Package 'DEEVD'

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Type Package

Title Density Estimation by Extreme Value Distributions

Version 1.2.2

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Description Provides mean squared error (MSE) and plot the kernel densities related to extreme value distributions with their estimated values.
By using Gumbel and Weibull Kernel. See Salha et al. (2014) <doi:10.4236/ojs.2014.48061> and Khan and Akbar (2021) <doi:10.4236/ojs.2021.112018 >.

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R topics documented:

DEEVD-package *DEEVD*

Description

Two extreme value distributions; Weibull and Gumbel kernel related functions are presented. `Weibull` and `Gumbel` present estimated values and `plot.Weibull` and `plot.Gumbel` plot the densities. While mean squared error can be calculated by using `mse`. Further, some related data sets are also presented.

Details

Density Estimation by Extreme Value Distributions

Author(s)

Javaria Ahmad Khan, Atif Akbar.

References

- Salha, R. B., El Shekh Ahmed, H. I., & Alhoubi, I. M. 2014. Hazard Rate Function Estimation Using Weibull Kernel. *Open Journal of Statistics* **4** (08), 650-661.
- Khan, J. A., & Akbar, A. 2021. Density Estimation Using Gumbel Kernel Estimator. *Open Journal of Statistics* **11** (2), 319-328.

See Also

Useful links:

- https://CRAN.R-project.org/package=DEEVD

Gumbel *Estimate Density Values by Gumbel kernel*

Description

The Gumbel kernel is developed by Khan and Akbar (2020). They provided evidence that performance of their proposed is better then Weibull kernel especially when data belongs to family of extreme distributions. Gumbel Kernel is

$$K_{Gumbel(x,\sqrt{h})}(j) = \frac{1}{\sqrt{h}} exp - \left(\frac{j-x}{\sqrt{h}} + exp\left(\frac{j-x}{\sqrt{h}} \right) \right)$$

Usage

```
Gumbel(x = NULL, y, k = NULL, h = NULL)
```

Arguments

x	scheme for generating grid points
y	a numeric vector of positive values.
k	gird points
h	the bandwidth

Details

In this function, choice of bandwidth, number of grid points and scheme that how these grid points are generated are user based. If any parameter(s) is missing then function used default parameters. But at least x or k should be specified otherwise NA will be produced. If x is missing then function will generate k grid points between minimum and maximum values of vector. Similarly, if k is missing then function consider it same to length of main vector. In case if h is missing then function used normal scale rule bandwidth for non-normal data and described in Silverman (1986).

Value

x	grid points
y	estimated values of density

Author(s)

Javaria Ahmad Khan, Atif Akbar.

References

Khan, J. A., & Akbar, A. 2021. Density Estimation Using Gumbel Kernel Estimator. *Open Journal of Statistics* **11** (2), 319-328.

See Also

For other kernel see Weibull. To plot the density by using Gumbel kernel plot.Gumbel and to calculate MSE use mse.

Examples

```
#Data can be simulated or real data
## Number of grid points "k" should be at least equal to the data size.
### If user define the generating scheme of gridpoints than number of gridpoints should
####be equal or greater than "k"
###### otherwise NA will be produduced.
y <- rexp(100, 1)
xx <- seq(min(y) + 0.05, max(y), length = 100)
h <- 2
den <- Gumbel(x = xx, y = y, k = 200, h = h)

##If scheme for generating gridpoints is unknown
y <- rexp(50, 1)
h <- 3
```

```
den <- Gumbel(y = y, k = 90, h = h)

##If user do not mention the number of grid points
y <- rexp(23, 1)
xx <- seq(min(y) + 0.05, max(y), length = 90)

## Not run:
#any bandwidth can be used
require(KernSmooth)
h <- dpik(y)   #Direct Plug-In Bandwidth
den <- Gumbel(x = xx, y = y, h = h)

## End(Not run)

#if bandwidth is missing
y <- rexp(100, 1)
xx <- seq(min(y) + 0.05, max(y), length = 100)
den <- Gumbel(x = xx, y = y, k = 90)
```

Mississippi *Flood discharge in per second from Mississippi river*

Description

A dataset containing the flood discharge in per second in cubic meter from Mississippi river.

Usage

```
Mississippi
```

Format

A vector with 23 observations

References

Gumbel, E. J. 1941. The return period of flood flows. *The Annals of Mathematical Statistics*. **12**, 163-190.

`mse` *Calculate Mean Square Error(MSE) by using Extreme value distributions*

Description

This function calculates the mean squared error (MSE) by using user specified kernel. But distribution of vector should be Exponential, Gamma, Gumbel, Frechet or Weibull. Any other choice of distribution will result `NaN`. This function is simillar to function `mse` in **DELTD**, but here more distributions are available for distribution vector.

Usage

```
mse(kernel, type)
```

Arguments

`kernel`	type of kernel which is to be used
`type`	mention distribution of vector.If exponential distribution then use `"Exp"`. If use gamma distribution then type `"Gamma"`.If Gumbel distribution is used with scale=1, then use `"Gumbel"`. If Weibull distribution then use `"Weibull"`. If use Weibull distribution with scale = 1 then use `"Weibull"`. If use Frechet distribution with scale=1 and shape=1 then use `"Frechet"`.

Value

Mean Squared Error (MSE)

Author(s)

Javaria Ahmad Khan, Atif Akbar

References

- Salha, R. B., El Shekh Ahmed, H. I., & Alhoubi, I. M. 2014. Hazard Rate Function Estimation Using Weibull Kernel. *Open Journal of Statistics* **4** (08), 650-661.
- Khan, J. A., & Akbar, A. 2021. Density Estimation Using Gumbel Kernel Estimator. *Open Journal of Statistics* **11** (2), 319-328.

Examples

```
y <- rexp(100, 1)
xx <- seq(min(y) + 0.05, max(y), length = 500)
h <- 2
gr <- Gumbel(x = xx, y = y, k = 200, h = h)
mse(kernel = gr, type = "Exp")
## if distribution is other than mentioned \code{type} is used then NaN will be produced.
## Not run:
```

```
mse(kernel = gr, type ="Beta")

## End(Not run)
```

---

plot.Gumbel *Density Plot by Gumbel kernel*

Description

Plot kernel density by using Gumbel Kernel.

Usage

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

Arguments

`x`	an object of class "Gumbel"
`...`	Not presently used in this implementation

Value

nothing

Author(s)

Javaria Ahmad Khan, Atif Akbar.

References

Khan, J. A., & Akbar, A. 2021. Density Estimation Using Gumbel Kernel Estimator. *Open Journal of Statistics* **11** (2), 319-328.

See Also

For Weibull kernel see `plot.Weibull`. To calculate Gumbel estimated values see `Gumbel` and for MSE `mse`.

Examples

```
y <- rlnorm(100, meanlog = 0, sdlog = 1)
h <- 1.5
xx <- seq(min(y) + 0.05, max(y), length = 200)
den <- Gumbel(x = xx, y = y, k = 200, h = h)
plot(den, type = "l")

##other details can also be added
y <- rlnorm(100, meanlog = 0, sdlog = 1)
```

```
grid <- seq(min(y) + 0.05, max(y), length = 200)
h <- 0.79 * IQR(y) * length(y) ^ (-1/5)
gr <- Gumbel(x = grid, y = y, k = 200, h = h)
plot(gr, type = "s", ylab = "Density Function", lty = 1, xlab = "Time")

## To add true density along with estimated
d1 <- density(y, bw = h)
lines(d1, type = "p", col = "red")
legend("topright", c("Real Density", "Density by Gumbel Kernel"),
col=c("red", "black"), lty=c(1,2))
```

`plot.Weibull` *Density Plot by Weibull kernel*

Description

Plot density by using Weibull Kernel.

Usage

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

Arguments

`x`	an object of class "Weibull"
`...`	Not presently used in this implementation

Value

nothing

Author(s)

Javaria Ahmad Khan, Atif Akbar.

References

Salha, R. B., El Shekh Ahmed, H. I., & Alhoubi, I. M. 2014. Hazard Rate Function Estimation Using Weibull Kernel. *Open Journal of Statistics* **4** (08), 650-661.

See Also

For Gumbel kernel see `plot.Gumbel`. To calculate Weibull estimated values see `Weibull` and for MSE use `mse`.

Examples

```
y <- rlnorm(100, meanlog = 0, sdlog = 1)
h <- 1.5
xx <- seq(min(y) + 0.05, max(y), length = 200)
den <- Weibull(x = xx, y = y, k = 200, h = h)
plot(den, type = "l")

##other details can also be added
y <- rlnorm(100, meanlog = 0, sdlog = 1)
grid <- seq(min(y) + 0.05, max(y), length = 200)
h <- 0.79 * IQR(y) * length(y) ^ (-1/5)
gr <- Weibull(x = grid, y = y, k = 200, h = h)
plot(gr, type = "s", ylab = "Density Function", lty = 1, xlab = "Time")

## To add true density along with estimated
d1 <- density(y, bw = h)
lines(d1, type = "p", col = "green")
legend("topright", c("Real Density", "Density by Weibull Kernel"),
col=c("green", "black"), lty=c(1,2))
```

Rhone *Flood discharge in per second from Rhone river*

Description

A dataset containing the flood discharge in per second in cubic meter from Rhone river.

Usage

```
Rhone
```

Format

A vector with 23 observations

References

Gumbel, E. J. 1941. The return period of flood flows. *The Annals of Mathematical Statistics*. **12**, 163-190.

`Suicide` *Data of control patients of Suicide study*

Description

A dataset which contains a length of treatment spells (in days) of control patients in suicide study.

Usage

```
Suicide
```

Format

A vector with 86 observations

References

Silverman, B. W. 1986. *Density Estimation*. Chapman & Hall/ CRC, London.

`Weibull` *Estimated Density Values by Weibull kernel*

Description

The Weibull kernel is developed by Salha et al. (2014). They used it to nonparametric estimation of the probability density function (pdf) and the hazard rate function for independent and identically distributed (iid) data. Weibull Kernel is

$$K_w\left(x, \frac{1}{h}\right)(t) = \frac{\Gamma(1+h)}{hx}\left[\frac{t\Gamma(1+h)}{x}\right]^{\frac{1}{h}-1} exp\left(-\left(\frac{t\Gamma(1+h)}{x}\right)^{\frac{1}{h}}\right)$$

Usage

```
Weibull(x = NULL, y, k = NULL, h = NULL)
```

Arguments

`x`	scheme for generating grid points
`y`	a numeric vector of positive values
`k`	number of gird points
`h`	the bandwidth

Details

see the details in the `Gumbel`

Value

x	grid points
y	estimated values of density

Author(s)

Javaria Ahmad Khan, Atif Akbar.

References

Salha, R. B., El Shekh Ahmed, H. I., & Alhoubi, I. M. 2014. Hazard Rate Function Estimation Using Weibull Kernel. *Open Journal of Statistics* **4** (08), 650-661. Silverman, B. W. 1986. *Density Estimation*. Chapman & Hall/ CRC, London.

See Also

For Gumbel kernel see `Gumbel`. To plot its density see `plot.Weibull` and to calculate MSE `mse`.

Examples

```
#Data can be simulated or real data
## Number of grid points "k" should be at least equal to the data size.
### If user define the generating scheme of gridpoints than number of gridpoints should
####be equal or greater than "k"
##### otherwise NA will be produduced.
y <- rexp(100, 1)
xx <- seq(min(y) + 0.05, max(y), length = 100)
h <- 2
den <- Weibull(x = xx, y = y, k = 200, h = h)

##If scheme for generating gridpoints is unknown
y <- rexp(50, 1)
h <- 3
den <- Weibull(y = y, k = 90, h = h)

##If user do not mention the number of grid points
y <- rexp(23, 1)
xx <- seq(min(y) + 0.05, max(y), length = 90)

## Not run:
#any bandwidth can be used
require(KernSmooth)
h <- dpik(y)
den <- Weibull(x = xx, y = y, h = h)

## End(Not run)

#if bandwidth is missing
y <- rexp(100, 1)
xx <- seq(min(y) + 0.05, max(y), length = 100)
den <- Weibull(x = xx, y = y, k = 90)
```

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