Package ‘LambertW’

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Type Package

Title Lambert W parameter estimation, plots, simulation (Skew Analysis)

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Description Lambert W random variables (RV) offer a new way of dealing with slightly skewed data. It is based on an input/ouput framework - for details see References. This package contains the most important functions to perform an adequate analysis. Lambert W data can be simulated, parameters estimated and results can be plotted in a proper way.

Depends moments, gsl, MASS, maxLik, nortest

License GPL (>= 2)

LazyLoad yes

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R topics documented:

`LambertW-package` *Lambert W Random Variables*

Description

Lambert W random variables (RV) offer a new way of dealing with slightly skewed data. It is based on an input/ouput framework - for details see References. This package contains the most important functions to perform an adequate analysis. Lambert W data can be simulated, parameters estimated and results can be plotted in a proper way. Quantile functions allow a more realistic analysis and inference of skewed data.

Details

Package:	LambertW
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License:	GPL-2
LazyLoad:	yes

Author(s)

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Maintainer: Georg M. Goerg <e0225792@student.tuwien.ac.at>

References

Goerg, G.M. (2009). “Lambert W Random Variables - A new class of skewed distribution functions”. Unpublished

Examples

```
data(AA)
attach(AA)
X=AA[AA$sex=="f",]
y=X$bmi

op=par(no.readonly=TRUE)
par(mfrow=c(2,1), mar=c(2,4,3,1))
plot(y)
hist(y, prob=TRUE, 15)
lines(density(y))
par(op)

fit.gmm=IGMM(y)
summary(fit.gmm) # Delta is significant and positive
plot(fit.gmm)
# Comparison of Theoretical and Empirical Moments
mom.LambertW.X.Gauss(fit.gmm$theta)
rbind(mean(y), sd(y), skewness(y), kurtosis(y))

x=get.input(y, fit.gmm$theta)$x
normfit(x)

plot(fit.gmm)
fit.ml=MLE_LambertW(y)
summary(fit.ml)
plot(fit.ml)
```

`AA` *Australian athletes data set*

Description

These data were collected in a study of how data on various characteristics of the blood varied with sport body size and sex of the athlete. Equivalent to the `ais` dataset in the DAAG package.

Usage

```
data(AA)
```

Format

A data frame with 202 observations on the following 13 variables.

rcc red blood cell count, in $10^{12} l^{-1}$

wcc while blood cell count, in 10^{12} per liter

hc hematocrit, percent

hg hemaglobin concentration, in g per decaliter

ferr plasma ferritins, ng dl^{-1}

bmi Body mass index, kg $cm^{-2} 10^2$

ssf sum of skin folds

pcBfat percent Body fat

lbm lean body mass, kg

ht height, cm

wt weight, kg

sex a factor with levels `f` `m`

sport a factor with levels `B_Ball` `Field` `Gym` `Netball` `Row` `Swim` `T_400m` `T_Sprnt` `Tennis` `W_Polo`

Details

Do blood hemoglobin concentrations of athletes in endurance-related events differ from those in power-related events?

Source

These data were the basis for the analyses that are reported in Telford and Cunningham (1991).

References

Telford, R.D. and Cunningham, R.B. 1991. Sex, sport and body-size dependency of hematology in highly trained athletes. Medicine and Science in Sports and Exercise 23: 788-794.

Examples

```
data(AA)
attach(AA)
X=AA[AA$sex=="f",]
y=X$bmi

op=par(no.readonly=TRUE)
par(mfrow=c(2,1), mar=c(2,4,3,1))
plot(y)
```

```
hist(y, prob=TRUE, 15)
lines(density(y))
par(op)

fit.gmm=IGMM(y)
summary(fit.gmm) # Delta is significant and positive
plot(fit.gmm)
# Comparison of Theoretical and Empirical Moments
mom.LambertW.X.Gauss(fit.gmm$theta)
rbind(mean(y), sd(y), skewness(y), kurtosis(y))

x=get.input(y, fit.gmm$theta)$x

op=par(no.readonly=TRUE)
par(mfrow=c(2,1), mar=c(2,4,3,1))
plot(x)
hist(x, prob=TRUE, 15)
lines(density(x))
par(op)

plot(fit.gmm)
```

`d1W` *First derivative of W (principal branch)*

Description

Computes the first derivative of the Lambert W function (principal branch).

Usage

```
d1W(z)
```

Arguments

`z`	value `z` where the derivative shall be computed

Value

Derivative of $W_0(.)$ evaluated at z.

Author(s)

Georg M. Goerg

References

Goerg, G.M. (2009). "Lambert W Random Variables - A new class of skewed distribution functions". Unpublished

`d1W_1`	*First derivative of W (non-principal branch)*

Description

Computes the first derivative of the Lambert W function (principal branch).

Usage

```
d1W_1(z)
```

Arguments

`z`	value `z` where the derivative shall be computed

Value

Derivative of $W_1(.)$ evaluated at z.

Author(s)

Georg M. Goerg

References

Goerg, G.M. (2009). "Lambert W Random Variables - A new class of skewed distribution functions". Unpublished

`delta.01`	*Calculate delta for zero mean, unit variance output*

Description

This function calculates the input mean and standard deviation given δ such that the resulting Lambert W Gaussian RV has zero mean, and unit variance. This is useful for generating, e.g. a standardized white noise sequence.

Usage

```
delta.01(delta)
```

Arguments

`delta`	skewness parameter `delta`

Value

`M`	mean of X
`S`	standard deviation of X

Author(s)

Georg M. Goerg

References

Goerg, G.M. (2009). “Lambert W Random Variables - A new class of skewed distribution functions”. Unpublished

Examples

```
delta.01(0) # for delta = 0 it holds input == output, therefore M =0, S=1
delta.01(0.1)
```

`delta.GMM` *GMM estimation of delta only*

Description

Given μ_x and σ_x, this function computes such a δ that the sample skewness of the back transformed data equals the theoretical one gamma(X). In particular, for Gaussian and student-t input gamma(X) = 0 (default value), so `delta.GMM` finds this delta that "symmetrizes" some given data `y`.

A robust measure of the skewness is possible via the MedCouple estimator.

Usage

```
delta.GMM(y, robust = FALSE, c = mean(y), s = sqrt(var(y)), gamma_x = 0)
```

Arguments

`y`	data
`robust`	Should the skewness be measured in a robust way? `robust=TRUE/FALSE`; default is `FALSE`
`c`	the value that centers `y`; default value is the sample mean of `y`
`s`	standardizing constant for `y-c`; default value is the sample standard deviation of `y`
`gamma_x`	theoretical skewness. default value `gamma_x = 0`

Value

Parameter vector theta, where μ_x and σ_x equal simply the sample moments of the back transformed data.

Author(s)

Georg M. Goerg

References

Goerg, G.M. (2009). “Lambert W Random Variables - A new class of skewed distribution functions”. Unpublished

See Also

`mc` for a robust measure of skewness

`delta.test` *Test for significance of delta*

Description

Given the simulated critical values for the GMM method and for delta=0 (see Goerg (2009)), this function performs a test on the significance an estimated delta.

Usage

```
delta.test(object)
```

Arguments

`object`	object of class `LWest`

Details

If the data is truly Gaussian – hence true $\delta = 0$ – then

$$\frac{\widehat{\delta}\sqrt{N}}{0.4} \sim N(0, 1),$$

where N is the sample size, and $\widehat{\delta}$ is the estimated delta via GMM.

Value

A list with class "htest" containing the following components:

`statistic`	the value of the test statistic.
`p.value`	the p-value for the test.
`method`	the character string "Simulation based GMM significanc test (Asymptotic Gaussian)"
`data.name`	a character string giving the name(s) of the data.

Author(s)

Georg M. Goerg

References

Goerg, G.M. (2009). “Lambert W Random Variables - A new class of skewed distribution functions”. Unpublished

Examples

```
set.seed(1)
y=rnorm(1000)
fit=IGMM(y)
delta.test(fit) # not-significant because data is truly Gaussian

data(AA)
attach(AA)
X=AA[AA$sex=="f",]
y=X$bmi

fit=IGMM(y)
delta.test(fit) ### Significant delta as the data is highly skewed to the right
```

---

dLambertW *Probability Density Function*

Description

Computes the probability density of Y for Gaussian and student-t input.

Usage

```
dLambertW(y, theta = c(0, 0, 1), distname = c("normal"))
```

Arguments

y	value
theta	parameter vector
distname	input distribution

Value

Value of the ddf at y.

Author(s)

Georg M. Goerg

References

Goerg, G.M. (2009). "Lambert W Random Variables - A new class of skewed distribution functions". Unpublished

Examples

```
theta.s=c(0.1,0,1)

aux.lambert=function(y){
dLambertW(y, theta=theta.s)
}

support(theta.s)

plot(aux.lambert, -3.5,3.5, ylab="Probability")
plot(dnorm, -3.5,3.5, add=TRUE, lty=2)
legend("topleft" , c("Lambert W - Gaussian" , "Gaussian"), lty=1:2)

#############
data(AA)
attach(AA)
X=AA[AA$sex=="f",]
y=X$bmi

fit.gmm=IGMM(y)
summary(fit.gmm) # Delta is significant and positive
plot(fit.gmm)
```

---

get.input *Back-transform Y to X*

Description

Given the data y and theta, this function calculates the back transformed data x_{delta}.

Usage

```
get.input(y, theta)
```

Arguments

y	data
theta	parameter vector

Value

u	Centered and normalized data u
x	Original input data x

Author(s)

Georg M. Goerg

References

Goerg, G.M. (2009). “Lambert W Random Variables - A new class of skewed distribution functions”. Unpublished

Examples

```
y=rLambertW(n=1000, c(0.1,0,1))
fit.gmm=IGMM(y)
summary(fit.gmm)

x=get.input(y, fit.gmm$theta)$x
plot(x)
normfit(x)
```

`H` *Underlying transformation H*

Description

The Lambert W function is the inverse of this function.

Usage

```
H(u)
```

Arguments

`u`	value in R

Value

Returns the value z = u exp(u).

Author(s)

Georg M. Goerg

References

Goerg, G.M. (2009). “Lambert W Random Variables - A new class of skewed distribution functions”. Unpublished

`H_delta` *Transformation with delta*

Description

Function of the underlying transformation for Lambert W RV.

Usage

```
H_delta(u, delta)
```

Arguments

`u`	value in R
`delta`	skewness parameter

Value

Returns z = u exp(delta * u).

Author(s)

Georg M. Goerg

References

Goerg, G.M. (2009). "Lambert W Random Variables - A new class of skewed distribution functions". Unpublished

`IGMM` *Iterative Generalized Method of Moments – IGMM*

Description

Computes via iterations this value of theta that generates input data x, as close as possible to the theoretical X. Implementation of the Algorithm described in Goerg (2009).

Usage

```
IGMM(y, robust = FALSE, tol = 10^(-6), gamma_x = 0)
```

Arguments

`y`	data
`robust`	Should the skewness be measured in a robust way (see `mc`)? default `FALSE`
`tol`	tolerance level for stopping of iterations (conversion reached)
`gamma_x`	Theoretical skewness of input X; by default 0

Value

`theta`	optimal theta
`iterations`	number of iterations
`call`	function call

Author(s)

Georg M. Goerg

References

Goerg, G.M. (2009). “Lambert W Random Variables - A new class of skewed distribution functions”. Unpublished

Examples

```
x=rnorm(1000)
fit=IGMM(x)
summary(fit)

y=rLambertW(n=1000, c(0.1, 2,1))
fity=IGMM(y)
summary(fity)
plot(fity)
```

`IGMM.default` *Iterative Generalized Method of Moments (IGMM)*

Description

Computes via iterations this value of theta that generates input data x, as close as possible to the theoretical X. Implementation of the Algorithm described in Goerg (2009).

Usage

```
## Default S3 method:
IGMM(y, robust = FALSE, tol = 10^(-6), gamma_x = 0)
```

Arguments

`y`	data
`robust`	Should the skewness be measured in a robust way (see `mc`)? default `FALSE`
`tol`	tolerance level for stopping of iterations (conversion reached)
`gamma_x`	Theoretical skewness of input X; by default 0

Value

`theta`	optimal theta
`iterations`	number of iterations
`call`	function call

Author(s)

Georg M. Goerg

References

Goerg, G.M. (2009). "Lambert W Random Variables - A new class of skewed distribution functions". Unpublished

Examples

```
x=rnorm(1000)
fit=IGMM(x)
summary(fit)

y=rLambertW(n=1000, c(0.1, 2,1))
fity=IGMM(y)
summary(fity)
plot(fity)
```

`KS.test.t` *One-sided Kolmogorov - Smirnov test for student-t distribution*

Description

Performs a one-sided KS test if data is student-t with nu degrees of freedom, mean mu_x, and stand. dev. $sigma_x$. If these parameters are not specified, the MLE estimates for the data are used (see `fitdistr`).

Usage

```
KS.test.t(y, theta = NULL)
```

Arguments

`y`	data
`theta`	theta incl. df parameter nu

Value

A list with class "htest" containing the following components:

`statistic`	the value of the Kolomogorv-Smirnov statistic.
`p.value`	the p-value for the test.
`method`	the character string "One-sample Kolmogorov-Smirnov test student-t" plus rounded parameter values.
`data.name`	a character string giving the name(s) of the data.

Author(s)

Georg M. Goerg

References

Goerg, G.M. (2009). "Lambert W Random Variables - A new class of skewed distribution functions". Unpublished

See Also

`fitdistr`, `ks.test`

`mc` *MedCouple Estimator*

Description

Robust measure of skewness.

Usage

```
mc(x)
```

Arguments

`x`	data

Value

A robust measure of skewness. Details see references.

Author(s)

Georg M. Goerg

References

Brys, G., M. Hubert, and A. Struyf (2004). “A robust measure of skewness”. Journal of Computational and Graphical Statistics 13 (4), 996 - 1017.

Examples

```
x=rnorm(100)
mc(x)
y=rLambertW(n=100, theta=c(0.4,1,2))
mc(y)
```

`MLE_LambertW` *Maximum Likelihood Estimation*

Description

MLE of Lambert W RV for Gaussian and student-t input.

Usage

```
MLE_LambertW(y, distname = c("normal"), theta.0 = IGMM(y)$theta)
```

Arguments

`y`	data
`distname`	input distribution. By defaul `"normal"`. Alternative `"t"`
`theta.0`	Starting value for numerical optimization. By default the GMM estimate.

Value

An object of class `LWest`

`data`	the data
`theta.0`	initial value
`theta`	MLE for theta
`logLH`	log-likelihood function (argument for the `summary` function to calculate the Hessian numerically)
`call`	function call
`message`	message from the optimization method. What kind of convergence?
`distname`	input distribution
`method`	Estimation method. Here "MLE"

Author(s)

Georg M. Goerg

References

Goerg, G.M. (2009). "Lambert W Random Variables - A new class of skewed distribution functions". Unpublished

Examples

```
data(AA)
attach(AA)

X=AA[AA$sex=="f",]
y=X$bmi

fit.ml=MLE_LambertW(y)
summary(fit.ml)
plot(fit.ml)
```

MLE_LambertW.default — *Maximum Likelihood Estimation*

Description

MLE of Lambert W RV for Gaussian and student-t input.

Usage

```
## Default S3 method:
MLE_LambertW(y, distname = c("normal"), theta.0 = IGMM(y)$theta)
```

Arguments

`y`	data
`distname`	input distribution. By defaul `"normal"`. Alternative `"t"`
`theta.0`	Starting value for numerical optimization. By default the GMM estimate.

Value

An object of class `LWest`

`data`	the data
`theta.0`	initial value
`theta`	MLE for theta
`logLH`	log-likelihood function (argument for the `summary` function to calculate the Hessian numerically)
`call`	function call
`message`	message from the optimization method. What kind of convergence?
`distname`	input distribution
`method`	Estimation method. Here "MLE"

Author(s)

Georg M. Goerg

References

Goerg, G.M. (2009). "Lambert W Random Variables - A new class of skewed distribution functions". Unpublished

Examples

```
data(AA)
attach(AA)

X=AA[AA$sex=="f",]
y=X$bmi

fit.ml=MLE_LambertW(y)
summary(fit.ml)
plot(fit.ml)
```

---

mom.LambertW.U.Gauss   *Moments of Z for Standard Gaussian Input*

Description

Given delta, computes the first 4 moments of Z for standard Gaussian input U.

Usage

```
mom.LambertW.U.Gauss(delta)
```

Arguments

`delta`	skewness parameter

Value

First four moments of Z

`mu_z`	mean
`sigma_z`	stand. dev.
`skew`	Pearson skewness
`kurt`	Pearson kurtosis

Author(s)

Georg M. Goerg

References

Goerg, G.M. (2009). "Lambert W Random Variables - A new class of skewed distribution functions". Unpublished

---

mom.LambertW.X.Gauss

Moments of Y for Gaussian Input

Description

Computes the first 4 moments of Y given theta and Gaussian input

Usage

```
mom.LambertW.X.Gauss(theta)
```

Arguments

theta	parameter vector

Value

First four moments of Y

mu_y	mean
sigma_y	stand. dev.
skew	Pearson skewness
kurt	Pearson kurtosis

Author(s)

Georg M. Goerg

References

Goerg, G.M. (2009). "Lambert W Random Variables - A new class of skewed distribution functions". Unpublished

Examples

```
data(AA)
attach(AA)
X=AA[AA$sex=="f",]
y=X$bmi

fit.gmm=IGMM(y)
summary(fit.gmm) # Delta is significant and positive
plot(fit.gmm)
```

```
# Comparison of Theoretical and Empirical Moments
mom.LambertW.X.Gauss(fit.gmm$theta)
rbind(mean(y), sd(y), skewness(y), kurtosis(y))
```

---

normfit *Graphical and stastical Gaussianity check*

Description

Performs a check whether data is Gaussian or not. Graphical and statistical inference.

Usage

```
normfit(data, volatility = FALSE, plot.it = TRUE)
```

Arguments

`data`	data
`volatility`	Should the squared data and its autocorrelation be plotted. Useful for financial data to see if squares exhibit dependence (typically they do for asset returns)
`plot.it`	Should graphical inference be plotted (histogram, densities, qqplot, ...); default `TRUE`

Value

Three results of normality tests are returned (each of class `htest`)

`ad`	Anderson Darling
`sw`	Shapiro-Wilk
`sf`	Shapiro-Francia

Author(s)

Georg M. Goerg

References

Goerg, G.M. (2009). "Lambert W Random Variables - A new class of skewed distribution functions". Unpublished

Thode Jr., H.C. (2002): "Testing for Normality". Marcel Dekker, New York.

Examples

```
y=rLambertW(200, theta=c(0.1, 0, 1))
normfit(y)

fit=IGMM(y)
summary(fit)

fit1=MLE_LambertW(y)
plot(fit1)
x.d=get.input(y, fit1$theta)$x

normfit(y)
x11()
normfit(x.d)
```

---

pLambertW *Cumulative Distribution Function*

Description

Cumulative distribution function (cdf) for Lambert W RV.

Usage

```
pLambertW(y, theta = c(0, 0, 1), distname = "normal")
```

Arguments

`y`	value
`theta`	parameter vector
`distname`	input distribution

Value

Value of the cdf at y.

Author(s)

Georg M. Goerg

References

Goerg, G.M. (2009). "Lambert W Random Variables - A new class of skewed distribution functions". Unpublished

Examples

```
theta.s=c(0.1,0,1)

aux.lambert=function(y){
pLambertW(y, theta=theta.s)
}

support(theta.s)

plot(aux.lambert, -3.5,3.5, ylab="Probability")
plot(pnorm, -3.5,3.5, add=TRUE, lty=2)
legend("topleft" , c("Lambert W - Gaussian" , "Gaussian"), lty=1:2)
```

---

plot.LWest *Plot Lambert W Estimation Results*

Description

A plotting method for the `LWest` class. For the estimated delta dn given the data, plots a histogram, empirical density of the data, and compares it to the estimated theoretical Gaussian (t) and Lambert W - Gaussian (t) density.

Usage

```
## S3 method for class 'LWest':
plot(x,...)
```

Arguments

`x`	object of type `LWest`
`...`	...

Value

Plot

Author(s)

Georg M. Goerg

References

Goerg, G.M. (2009). “Lambert W Random Variables - A new class of skewed distribution functions”. Unpublished

Examples

```
x=rLambertW(200, theta=c(0.1, 0, 1))
fit=IGMM(x)
plot(fit)
```

`print.summary.LWest` *Summary of Estimation Results*

Description

Gives a "nice" summary for Lambert W estimation results (GMM or MLE). Output similar to `summary.lm`.

Usage

```
## S3 method for class 'summary.LWest':
print(x, ...)
```

Arguments

`x`	object of class `LWest`
`...`	...

Value

Output with estimation results plus useful information for the theoretical Y and X implied by the estimated θ.

Author(s)

Georg M. Goerg

References

Goerg, G.M. (2009). “Lambert W Random Variables - A new class of skewed distribution functions”. Unpublished

Examples

```
x=rLambertW(200, theta=c(0.1, 0, 1))
fit=IGMM(x)
summary(fit)

fit1=MLE_LambertW(x)
summary(fit1)
```

`p_1` *Non-principal branch probability*

Description

Computes the probability that the non-principal branch is caused the observed data.

Usage

```
p_1(delta, distname = "normal", nu = NULL)
```

Arguments

`delta`	skewness parameter
`distname`	distribution
`nu`	degrees of freedom (if `distname="t"`)

Details

This probability equals

$$P(U < -\frac{1}{|\delta|})$$

Value

Probability (in practice very small).

Author(s)

Georg M. Goerg

References

Goerg, G.M. (2009). "Lambert W Random Variables - A new class of skewed distribution functions". Unpublished

Examples

```
p_1(0.1)
```

qLambertW — *Quantile function*

Description

Computes the quantiles given a probability level p.

Usage

```
qLambertW(p, theta, distname = "normal")
```

Arguments

`p`	vector of probability levels
`theta`	parameter vector
`distname`	input distribution

Value

Value(s) of quantile(s) that result(s) in probability level(s) p.

Author(s)

Georg M. Goerg

References

Goerg, G.M. (2009). "Lambert W Random Variables - A new class of skewed distribution functions". Unpublished

Examples

```
p.v=c(0.1, 0.5, 0.9, 0.95,0.99)

qnorm(p.v)
sapply(p.v, qLambertW, theta=c(0,0,1)) # should give the same as above

# positively skewed data -> quantiles are lower
qLambertW(p.v, theta=c(0.1,0,1))

qLambertW(p.v, theta=c(0.3,0,1))
```

`qqLambertW` *QQ - Plot for Lambert W*

Description

A qq-plot with Lambert W - Gaussian (t) quantiles.

Usage

```
qqLambertW(y, theta = IGMM(y)$theta, distname = "normal", plot.it = TRUE, ...)
```

Arguments

`y`	data
`theta`	parameter vector
`distname`	input distribution
`plot.it`	should it be plotted
`...`	...

Value

`x`	Theoretical quantiles (sorted)
`y`	Empirical quantiles (sorted)

Author(s)

Georg M. Goerg

References

Goerg, G.M. (2009). "Lambert W Random Variables - A new class of skewed distribution functions". Unpublished

Examples

```
y=rLambertW(n=200, c(0.2,1,2))
qqLambertW(y, theta=IGMM(y)$theta)
```

rLambertW *Random Generation of Lambert W RV*

Description

Random generation of Lambert W RV

Usage

```
rLambertW(n, theta = c(0, 0, 1), distname = "normal", innov = NULL, ZmUv = FALSE)
```

Arguments

n	number of observations
theta	parameter vector
distname	distribution
innov	pre-specified input. optional.
ZmUv	Should the mean and stand. dev. of X be chosen such that Y is a zero mean, unit variance RV. default FALSE

Details

If the input data is given via innov, then the theoretical mean and standard deviation are replace by the empirical counterparts.

Value

data vector y

Author(s)

Georg M. Goerg

References

Goerg, G.M. (2009). “Lambert W Random Variables - A new class of skewed distribution functions”. Unpublished

Examples

```
set.seed(1)
x=rnorm(1000)
skewness(x) #almost no skewness
mc(x) # close to zero

y=rLambertW(n=1000, c(0.5,0,1))
mom.LambertW.X.Gauss(c(0.5,0,1))
```

```
skewness(y) # high positive skewness (in theory equal to 3.70)
mc(y) # also the robust measure gives a high value

op=par(no.readonly=TRUE)
par(mfrow=c(2,2), mar=c(2,4,3,1))
plot(x)
hist(x, prob=TRUE, 15)
lines(density(x))

plot(y)
hist(y, prob=TRUE, 15)
lines(density(y))
par(op)
```

`sd` *Standard deviation*

Description

The package `gsl` has one function called `sd`, which does not calculate the sample standard deviation. Hence, here it is re-introduced as the root of `var(x)`.

Usage

```
sd(x)
```

Arguments

`x`	data

Value

empirical standard deviation

Author(s)

Georg M. Goerg

`summary.LWest` *Summary of Lambert W estimation*

Description

Given an object of class `LWest` calculates useful information, such as Hessian, theoretical support, ...

Usage

```
## S3 method for class 'LWest':
summary(object, ...)
```

Arguments

`object`	object of class `LWest`
`...`	...

Value

`call`	function call
`coefmat`	matrix with 4 columns for the estimated theta, its standard errors, t-statistic and corresponding (two-sided)p-values
`distname`	distribution
`nobs`	number of observations
`input`	back-transformed data
`support`	support of Y
`data.range`	original data range
`method`	Estimation method used.
`hessian`	Hessian at the optimum. Only if `method` is MLE; otherwise `NULL`
`p_1`	Probability for the non-principal branch

Author(s)

Georg M. Goerg

References

Goerg, G.M. (2009). “Lambert W Random Variables - A new class of skewed distribution functions”. Unpublished

`support` *Truncated support*

Description

Given θ calculates the support of Y.

Usage

```
support(theta)
```

Arguments

`theta`	parameter vector

Value

Half-open interval on the real line (if $\delta \neq 0$)

Author(s)

Georg M. Goerg

References

Goerg, G.M. (2009). "Lambert W Random Variables - A new class of skewed distribution functions". Unpublished

Examples

```
support(c(0,0,1))

support(c(0.1,0,1))
```

`vec.norm` *Euclidean norm*

Description

Calculates the Euclidean norm of a vector.

Usage

```
vec.norm(x)
```

Arguments

`x`	n-dimensional vector

Value

Euclidean norm of a vector `x`

Author(s)

Georg M. Goerg

`W` *Lambert W function (principal branch)*

Description

Principal branch of the Lambert W function. This is a short name for `lambert_W0` in the package `gsl`.

Usage

```
W(z)
```

Arguments

`z`	value

Value

Function value or NaN.

Author(s)

Georg M. Goerg

References

Goerg, G.M. (2009). "Lambert W Random Variables - A new class of skewed distribution functions". Unpublished

Corless, R. M., G. H. Gonnet, D. E. G. Hare, and D. J. Jeffrey (1993). "On the Lambert W function". preprint.

See Also

`lambert_W0`

Examples

```
W(5) # exists
W(-5) # does not exist
```

`W_1` *Lambert W function (non-principal branch)*

Description

Non-principal solution of the Lambert W function. Short for `lambert_W1` in the `gsl` package.

Usage

```
W_1(z)
```

Arguments

`z`	value

Value

Function value or NaN

Author(s)

Georg M. Goerg

References

Goerg, G.M. (2009). “Lambert W Random Variables - A new class of skewed distribution functions”. Unpublished

Corless, R. M., G. H. Gonnet, D. E. G. Hare, and D. J. Jeffrey (1993). “On the Lambert W function”. preprint.

See Also

`lambert_W1`

Examples

```
W(-0.25) # the "reasonable" input event
W_1(-0.25) # the "extreme" input event
```

W_delta — *Inverse transformation for Lambert W random variables*

Description

Inverse transformation for Lambert W RVs. This function uses the principal branch.

Usage

```
W_delta(z, delta)
```

Arguments

`z`	value
`delta`	skewness parameter

Value

Computes the value $1/\delta * W(\delta z)$.

Author(s)

Georg M. Goerg

References

Goerg, G.M. (2009). "Lambert W Random Variables - A new class of skewed distribution functions". Unpublished

W_delta_1 — *Inverse transformation (non-principal)*

Description

Inverse transformation for Lambert W RVs. This function uses the non-principal branch.

Usage

```
W_delta_1(z, delta)
```

Arguments

`z`	value
`delta`	skewness parameter

Value

Computes the value $1/\delta * W_[1](\delta z)$.

Author(s)

Georg M. Goerg

References

Goerg, G.M. (2009). "Lambert W Random Variables - A new class of skewed distribution functions". Unpublished

Index