The ig package

September 21, 2007

Version: 1.0

Date: 2007-09-05

Title: The **ig** package

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Description: A collection of utilities for robust and classical versions of the inverse Gaussian distribution known as the inverse Gaussian type distribution (IGTD).

License: GPL

URL: http://www.r-project.org

R topics documented:

Description

The function `ACIig()` produces a plot of an approximate confidence region and computes approximate confidence intervals (ACI) for the parameters mu and lambda of the IGTD from a sample of observations.

Usage

```
ACIig(x, kernel = "normal", conf.level = 95, chart = c(NULL, NULL, NULL,
NULL),col = 1)
```

Arguments

`x`	Vector of observations.
`kernel`	Kernel of the pdf of the associated symmetrical distribution by means of which the IGTD is obtained. The kernels: `"Laplace"`, `"logistic"`, `"normal"` and `"t"` are available.
`conf.level`	Confidence level of the region.
`chart`	Vector of limits of the graphs. It is a vector of the type: `c(xmin,xmax,ymin,ymax)`.
`col`	Color of an approximate confidence region in the plot.

Details

In order to construct a confidence region for μ and λ, we use the asymptotic normality of the MLE.

Value

`ACIig()` shows a plot of an approximate confidence region and computes ACI for the parameters of the IGTD from a sample of observations.

Author(s)

Víctor Leiva <victor.leiva@uv.cl>, Hugo Hernández <hugo.hernandez@msn.com>, and Antonio Sanhueza <asanhue@ufro.cl>.

References

Sanhueza, A., Leiva, V. and Balakrishnan, N. (2007). A new class of inverse Gaussian type distributions. Metrika (in press).

Examples

```
## Generates a sample from the IGTD
## Estimates the parameters of the IGTD with g="normal" by means of a confidence region
x<-rig(300,mu=1,lambda=1,kernel="normal")
ACIig(x, kernel="normal")
```

`descriptive.summary` *Descriptive summary of the data*

Description

The function `descriptive.summary()` gives a descriptive summary of the data.

Usage

```
descriptive.summary(x)
```

Arguments

`x`	Vector of observations.

Details

The function `descriptive.summary()` gives a descriptive summary of the data containing: mean, median, mode, standard deviation, coefficients of variation, skewness and kurtosis, range, minimum, maximum and the number de observations. This function uses the command `basicStats()` of the R package named **Fbasics** and the command `search.mode()` that allows to find the empirical mode of the data.

Value

The function `descriptive.summary()` carries out a descriptive summary of the data

Author(s)

Víctor Leiva <victor.leiva@uv.cl>, Hugo Hernández <hugo.hernandez@msn.com>, and Antonio Sanhueza <asanhue@ufro.cl>.

Examples

```
## Generates a sample from the IGTD
## Produces a descriptive summary of the data
x<-rig(300,mu=1,lambda=1,kernel="normal")
descriptive.summary (x)
```

`diagnosticsig` *Diagnostic plots for the inverse Gaussian type distribution*

Description

The function `diagnosticsig()` produces an index plot of the total local influence.

Usage

```
diagnosticsig(data, kernel = "normal", main = "", ylim = NULL)
```

Arguments

`data`	Vector of observations.
`kernel`	Kernel of the pdf of the associated symmetrical distribution by means of which the IGTD is obtained. The kernels: `"Laplace"`, `"logistic"`, `"normal"` and `"t"` are available. When the `t` kernel is considered, the value for the parameter nu must be incorporated.
`main`	An overall title for the plot.
`ylim`	Limit for the y axis.

Details

The local influence diagnostics method (Cook, 1986) is used to evaluate the local influence by means of likelihood displacement.

Value

`diagnosticsig()` gives an influence diagnostics through a graphical plot for the IGTD from a sample of observations.

Author(s)

Víctor Leiva <victor.leiva@uv.cl>, Hugo Hernández <hugo.hernandez@msn.com>, and Antonio Sanhueza <asanhue@ufro.cl>.

References

Cook, R. D. and Weisberg, S. (1982). Residuals and Influence in Regression. Chapman and Hall, London.

Cook, R. D. (1986). Assessment of local influence (with discussion). Journal of the Royal Statistical Society Series B 48, 133-169.

Sanhueza, A., Leiva, V. and Balakrishnan, N. (2007). A new class of inverse Gaussian type distributions. Metrika (in press).

Examples

```
## Generates a sample from the IGTD
## Produces influence diagnostics for the IGTD with g="normal"
x<-rig(300,mu=1,lambda=1,kernel="normal")
diagnosticsig(x, kernel="normal")
```

`dig.kotz` *Probability density function (pdf) of the inverse Gaussian type distribution generated from the Kotz kernel*

Description

Compute the probabilility density function of inverse Gaussian distribution generated from the Kotz distribution with parameters `q`, `r` and `s`.

Usage

```
dig.kotz(t, mu, lambda, parameters = c(1, 1, 1), log = FALSE)
```

Arguments

`t`	Vector of observations.
`mu`	Mean.
`lambda`	Scale parameter.
`parameters`	Parameters of the Kotz distribution.
`log`	Logical; if TRUE, probabilities p are given as log(p).

Details

The IGTD has pdf given by

$$f_T(t) = f_Z(a_t)\sqrt{\lambda}/\sqrt{t^3},$$

with $t > 0$, $\mu > 0$ and $\lambda > 0$, where $f_Z(\cdot) = c\,g(\cdot)$ is the pdf of the Kotz distribution $a_t = a_t(\mu, \lambda) = \sqrt{\lambda/\mu}[\sqrt{t/\mu} - \sqrt{\mu/t}]$.

Value

`dig.kotz()` gives the pdf of an IGTD generated from the Kotz kernel.

Author(s)

Víctor Leiva <victor.leiva@uv.cl>, Hugo Hernández <hugo.hernandez@msn.com>, and Antonio Sanhueza <asanhue@ufro.cl>.

References

Sanhueza, A., Leiva, V. and Balakrishnan, N. (2007). A new class of inverse Gaussian type distributions. Metrika (in press).

Examples

```
x<-seq(-3,3,by=0.01)
y<-dig.kotz(x,1.0,1.0,c(1,2,3))
plot(x,y,type="l",xlab="x",ylab="f(x)")
```

---

dig.PVII	*Probability density function (pdf) of the inverse Gaussian type distribution generated from the Pearson type VII kernel*

Description

Compute the probabilility density function of inverse Gaussian distribution generated from the the Pearson type VII kernel with parameters `q` and `r`.

Usage

```
dig.PVII(t, mu, lambda, parameters = c(1, 1), log = FALSE)
```

Arguments

`t`	Vector of observations.
`mu`	Mean.
`lambda`	Scale parameter.
`parameters`	Parameters of the Kotz distribution.
`log`	Logical; if TRUE, probabilities p are given as log(p).

Details

The IGTD has pdf given by

$$f_T(t) = f_Z(a_t)\sqrt{\lambda}/\sqrt{t^3},$$

with $t > 0$, $\mu > 0$ and $\lambda > 0$, where $f_Z(\cdot) = c\,g(\cdot)$ is the pdf of the Pearson VII distribution $a_t = a_t(\mu, \lambda) = \sqrt{\lambda/\mu}[\sqrt{t/\mu} - \sqrt{\mu/t}]$.

Value

`dig.PVII()` gives the pdf of an IGTD generated from the Pearson VII kernel.

Author(s)

Víctor Leiva <victor.leiva@uv.cl>, Hugo Hernández <hugo.hernandez@msn.com>, and Antonio Sanhueza <asanhue@ufro.cl>.

References

Sanhueza, A., Leiva, V. and Balakrishnan, N. (2007). A new class of inverse Gaussian type distributions. Metrika (in press).

Examples

```
x<-seq(-3,3,by=0.01)
y<-dig.PVII(x,1.0,1.0,c(1,1))
plot(x,y,type="l",xlab="x",ylab="f(x)")
```

`dig` *Probability density function (pdf) of the inverse Gaussian type distribution*

Description

Probability density function for the inverse Gaussian type distribution with mean parameter mu, scale parameter lambda and associated kernel g. The IGTD is a generalization of the inverse Gaussian type distribution; for details see Sanhueza, Leiva and Balakrishnan (2007). The g function corresponds to the kernel of the pdf of the associated symmetrical distribution. In the ig package, the IGTD can be obtained from the following kernels: Laplace, logistic, normal (classical case) and Student-t. All these kernels are implemented in the `R` software. The Laplace or double exponential distribution is obtained from the **normalp** package developed by Mineo (2005).

Usage

```
dig(x, mu = 1, lambda = 1, kernel = "normal", parameter.nu = 1, log = FALSE)
```

Arguments

`x`	Vector of observations.
`mu`	Mean.
`lambda`	Scale parameter.
`kernel`	Kernel of the pdf of the associated symmetrical distribution by means of which the IGTD is obtained. The kernels: `"Laplace"`, `"logistic"`, `"normal"` and `"t"` are available.
`parameter.nu`	Additional parameter of the IGTD when the `t` kernel is used. This parameter corresponds to a shape parameter known as `"degree of freedom"`. For default `nu=1`, in which case the Cauchy distribution is obtained. The Student-t distribution has always degrees of kurtosis greater than normal distribution. This aspect is transferred to the IGTD and produces robust parameter estimates for the IGTD.
`log`	Logical; if TRUE, probabilities p are given as log(p).

Details

If mu, lambda or g are not specified, then they assume the default values 0, 1 and `"normal"`, respectively. The IGTD has pdf given by

$$f_T(t) = f_Z(a_t)\sqrt{\lambda}/\sqrt{t^3},$$

with $t > 0$, $\mu > 0$ and $\lambda > 0$, where $f_Z(\cdot) = c\, g(\cdot)$ is the pdf of the associated symmetrical about zero distribution and $a_t = a_t(\mu, \lambda) = \sqrt{\lambda/\mu}[\sqrt{t/\mu} - \sqrt{\mu/t}]$.

Value

`dig()` gives the pdf of an IGTD.

Author(s)

Víctor Leiva <victor.leiva@uv.cl>, Hugo Hernández <hugo.hernandez@msn.com>, and Antonio Sanhueza <asanhue@ufro.cl>.

References

Mineo, A. (2003). A new package for the general error distribution. R News 3, 13-16.

Sanhueza, A., Leiva, V. and Balakrishnan, N. (2007). A new class of inverse Gaussian type distributions. Metrika (in press).

Examples

```
## Compute the pdf of the IGTD with g="normal" for a vector x with mu=1, lambda=1
## At the end we have the graph of this pdf
x <- seq(0, 4,by=0.01)
fx <- dig(x,mu=1.0,lambda=1.0,kernel="normal")
print(fx)
plot(x, fx, main = "pdf of the IGTD (classical case)", ylab="f(x)")
```

`dLaplace` *Probability density function (pdf) of the Laplace distribution*

Description

Compute the probabilility density function of Laplace distribution.

Usage

```
dLaplace(x)
```

Arguments

`x`	Vector of observations.

Details

The Laplace distribution has pdf given by

$$f_T(t) = (1/2)\exp(-|t|),$$

with $-\infty < t < +\infty$

Value

`dLaplace()` gives the pdf of an Laplace distribution.

Author(s)

Víctor Leiva <victor.leiva@uv.cl>, Hugo Hernández <hugo.hernandez@msn.com>, and Antonio Sanhueza <asanhue@ufro.cl>.

References

Johnson, N., Kotz, S. and Balakrishnan, N. (1994). Continuous univariate distributions, vol 1.

Examples

```
x<-seq(-3,3,by=0.01)
y<-dLaplace(x)
plot(x,y,type="l",xlab="x",ylab="f(x)")
```

`fracture` *Data set*

Description

Several data sets related to the IGTD are available in the ig package, which have been taken from the literature of this topic.

Usage

```
data(fracture)
```

Format

A vector containing 19 observations.

Details

psi21, psi26 and psi31 were taken from Birnbaum and Saunders (1969), who reported fatigue life data correspond to the cycles ($\times 10^{-3}$) of aluminum specimens of type 6061-T6. These specimens were cut in a parallel angle to the direction of rotation and oscillating at 18 cycles per seconds. They were exposed to a pressure with maximum stress of 21,000, 26,000, and 31,000 psi (pounds per square inch), for $n = 101, 102$, and 101 specimens, respectively.

Other data set names are: repairtimes, shelflife, fracture, precipitations and runoff Chhikara and Folks (1989), which correspond to maintenance data on active repair times (in hours) for an airborne communications transceiver, shelflife (in days) of a food product, fracture toughnesses of MIG welds and precipitation (in inches) and runoff amounts at Jug Bridge, Maryland, respectively.

References

Chhikara, R. S. and Folks, J. L. (1989). The Inverse Gaussian Distribution. Marcel Dekker, New York.

`hfig` *function (hf) of the inverse Gaussian type distribution*

Description

Hazard function or failure rate for the IGTD with mean parameter mu, scale parameter lambda and associated kernel `g`.

Usage

```
hfig(t, mu = 1, lambda = 1, kernel = "normal", parameter.nu = 1)
```

Arguments

`t`	Vector of quantiles.
`mu`	Mean.
`lambda`	Scale parameter.
`kernel`	Kernel of the pdf of the associated symmetrical distribution by means of which the IGTD is obtained. The kernels: ”Laplace”, ”logistic”, ”normal.ªnd ”t.ªre available.
`parameter.nu`	Additional parameter of the IGTD when the t kernel is used. This parameter corresponds to a shape parameter and it is also known as ”degree of freedom”. For default `nu=1`, in which case the Cauchy distribution is obtained. The Student-t distribution has always degrees of kurtosis greater than normal distribution. This aspect is transferred to the IGTD and produces robust parameter estimates for the IGTD.

Details

The IGTD has hf given by

$$h_T(t) = \frac{f_Z(a_t)\,\frac{\sqrt{\lambda}}{\sqrt{t^3}}}{F_Z(-a_t) - \int_{b_t}^{\infty} c\, g(u^2 - \frac{4\,\lambda}{\mu})\,\mathrm{d}u}.$$

Value

`hfig()` gives the hf of an IGTD.

Author(s)

Víctor Leiva <victor.leiva@uv.cl>, Hugo Hernández <hugo.hernandez@msn.com>, and Antonio Sanhueza <asanhue@ufro.cl>.

Examples

```
## Computes the hf of the IGTD with g="normal" for a vector x with mu=1, lambda=1 and g="normal"
## At the end we have the graph of the IGTD hf
x <- seq(0, 4,by=0.01)
hx <- hfig(x,mu=1.0,lambda=1.0,kernel="normal")
print(hx)
plot(x, hx, main = "Hazard function of the IGTD (classical case)", ylab="h(x)")
```

`histig` *Histogram, box-plot and estimated pdf of the IGTD*

Description

The function `histig()` produces a histogram and a a box-plot for the data. Also, the estimated pdf may be sketched on the histogram.

Usage

```
histig(x, main = "Histogram and boxplot", xlab = "Data", ylab = "Frequency",
pdf = "FALSE", kernel.pdf = "normal", col = NULL,
boxplot = "TRUE", col.pdf = 1, col.boxplot = 4)
```

Arguments

`x`	Vector of observations.
`main`	A title of histogram.
`xlab`	A title for the x axis.
`ylab`	A title for the x axis.
`pdf`	Logical; if TRUE, the pdf is sketched on the histogram, otherwise not.
`kernel.pdf`	Kernel of the pdf of the associated symmetrical distribution by means of which the IGTD is obtained. The kernels: `"Laplace"`, `"logistic"`, `"normal"` and `"t"` are available.
`col`	Color inside the histogram.
`boxplot`	Logical; if TRUE (default), the boxplot is plotted, otherwise not.
`col.pdf`	Color of the estimated pdf curve.
`col.boxplot`	Color inside the boxplot.

Details

The function `histig()` simultaneously produces a box-plot and a histogram for the data. The box-plot may be supressed by the instruction `boxplot=FALSE`. Also, the estimated pdf may be sketched on the histogram adding the instruction `pdf=TRUE`.

Value

The function `histig()` carries out an exploratory graphical analysis.

Author(s)

Víctor Leiva <victor.leiva@uv.cl>, Hugo Hernández <hugo.hernandez@msn.com>, and Antonio Sanhueza <asanhue@ufro.cl>.

`kappaII` *Transformation of the IGTD distribution*

Description

Compute the value of a tranformation of the IGT distribution.

Usage

```
kappaII(t = 1, theta = c(1, 1))
```

Arguments

`t`	Vector of observations.
`theta`	Vector of parameters of mu and lambda.

Value

`kappa()` compute the value of a tranformation of the IGT distribution.

Author(s)

Víctor Leiva <victor.leiva@uv.cl>, Hugo Hernández <hugo.hernandez@msn.com>, and Antonio Sanhueza <asanhue@ufro.cl>.

References

Sanhueza, A., Leiva, V. and Balakrishnan, N. (2007). A new class of inverse Gaussian type distributions. Metrika (in press).

`ksig` *Test of Kolmogorov-Smirnov for the inverse Gaussian type distribution*

Description

The function ksig gives the values for the KS test assuming an IGTD with parameters mu, lambda and an specific kernel. In addition, optionally, this function allows one to show a comparative graph between the empirical and theoretical cdfs for a given data set.

Usage

```
ksig(x, kernel = "normal", alternative = "two.sided", graph = TRUE, xlab = NULL, ylab = NULL
```

Arguments

`x`	Vector of observations.
`kernel`	Kernel of the pdf of the associated symmetrical distribution by means of which the IGTD is obtained. The kernels: `"Laplace"`, `"logistic"`, `"normal"` and `"t"` are available.
`alternative`	indicates the alternative hypothesis and must be one of `"two.sided"` (default), `"less"`, or `"greater"`.
`graph`	Logical; if TRUE (default), the cdf plot is provided.
`xlab`	A title for the x axis.
`ylab`	A title for the y axis.

Details

The Kolmogorov-Smirnov test is a goodness-of-fit technique based on the maximum distance between the empirical and theoretical cdfs.

Value

The function `ksig()` carries out the KS test for the IGTD.

Author(s)

Víctor Leiva <victor.leiva@uv.cl>, Hugo Hernández <hugo.hernandez@msn.com>, and Antonio Sanhueza <asanhue@ufro.cl>.

`ll` *Analitical first derivative with respect to lambda*

Description

Compute the first analitical derivative of the loglikelihood with respect to lambda.

Usage

```
ll(theta, x, kernel = "normal", nu = 1)
```

Arguments

`theta`	Vector of parameters `mu` and `lambda`.
`x`	Vector of observations.
`kernel`	Kernel of the pdf of the associated symmetrical distribution by means of which the IGTD is obtained.
`nu`	Additional parameter of the IGTD when the t kernel is used.

Author(s)

Víctor Leiva <victor.leiva@uv.cl>, Hugo Hernández <hugo.hernandez@msn.com>, and Antonio Sanhueza <asanhue@ufro.cl>.

References

Sanhueza, A., Leiva, V. and Balakrishnan, N. (2007). A new class of inverse Gaussian type distributions. Metrika (in press).

`lll` *Analitical second derivative with respect to lambda*

Description

Compute the second analitical derivative of the loglikelihood with respect to lambda.

Usage

```
lll(theta, x, kernel = "normal", nu = 1)
```

Arguments

`theta`	Vector of parameters `mu` and `lambda`.
`x`	Vector of observations.
`kernel`	Kernel of the pdf of the associated symmetrical distribution by means of which the IGTD is obtained.
`nu`	Additional parameter of the IGTD when the t kernel is used.

Author(s)

Víctor Leiva <victor.leiva@uv.cl>, Hugo Hernández <hugo.hernandez@msn.com>, and Antonio Sanhueza <asanhue@ufro.cl>.

References

Sanhueza, A., Leiva, V. and Balakrishnan, N. (2007). A new class of inverse Gaussian type distributions. Metrika (in press).

lml	*Analitical second derivative with respect to mu and lambda*

Description

Compute the second analitical derivative of the loglikelihood with respest to mu and lambda.

Usage

```
lml(theta, x, kernel = "normal", nu = 1)
```

Arguments

`theta`	Vector of parameters `mu` and `lambda`.
`x`	Vector of observations.
`kernel`	Kernel of the pdf of the associated symmetrical distribution by means of which the IGTD is obtained.
`nu`	Additional parameter of the IGTD when the t kernel is used.

Author(s)

Víctor Leiva <victor.leiva@uv.cl>, Hugo Hernández <hugo.hernandez@msn.com>, and Antonio Sanhueza <asanhue@ufro.cl>.

References

Sanhueza, A., Leiva, V. and Balakrishnan, N. (2007). A new class of inverse Gaussian type distributions. Metrika (in press).

lmm	*Analitical second derivative with respect to mu*

Description

Compute the second analitical derivative of the loglikelihood with respest to mu

Usage

```
lmm(theta, x, kernel = "normal", nu = 1.0)
```

Arguments

`theta`	Vector of parameters mu and lambda.
`x`	Vector of observations.
`kernel`	Kernel of the pdf of the associated symmetrical distribution by means of which the IGTD is obtained.
`nu`	Additional parameter of the IGTD when the t kernel is used.

Author(s)

Víctor Leiva <victor.leiva@uv.cl>, Hugo Hernández <hugo.hernandez@msn.com>, and Antonio Sanhueza <asanhue@ufro.cl>.

References

Sanhueza, A., Leiva, V. and Balakrishnan, N. (2007). A new class of inverse Gaussian type distributions. Metrika (in press).

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lmu — *Analitical first derivative with respect to mu*

Description

Compute the first analitical derivative of the loglikelihood with respest to mu.

Usage

```
lmu(theta, x, kernel = "normal", nu = 1.0)
```

Arguments

`theta`	Vector of parameters mu and lambda.
`x`	Vector of observations.
`kernel`	Kernel of the pdf of the associated symmetrical distribution by means of which the IGTD is obtained.
`nu`	Additional parameter of the IGTD when the t kernel is used.

Author(s)

Víctor Leiva <victor.leiva@uv.cl>, Hugo Hernández <hugo.hernandez@msn.com>, and Antonio Sanhueza <asanhue@ufro.cl>.

References

Sanhueza, A., Leiva, V. and Balakrishnan, N. (2007). A new class of inverse Gaussian type distributions. Metrika (in press).

`Loglikig` — *Loglikelihood function associated to the inverse Gaussian type distribution*

Description

Compute the loglikelihood function associated to the inverse Gaussian type distribution.

Usage

```
Loglikig(x, kernel = "normal", nu.fixed = 2)
```

Arguments

`x`	Vector of observations.
`kernel`	Kernel of the pdf of the associated symmetrical distribution by means of which the IGTD is obtained. The kernels: `"Laplace"`, `"logistic"`, `"normal"` and `"t"` are available.
`nu.fixed`	Additional parameter of the IGTD when the `t` kernel is used.

Author(s)

Víctor Leiva <victor.leiva@uv.cl>, Hugo Hernández <hugo.hernandez@msn.com>, and Antonio Sanhueza <asanhue@ufro.cl>.

References

Sanhueza, A., Leiva, V. and Balakrishnan, N. (2007). A new class of inverse Gaussian type distributions. Metrika (in press).

`mleig` — *Maximum likelihood estimation (MLE) of the inverse Gaussian type distribution*

Description

The function mleig estimates the parameters mu and lambda of the IGTD from a sample of observations. Also, the parameter nu is estimated when the t kernel is considered. In addition, the value for the log-likelihood function from a sample of the IGTD is given.

Usage

```
mleig(x, kernel = "normal")
```

Arguments

`x`	Vector of observations.
`kernel`	Kernel of the pdf of the associated symmetrical distribution by means of which the IGTD is obtained. The kernels: `"Laplace"`, `"logistic"`, `"normal"` and `"t"` are available.

Details

The used algorithm is based on a method proposed by Sanhueza, Leiva and Balakrishnan (2007), which uses a type-EM algorithm. The iterative procedure considers the estimates for mu and lambda of the classical IG case as initial values, which has a closed analytical form; see Chhikara and Folks (1989). The implemented method is a robust estimation procedure because for the classical IG case of the IGD, this gives equal weights for each case, independently of whether the value is in the tails or in the center of the distribution. However, for the IGT-t case, the method gives smaller weight to the extreme cases.

Value

`mleig()` estimate the parameters of the IGTD from a sample of observations.

Author(s)

Víctor Leiva <victor.leiva@uv.cl>, Hugo Hernández <hugo.hernandez@msn.com>, and Antonio Sanhueza <asanhue@ufro.cl>.

References

Chhikara, R. S., Folks, J. L. (1989). The Inverse Gaussian Distribution. Marcel Dekker, New York.

Sanhueza, A., Leiva, V., Balakrishnan, N. (2007). A new class of inverse Gaussian type distributions. Metrika (in press).

Examples

```
## Generates a sample from the IGTD
## Estimates the parameters of the IGTD with g="normal"
x<-rig(300,mu=1,lambda=1,kernel="normal")
mleig(x, kernel="normal")
```

`mleIGt` *Maximum Likelihood Estimators (MLE) of the parameters of the inverse Gaussian type distribution generated from the t kernel*

Description

Compute the MLE of the parameters of the inverse Gaussian type distribution generated from the t kernel.

Usage

```
mleIGt(x, nu.fixed = 2)
```

Arguments

`x`	Vector of observations.
`nu.fixed`	Parameter of the IGTD when the t kernel is used.

Author(s)

Víctor Leiva <victor.leiva@uv.cl>, Hugo Hernández <hugo.hernandez@msn.com>, and Antonio Sanhueza <asanhue@ufro.cl>.

References

Sanhueza, A., Leiva, V. and Balakrishnan, N. (2007). A new class of inverse Gaussian type distributions. Metrika (in press).

`mleIG` *Maximum Likelihood Estimators (MLE) of the parameters of the inverse Gaussian distribution*

Description

Compute the MLE of the parameters of the inverse Gaussian distribution.

Usage

```
mleIG(x)
```

Arguments

`x`	Vector of observations.

Author(s)

Víctor Leiva <victor.leiva@uv.cl>, Hugo Hernández <hugo.hernandez@msn.com>, and Antonio Sanhueza <asanhue@ufro.cl>.

References

Seshadri V. (1999). The inverse Gaussian distribution: statistical theory and applications. Springer. New York.

`pig` *Cumulative distribution function (cdf) of the inverse Gaussian type distribution*

Description

Cumulative distribution function for the IGDT with mean mu, scale parameter lambda and associated kernel g.

Usage

```
pig(q, mu = 1, lambda = 1, kernel = "normal", parameter.nu = 1,
    lower.tail = TRUE, log.p = FALSE)
```

Arguments

`q`	Vector of quantiles.
`mu`	Mean.
`lambda`	Scale parameter.
`kernel`	Kernel of the pdf of the associated symmetrical distribution by means of which the IGTD is obtained. The kernels: `"Laplace"`, `"logistic"`, `"normal"` and `"t"` are available.
`parameter.nu`	Additional parameter of the IGTD when the t kernel is used.
`lower.tail`	Logical; if TRUE (default), probabilities are P[X <= x], otherwise, P[X >x].
`log.p`	Logical; if TRUE, probabilities p are given as log(p).

Details

The IGTD has cdf given by

$$F_T(t) = F_Z(a_t) + \int_{b_t}^{\infty} c\, g(u^2 - \frac{4\,\lambda}{\mu})\mathrm{d}u,$$

where $b_t = \sqrt{\lambda/\mu}[\sqrt{t/\mu} + \sqrt{\mu/t}]$, μ is the mean, λ the scale parameter, g is the kernel of the pdf of the associated symmetrical distribution, c the normalization constant and $F_Z(\cdot)$ denotes the cdf of the associated symmetrical distribution.

Value

`pig()` gives the cdf of an IGTD.

Author(s)

Víctor Leiva <victor.leiva@uv.cl>, Hugo Hernández <hugo.hernandez@msn.com>, and Antonio Sanhueza <asanhue@ufro.cl>.

References

Sanhueza, A., Leiva, V. and Balakrishnan, N. (2007). A new class of inverse Gaussian type distributions. Metrika (in press).

Examples

```
## Compute the cdf for a vector q with mu=1, lambda=1 and g="normal"
## At the end we have the graph of the cdf of the IGTD with g="normal".
x <- seq(0, 4,by=0.01)
px <- pig(x,mu=1.0,lambda=1.0,kernel="normal")
print(px)
plot(x, px, main = "cdf of the IGTD (g='normal')", ylab="F(x)")
```

`ppig` *Probability versus probability (PP) plot for the IGTD*

Description

The function `ppig()` produces a PP plot for the IGTD based on their MLE. Also, a line going through the first and the third quartile can be sketched. In addition, the coefficient of determination of least squares for the fit line is given.

Usage

```
ppig(x, kernel = "normal", line = FALSE, xlab = "Empirical distribution function",
     ylab = "Theoretical distribution function")
```

Arguments

`x`	Vector of observations.
`kernel`	Kernel of the pdf of the associated symmetrical distribution by means of which the IGTD is obtained. The kernels: `"Laplace"`, `"logistic"`, `"normal"` and `"t"` are available.
`line`	Logical; if TRUE (default), a line going by the first and third quartile is sketched.
`xlab`	A title for the x axis.
`ylab`	A title for the y axis.

Value

The function `ppig()` carries out a PP plot for the IGTD.

Author(s)

Víctor Leiva <victor.leiva@uv.cl>, Hugo Hernández <hugo.hernandez@msn.com>, and Antonio Sanhueza <asanhue@ufro.cl>.

Examples

```
## Generates a sample from the IGTD
## Produces a PP plot for the IGTD with g="normal"
x<-rig(300,mu=1,lambda=1,kernel="normal")
ppig(x,kernel="normal", line=TRUE)
```

`precipitations` *Data set*

Description

Several data sets related to the IGTD are available in the ig package, which have been taken from the literature of this topic.

Usage

```
data(precipitations)
```

Format

A vector containing 25 observations.

Details

psi21, psi26 and psi31 were taken from Birnbaum and Saunders (1969), who reported fatigue life data correspond to the cycles ($\times 10^{-3}$) of aluminum specimens of type 6061-T6. These specimens were cut in a parallel angle to the direction of rotation and oscillating at 18 cycles per seconds. They were exposed to a pressure with maximum stress of 21,000, 26,000, and 31,000 psi (pounds per square inch), for $n = 101, 102$, and 101 specimens, respectively.

Other data set names are: repairtimes, shelflife, fracture, precipitations and runoff Chhikara and Folks (1989), which correspond to maintenance data on active repair times (in hours) for an airborne communications transceiver, shelflife (in days) of a food product, fracture toughnesses of MIG welds and precipitation (in inches) and runoff amounts at Jug Bridge, Maryland, respectively.

References

Chhikara, R. S. and Folks, J. L. (1989). The Inverse Gaussian Distribution. Marcel Dekker, New York.

psi21 *Data set*

Description

Several data sets related to the IGTD are available in the ig package, which have been taken from the literature of this topic.

Usage

```
data(psi21)
```

Format

A vector containing 101 observations.

Details

psi21, psi26 and psi31 were taken from Birnbaum and Saunders (1969), who reported fatigue life data correspond to the cycles ($\times 10^{-3}$) of aluminum specimens of type 6061-T6. These specimens were cut in a parallel angle to the direction of rotation and oscillating at 18 cycles per seconds. They were exposed to a pressure with maximum stress of 21,000, 26,000, and 31,000 psi (pounds per square inch), for $n = 101, 102$, and 101 specimens, respectively.

Other data set names are: repairtimes, shelflife, fracture, precipitations and runoff Chhikara and Folks (1989), which correspond to maintenance data on active repair times (in hours) for an airborne communications transceiver, shelflife (in days) of a food product, fracture toughnesses of MIG welds and precipitation (in inches) and runoff amounts at Jug Bridge, Maryland, respectively.

References

Chhikara, R. S. and Folks, J. L. (1989). The Inverse Gaussian Distribution. Marcel Dekker, New York.

psi26 *Data set*

Description

Several data sets related to the IGTD are available in the ig package, which have been taken from the literature of this topic.

Usage

```
data(psi26)
```

Format

A vector containing 102 observations.

Details

psi21, psi26 and psi31 were taken from Birnbaum and Saunders (1969), who reported fatigue life data correspond to the cycles ($\times 10^{-3}$) of aluminum specimens of type 6061-T6. These specimens were cut in a parallel angle to the direction of rotation and oscillating at 18 cycles per seconds. They were exposed to a pressure with maximum stress of 21,000, 26,000, and 31,000 psi (pounds per square inch), for $n = 101, 102$, and 101 specimens, respectively.

Other data set names are: repairtimes, shelflife, fracture, precipitations and runoff Chhikara and Folks (1989), which correspond to maintenance data on active repair times (in hours) for an airborne communications transceiver, shelflife (in days) of a food product, fracture toughnesses of MIG welds and precipitation (in inches) and runoff amounts at Jug Bridge, Maryland, respectively.

References

Chhikara, R. S. and Folks, J. L. (1989). The Inverse Gaussian Distribution. Marcel Dekker, New York.

`psi31` *Data set*

Description

Several data sets related to the IGTD are available in the ig package, which have been taken from the literature of this topic.

Usage

```
data(psi31)
```

Format

A vector containing 101 observations.

Details

psi21, psi26 and psi31 were taken from Birnbaum and Saunders (1969), who reported fatigue life data correspond to the cycles ($\times 10^{-3}$) of aluminum specimens of type 6061-T6. These specimens were cut in a parallel angle to the direction of rotation and oscillating at 18 cycles per seconds. They were exposed to a pressure with maximum stress of 21,000, 26,000, and 31,000 psi (pounds per square inch), for $n = 101, 102$, and 101 specimens, respectively.

Other data set names are: repairtimes, shelflife, fracture, precipitations and runoff Chhikara and Folks (1989), which correspond to maintenance data on active repair times (in hours) for an airborne communications transceiver, shelflife (in days) of a food product, fracture toughnesses of MIG welds and precipitation (in inches) and runoff amounts at Jug Bridge, Maryland, respectively.

References

Chhikara, R. S. and Folks, J. L. (1989). The Inverse Gaussian Distribution. Marcel Dekker, New York.

---

qig *Quantile function (qf) of the inverse Gaussian type distribution*

Description

Quantile function for the IGDT with mean mu, scale parameter lambda and associated kernel g.

Usage

```
qig(p, mu = 1, lambda = 1, kernel = "normal", parameter.nu = 1,
    lower.tail = TRUE, log.p = FALSE)
```

Arguments

`p`	Vector of quantiles.
`mu`	Mean.
`lambda`	Scale parameter.
`kernel`	Kernel of the pdf of the associated symmetrical distribution by means of which the IGTD is obtained. The kernels: `"Laplace"`, `"logistic"`, `"normal"` and `"t"` are available.
`parameter.nu`	Additional parameter of the IGTD when the t kernel is used.
`lower.tail`	Logical; if TRUE (default), probabilities are P[X <= x], otherwise, P[X >x].
`log.p`	Logical; if TRUE, probabilities pr are given as log(pr).

Details

Unfortunately, it is not possible to find the qf of the IGTD in a closed analytical form, so these values must be obtained by numerical methods.

Value

`qig()` gives the qf of an IGTD.

Author(s)

Víctor Leiva <victor.leiva@uv.cl>, Hugo Hernández <hugo.hernandez@msn.com>, and Antonio Sanhueza <asanhue@ufro.cl>.

References

Sanhueza, A., Leiva, V. and Balakrishnan, N. (2007). A new class of inverse Gaussian type distributions. Metrika (in press).

Examples

```
## Compute the 50
## of the IGT with mu=1, lambda=1 and kernel="normal"
x <- 0.5
q <- qig(0.5,mu=1.0,lambda=1.0,kernel="normal")
q
```

`qqig` *Quantile versus quantile (QQ) plot for the the IGTD*

Description

The function qqig produces a QQ plot for the IGTD based on the MLE of their parameters. Also, a line going through the first and the third quartile can be sketched. In addition, the coefficient of determination of least squares for the fit line is given.

Usage

```
qqig(x, kernel = "normal", line = FALSE, xlab = "Empirical quantiles",
     ylab = "Theoretical quantiles")
```

Arguments

`x`	Vector of observations.
`kernel`	Kernel of the pdf of the associated symmetrical distribution by means of which the IGTD is obtained. The kernels: `"Laplace"`, `"logistic"`, `"normal"` and `"t"` are available.
`line`	Logical; if TRUE (default), a line going by the first and third quartile is sketched.
`xlab`	A title for the x axis.
`ylab`	A title for the y axis.

Value

The function `qqig()` carries out a QQ plot for the IGTD.

Author(s)

Víctor Leiva <victor.leiva@uv.cl>, Hugo Hernández <hugo.hernandez@msn.com>, and Antonio Sanhueza <asanhue@ufro.cl>.

Examples

```
## Generates a sample from the IGTD
## Produces a QQ plot for the IGTD with g="normal"
x<-rig(300,mu=1,lambda=1,kernel="normal")
qqig(x, kernel="normal", line=TRUE)
```

`RCig` *Relative change on the MLE of the IGTD*

Description

The function RCig computes the relative change (RC) on the MLE when some observations are removed in order to evaluate the effect of their potential influence.

Usage

```
RCig(x, cases.removed = NULL, kernel = "normal")
```

Arguments

`x`	Vector of observations.
`cases.removed`	Index of the potentially influential case(s) that must be removed.
`kernel`	Kernel of the pdf of the associated symmetrical distribution by means of which the IGTD is obtained. The kernels: `"Laplace"`, `"logistic"`, `"normal"` and `"t"` are available.

Details

This function computes the relative changes (RC), in percentage, of each estimated parameter, defined by $\mathrm{RC}_{\theta_j} = |(\hat{\theta}_j - \hat{\theta}_{j(\mathrm{I})})/\hat{\theta}_j| \times 100\,\%$, where $\hat{\theta}_{j(\mathrm{I})}$ denotes the MLE of θ_j after the set I of cases has been removed.

Value

`RCig()` gives the RC on the MLE of the parameters of the IGTD from a sample of observations without to consider some potentially influential case(s) related to the MLE of the complete sample.

Author(s)

Víctor Leiva <victor.leiva@uv.cl>, Hugo Hernández <hugo.hernandez@msn.com>, and Antonio Sanhueza <asanhue@ufro.cl>.

References

Sanhueza, A., Leiva, V. and Balakrishnan, N. (2007). A new class of inverse Gaussian type distributions. Metrika (in press).

Examples

```
## Generates a sample from the IGTD
## Computes the RC the MLE of the parameters of the IGTD with g="normal" when the
##  case 1 has been removed
x<-rig(300,mu=1,lambda=1,kernel="normal")
RCig(x,cases.removed=c(1),kernel="normal")
```

`repairtimes` *Data set*

Description

Several data sets related to the IGTD are available in the ig package, which have been taken from the literature of this topic.

Usage

```
data(repairtimes)
```

Format

A vector containing 46 observations.

Details

psi21, psi26 and psi31 were taken from Birnbaum and Saunders (1969), who reported fatigue life data correspond to the cycles ($\times 10^{-3}$) of aluminum specimens of type 6061-T6. These specimens were cut in a parallel angle to the direction of rotation and oscillating at 18 cycles per seconds. They were exposed to a pressure with maximum stress of 21,000, 26,000, and 31,000 psi (pounds per square inch), for $n = 101, 102$, and 101 specimens, respectively.

Other data set names are: repairtimes, shelflife, fracture, precipitations and runoff Chhikara and Folks (1989), which correspond to maintenance data on active repair times (in hours) for an airborne communications transceiver, shelflife (in days) of a food product, fracture toughnesses of MIG welds and precipitation (in inches) and runoff amounts at Jug Bridge, Maryland, respectively.

References

Chhikara, R. S. and Folks, J. L. (1989) The Inverse Gaussian Distribution. Marcel Dekker, New York.

Description

Generate random numbers from the IGTD with mean mu, scale parameter lambda and associated kernel g.

Usage

```
rig(n, mu = 1, lambda = 1, kernel = "normal", parameter.nu = 1)
```

Arguments

`n`	Number of observations.
`mu`	Mean.
`lambda`	Scale parameter.
`kernel`	Kernel of the pdf of the associated symmetrical distribution by means of which the IGTD is obtained. The kernels: `"Laplace"`, `"logistic"`, `"normal"` and `"t"` are available.
`parameter.nu`	Additional parameter of the IGTD when the t kernel is used.

Details

Statistical inference tools may not exist in closed form for the IGTD, which is not the case for the classical IGD. Hence, simulation and numerical studies are needed, which require a random number (r.n) generator. Next, we present a r.n. generator for the IGTD following a similar procedure to the one given in Chhikara and Folks (1989, pp. 52-53) for the classical inverse Gaussian distribution.

Value

`rig()` gives a vector of n random numbers from the IGTD for mu, lambda and kernel specified.

Author(s)

Víctor Leiva <victor.leiva@uv.cl>, Hugo Hernández <hugo.hernandez@msn.com>, and Antonio Sanhueza <asanhue@ufro.cl>.

References

Chhikara, R. S. and Folks, J. L. (1989). The Inverse Gaussian Distribution. Marcel Dekker, New York.

Examples

```
## Generate a sample x from the IGTD. At the end we have the histogram of x
x <- rig(1000,mu=1.0,lambda=1.0,kernel="normal")
hist(x, main="Histogram of a sample from IGTD")
```

`runoff` *Data set*

Description

Several data sets related to the IGTD are available in the ig package, which have been taken from the literature of this topic.

Usage

```
data(runoff)
```

Format

A vector containing 25 observations.

Details

psi21, psi26 and psi31 were taken from Birnbaum and Saunders (1969), who reported fatigue life data correspond to the cycles ($\times 10^{-3}$) of aluminum specimens of type 6061-T6. These specimens were cut in a parallel angle to the direction of rotation and oscillating at 18 cycles per seconds. They were exposed to a pressure with maximum stress of 21,000, 26,000, and 31,000 psi (pounds per square inch), for $n = 101, 102$, and 101 specimens, respectively.

Other data set names are:repairtimes, shelflife, fracture, precipitations and runoff Chhikara and Folks (1989), which correspond to maintenance data on active repair times (in hours) for an airborne communications transceiver, shelflife (in days) of a food product, fracture toughnesses of MIG welds and precipitation (in inches) and runoff amounts at Jug Bridge, Maryland, respectively.

References

Chhikara, R. S. and Folks, J. L. (1989). The Inverse Gaussian Distribution. Marcel Dekker, New York.

search.mode	*Function for obtaining the empirical mode of the data*

Description

Function for obtaining the empirical mode of the data.

Usage

```
search.mode(x)
```

Arguments

x	Vector of observations.

Author(s)

Víctor Leiva <victor.leiva@uv.cl>, Hugo Hernández <hugo.hernandez@msn.com>, and Antonio Sanhueza <asanhue@ufro.cl>.

sfig	*Survival function (sf) of the inverse Gaussian type distribution*

Description

Survival function for the IGTD with mean parameter mu, scale parameter lambda and associated kernel g.

Usage

```
sfig(t, mu = 1, lambda = 1, kernel = "normal", parameter.nu = 1)
```

Arguments

t	Vector of quantiles.
mu	Mean.
lambda	Scale parameter.
kernel	Kernel of the pdf of the associated symmetrical distribution by means of which the IGTD is obtained. The kernels: `"Laplace"`, `"logistic"`, `"normal"` and `"t"` are available.
parameter.nu	Additional parameter of the IGTD when the t kernel is used. This parameter corresponds to a shape parameter and it is also known as `"degree of freedom"`. For default `nu=1`, in which case the Cauchy distribution is obtained. The Student-t distribution has always degrees of kurtosis greater than normal distribution. This aspect is transferred to the IGTD and produces robust parameter estimates for the IGTD.

Details

The IGTD has sf given by

$$S_T(t) = F_Z(-a_t) - \int_{b_t}^{\infty} c\, g(u^2 - \frac{4\,\lambda}{\mu})\; \mathrm{d}u;\; t > 0.$$

Value

`sfig()` gives the sf of an IGTD.

Author(s)

Víctor Leiva <victor.leiva@uv.cl>, Hugo Hernández <hugo.hernandez@msn.com>, and Antonio Sanhueza <asanhue@ufro.cl>.

Examples

```
## Compute the sf of the IGTD with g="normal" for a vector x with mu=1, lambda=1
## At the end we have the graph of the IGTD sf
x <- seq(0, 4,by=0.01)
sx <- sfig(x,mu=1.0,lambda=1.0,kernel="normal")
print(sx)
plot(x, sx, main = "Survival of the IGTD (classical case)", ylab="S(x)")
```

`shelflife` *Data set*

Description

Several data sets related to the IGTD are available in the ig package, which have been taken from the literature of this topic.

Usage

```
data(shelflife)
```

Format

A vector containing 26 observations.

Details

psi21, psi26 and psi31 were taken from Birnbaum and Saunders (1969), who reported fatigue life data correspond to the cycles ($\times 10^{-3}$) of aluminum specimens of type 6061-T6. These specimens were cut in a parallel angle to the direction of rotation and oscillating at 18 cycles per seconds. They were exposed to a pressure with maximum stress of 21,000, 26,000, and 31,000 psi (pounds per square inch), for $n = 101, 102$, and 101 specimens, respectively.

Other data set names are: repairtimes, shelflife, fracture, precipitations and runoff Chhikara and Folks (1989), which correspond to maintenance data on active repair times (in hours) for an airborne communications transceiver, shelflife (in days) of a food product, fracture toughnesses of MIG welds and precipitation (in inches) and runoff amounts at Jug Bridge, Maryland, respectively.

References

Chhikara, R. S. and Folks, J. L. (1989). The Inverse Gaussian Distribution. Marcel Dekker, New York.

`sicig` *Schwartz information criterium (SIC) for a sample of the IGTD*

Description

The function `sicig()` gives the SIC value assuming an IGTD with parameters mu, lambda and a specific kernel.

Usage

```
sicig(x, kernel = "normal", nu.fixed = 2)
```

Arguments

`x`	Vector of observations.
`kernel`	Kernel of the pdf of the associated symmetrical distribution by means of which the IGTD is obtained. The kernels: `"Laplace"`, `"logistic"`, `"normal"` and `"t"` are available.
`nu.fixed`	Additional parameter of the IGTD when the t kernel is used. This parameter corresponds to a shape parameter and it is also known as `"degree of freedom"`. For default `nu=1`, in which case the Cauchy distribution is obtained. The Student-t distribution has always degrees of kurtosis greater than normal distribution. This aspect is transferred to the IGTD and produces robust parameter estimates for the IGTD.

Details

The SIC is a selection model criterion based on information loss. According to this criterion, it is possible to choice a hypothetic model that better describe the data set considering the smaller SIC value. The SIC is defined as $SIC = -l(\theta)/n + p\log(n)/(2n)$, where $l(\theta)$ is the log-likelihood function associated with the model, n is the sample size, and p is the number of involved parameters; for more details see Spieglhaiter, Best, Carlin and van der Linde (2002).

Author(s)

Víctor Leiva <victor.leiva@uv.cl>, Hugo Hernández <hugo.hernandez@msn.com>, and Antonio Sanhueza <asanhue@ufro.cl>.

References

Spieglhaiter, D. J., Best, N. G., Carlin, B. P., van der Linde, A. (2002). Bayesian measures of complexity and fit. Journal of the Royal Statistical Society Series B 64, 1-34.

`wg`	*Weights in the likelihood fucntion of the inverse Gaussian type distribution*

Description

Compute the weights in the likelihood fucntion of the inverse Gaussian type distribution given by: $w = g'(u)/g(u)$, where g is the kernel of the pdf of the symmetrical distribution.

Usage

```
wg(u, kernel, nu = 1)
```

Arguments

`u`	Vector of values.
`kernel`	Kernel of the pdf of the associated symmetrical distribution by means of which the IGTD is obtained.
`nu`	Additional parameter of the IGTD when the `t` kernel is used.

Author(s)

Víctor Leiva <victor.leiva@uv.cl>, Hugo Hernández <hugo.hernandez@msn.com>, and Antonio Sanhueza <asanhue@ufro.cl>.

References

Sanhueza, A., Leiva, V. and Balakrishnan, N. (2007). A new class of inverse Gaussian type distributions. Metrika (in press).

`wgp`	*Derivative of the weights in the likelihood fucntion of the inverse Gaussian type distribution*

Description

Compute the derivative of the weights in the likelihood fucntion of the inverse Gaussian type distribution.

Usage

```
wgp(u, kernel, nu = 1)
```

Arguments

`u`	Vector of values.
`kernel`	Kernel of the pdf of the associated symmetrical distribution by means of which the IGTD is obtained.
`nu`	Additional parameter of the IGTD when the `t` kernel is used.

Author(s)

Víctor Leiva <victor.leiva@uv.cl>, Hugo Hernández <hugo.hernandez@msn.com>, and Antonio Sanhueza <asanhue@ufro.cl>.

References

Sanhueza, A., Leiva, V. and Balakrishnan, N. (2007). A new class of inverse Gaussian type distributions. Metrika (in press).