Package ‘kde1d’

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Type Package

Title Univariate Kernel Density Estimation

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Suggests testthat

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

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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


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 `randtoolbox::sobol()`).

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

```r
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
```

---

**equi_jitter**

*Conditionally equidistant jittering*

Description

Converts ordered variables to numeric and Adds deterministic uniform noise. See Details.

Usage

```r
equi_jitter(x)
```
Arguments

x observations; the function does nothing if x is already numeric.

Details

Jittering makes discrete variables continuous by adding noise. This simple trick allows to consistently estimate densities with tools designed for the continuous case (see, Nagler, 2018a/b). The drawback is that estimates are random and the noise may deteriorate the estimate by chance.

Here, we add a form of deterministic noise that makes estimators well behaved. Tied occurrences of a factor level are spread out uniformly (i.e., equidistantly) on the interval [−0.5, 0.5]. This is similar to adding random noise that is uniformly distributed, conditional on the observed outcome. Integrating over the outcome, one can check that the unconditional noise distribution is also uniform on [−0.5, 0.5].

Asymptotically, the deterministic jittering variant is equivalent to the random one.

References


Examples

x <- as.factor(rbinom(10, 1, 0.5))
equi_jitter(x)

kde1d

Univariate local-polynomial likelihood kernel density estimation

Description

The estimators can handle data with bounded, unbounded, and discrete support, see Details.

Usage

kde1d(
  x,
  xmin = NaN,
  xmax = NaN,
  mult = 1,
  bw = NA,
  deg = 2,
  weights = numeric(0)
)
**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 $bw \times mult$.
- **bw**: bandwidth parameter; has to be a positive number or NA; the latter uses the plug-in methodology of Sheather and Jones (1991) with appropriate modifications for $deg > 0$.
- **deg**: degree of the polynomial; either 0, 1, or 2 for log-constant, log-linear, and log-quadratic fitting, respectively.
- **weights**: optional vector of weights for individual observations.

**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). A specific form of deterministic jittering is used, see `equi_jitter()`.

**Value**

An object of class kde1d.

**References**


**See Also**

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

```r
## 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"
)

## weighted estimate
x <- rnorm(100) # simulate data
weights <- rexp(100) # weights as in Bayesian bootstrap
fit <- kde1d(x, weights = weights) # weighted fit
plot(fit) # compare with unweighted fit
lines(kde1d(x), col = 2)
```

plot.kde1d

Plotting `kde1d` objects

Description

Plotting `kde1d` objects
Usage

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

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

Arguments

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

See Also

`kde1d()`

Examples

```r
## 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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