Package 'weibullness'

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Title Goodness-of-Fit Test for Weibull Distribution (Weibullness)

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Depends R (>= 3.1.0)

Description

Performs a goodness-of-fit test of Weibull distribution (weibullness test) and provides the maximum likelihood estimates of the three-parameter Weibull distribution. Note that the threshold parameter is estimated based on the correlation from the Weibull plot. For more details, see Park (2018) <doi:10.1155/2018/6056975>. This work was supported by the National Research Foundation of Korea (NRF) grant funded by the Korea government (No. NRF-2017R1A2B4004169).

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BugReports https://github.com/AppliedStat/R/issues

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R topics documented:

`print.weibull.estimate` *Print the estimated values*

Description

Printing objects of class "weibull.estimate".

See Also

weibull.mle, weibull.wp, `print`

`print.wp.test.critical` *Print the critical value for wp.test*

Description

Printing objects of class "wp.test.critical".

See Also

wp.test.critical, `print`

`weibull.mle` *Maximum likelihood estimates of three-parameter Weibull distribution*

Description

Calculates the maximum likelihood estimates of three-parameter Weibull distribution.

Usage

```
weibull.mle(x, threshold, interval, interval.threshold, extendInt="downX",
            a, tol = .Machine$double.eps^0.25, maxiter = 1000, trace = 0)
```

Arguments

x	a numeric vector of observations.
threshold	the threshold parameter value.
interval	a vector containing the end-points of the interval to be estimated for the shape parameter.
interval.threshold	a vector containing the end-points of the interval to be estimated for the threshold parameter.
extendInt	character string specifying if the interval c(left,right) should be extended or directly produce an error when f() has no differing signs at the endpoints. The default, "downX", keep lowering the the left end of the interval so that f() has different signs. See uniroot.
a	the offset fraction to be used; typically in (0,1).
tol	the desired accuracy (convergence tolerance).
maxiter	the maximum number of iterations.
trace	integer number; if positive, tracing information is produced. Higher values giving more details.

Details

The three-parameter Weibull distribution has the cumulative distribution function

$$F(x) = 1 - \exp\Big[-\Big(\frac{x-\theta}{\beta}\Big)^{\alpha}\Big],$$

where $x > \theta$. The shape (α) and scale (β) parameters are estimated using the maximum likelihood. The maximum likelihood estimation is performed using the method by Farnum and Booth (1997). If the threshold (θ) is missing, it is estimated by weibull.threshold. If threshold=0, then weibull.mle calculates the maximum likelihood estimates of the two-parameter Weibull distribution.

If interval is missing, the interval is given by the method in Farnum and Booth (1997).

If interval.threshold is missing, the interval is initally given by (min(x)-sd(x),min(x)). If this interval does not include the estimate, its lower bound is extended (see also uniroot).

The choice of a follows ppoints function.

Convergence is declared either if f(x) == 0 or the change in x for one step of the algorithm is less than tol (see also uniroot).

If the algorithm does not converge in maxiter steps, a warning is printed and the current approximation is returned (see also uniroot).

Value

An object of class "weibull.estimate", a list with two parameter estimates (if threshold is given) or three parameter estimates.

Author(s)

Chanseok Park

References

Park, C. (2018). A Note on the Existence of the Location Parameter Estimate of the Three-Parameter Weibull Model Using the Weibull Plot. *Mathematical Problems in Engineering*, **2018**, 1-6.
https://doi.org/10.1155/2018/6056975

Park, C. (2017). Weibullness test and parameter estimation of the three-parameter Weibull model using the sample correlation coefficient. *International Journal of Industrial Engineering - Theory, Applications and Practice*, **24**(4), 376-391.
http://journals.sfu.ca/ijietap/index.php/ijie/article/view/2848

Farnum, N. R. and P. Booth (1997). Uniqueness of Maximum Likelihood Estimators of the 2-Parameter Weibull Distribution. *IEEE Transactions on Reliability*, **46**, 523-525.

See Also

`weibull.wp` for the parameter estimation using the Weibull plot.

`fitdistr` for maximum-likelihood fitting of univariate distributions in package **MASS**.

Examples

```
library(weibullness)

# Three-parameter Weibull
data = c(355,725,884,462,1092,190,166,172,188,224,267,298,355,471,
        154,101,76,811,80,249,752,305,301,386,667,212,186,127,
        121,214,242,237,355,210,253,400,401,514,211,285)
weibull.mle(data)

# Two-parameter Weibull
weibull.mle(data, threshold=0)
```

`Weibull.Plot.Quantiles` *Weibull quantile values*

Description

Quantiles for the Weibullness Test. They are obtained from the sample correlation from the Weibull plot. The number of Monte Carlo iterations is 1E08.

Data set representing the quantiles and the associated critical values for the Weibullness test. They were obtained by conducting Monte Carlo simulations where the sample correlation coefficients were calculated based on the Weibull plot. We used 1.0E08 Monte Carlo iterations in the simulation.

Usage

```
Weibull.Plot.Quantiles
```

Format

This data frame contains 998 rows and 1001 columns.

References

Park, C. (2017). Weibullness test and parameter estimation of the three-parameter Weibull model using the sample correlation coefficient. *International Journal of Industrial Engineering - Theory, Applications and Practice* 24(4), 376-391.
http://journals.sfu.ca/ijietap/index.php/ijie/article/view/2848

`weibull.threshold` *Estimate of threshold parameter of three-parameter Weibull distribution*

Description

Calculates the estimate of the threshold parameter.

Usage

```
weibull.threshold(x, a, interval.threshold, extendInt="downX")
```

Arguments

`x`	a numeric vector of observations.
`a`	the offset fraction to be used; typically in (0,1).
`interval.threshold`	a vector containing the end-points of the interval to be estimated for the threshold parameter.
`extendInt`	character string specifying if the interval c(left,right) should be extended or directly produce an error when f() has no differing signs at the endpoints. The default, "downX", keep lowering the the left end of the interval so that f() has different signs. See `uniroot`.

Details

The three-parameter Weibull distribution has the cumulative distribution function

$$F(x) = 1 - \exp\Big[- \Big(\frac{x-\theta}{\beta}\Big)^{\alpha}\Big],$$

where $x > \theta$. The threshold parameter (θ) is estimated by maximizing the correlation function from the Weibull plot.

The choice of a follows ppoints function.

If interval.threshold is missing, the interval is initially given by (min(x)-sd(x),min(x)). If this interval does not include the estimate, its lower bound is extended (see also uniroot).

Value

weibull.threshold returns a numeric value.

Author(s)

Chanseok Park

References

Park, C. (2018). A Note on the Existence of the Location Parameter Estimate of the Three-Parameter Weibull Model Using the Weibull Plot. *Mathematical Problems in Engineering*, **2018**, 1-6.
https://doi.org/10.1155/2018/6056975

Park, C. (2017). Weibullness test and parameter estimation of the three-parameter Weibull model using the sample correlation coefficient. *International Journal of Industrial Engineering - Theory, Applications and Practice*, **24**(4), 376-391.
http://journals.sfu.ca/ijietap/index.php/ijie/article/view/2848

See Also

weibull.mle

Examples

```
library(weibullness)

# Data
data = c(355,725,884,462,1092,190,166,172,188,224,267,298,355,471,
        154,101,76,811,80,249,752,305,301,386,667,212,186,127,
        121,214,242,237,355,210,253,400,401,514,211,285)
weibull.threshold(data)
```

---

weibull.wp — *Estimate of shape and scale parameters of Weibull using the Weibull plot*

Description

Calculates the estimates of the shape and scale parameters.

Usage

```
weibull.wp(x, n, a=0.5)
```

Arguments

x	a numeric vector of observations.
n	The number of observations is needed if there is right-censoring.
a	the offset fraction to be used; typically in (0,1).

Details

`weibull.wp` obtains the estimates of the shape and scale parameters using the intercept and slope estimates from the Weibull plot.

Value

An object of class `"weibull.estimate"`, a list with two parameter estimates

Author(s)

Chanseok Park

References

Park, C. (2018). A Note on the Existence of the Location Parameter Estimate of the Three-Parameter Weibull Model Using the Weibull Plot. *Mathematical Problems in Engineering*, **2018**, 1-6.
https://doi.org/10.1155/2018/6056975

Park, C. (2017). Weibullness test and parameter estimation of the three-parameter Weibull model using the sample correlation coefficient. *International Journal of Industrial Engineering - Theory, Applications and Practice*, **24**(4), 376-391.
http://journals.sfu.ca/ijietap/index.php/ijie/article/view/2848

See Also

`weibull.mle` for the parameter estimation using the maximum likelihood method.

`fitdistr` for maximum-likelihood fitting of univariate distributions in package **MASS**.

Examples

```
library(weibullness)

data = c(355,725,884,462,1092,190,166,172,188,224,267,298,355,471,
        154,101,76,811,80,249,752,305,301,386,667,212,186,127,
        121,214,242,237,355,210,253,400,401,514,211,285)
weibull.wp(data)
```

`wp.test` *The Weibullness Test from the Weibull Plot*

Description

Performs the statistical test of Weibullness (Goodness-of-fit test for the Weibull distribution) using the sample correlation from the Weibull plot.

Usage

```
wp.test(x, a)
```

Arguments

`x`	a numeric vector of data values. Missing values are allowed, but the number of non-missing values must be between 3 and 1000.
`a`	the offset fraction to be used; typically in (0,1). See ppoints().

Details

The Weibullness test is constructed using the sample correlation which is calculated using the associated Weibull plot. The critical value is then looked up in Weibull.Plot.Quantiles. There is `print` method for class `"htest"`.

Value

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

`statistic`	the value of the test statistic (sample correlation from the Weibull plot)
`p.value`	the p-value for the test.
`sample.size`	sample size (missing observations are deleted).
`method`	a character string indicating the Weibullness test.
`data.name`	a character string giving the name(s) of the data.

Author(s)

Chanseok Park

References

Park, C. (2017). Weibullness test and parameter estimation of the three-parameter Weibull model using the sample correlation coefficient. *International Journal of Industrial Engineering - Theory, Applications and Practice*, **24**(4), 376-391.
http://journals.sfu.ca/ijietap/index.php/ijie/article/view/2848

Vogel, R. M. and C. N. Kroll (1989). Low-Flow Frequency Analysis Using Probability-Plot Correlation Coefficients. *Journal of Water Resources Planning and Management*, **115**, 338-357.

See Also

ks.test for performing the Kolmogorov-Smirnov test for the goodness of fit test of two samples.

shapiro.test for performing the Shapiro-Wilk test for normality.

Examples

```
library(weibullness)

# For Weibullness hypothesis test.
x = rweibull(10, shape=1)
wp.test(x)
```

---

wp.test.critical *Critical value for the Weibullness test*

Description

Calculates the critical value for the Weibullness test

Usage

```
wp.test.critical(alpha, n)
```

Arguments

alpha	the significance level.
n	the sample size.

Details

This function calculates the critical value for the Weibullness test which is constructed using the sample correlation from the associated Weibull plot. The critical value is then looked up in Weibull.Plot.Quantiles. There is print method for class "wp.test.critical".

Value

A list with class "wp.test.critical" containing the following components:

sample.size	sample size (missing observations are deleted).
alpha	significance level.
critical.value	critical value.
data.name	a character string giving the name(s) of the data.

Author(s)

Chanseok Park

References

Park, C. (2017). Weibullness test and parameter estimation of the three-parameter Weibull model using the sample correlation coefficient. *International Journal of Industrial Engineering - Theory, Applications and Practice*, **24**(4), 376-391.
http://journals.sfu.ca/ijietap/index.php/ijie/article/view/2848

Vogel, R. M. and C. N. Kroll (1989). Low-Flow Frequency Analysis Using Probability-Plot Correlation Coefficients. *Journal of Water Resources Planning and Management*, **115**, 338-357.

See Also

`ks.test` for performing the Kolmogorov-Smirnov test for the goodness of fit test of two samples.

`shapiro.test` for performing the Shapiro-Wilk test for normality.

Examples

```
library(weibullness)

# Critical value with alpha (significance level) and n (sample size).
wp.test.critical(alpha=0.01, n=10)
```

---

wp.test.pvalue *The p-value for the Weibullness test*

Description

Calculates the p-value for the Weibullness test which is based on the sample correlation from the Weibull plot.

Usage

```
wp.test.pvalue(r, n)
```

Arguments

`r`	the sample correlation coefficient from the Weibull plot; r is in (0,1).
`n`	the sample size.

Details

The p-value for the Weibullness test which is based on the sample correlation from the Weibull plot. There is `print` method for class `"htest"`.

Value

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

`statistic`	the value of the test statistic (sample correlation from the Weibull plot)
`p.value`	the p-value for the test.
`method`	a character string indicating the Weibullness test.

Author(s)

Chanseok Park

References

Park, C. (2017). Weibullness test and parameter estimation of the three-parameter Weibull model using the sample correlation coefficient. *International Journal of Industrial Engineering - Theory, Applications and Practice*, **24**(4), 376-391.
http://journals.sfu.ca/ijietap/index.php/ijie/article/view/2848

Vogel, R. M. and C. N. Kroll (1989). Low-Flow Frequency Analysis Using Probability-Plot Correlation Coefficients. *Journal of Water Resources Planning and Management*, **115**, 338-357.

See Also

`ks.test` for performing the Kolmogorov-Smirnov test for the goodness of fit test of two samples.

`shapiro.test` for performing the Shapiro-Wilk test for normality.

Examples

```
library(weibullness)

# p.value with r (sample correlation from the Weibull plot) and n (sample size).
wp.test.pvalue(r=0.6, n=10)
```

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