Package ‘kdist’

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Title K-Distribution and Weibull Paper
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Description Density, distribution function, quantile function and random generation for the K-distribution. A plotting function that plots data on Weibull paper and another function to draw additional lines. See results from package in T Lamont-Smith (2018), submitted J. R. Stat. Soc.
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The K-distribution.

Description

Density, distribution function, quantile function and random generation for the K-distribution with parameters shape and scale.

Usage

\begin{align*}
\text{dk}(x, \text{shape} = 1, \text{scale} = 1, \text{intensity} = \text{FALSE}, \text{log} = \text{FALSE}) \\
\text{pk}(q, \text{shape} = 1, \text{scale} = 1, \text{intensity} = \text{FALSE}, \text{log.p} = \text{FALSE}, \text{lower.tail} = \text{TRUE}) \\
\text{qk}(p, \text{shape} = 1, \text{scale} = 1, \text{intensity} = \text{FALSE}, \text{log.p} = \text{FALSE}) \\
\text{rk}(n, \text{shape} = 1, \text{scale} = 1, \text{intensity} = \text{FALSE})
\end{align*}

Arguments

\begin{itemize}
\item \text{x} \quad \text{vector of quantiles}
\item \text{q} \quad \text{vector of probabilities}
\item \text{shape, scale} \quad \text{shape and scale parameters both defaulting to 1.}
\item \text{intensity} \quad \text{logical; if TRUE, quantiles are intensities not amplitudes.}
\item \text{log, log.p} \quad \text{logical; if TRUE, probabilities p are given as log(p).}
\item \text{lower.tail} \quad \text{logical; if TRUE (default), probabilities are P[X = x], otherwise, P[X > x].}
\item \text{p} \quad \text{vector of probabilities}
\item \text{n} \quad \text{number of observations}
\end{itemize}

Details

The K-distribution with shape parameter \(\nu\) and scale parameter \(b\) has amplitude density given by 
\(f(x) = \left[4x^{\nu}/\Gamma(\nu)\right][((b/\nu)(1 + \nu/2))]K(2x\sqrt{(b/\nu)}),\nu - 1)\). Where \(K\) is a modified Bessel function of the second kind. For \(\nu \rightarrow \infty\), the K-distribution tends to a Rayleigh distribution, and for \(\nu = 1\) it is the Exponential distribution. The function \text{base::besselK} is used in the calculation, and care should be taken with large input arguments to this function, e.g. \(b\) very small or \(x, \nu\) very large. The cumulative distribution function for the amplitude, \(x\) is given by \(F(x) = 1 - 2x^\nu(\nu/b)^\nu/2)K(2x\sqrt{(b/\nu)},\nu)\). The K-Distribution is a compound distribution, with Rayleigh distributed amplitudes (exponential intensities) modulated by another underlying process whose amplitude is chi-distributed and whose intensity is Gamma distributed. An Exponential distributed number multiplied by a Gamma distributed random number is used to generate the random variates. The \(m\)th moments are given by \(\mu_m = (b/\nu)^{m/2}\Gamma(0.5m + 1)\Gamma(0.5m + \nu)/\Gamma(\nu)\), so that the root mean square value of \(x\) is the scale factor, \(< x^2 > = b\).
**Value**

The function \(dk\) gives the density, \(pk\) gives the distribution function, \(qk\) gives the quantile function, and \(rk\) generates random variates.

**References**


**See Also**

Distributions for other standard distributions, including \(dweibull\) for the Weibull distribution and \(dexp\) for the exponential distribution.

**Examples**

```r
#=====
r <- rk(10000, shape = 3, scale = 5, intensity = FALSE)
fn <- stats::ecdf(r)
x <- seq(0, 10, length = 100)
plot(x, fn(x))
lines(x, pk(x, shape = 3, scale = 5, intensity = FALSE))
#=====
r <- rk(10000, shape = 3, scale = 5, intensity = FALSE)
d <- density(r)
x <- seq(0, 10, length = 100)
plot(d, xlim=c(0,10))
lines(x, dk(x, shape = 3, scale = 5, intensity = FALSE))
```

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**kdist**

*kdist: A package for calculating and plotting non-Gaussian distributions*

**Description**

The kdist package provides two categories of important functions: \(dk\) etc, and \(weiplot\).

**dk functions**

The kdist functions \(dk\), \(pk\), \(qk\) and \(rk\), calculates the K-distribution

**weiplot functions**

\(weiplot\) takes data and plots it on Weibull paper. \(Weilines\) adds lines to a Weibull plot.
weilines

Add Lines onto a Weibull Plot

Description
Weibull distributed data plots as a straight line on log-log plot using wlines(). It is best used after function wplot() has been called.

Usage
weilines(x, y, lty = NULL, lwd = NULL, col = "black", type = "l", pch = 0)

Arguments
x
vector of values
y
vector of values the same length as x
lty
type of plotting line type
lwd
line width
col
line color
type
symbol type for type = "b"

Details
A Weibull plot uses log paper and has log(1/(1-F(x))) versus x, where the data values x have an empirical cdf of F(x). The plot margins may need to be adjusted so that the right hand axis is visible.

See Also
wplot() creates the Weibull plot

Examples
dummy <- c(0,0)
weiplot(dummy, xlim = c(1e-3, 1), type = "n")
x <- 10^seq(-3, 2, length = 100)
weilines(x, pexp(x), col = "red")
weilines(x, pweibull(x, 2), col = "blue")
weilines(x, pweibull(x, 3), col = "green")
Description
A special type of plot where Weibull distributed data plots as a straight line. This was also originally called Rayleigh paper. Both Rayleigh and exponential distributions also plot as straight lines.

Usage
weiplot(data, n = 70, type = "p", xlim = NULL, ylim = c(0, 1),
        main = "Weibull Plot", sub = NULL, ylab = "log(1/(1-F(x)))",
        ylab2 = "F(x)", xlab = "x", percent = "false")

Arguments
data   data values from which a cumulative density function will be estimated using ecdf(data)
n     number of points required in plot (default n = 70).
type   plot type
xlim   the minimum and maximum to be used for the x-axis
ylim   the minimum and maximum to be used for the y-axis
main   the title of the plot
sub    the sub-title of the plot
ylab   the title of the left y-axis
ylab2  the title of the right y-axis
xlab   the title of the x-axis
percent logical; display right hand axis as percentages

Details
A Weibull plot uses log paper and has log(1/(1-F(x))) versus x, where the data values x have an empirical cdf of F(x). The plot margins may need to be adjusted so that the right hand axis is visible.

See Also
weilines() adds lines to a Weibull plot

Examples

```
graphics::par(mar = c(5, 5, 5, 5))
r <- rexp(100000)
weiplot(r, xlim = c(1e-3, 10))
x <- 10*seq(-3, 2, length = 100)
weilines(x, pexp(x))
```
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