

# Package ‘kdist’

May 8, 2026

**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

**Date/Publication** 2018-05-16 14:22:02 UTC

## Contents

k . . . . .	2
kdist . . . . .	3
weilines . . . . .	4
weiplot . . . . .	5
<b>Index</b>	<b>6</b>

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  $f(x) = [4x^\nu/\Gamma(\nu)][(\nu/b)^{\nu/2}(1 + \nu/2)]K(2x\sqrt{\nu/b}, \nu - 1)$ . 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 base `::besse1K` 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  $F(x) = 1 - 2x^\nu(\nu/b)^{\nu/2}K(2x\sqrt{\nu/b}, \nu)$ . 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,  $\langle x^2 \rangle = b$ .

**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**

<code>x</code>	vector of values
<code>y</code>	vector of values the same length as <code>x</code>
<code>lty</code>	line type
<code>lwd</code>	line width
<code>col</code>	line color
<code>type</code>	type of plotting
<code>pch</code>	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)  
wplot(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 <code>ecdf(data)</code>
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))
```

# Index

dk (k), [2](#)

k, [2](#)

kdist, [3](#)

kdist-package (kdist), [3](#)

pk (k), [2](#)

qk (k), [2](#)

rk (k), [2](#)

weilines, [4](#)

weipLOT, [5](#)