Package ‘bpkde’

February 19, 2015

Version 1.0-7
Date 2014-09-05
Title Back-Projected Kernel Density Estimation
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Suggests mvtnorm, KernSmooth
Description Nonparametric multivariate kernel density estimation using a back-projected kernel.
License GPL-2
Repository CRAN
Repository/R-Forge/Project bpkde
Repository/R-Forge/Revision 8
Repository/R-Forge/DateTimeStamp 2014-09-05 18:17:41
Date/Publication 2014-09-09 19:40:58
NeedsCompilation yes

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**bpk**

*Back Projected Kernel*

**Description**

Evaluate a d dimensional back projected kernel.

**Usage**

```r
bpk(x, bandwidths, a = 1.0, kernel = dnorm, ...)
```

**Arguments**

- `x`: a numeric matrix of dimension N by d who’s rows contain the points where the kernel will be evaluated.
- `bandwidths`: a list with elements `alphas`, the set of projection directions, and `lambdas`, their associated bandwidth estimates.
- `a`: a single numeric value containing a common scaling parameter.
- `kernel`: a function for evaluating the univariate kernel.
- `...`: additional arguments are ignored.

**Value**

a numeric vector where element i contains the value of the kernel evaluated at row i of X.

**Author(s)**

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**bpkde**

*Back-Projected Kernel Density Estimation*

**Description**

Compute a d-dimensional kernel density estimate using a back-projected kernel.

**Usage**

```r
bpkde(data, alphas, kernel = dnorm, bw = bw.SJ, score.fun = M1, r = 7, padding = 4)
```
Arguments

data: a matrix or data frame. The data is coerced to a numeric matrix using the `data.matrix` function.

alphas: a numeric matrix of dimension `d` by `K` whose columns contain the directions (as unit vectors) used for the back projection. If missing, 90 equally spaced directions spanning the interval \([-\pi/2, \pi/2]\) are used when `d == 2` and 450 randomly chosen directions are used when `d == 3`. This argument must be provided for `d >= 4`.

call: a function for evaluating the univariate kernel.

bw: the function used to compute the univariate bandwidth estimates.

score.fun: the function used to compute the least squares cross-validation score for the kernel; see `m0` and `mQ`.

r: the computations are performed using linear binning and the discrete Fourier transform. The number of the grid points used is `2^r`.

padding: a positive numeric value specifying the amount of zero-padding in units of bandwidth.

Value

a list with class `c("bpkde", "mvkdex")` containing the following elements.

- **axes**: a numeric matrix whose columns contain the grid points used along each axis to bin the data.
- **z**: a numeric array containing the discrete kernel density estimate.
- **params**: a list containing the optimal common scaling parameter `omega.hat`, the input set of directions `alphas`, and the computed univariate bandwidths `lambdas`.

References


Author(s)

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Examples

data(Trimodal2)
f.hat <- bpkde(Trimodal2)
discretize.kernel  Discretize Kernel

Description

Computes a discrete approximation of the kernel.

Usage

discretize.kernel(grid, kern.fun, ..., grid.fun = NULL, scale = TRUE)

Arguments

grid  a list created by the mvlinbin function.
kern.fun  a function for evaluating the kernel. The first argument must be a matrix whose rows contain the points where the density is to be evaluated. See, for example, the dmvnorm function in the mvtnorm package.
...  additional arguments are passed to kern.fun.
grid.fun  a function that returns the grid points where the kernel will be evaluated.
scale  a logical value. If TRUE then the kernel is scaled so that it integrates to 1 on the provided grid.

Value

a list with class kernel containing the following elements.

axes  a numeric matrix whose columns contain the grid points along each axis where the kernel was evaluated.
z  a numeric array containing the discrete representation of the kernel.
dft  a numeric array containing the discrete Fourier transform of the kernel z.
kern.fun  the name of kern.fun.
params  a list containing the parameters passed to kern.fun through ... .

Author(s)

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**kernels**

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**Univariate Kernels**

**Description**
Evaluate univariate kernels.

**Usage**

```
biweight(x)
epanechnikov(x)
rectangular(x)
triangular(x)
```

**Arguments**

- `x` a numeric vector.

**Value**
a numeric vector.

**Author(s)**
Kjell Konis <kjell.konis@me.com>

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**M0**

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**M0 Least-Squares Cross-Validation**

**Description**
Compute the M0 least-squares cross-validation score.

**Usage**

```
M0(grid, kern.fun, ...)
```

**Arguments**

- `grid` an object of class `linbin`.
- `kern.fun` the density function of the kernel. The first argument must be a matrix whose rows contain the points where the density function will be evaluated. See, for example, the `dmvnorm` function in the `mvtnorm` package.
- `...` additional arguments are passed to `kern.fun`. 
Value
a single numeric value: the M0 least-squares cross-validation score.

Author(s)
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References

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M1 Least-Squares Cross-Validation

Description
Compute the M1 least-squares cross-validation score.

Usage
M1(grid, kern.fun, ...)

Arguments
grid an object of class linbin.
kern.fun the density function of the kernel. The first argument must be a matrix whose rows contain the points where the density function will be evaluated. See, for example, the dmvnorm function in the mvtnorm package.
... additional arguments are passed to kern.fun.

Details
The computation is done using the Fourier transform of the kernel and the data as described in Silverman (1986).

Value
a single numeric value: the M1 least-squares cross-validation score.

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References
mvlinbin

Multivariate Linear Binning

Description

Compute a binned approximation of the data on a regularly spaced grid using the multivariate linear binning rule described in Wand (1994).

Usage

`mvlinbin(X, r = 7, padding)`

Arguments

- `x` a numeric matrix.
- `r` a positive integer value. The number of grid points $M$ in each dimension is given by $M = 2^r$.
- `padding` a numeric vector of positive values with length equal to the number of columns of `X` specifying the amount of zero-padding added to each coordinate direction. No padding is added when this argument is missing.

Value

a list with class `mvlinbin` containing the following elements.

- `axes` a numeric matrix whose columns contain the grid points used along each axis to bin the data.
- `xi` a numeric array containing the binned approximation of the data.
- `X` a numeric matrix containing the input data.
- `deltas` a numeric vector containing the grid spacing.
- `m` an integer value giving the number of grid points used in each coordinate direction.
- `n` an integer value containing the number of data points binned.
- `d` an integer value giving the dimensionality of the data.

Author(s)

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References

Example Data Sets from Wand & Jones

Description

The 12 normal mixture densities considered in Wand and Jones (1993).

Usage

data(Uncorrelated.Normal)
data(Correlated.Normal)
data(Skewed)
data(Kurtotic)
data(Bimodal1)
data(Bimodal2)
data(Bimodal3)
data(Bimodal4)
data(Trimodal1)
data(Trimodal2)
data(Trimodal3)
data(Quadrimodal)

Details

These 12 data sets consist of 500 points drawn from the Gaussian mixture distributions described in Wand and Jones (1993). The code is provided in the scripts subdirectory of this package.

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