VIX*

Description

Log-return data of VIX from 1990 to 2011

Usage

```
data(vix_logr)
```

References

See Yahoo Finance ^VIX for more details.

Index