Package 'tsqn'

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Type Package

Title Applications of the Qn Estimator to Time Series (Univariate and Multivariate)

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Depends R (>= 3.2.3), robustbase, MASS, fracdiff

Suggests knitr, rmarkdown, testthat (>= 3.0.0)

Description Time Series Qn is a package with applications of the Qn estimator of Rousseeuw and Croux (1993) <doi:10.1080/01621459.1993.10476408> to univariate and multivariate Time Series in time and frequency domains. More specifically, the robust estimation of autocorrelation or autocovariance matrix functions from Ma and Genton (2000, 2001) <doi:10.1111/1467-9892.00203>, <doi:10.1006/jmva.2000.1942> and Cotta (2017) <doi:10.13140/RG.2.2.14092.10883> are provided. The robust pseudo-periodogram of Molinares et. al. (2009) <doi:10.1016/j.jspi.2008.12.014> is also given. This packages also provides the M-estimator of the long-memory parameter d based on the robustification of the GPH estimator proposed by Reisen et al. (2017) <doi:10.1016/j.jspi.2017.02.008>.

License GPL (>= 2)

VignetteBuilder knitr

LazyData true

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RoxygenNote 7.3.3

NeedsCompilation no

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corMatQn   *Robust correlation matrix*

Description

Computes the robust correlation matrix of the matrix x proposed by Ma and Genton (2001) using the robust scale Qn of Rousseeuw and Croux (1993).

Usage

```
corMatQn(x)
```

Arguments

x   a numeric matrix

Value

a numeric matrix

References

Ma, Y. and Genton, M. G. (2001) Highly robust estimation of dispersion matrices. *Journal of Multivariate Analysis*, **78**, 11–36.

Rousseeuw, P. J. and Croux, C. (1993) Alternatives to the median absolute deviation. *Journal of the American Statistical Association*, **88**, 1273–1283.

Examples

```
dataset <- cbind(rnorm(100),rnorm(100))
corMatQn(dataset)
```

---

corQn *Robust correlation between the variables* x *and* y

Description

Computes the robust correlation of x and y proposed by Ma and Genton (2001) using the robust scale Qn of Rousseeuw and Croux (1993).

Usage

```
corQn(x, y)
```

Arguments

x   a numeric vector

y   a numeric vector

Value

a numerical value with the robust correlation between x and y

References

Ma, Y. and Genton, M. G. (2001) Highly robust estimation of dispersion matrices. *Journal of Multivariate Analysis*, **78**, 11–36.

Rousseeuw, P. J. and Croux, C. (1993) Alternatives to the median absolute deviation. *Journal of the American Statistical Association*, **88**, 1273–1283.

Examples

```
corQn(rnorm(100),rnorm(100))
```

---

covMatQn *Robust covariance matrix*

Description

Computes the robust covariance matrix of the matrix x proposed by Ma and Genton (2001) using the robust scale Qn of Rousseeuw and Croux (1993).

Usage

```
covMatQn(x)
```

Arguments

x   a numeric matrix

Value

a numeric matrix

References

Ma, Y. and Genton, M. G. (2001) Highly robust estimation of dispersion matrices. *Journal of Multivariate Analysis*, **78**, 11–36.

Rousseeuw, P. J. and Croux, C. (1993) Alternatives to the median absolute deviation. *Journal of the American Statistical Association*, **88**, 1273–1283.

Examples

```
dataset <- cbind(rnorm(100),rnorm(100))
covMatQn(dataset)
```

---

covQn   *Robust covariance between the variables* x *and* y

Description

Computes the robust covariance of x and y proposed by Ma and Genton (2001) using the robust scale Qn of Rousseeuw and Croux (1993).

Usage

```
covQn(x, y)
```

Arguments

x   a numeric vector
y   a numeric vector

Value

a numerical value with the robust covariance between x and y

References

Ma, Y. and Genton, M. G. (2001) Highly robust estimation of dispersion matrices. *Journal of Multivariate Analysis*, **78**, 11–36.

Rousseeuw, P. J. and Croux, C. (1993) Alternatives to the median absolute deviation. *Journal of the American Statistical Association*, **88**, 1273–1283.

Examples

```
covQn(rnorm(100),rnorm(100))
```

| GPH_estimate | *Classical and Robust Geweke and Porter-Hudak (GPH) estimators for the long-memory parameter d of a long-range dependent stationary processes* |

Description

Estimate the fractional (or "memory") parameter d of long-range dependent stationary processes by the method of Geweke and Porter-Hudak (GPH). (GPH-M) and (GPH-Qn) correspond to the estimators devised by Reisen et al. (2017) and Molinares (2009), respectively.

Usage

```
GPH_estimate(series, bandw.exp = 0.7, method = "GPH")
```

Arguments

series	univariate time series
bandw.exp	the bandwidth used in the regression equation
method	character string giving the type of GPH to be computed. Allowed values are "GPH" (the default), "GPH-M" or "GPH-Qn".

Value

d GPH estimate

sd.as asymptotic standard deviation

sd.reg standard error deviation

Author(s)

Valderio Reisen, Céline Lévy-Leduc and Higor Cotta.

References

Reisen, V. A. and Lévy-Leduc, C. and Taqqu, M. (2017) An M-estimator for the long-memory parameter. *To appear in Journal of Statistical Planning and Inference*.

Molinares, F. F. and Reisen, V. A., and Cribari-Neto, F. (2009) Robust estimation in long-memory processes under additive outliers. *Journal of Statistical Planning and Inference*, **139**, 2511–2525. #' @references Geweke, J. and Porter-Hudak, S. (1983) The estimation and application of long memory time series models. *Journal of Time Series Analysis*, **4**, 221–238.

Examples

```
library(fracdiff)
simseries <- fracdiff.sim(1500, d = 0.3)
GPH_estimate(simseries$series,method="GPH")$d
## Not run:
GPH_estimate(simseries$series,method="GPH-Qn")$d
GPH_estimate(simseries$series,method="GPH-M")$d

## End(Not run)
```

PerioMrob   *Robust M-periodogram*

Description

This function computes the robust M-periodogram proposed by Reisen et al. (2017).

Usage

```
PerioMrob(series)
```

Arguments

series   univariate time series

Value

a numeric vector containing the robust estimates of the spectral density

Author(s)

Valderio Reisen, Céline Lévy-Leduc and Higor Cotta.

References

Reisen, V. A. and Lévy-Leduc, C. and Taqqu, M. (2017) An M-estimator for the long-memory parameter. *To appear in Journal of Statistical Planning and Inference*.

Geweke, J. and Porter-Hudak, S. (1983) The estimation and application of long memory time series models. *Journal of Time Series Analysis*, **4**, 221–238.

Examples

```
PerioMrob(ldeaths)
```

PerQn   *Robust periodogram based on the Robust ACF*

Description

Computes the robust pseudo-periodogram of Molinares et al (2009) based on the robust ACF by Ma and Genton (2000).

Usage

```
PerQn(x, window = "truncated", bandw.rob = 0.7)
```

Arguments

x	univariate time series
window	character string giving the type of the window. Allowed values are "truncated" (the default) or "NULL".
bandw.rob	is a numeric value giving the truncation point.

Value

a numeric vector containing the values of the robust periodogram proposed by Molinares (2009).

Author(s)

Valderio Reisen and Higor Cotta

References

Molinares, F. F. and Reisen, V. A., and Cribari-Neto, F. (2009) Robust estimation in long-memory processes under additive outliers. *Journal of Statistical Planning and Inference*, **139**, 2511–2525.

Ma, Y. and Genton, M. G. (2000) Highly robust estimation of the autocovariance function. *Journal of Time Series Analysis*, **21**, 663–684.

Examples

```
PerQn(ldeaths)
```

---

plot.robacf   *Plot Robust Autocovariance and Robust Autocorrelation Functions*

Description

Plot method for objects of class "robacf".

Usage

```
## S3 method for class 'robacf'
plot(
  x,
  type = "h",
  xlab = "Lag",
  ylab = NULL,
  ylim = NULL,
  main = NULL,
  max.mfrow = 6,
  ask = Npgs > 1 && dev.interactive(),
  mar = if (nser > 2) c(3, 2, 2, 0.8) else par("mar"),
  oma = if (nser > 2) c(1, 1.2, 1, 1) else par("oma"),
  mgp = if (nser > 2) c(1.5, 0.6, 0) else par("mgp"),
  xpd = par("xpd"),
  cex.main = if (nser > 2) 1 else par("cex.main"),
  verbose = getOption("verbose"),
  ...
)
```

Arguments

x	an object of class "robacf".
type	the type of plot to be drawn, default to histogram like vertical lines.
xlab	the x label of the plot.
ylab	the y label of the plot.
ylim	numeric of length 2 giving the y limits for the plot.
main	overall title for the plot.
max.mfrow	positive integer; for multivariate x indicating how many rows and columns of plots should be put on one page, using par(mfrow = c(m,m))(see [par](par)).
ask	logical; if TRUE, the user is asked before a new page is started.
mar, oma, mgp, xpd, cex.main	
	graphics parameters as in par(*), by default adjusted to use smaller than default margins for multivariate x only.
verbose	logical. Should R report extra information on progress?
...	graphics parameters to be passed to the plotting routines.

Value

None

Contributions

plot.acf (stats) - R Core

Examples

```
robacf(cbind(ldeaths,mdeaths))
```

---

pm10   *PM10 Concentrations at Monitoring Stations*

Description

Hourly PM10 concentration measurements collected at monitoring stations.

Usage

```
data(pm10)
```

Format

A data frame with 1826 observations on the following 8 variables.

Laranjeiras PM10 concentration at Laranjeiras station.

Carapina PM10 concentration at Carapina station.

Camburi PM10 concentration at Camburi station.

Sua PM10 concentration at Sua station.

VixCentro PM10 concentration at VixCentro station.

Ibes PM10 concentration at Ibes station.

VVCentro PM10 concentration at VVCentro station.

Cariacica PM10 concentration at Cariacica station.

Source

Packaged from inst/extdata/pm10data.csv.

Examples

```
data(pm10)
str(pm10)
summary(pm10$VixCentro)
```

---

robacf   *Robust autocorrelation or autocovariance function estimation*

Description

This function computer and plots(by default) the robust estimates of the autocovariance or the autocorrelation function based on the Qn.

Usage

```
robacf(
  x,
  lag.max = NULL,
  type = c("correlation", "covariance"),
  plot = TRUE,
  na.action = na.fail,
  demean = TRUE,
  ...
)
```

Arguments

x	a numeric vector or matrix.
lag.max	maximum lag at which to calculate the acf. Default is 10*log10(N/m) where N is the number of observations and m the number of series. Will be automatically limited to one less than the number of observations in the series.
type	character string giving the type of acf to be computed. Allowed values are "correlation" (the default) or "covariance". Accepts parcial names.
plot	logical. If TRUE (the default) the acf is plotted.
na.action	function to be called to handle missing values. na.pass can be used.
demean	logical. Should the covariances be about the sample means?
...	further arguments to be passed to plot.acf.

Value

An object of class "robacf", which is a list with the following elements:

lag A three dimensional array containing the lags at which the acf is estimated.

acf An array with the same dimensions as lag containing the estimated acf.

type The type of correlation (same as the type argument).

n.used The number of observations in the time series.

series The name of the series x.

snames The series names for a multivariate time series.

The result is returned invisibly if plot is TRUE.

Author(s)

Higor Cotta, Valderio Reisen and Pascal Bondon

References

Cotta, H. and Reisen, V. A. and Bondon, P. and Stummer, W. (2017) Robust Estimation of Co-variance and Correlation Functions of a Stationary Multivariate Process. *To appear in 2017 25th European Signal Processing Conference (EUSIPCO 2017).*

Ma, Y. and Genton, M. G. (2000) Highly robust estimation of the autocovariance function. *Journal of Time Series Analysis*, **21**, 663–684.

Ma, Y. and Genton, M. G. (2001) Highly robust estimation of dispersion matrices. *Journal of Multivariate Analysis*, **78**, 11–36.

Rousseeuw, P. J. and Croux, C. (1993) Alternatives to the median absolute deviation. *Journal of the American Statistical Association*, **88**, 1273–1283.

Examples

```
data.set <- cbind(fdeaths,mdeaths)
robacf(data.set)
robacf(data.set,type="covariance",lag.max=10)
```

TimeSeriesQn	*Applications of the Qn estimator to time series (univariate and multi-variate)*

Description

This package contains applications of the Qn estimator of Rousseeuw and Croux(1993) to univariate and multivariate Time Series in time and frequency domains. More especifically, the robust estimation of autocorrelation or autocovariance matrix functions from Ma and Genton (2000,2001) and Cotta et. al. (2017). The robust periodogram of Molinares et. al. (2009) and the M-Periodogram of Reisen et. al. (2017). The robust GPH estimator of d considering robust periodogram approach.

Details

Package metadata (version, date, license, and dependencies) are provided by the package DE-SCRIPTION and shown by the help system and CRAN reference manual.

Author(s)

Higor Cotta, Valderio Reisen, Pascal Bondon and Céline Lévy-Leduc

Maintainer: Higor Cotta <cotta.higor@gmail.com>

References

H. Cotta, V. Reisen, P. Bondon, W. Stummer (2017): Robust Estimation of Covariance and Correlation Functions of a Stationary Multivariate Process. *To appear in 2017 25th European Signal Processing Conference (EUSIPCO 2017)*

V. Reisen, C. Lévy-Leduc, M. Taqqu (2017): An M-estimator for the long-memory parameter. *To appear in Journal of Statistical Planning and Inference*.

Y. Ma, M. Genton (2000): Highly robust estimation of the autocovariance function. *Journal of Time Series Analysis*, 21, 663–684.

Y. Ma, M. Genton (2001): Highly robust estimation of dispersion matrices. *Journal of Multivariate Analysis*, 78, 11–36.

P. J. Rousseuw, C. Croux (1993): Alternatives to the median absolute deviation.*Journal of the American Statistical Association*, Taylor & Francis Group, 88, n. 424, p. 1273—1283.

Examples

```
x <- rnorm(1000,10,1)
y <- rnorm(1000,100,10)
xy <- cbind(x,y)

covQn(x,y)
corQn(x,y)
covMatQn(xy)
corMatQn(xy)


robacf(x)

dataset <- cbind(fdeaths,mdeaths)
robacf(dataset)
robacf(dataset,type="covariance",lag.max=10)

PerQn(ldeaths)

library(fracdiff)
simseries <- fracdiff.sim(1500, d = 0.3)
GPH_estimate(simseries$series,method="GPH")$d
GPH_estimate(simseries$series,method="GPH-Qn")$d
```

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