# Package 'kdist'

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**Title** K-Distribution and Weibull Paper

**Version** 0.2

**Maintainer** Tim Lamont-Smith <t.lamontsmith@gmail.com>

**Author** Tim Lamont-Smith [aut, cre]

**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.

**Depends** R (>= 3.1.1)

**Imports** stats, graphics

**License** GPL-3

**Encoding** UTF-8

**LazyData** true

**RoxygenNote** 5.0.1

**NeedsCompilation** no

**Repository** CRAN

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## R topics documented:

k *The K-distribution.*

## Description

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

## Usage

```
dk(x, shape = 1, scale = 1, intensity = FALSE, log = FALSE)

pk(q, shape = 1, scale = 1, intensity = FALSE, log.p = FALSE,
  lower.tail = TRUE)

qk(p, shape = 1, scale = 1, intensity = FALSE, log.p = FALSE)

rk(n, shape = 1, scale = 1, intensity = FALSE)
```

## Arguments

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

## Details

The K-distribution with shape parameter $\nu$ and scale parameter $b$ has amplitude density given by $f(x) = [4x^{\nu}/\Gamma(\nu)][(\nu/b)^(1+\nu/2)]K(2x\sqrt{(}\nu/b), \nu - 1)$. Where $K$ is a modified Bessel function of the second kind. For $\nu -> Inf$, the K-distrubution tends to a Rayleigh distribution, and for $\nu = 1$ it is the Exponential distribution. The function base::besselK is used in the calculation, and care should be taken with large input arguements to this function, e.g. $b$ very small or $x, \nu$ very large. The cumulative distribution function for the amplitude, $x$ is given by $F(x) = 1-2x^{\nu}(\nu/b)^(\nu/2)K(2x\sqrt{(}\nu/b), \nu)$. 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

E Jakeman and R J A Tough, "Non-Gaussian models for the statistics of scattered waves", Adv. Phys., 1988, vol. 37, No. 5, pp471-529

## See Also

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

## Examples

```
#=====
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*

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## 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` | line type |
| `lwd` | line width |
| `col` | line color |
| `type` | type of plotting |
| `pch` | 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, 10), 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")
```

`weiplot` *Create Weibull Plot.*

## 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(0.01, 10),
  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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