Package ‘AsyK’

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Type Package

Title Kernel Density Estimation and Selection of Optimum Bandwidth

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Author Javaria Ahmad Khan, Atif Akbar.

Maintainer Javaria Ahmad Khan <jakhan0@yahoo.com>

Description A collection of functions related to density estimation by using Chen's (2000) idea. Mean Squared Errors (MSE) are calculated for estimated curves. For this purpose, R functions allow the distribution to be Gamma, Exponential or Weibull. For details see Chen (2000), Scaillet (2004) <doi:10.1080/10485250310001624819> and Khan and Akbar.

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AsyK-package *AsyK*

Description

A collection of functions related to density estimation by using Chen's (2000) idea. For observing estimated values see `Laplace` and `RIG`. Plots by using these kernels can be drawn by `plot.Laplace` and `plot.RIG`. Additionally, their combined plot is drawn by using `compLR`. Mean squared errors (MSE) can be calculated by `mseLap` and `mseRIG`. Further `laphcomp` and `righcomp` allows to calculate MSE by using 19 different bandwidths for both kernels. Here we also present a normal scale rule bandwidth which is given by Silverman (1986) for nonnormal data.

Details

Kernel Density Estimation and Selection of Optimum Bandwidth

Author(s)

Javaria Ahmad Khan, Atif Akbar.

See Also

Useful links:

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

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compLR *Plot Density by RIG and Laplace kernel.*

Description

Plot densities by using Resiprocal Inverse Gaussian and Laplace Kernel.

Usage

```
compLR(y, k, h)
```

Arguments

y	a numeric vector of positive values.
k	gird points.
h	the bandwidth

Details

It plot the densities by Laplace, RIG kernel and with real density at the same time.

Author(s)

Javaria Ahmad Khan, Atif Akbar.

References

- Khan, J. A.; Akbar, A. Density Estimation by Laplace Kernel. *Working paper, Department of Statistics, Bahauddin Zakariya University, Multan, Pakistan.*
- Scaillet, O. 2004. Density estimation using inverse and reciprocal inverse Gaussian kernels. *Nonparametric Statistics*, **16**, 217-226.

Examples

```
y<-rexp(100,1)
h<-0.79 * IQR(y) * length(y) ^ (-1/5)
compLR(y,80,h)
```

---

laphcomp — *Calculate MSE with and ranking of Bandwidth with respect to MSE for Laplace Kernel.*

Description

Caculate MSE with 19 bandwidths by using Laplace Kernel.

Usage

```
laphcomp(y, k, type)
```

Arguments

y	a numeric vector of positive values.
k	gird points.
type	mention distribution of vector.If exponential distribution then use "Exp". if use gamma distribution then use "Gamma".If Weibull distribution then use "Weibull".

Details

This function helps to calculate MSE by using 19 different bandwidths which are Normal Scale Rule (NSR), Complete Cross Validation (CCV), Biased Cross Validation (BCV), Unbiased Cross Validation (UBCV), Direct Plug-In (DPI), Modified Cross Validation (MCV), Maximum Likelihood Cross Validation (MLCV), Trimmed Cross Validation (TCV), Smooth Cross Validation (SCV), Bootstrap without Sampling (bWOs), Bootstrap with Sampling (bWs), Bandwidth of Altman and Leger (AL), One-sided Cross Validation (OCV), Akaike information criterion (AIC), Indirect Cross Validation (ICV), Mallow' Cp (MallowCp), Generalized Cross Validation (GCV), Polansky and Baker Plug-In (PB), and Gasser, Kniep, and Köhler Cross Validation (GKK). For RIG kernel see righcomp.

Value

MSE with 19 bandwidths, Ranks, Minimum MSE, Maximum MSE

Author(s)

Javaria Ahmad Khan, Atif Akbar.

References

Khan, J. A.; Akbar, A. Density Estimation by Laplace Kernel. *Working paper, Department of Statistics, Bahauddin Zakariya University, Multan, Pakistan.*

Examples

```
y<-rexp(100,1)
 laphcomp(y, 200, "Exp")
```

Laplace — *Estimated Density Values by Laplace kernel*

Description

Estimated Kernel density values by using Laplace Kernel.

Usage

```
Laplace(y, k, h)
```

Arguments

y	a numeric vector of positive values.
k	gird points.
h	the bandwidth

Details

Laplace kernel is developed by Khan and Akbar. Kernel is developed by using Chen's idea. Laplace kernel is;

$$K_{Laplace\left(x,h^{\frac{1}{2}}\right)}(u) = \frac{1}{2\sqrt{h}}exp\left(-\frac{|u-x|}{\sqrt{h}}\right)$$

Value

x	grid points
y	estimated values of density

Author(s)

Javaria Ahmad Khan, Atif Akbar.

References

Khan, J. A.; Akbar, A. Density Estimation by Laplace Kernel. *Working paper, Department of Statistics, Bahauddin Zakariya University, Multan, Pakistan.*

See Also

To examine laplace density plot see `plot.Laplace` and for Mean Squared Error `mseLap`. Similarly, for RIG kernel `RIG`.

Examples

```
y <- rexp(100,1)
h <- 0.79 * IQR(y) * length(y) ^ (-1/5)
Laplace(y,200,h)
```

---

mseLap *Calculate Mean Squared Error(MSE) when Laplace Kernel is used.*

Description

Calculate MSE by using Laplace Kernel.

Usage

```
mseLap(y, k, h, type)
```

Arguments

`y`	a numeric vector of positive values.
`k`	gird points.
`h`	the bandwidth
`type`	mention distribution of vector.If exponential distribution then use "Exp". if use gamma distribution then use "Gamma".If Weibull distribution then use "Weibull".

Value

Mean Squared Error

References

Khan, J. A.; Akbar, A. Density Estimation by Laplace Kernel. *Working paper, Department of Statistics, Bahauddin Zakariya University, Multan, Pakistan.*

See Also

For further MSE by using RIG kernel see mseRIG. For density estimation by using Laplace Kernel plot.Laplace and for estimated values of density Laplace.

Examples

```
y<-rexp(100,1)
 h<-0.79 * IQR(y) * length(y) ^ (-1/5)
 mseLap(y, 200, h, "Exp")
```

---

mseRIG *Calculate Mean Squared Error(MSE) when RIG kernel is used.*

Description

Calculate MSE by using Resiprocal Inverse Gaussian Kernel.

Usage

```
mseRIG(y, k, h, type)
```

Arguments

y	a numeric vector of positive values.
k	gird points.
h	the bandwidth
type	mention distribution of vector.If exponential distribution then use "Exp". if use gamma distribution then use "Gamma".If Weibull distribution then use "Weibull".

Value

Mean Squared Error

References

Scaillet, O. 2004. Density estimation using inverse and reciprocal inverse Gaussian kernels. *Nonparametric Statistics*, **16**, 217-226.

See Also

For further MSE by using Laplace kernel see mseLap. For density estimation by using RIG Kernel plot.RIG and for estimated values of density RIG.

Examples

```
y<-rexp(100,1)
h<-0.79 * IQR(y) * length(y) ^ (-1/5)
mseRIG(y,200,h,"Exp")
```

NSR *Bandwidth Calculation.*

Description

Calculate Bandwidth proposed by Silverman for nonnormal data.

Usage

```
NSR(y)
```

Arguments

y a numeric vector of positive values.

Value

h

Author(s)

Javaria Ahmad Khan, Atif Akbar.

References

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

Examples

```
y<-rexp(10,1)
 NSR(y)
```

plot.Laplace *Density Plot by Laplace kernel*

Description

Plot density by using Laplace Kernel.

Usage

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

Arguments

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

Value

nothing

Author(s)

Javaria Ahmad Khan, Atif Akbar.

References

Khan, J. A.; Akbar, A. Density Estimation by Laplace Kernel. *Working paper, Department of Statistics, Bahauddin Zakariya University, Multan, Pakistan.*

See Also

To examine Laplace estimated values for density see `Laplace` and for Mean Squared Error `mseLap`. Similarly, for plot of Laplace kernel `plot.RIG`.

Examples

```
y <- rexp(100,1)
h <- 0.79 * IQR(y) * length(y) ^ (-1/5)
den <- Laplace(y, 200, h)
plot(den, type = "s", ylab = "Density Function", lty = 1, xlab = "Time")
d1 <- density(y, bw=h)
lines(d1,type="p",col="red")
legend("topright", c("Real Density", "Density by Laplace Kernel"), col=c("red", "black"))
```

---

plot.RIG — *Density Plot by Resiprocal Inverse Gaussian kernel*

Description

Plot density by using Resiprocal Inverse Gaussian Kernel.

Usage

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

Arguments

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

Value

nothing

Author(s)

Javaria Ahmad Khan, Atif Akbar.

References

Scaillet, O. 2004. Density estimation using inverse and reciprocal inverse Gaussian kernels. *Nonparametric Statistics*, **16**, 217-226.

See Also

To examine RIG estimated values for density see `RIG` and for Mean Squared Error `mseRIG`. Similarly, for plot of Laplace kernel `plot.Laplace`.

Examples

```
y <- rexp(100, 1)
h <- 0.79 * IQR(y) * length(y) ^ (-1/5)
den<-RIG(y,200,h)
plot(den, type = "s", ylab = "Density Function", lty = 1, xlab = "Time")
d1 <- density(y, bw=h) #To add true density along with estimated
lines(d1,type="p",col="red")
legend("topright", c("Real Density", "Density by RIG Kernel"), col=c("red", "black"), lty=c(1,2))
```

RIG *Estimated Density Values by Resiprocal Inverse Gaussian kernel*

Description

Estimated Kernel density values by using Resiprocal Inverse Gaussian Kernel.

Usage

```
RIG(y, k, h)
```

Arguments

y	a numeric vector of positive values.
k	gird points.
h	the bandwidth

Details

Scaillet 2003. proposed Resiprocal Inverse Gaussian kerenl. He claimed that his proposed kernel share the same properties as those of gamma kernel estimator.

$$K_{RIG\left(\ln ax4\ln\left(\frac{1}{h}\right)\right)}(y) = \frac{1}{\sqrt{2\pi y}} exp\left[-\frac{x-h}{2h}\left(\frac{y}{x-h} - 2 + \frac{x-h}{y}\right)\right]$$

Value

x	grid points
y	estimated values of density

Author(s)

Javaria Ahmad Khan, Atif Akbar.

References

Scaillet, O. 2004. Density estimation using inverse and reciprocal inverse Gaussian kernels. *Nonparametric Statistics*, **16**, 217-226.

See Also

To examine RIG density plot see `plot.RIG` and for Mean Squared Error `mseRIG`. Similarly, for Laplace kernel `Laplace`.

Examples

```
y <- rexp(100,1)
h <- 0.79 * IQR(y) * length(y) ^ (-1/5)
RIG(y,200,h)
```

---

righcomp — *Calculate MSE with and ranking of Bandwidth with respect to MSE for RIG kernel.*

Description

Caculate MSE with 19 bandwidths by using Resiprocal Inverse Gaussian Kernel.

Usage

```
righcomp(y, k, type)
```

Arguments

y	a numeric vector of positive values.
k	gird points.
type	mention distribution of vector.If exponential distribution then use "Exp". if use gamma distribution then use "Gamma".If Weibull distribution then use "Weibull".

Details

This function helps to calculate MSE by using 19 different bandwidths which are Normal Scale Rule (NSR), Complete Cross Validation (CCV), Biased Cross Validation (BCV), Unbiased Cross Validation (UBCV), Direct Plug-In (DPI), Modified Cross Validation (MCV), Maximum Likelihood Cross Validation (MLCV), Trimmed Cross Validation (TCV),Smooth Cross Validation (SCV), Bootstrap without Sampling (bWOs), Bootstrap with Sampling (bWs), Bandwidth of Altman and Leger (AL),One-sided Cross Validation (OCV), Akaike information criterion (AIC),Indirect Cross Validation (ICV), Mallow' Cp (MallowCp), Generalized Cross Validation (GCV), Polansky and Baker Plug-In (PB), and Gasser, Kniep, and Köhler Cross Validation (GKK). For Laplace kernel see `laphcomp`

Value

MSE with 19 bandwidths, Ranks, Minimum MSE, Maximum MSE

Author(s)

Javaria Ahmad Khan, Atif Akbar.

References

Scaillet, O. 2004. Density estimation using inverse and reciprocal inverse Gaussian kernels. *Nonparametric Statistics*, **16**, 217-226.

Examples

```
y<-rexp(100,1)
 righcomp(y, 200, "Exp")
```

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