Package ‘monreg’

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Title Nonparametric Monotone Regression

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Description Estimates monotone regression and variance functions in a nonparametric model, based on Dette, Holger, Neumeyer, and Pilz (2006) <doi:10.3150/bj/1151525131>.

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NeedsCompilation yes

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R topics documented:

monreg *Estimating Monotone Regression Functions Nonparametrically*

Description

monreg provides a strictly monotone estimator of the regression function based on the nonparametric regression model.

Usage

```
monreg(x, y, a = min(x), b = max(x), N = length(x), t = length(x),
       hd, Kd = "epanech", hr, Kr = "epanech", degree = 1,
       inverse = 0, monotonie = "isoton")
```

Arguments

x	vector containing the x-values (design points) of a sample
y	vector containing the y-values (response) of a sample
a	lower bound of the support of the design points density function, or smallest fixed design point
b	upper bound of the support of the design points density function, or largest fixed design point
N	number or vector of evaluation points of the unconstrained nonparametric regression estimator (e.g. Nadaraya-Watson estimator)
t	number or vector of points where the monotone estimation is computed
hd	bandwith of kernel K_d of the density estimation step
Kd	Kernel for the density estimation step (monotonization step). 'epanech' for Epanechnikov, 'rectangle' for rectangle, 'biweight' for biweight, 'triweight' for triweight, 'triangle' for triangle, 'cosine' for cosine kernel
hr	bandwith of kernel K_r of the regression estimation step.
Kr	Kernel for the regression estimation step (unconstrained estimation). 'epanech' for Epanechnikov, 'rectangle' for rectangle, 'biweight' for biweight, 'triweight' for triweight, 'triangle' for triangle, 'cosine' for cosine kernel.
degree	Determines the method for the unconstrained estimation. '0' for the classical Nadaraya-Watson estimate, '1' for the local linear estimate. As well degree can be the vector of the unconditional estimator provided by the user for the design points given in the vector N
inverse	For '0' the original regression function is estimated, for '1' the inverse of the regression function is estimated.
monotonie	Determines the type of monotonicity. 'isoton´ if the regression function is assumed to be isotone, 'antinton' if the regression function is assumed to be antitone.

Details

Nonparametric regression models are of the form $Y_i = m(X_i) + \sigma(X_i) \cdot \varepsilon_i$, where m is the regression funtion and σ the variance function. `monreg` performs a monotone estimate of the unknown regression function m. `monreg` first estimates m by an unconstrained nonparametric method, the classical Nadaraya-Watson estimate or the local- linear estimate (unless the user decides to pass his or her own estimate). In a second step the inverse of the (monotone) regression function is calculated, by monotonizing this unconstrained estimate. With the above notation and $\hat{m}$ for the unconstrained estimate, the second step writes as follows,

$$\hat{m}_I^{-1} = \frac{1}{Nh_d} \sum_{i=1}^{N} \int_{-\infty}^{t} K_d \Big(\frac{\hat{m}(\frac{i}{N}) - u}{h_d} \Big) \, du.$$

Finally, the monotone estimate achieved by inversion of $\hat{m}_I^{-1}$.

Value

`monreg` returns a list of values

`xs`	the input values x, standardized on the interval $[0, 1]$
`y`	input variable y
`z`	the points, for which the unconstrained function is estimated
`t`	the points, for which the monotone function values will be estimated
`length.x`	length of the vector x
`length.z`	length of the vector z
`length.t`	length of the vector t
`hd`	bandwidth used with the Kernel K_d
`hr`	bandwidth used with the Kernel K_r
`Kd`	kernel used for the monotonization step
`Kr`	kernel used for the initial unconstrained regression estimate
`degree`	method, which was used for the unconstrained regression estimate
`ldeg.vektor`	length of the vector degree. If ldeg.vektor is not equal to 1 the user provided the vector of the unconditional estimator for the design points given in the vector N
`inverse`	indicates, if the origin regression function or its inverse has been estimated
`estimation`	the monotone estimate at the design points t

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Author(s)

This R Package was developed by Kay Pilz and Stefanie Titoff. Earlier developements of the estimator were made by Holger Dette and Kay Pilz.

See Also

`monvardiff` and `monvarresid` for monotone variance function estimation.

Examples

```
x <- rnorm(100)
y <- x + rnorm(100)
mon1 <- monreg(x, y, hd = .5, hr = .5)
plot(mon1$t, mon1$estimation)
```

`monvardiff` *Estimating Monotone Variance Functions Using Pseudo-Residuals*

Description

monvardiff provides a strictly monotone estimator of the variance function based on the nonparametric regression model.

Usage

```
monvardiff(x,y,a=min(x),b=max(x),N=length(x),t=length(x),r=2,hr,Kr="epanech",
           hd,Kd="epanech",degree=1,inverse=0,monotonie="isoton")
```

Arguments

`x`	vector containing the x-values (design points) of a sample
`y`	vector containing the y-values (response) of a sample
`a`	lower bound of the support of the design points density function, or smallest fixed design point
`b`	upper bound of the support of the design points density function, or largest fixed design point
`N`	number or vector of evaluation points of the unconstrained nonparametric variance estimator (e.g. Nadaraya-Watson estimator)
`t`	number or vector of points where the monotone estimation is computed
`r`	order of the difference scheme, i.e. weights $d_0, ..., d_r$ to calculate the pseudo-residuals
`hr`	bandwith of kernel Kr of the variance estimation step
`Kr`	Kernel for the variance estimation step (unconstrained estimation). 'epanech' for Epanechnikov, 'rectangle' for rectangle, 'biweight' for biweight, 'triweight' for triweight, 'triangle' for triangle, 'cosine' for cosine kernel
`hd`	bandwith of kernel K_d of the density estimation step
`Kd`	Kernel for the density estimation step (monotonization step). 'epanech' for Epanechnikov, 'rectangle' for rectangle, 'biweight' for biweight, 'triweight' for triweight, 'triangle' for triangle, 'cosine' for cosine kernel
`degree`	determines the method for the unconstrained variance estimation. '0' for the classical Nadaraya-Watson estimate, '1' for the local linear estimate. As well `degree` can be the vector of the unconditional estimator provided by the user for the design points given in the vector `N`

`inverse`	for '0' the original variance function is estimated, for '1' the inverse of the variance function is estimated.
`monotonie`	determines the type of monotonicity. 'isoton' if the variance function is assumed to be isotone, 'antinton' if the variance function is assumed to be antitone.

Details

Nonparametric regression models are of the form $Y_i = m(X_i) + \sigma(X_i) \cdot \varepsilon_i$, where m is the regression funtion and σ the variance function. `monvardiff` performs a monotone estimate of the unknown variance function $s = \sigma^2$. `monvardiff` first estimates s by an unconstrained nonparametric method, the classical Nadaraya-Watson estimate or the local- linear estimate (unless the user decides to pass his or her own estimate). This estimation contains the usage of the Pseudo-Residuals. In a second step the inverse of the (monotone) variance function is calculated by monotonizing the unconstrained estimate from the first step. With the above notation and $\hat{s}$ for the unconstrained estimate, the second step writes as follows,

$$\hat{s}_I^{-1} = \frac{1}{Nh_d} \sum_{i=1}^{N} \int_{-\infty}^{t} K_d \Big(\frac{\hat{s}(\frac{i}{N}) - u}{h_d} \Big) \, du.$$

Finally, the monotone estimate is achieved by inversion of $\hat{s}_I^{-1}$.

Value

`monvardiff` returns a list of values

`xs`	the input values x, standardized on the interval $[0, 1]$
`y`	input variable y
`z`	the points, for which the unconstrained function is estimated
`t`	the points, for which the monotone variance function will be estimated
`length.x`	length of the vector x
`length.z`	length of the vector z
`length.t`	length of the vector t
`r`	order of the difference scheme, i.e. number of weights to calculate the pseudo-residuals
`hr`	bandwidth used with the Kernel K_r
`hd`	bandwidth used with the Kernel K_d
`Kr`	kernel used for the unconstrained variance estimate
`Kd`	kernel used for the monotonization step
`degree`	method, which was used for the unconstrained variance estimate
`ldeg.vektor`	length of the vector degree. If ldeg.vektor is not equal to 1 the user provided the vector of the unconditional variance estimator for the design points given in the vector N
`inverse`	indicates, if the origin variance function or its inverse has been estimated
`estimation`	the monotone estimate at the design points t

Author(s)

This R Package was developed by Kay Pilz and Stefanie Titoff. Earlier developements of the estimator were made by Holger Dette and Kay Pilz.

See Also

`monreg` for monotone regression function estimation and `monvarresid` for monotone variance function estimation by nonparametric residuals.

`monvarresid` *Estimating Monotone Variance Functions Using Nonparametric Residuals*

Description

monvarresid provides a strictly monotone estimator of the variance function based on the nonparametric regression model.

Usage

```
monvarresid(x,y,a=min(x),b=max(x),N=length(x),t=length(x),h,K="epanech",hd,Kd="epanech",
           hr,Kr="epanech",mdegree=1,sdegree=1,inverse=0,monotonie="isoton")
```

Arguments

`x`	vector containing the x-values (design points) of a sample
`y`	vector containing the y-values (response) of a sample
`a`	lower bound of the support of the design points density function, or smallest fixed design point
`b`	upper bound of the support of the design points density function, or largest fixed design point
`N`	number or vector of evaluation points of the unconstrained nonparametric variance estimator (e.g. Nadaraya-Watson estimator)
`t`	number or vector of points where the monotone estimation is computed
`h`	bandwith of kernel K of the regression estimation step
`K`	Kernel for the regression estimation step. 'epanech' for Epanechnikov, 'rectangle' for rectangle, 'biweight' for biweight, 'triweight' for triweight, 'triangle' for triangle, 'cosine' for cosine kernel
`hd`	bandwith of kernel K_d of the density estimation step
`Kd`	Kernel for the density estimation step (monotonization step). 'epanech' for "Epanechnikov, 'rectangle' for rectangle, 'biweight' for biweight, 'triweight' for triweight, 'triangle' for triangle, 'cosine' for cosine kernel
`hr`	bandwith of kernel K_r of the variance estimation step

Kr
: Kernel for the variance estimation step (unconstrained estimation). 'epanech' for "Epanechnikov, 'rectangle' for rectangle, 'biweight' for biweight, 'triweight' for triweight, 'triangle' for triangle, 'cosine' for cosine kernel.

mdegree
: determines the method for the regression estimation. '0'for the classical Nadaraya-Watson estimate, '1' for the local linear estimate. As well `mdegree` can be the vector of the estimator provided by the user for the design points given by the vector `x`

sdegree
: Determines the method for the unconstrained variance estimation. '0' for the classical Nadaraya-Watson estimate, '1' for the local linear estimate. As well `sdegree` can be the vector of the unconditional estimator provided by the user for the design points given by the vector `N`

inverse
: For '0' the original variance function is estimated, for '1' the inverse of the variance function is estimated.

monotonie
: Determines the type of monotonicity. 'isoton' if the variance function is assumed to be isotone, 'antinton' if the variance function is assumed to be antitone.

Details

Nonparametric regression models are of the form $Y_i = m(X_i)+\sigma(X_i)\cdot\varepsilon_i$, where m is the regression funtion and σ the variance function. `monvarresid` performs a monotone estimate of the unknown variance function $s = \sigma^2$. `monvarresid` first estimates m by an unconstrained nonparametric method, the classical Nadaraya-Watson estimate or the local-linear estimate (unless the user decides to pass his or her own estimate). In a second step an unconstrained estimation for s is performed, again by the classical Nadaraya-Watson method or the local-linear estimate (unless the user decides to pass his or her own estimate). In a third step the inverse of the (monotone) variance function is calculated, by monotonizing the unconstrained estimate from the second step. With the above notation and $\hat{s}$ for the unconstrained estimate, the third step writes as follows,

$$\hat{s}_I^{-1} = \frac{1}{Nh_d} \sum_{i=1}^{N} \int_{-\infty}^{t} K_d\Big(\frac{\hat{s}(\frac{i}{N}) - u}{h_d}\Big)\, du.$$

Finally, the monotone estimate is achieved by inversion of $\hat{s}_I^{-1}$.

Value

`monvarresid` returns a list of values

xs
: the input values x, standardized on the interval $[0, 1]$

y
: input variable y

z
: the points, for which the unconstrained function is estimated

t
: the points, for which the monotone variance function will be estimated

length.x
: length of the vector x

length.z
: length of the vector z

length.t
: length of the vector t

h	bandwidth used with the Kernel K
hd	bandwidth used with the Kernel K_d
hr	bandwidth used with the Kernel K_r
K	kernel used for the regression estimation step
Kd	kernel used for the monotonization step
Kr	kernel used for the unconstrained variance estimate
mdegree	method, which was used for the unconstrained regression estimate
lmdeg	length of the vector mdegree. If lmdeg is not equal to 1 the user provided the vector of the unconditional regression estimator for the design points given by the vector x
sdegree	method, which was used for the unconstrained variance estimate
lsdeg	length of the vector sdegree. If lsdeg is not equal to 1 the user provided the vector of the unconditional variance estimator for the design points given by the vector N
inverse	indicates, if the origin variance function or its inverse has been estimated
estimation	the monotone estimate for the variance function at the design points t

Author(s)

This R Package was developed by Kay Pilz and Stefanie Titoff. Earlier developements of the estimator were made by Holger Dette and Kay Pilz.

See Also

`monreg` for monotone regression function estimation and `monvardiff` for monotone variance function estimation by differences.

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