Package 'kde1d'

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Type Package

Title Univariate Kernel Density Estimation

Version 0.2.1

Description Provides an efficient implementation of univariate local polynomial kernel density estimators that can handle bounded and discrete data. See Geenens (2014) <arXiv:1303.4121>, Geenens and Wang (2018) <arXiv:1602.04862>, Nagler (2018a) <arXiv:1704.07457>, Nagler (2018b) <arXiv:1705.05431>.

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Encoding UTF-8

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LinkingTo BH, Rcpp, RcppEigen

Imports cctools, graphics, Rcpp, qrng, stats, utils

RoxygenNote 6.0.1

Suggests testthat

URL https://github.com/tnagler/kde1d

BugReports https://github.com/tnagler/kde1d/issues

SystemRequirements C++11

NeedsCompilation yes

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Repository CRAN

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R topics documented:

`kde1d-package` *One-Dimensional Kernel Density Estimation*

Description

Provides an efficient implementation of univariate local polynomial kernel density estimators that can handle bounded and discrete data. The implementation utilizes spline interpolation to reduce memory usage and computational demand for large data sets.

References

Geenens, G. (2014). *Probit transformation for kernel density estimation on the unit interval*. Journal of the American Statistical Association, 109:505, 346-358, arXiv:1303.4121

Geenens, G., Wang, C. (2018). *Local-likelihood transformation kernel density estimation for positive random variables.* Journal of Computational and Graphical Statistics, to appear, arXiv:1602.04862

Nagler, T. (2018a). *A generic approach to nonparametric function estimation with mixed data.* Statistics & Probability Letters, 137:326–330, arXiv:1704.07457

Nagler, T. (2018b). *Asymptotic analysis of the jittering kernel density estimator.* Mathematical Methods of Statistics, in press, arXiv:1705.05431

`dkde1d` *Working with a kde1d object*

Description

Density, distribution function, quantile function and random generation for a 'kde1d' kernel density estimate.

Usage

```
dkde1d(x, obj)

pkde1d(q, obj)

qkde1d(p, obj)

rkde1d(n, obj, quasi = FALSE)
```

Arguments

x	vector of density evaluation points.
obj	a kde1d object.
q	vector of quantiles.
p	vector of probabilities.
n	integer; number of observations.
quasi	logical; the default (FALSE) returns pseudo-random numbers, use TRUE for quasi-random numbers (generalized Halton, see qrng::ghalton()).

Details

dkde1d() gives the density, pkde1d() gives the distribution function, qkde1d() gives the quantile function, and rkde1d() generates random deviates.

The length of the result is determined by n for rkde1d(), and is the length of the numerical argument for the other functions.

Value

The density, distribution function or quantile functions estimates evaluated respectively at x, q, or p, or a sample of n random deviates from the estimated kernel density.

See Also

kde1d()

Examples

```
set.seed(0)              # for reproducibility
x <- rnorm(100)          # simulate some data
fit <- kde1d(x)          # estimate density
dkde1d(0, fit)           # evaluate density estimate (close to dnorm(0))
pkde1d(0, fit)           # evaluate corresponding cdf (close to pnorm(0))
qkde1d(0.5, fit)         # quantile function (close to qnorm(0))
hist(rkde1d(100, fit))   # simulate
```

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kde1d *Univariate local-polynomial likelihood kernel density estimation*

Description

The estimator can handle for bounded, unbounded, and discrete support, see *Details*.

Usage

```
kde1d(x, xmin = NaN, xmax = NaN, mult = 1, bw = NA, deg = 2)
```

Arguments

x	vector (or one-column matrix/data frame) of observations; can be numeric or ordered.
xmin	lower bound for the support of the density (only for continuous data); NaN means no boundary.
xmax	upper bound for the support of the density (only for continuous data); NaN means no boundary.
mult	positive bandwidth multiplier; the actual bandwidth used is $bw * mult$.
bw	bandwidth parameter; has to be a positive number or NA; the latter uses the direct plug-in methodology of Sheather and Jones (1991).
deg	degree of the polynomial; either 0, 1, or 2 for log-constant, log-linear, and log-quadratic fitting, respectively.

Details

A gaussian kernel is used in all cases. If xmin or xmax are finite, the density estimate will be 0 outside of $[xmin, xmax]$. A log-transform is used if there is only one boundary (see, Geenens and Wang, 2018); a probit transform is used if there are two (see, Geenens, 2014). Discrete variables are handled via jittering (see, Nagler, 2018a, 2018b).

Value

An object of class kde1d.

References

Geenens, G. (2014). *Probit transformation for kernel density estimation on the unit interval*. Journal of the American Statistical Association, 109:505, 346-358, arXiv:1303.4121

Geenens, G., Wang, C. (2018). *Local-likelihood transformation kernel density estimation for positive random variables.* Journal of Computational and Graphical Statistics, to appear, arXiv:1602.04862

Nagler, T. (2018a). *A generic approach to nonparametric function estimation with mixed data.* Statistics & Probability Letters, 137:326–330, arXiv:1704.07457

Nagler, T. (2018b). *Asymptotic analysis of the jittering kernel density estimator.* Mathematical Methods of Statistics, in press, arXiv:1705.05431

Sheather, S. J. and Jones, M. C. (1991). A reliable data-based bandwidth selection method for kernel density estimation. Journal of the Royal Statistical Society, Series B, 53, 683–690.

See Also

dkde1d(), pkde1d(), qkde1d(), rkde1d(), plot.kde1d(), lines.kde1d()

Examples

```
## unbounded data
x <- rnorm(500)                  # simulate data
```

```
fit <- kde1d(x)                   # estimate density
dkde1d(0, fit)                    # evaluate density estimate
summary(fit)                      # information about the estimate
plot(fit)                         # plot the density estimate
curve(dnorm(x), add = TRUE,       # add true density
      col = "red")

## bounded data, log-linear
x <- rgamma(500, shape = 1)       # simulate data
fit <- kde1d(x, xmin = 0, deg = 1) # estimate density
dkde1d(seq(0, 5, by = 1), fit)    # evaluate density estimate
summary(fit)                      # information about the estimate
plot(fit)                         # plot the density estimate
curve(dgamma(x, shape = 1),       # add true density
      add = TRUE, col = "red",
      from = 1e-3)

## discrete data
x <- rbinom(500, size = 5, prob = 0.5)  # simulate data
x <- ordered(x, levels = 0:5)           # declare as ordered
fit <- kde1d(x)                         # estimate density
dkde1d(sort(unique(x)), fit)            # evaluate density estimate
summary(fit)                            # information about the estimate
plot(fit)                               # plot the density estimate
points(ordered(0:5, 0:5),               # add true density
       dbinom(0:5, 5, 0.5), col = "red")
```

`plot.kde1d` *Plotting kde1d objects*

Description

Plotting kde1d objects

Usage

```
## S3 method for class 'kde1d'
plot(x, ...)

## S3 method for class 'kde1d'
lines(x, ...)
```

Arguments

`x`	kde1d object.
`...`	further arguments passed to `plot.default()`

See Also

kde1d()

Examples

```
## continuous data
x <- rbeta(100, shape1 = 0.3, shape2 = 0.4)   # simulate data
fit <- kde1d(x)                               # unbounded estimate
plot(fit, ylim = c(0, 4))                     # plot estimate
curve(dbeta(x, 0.3, 0.4),                     # add true density
      col = "red", add = TRUE)
fit_bounded <- kde1d(x, xmin = 0, xmax = 1)   # bounded estimate
lines(fit_bounded, col = "green")

## discrete data
x <- rpois(100, 3)                          # simulate data
x <- ordered(x, levels = 0:20)              # declare variable as ordered
fit <- kde1d(x)                             # estimate density
plot(fit, ylim = c(0, 0.25))                # plot density estimate
points(ordered(0:20, 0:20),                 # add true density values
       dpois(0:20, 3), col = "red")
```

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