Package 'HEAT'

February 19, 2015

Type Package

Title Health Effects of Air Pollution and Temperature (HEAT)

Version 1.2

Date 2013-10-03

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Description Timeseries analysis is conducted using Korean mortality and environmental variables

Depends R (>= 2.10), splines

License GPL-2

LazyLoad yes

NeedsCompilation no

Repository CRAN

Date/Publication 2013-10-03 19:37:08

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HEAT-package *Health Effects of Air pollution and Temperature (HEAT)*

Description

Package HEAT provides Korea data of mortality and environment variables for time-series analysis. The package includes several functions to read specific city information, generate single and moving average lag days, and estimate a threshold point in a nonlinear relationship.

Details

Package:	HEAT
Type:	Package
Version:	1.2
Date:	2013-10-03
License:	GPL-2
LazyLoad:	yes

The package can be used to analyze Korea mortality and environment data, providing following functions: function `read6city` to load a single city's data, function `lagdata` to generate exposure variables at single and moving average lag days, function `threshpt` to estimate threshold point of a nonlinear relationship (e.g., U-, V-, or J-shape), function `summary.threshpt` to give summary informations for a fitted threshpt object, function `plot.threshpt` to produce some informative plots, and function `rrcalc` to calculate relative risks and their 95% confidence intervals below and above a threshold.

The package was supported by the Basic Science Research Program (#2010-0009581), International Research & Development Program (#2012K1A3A1A12054839), Women Scientist Research Program (#2012R1A1A3005549) and Global Research Lab (#K21004000001-10A0500-00710) through the National Research Foundation of Korea (NRF) funded by the Korea Ministry of Science, ICT (Information and Communication Technologies) and Future Planning.

Author(s)

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See Also

read6city, lagdata, threshpt

Examples

```
# read the Seoul data set and create lag variables
data(mort)
```

```
seoul = read6city(mort, 11)
seoul_lag = lagdata(seoul, c("meantemp", "mintemp", "meanpm10", "meanhumi"), 5)

# find a optimal threshold and conduct piecewise linear regression
mythresh = threshpt(nonacc ~ meantemp_m3 + meanpm10_m2 +  meanhumi + ns(sn, 4*10) + factor(dow),
     expvar = "meantemp_m3", family = "poisson", data = seoul_lag,
     startrng = 23, endrng = 33, searchunit = 0.2)

# provide summary informations
summary(mythresh)
```

`lagdata` *Creating single lagged and moving average variables*

Description

Function `lagdata` creates single lagged and moving average variables of the lag number that the user designate.

Usage

```
lagdata(data, varlist, laglength)
```

Arguments

`data`	Data includes lagged variables.
`varlist`	List of variables to be lagged.
`laglength`	Number of lag days.

Details

Certain exposure on the previous days has an effect on the event on now day. This effect is referred to as the lagged effects. Studies wanting to estimate lagged effects would include the exposure value for previous days in the time series model, and those wanting to estimate cumulative effect of the same day and the previous days would include the moving average value of the exposure.

Value

`lagdata` gives single lagged variables (varname_sxx, xx indicates lag length) and moving average variables (varname_mxx).

Author(s)

Youn-Hee Lim, Il-Sang Ohn, and Ho Kim

References

Dominici F. Time-series analysis of air pollution and mortality: a statistical review. Research report (Health Effects Institute), (123):3, 2004.
Gasparrini A and Armstrong B. Time series analysis on the health effects of temperature: advancements and limitations. Environmental research, 110(6):633-638, 2010.

Examples

```
# read the data
data(mort)
seoul = read6city(mort, 11)

# create lagged and moving average variables
seoul_lag = lagdata(seoul, c("meantemp", "mintemp", "meanpm10", "meanhumi"), 5)
```

`mort` *Data for Korean six cities*

Description

Mortality, air pollution and, meteorological data for six major cities (Seoul, Busan, Daegu, Incheon, Gwangju, and Daejeon) in Korea

Usage

```
data(mort)
```

Format

A data frame with 20454 observations on the following 24 variables.

`ccode` city code

`cname` a factor with levels `bs` `dg` `dj` `gj` `ic` `sl` `ul`

`yy` Year

`mm` Month

`dd` Day

`date` Date

`nonacc` Total moratliy excluding accidental mortality

`cardio` Cardiovascular mortality

`respir` Respiratory mortality

`influenza` Influenza epidemics (0,1)

`meanpm10` Daily average PM10 concentrations (ug/m3)

`meanso2` Daily average SO2 concentrations (ppb)

`meanno2` Daily average NO2 concentrations (ppb)

`meanco` Daily average CO concentrations (10ppm)

`maxco` Daily Maximum CO concentrations (10ppm)

`maxo3` Daily Maximum O3 concentrations (ppb)

`meantemp` Daily mean temperature (celcius)

`maxtemp` Daily maximum temperature (celcius)

`mintemp` Daily min temperature (celcius)

`meanhumi` Daily mean relative humidity (percent)

`meanpress` Daily mean air pressure (hPa)

`season` 1=spring, 2=summer, 3=fall, 4=winter

`dow` day of week, 1=Sun, ..., 7=Sat

`sn` sequential number of observations

Examples

```
data(mort)
## maybe str(mort) ; plot(mort) ...
```

`plot.threshpt` *Plots from a threshpt Object*

Description

Following four plots from a fitted `threshpt` object are provided:
Plot 1: plot for a response variable on the natural cubic spline of a exposure variable
Plot 2: plot for fitted response values with other mean covariates and 95% confidence intervals
Plot 3: plot for fitted response values
Plot 4: deviance by threshold point plot

Usage

```
## S3 method for class 'threshpt'
plot(x, select = NULL, se = T, expdf = 4,
xlim = NULL, ylim = NULL, xaxt = NULL, yaxt = NULL,
col.value = NULL, col.preval = NULL, col.ci = NULL, col.vline = NULL,
lwd = NULL, pch = NULL, pch.preval = NULL, main = NULL, xlab = NULL, ylab = NULL, ...)
```

Arguments

`x`	A fitted `threshpt` object produced by `threshpt()`
`select`	Select a plot type
`se`	When TRUE (default) upper and lower confidence interval lines are added to the plot 1 and 4. When FALSE, otherwise.

expdf	Degree of freedom of natural cubic spline function for the main exposure variable in plot 1; default value is four.
xlim	The x limits of the plot.
ylim	The y limits of the plot.
xaxt	A character which specifies the x axis type.
yaxt	A character which specifies the y axis type.
col.value	The color of main values or line in all kind of plot.
col.preval	The color of fitted value in plot 3.
col.ci	The color of confidence interval lines in plot 1 and 3.
col.vline	The color of vertical line that represents a optimum threshold in plot 2, 3 and 4.
lwd	Line width for plot 1
pch	Either an integer specifying a symbol or a single character to be used in plotting points in plot 2 and 3.
pch.preval	Either an integer specifying a symbol or a single character to be used in plotting fitted values in plot 3.
main	Overall title of the plot.
xlab	A title for the x axis of the plot
ylab	A title for the y axis of the plot
...	Not used.

Value

Generated four kind of plots from a fitted threshpt object

Author(s)

Youn-Hee Lim, Il-Sang Ohn, and Ho Kim

Examples

```
# read the Seoul data set and create lag variables
data(mort)
seoul = read6city(mort, 11)
seoul_lag = lagdata(seoul, c("meantemp", "mintemp", "meanpm10", "meanhumi"), 5)

# find a optimal threshold and conduct piecewise linear regression
mythresh = threshpt(nonacc ~ meantemp_m3 + meanpm10_m2 +  meanhumi + ns(sn, 4*10) + factor(dow),
     expvar = "meantemp_m3", family = "poisson", data = seoul_lag,
     startrng = 23, endrng = 33, searchunit = 0.2)

# obtain plots
plot(mythresh, select = 1, se = TRUE, expdf=8, col.value = "blue", col.ci = "light blue")
plot(mythresh, select = 2, se = FALSE, col.vline = "orange")
plot(mythresh, select = 3, pch = 1, pch.preval = 2)
plot(mythresh, select = 4)
```

print.summary.threshpt *Summary for a Threshpt fit*

Description

A default print method for summary informations for a `threshpt` object.

Usage

```
## S3 method for class 'summary.threshpt'
print(x, ...)
```

Arguments

`x`	Summary informations for a fitted `threshpt` object produced by threshpt()
`...`	Not used

Value

`Formula`	the formula which is used in the threshpt function
`Best fit`	estimated parameter coefficients of model with the minimum deviance
`Deviance`	deviance of fitted model
`Threshold`	threshold value of the model with the minimum deviance

Author(s)

Youn-Hee Lim, Il-Sang Ohn, and Ho Kim

print.threshpt *Print a threshpt Object*

Description

A default print method for a `threshpt` object

Usage

```
## S3 method for class 'threshpt'
print(x, ...)
```

Arguments

`x`	a fitted `threshpt` object produced by `threshpt()`
`...`	Not used

Value

`threshpt` returns a optimal threshold and estimates/etandard errors/p-values for the coefficients of a fitted `threshpt` object provided by `threshpt()`.

Author(s)

Youn-Hee Lim, Il-Sang Ohn, and Ho Kim

`read6city` *Read data for six major cities in Korea*

Description

`read6city` extracts a city-specific data set from `mort` data set.

Usage

```
read6city(data, code)
```

Arguments

`data`	data can be `mort` from `data(mort)`.
`code`	code must be one of the following: 11 for Seoul, 23 for Incheon 25 for Daejeon 22 for Daegu 21 for Busan 24 for Gwangju

Author(s)

Youn-Hee Lim, Il-Sang Ohn, and Ho Kim

Examples

```
data(mort)
seoul = read6city(mort, 11)
```

`rrcalc` *Estimation of relative risk*

Description

`rrcalc` caculates relative risks below and above a threshold. Relative risks and the 95% C.I.s of lower unit and upper unit based on the threshold are estimated.

Usage

```
rrcalc(object, rrunit = 1)
```

Arguments

`object`	a fitted `threshpt` object produced by `threshpt()`.
`rrunit`	Unit of relative risk.

Details

In GLM with log link, the coefficients of the exposure are equal to log values of RR. `rrcalc` gives relative risks in log link GLM, particularly, Poisson regression model.

Value

The results of "<Threshold" mean that the relative risk and 95% confidence interval when the exposure increases by `rrunit` below threshold. The results of ">=Threshold" mean those when the exposure increases by `rrunit` above threshold.
RR = exp(beta*rrunit) and 95% C.I = exp((beta-1.96*s.e(beta), beta+1.96*s.e(beta))*rrunit)

Author(s)

Youn-Hee Lim, Il-Sang Ohn, and Ho Kim

Examples

```
# read the Seoul data set and create lag variables
data(mort)
seoul = read6city(mort, 11)
seoul_lag = lagdata(seoul, c("meantemp", "mintemp", "meanpm10", "meanhumi"), 5)

# find a optimal threshold and conduct piecewise linear regression
mythresh = threshpt(nonacc ~ meantemp_m3 + meanpm10_m2 +  meanhumi + ns(sn, 4*10) + factor(dow),
     expvar = "meantemp_m3", family = "poisson", data = seoul_lag,
     startrng = 23, endrng = 33, searchunit = 0.2)


# calculate relative risks
rrcalc(mythresh)
```

summary.threshpt *Summary informations for a fitted* threshpt *object.*

Description

summary provides summary statistics for a threshpt object produced by threshpt()

Usage

```
## S3 method for class 'threshpt'
summary(object, ...)
```

Arguments

object	a fitted threshpt object produced by threshpt()
...	Not used

Value

summary.threshpt produces a list of summary informations for a fitted threshpt object with components

Formula	the formula which is used in the threshpt function
Best fit	estimated parameter coefficients of model with the minimum deviance
Deviance	deviance of a fitted threshpt model
Threshold	threshold value of the model with the minimum deviance

Author(s)

Youn-Hee Lim, Il-Sang Ohn, and Ho Kim

Examples

```
# read the Seoul data set and create lag variables
data(mort)
seoul = read6city(mort, 11)
seoul_lag = lagdata(seoul, c("meantemp", "mintemp", "meanpm10", "meanhumi"), 5)

# find a optimal threshold and conduct piecewise linear regression
mythresh = threshpt(nonacc ~ meantemp_m3 + meanpm10_m2 +  meanhumi + ns(sn, 4*10) + factor(dow),
     expvar = "meantemp_m3", family = "poisson", data = seoul_lag,
     startrng = 23, endrng = 33, searchunit = 0.2)

# provide summary informations
summary(mythresh)
```

threshpt *Conducting Piecewise Linear Regression*

Description

Function threshpt estimates a optimal threshold point of non-linear relationship using a piecewise linear regression analysis. A user needs to give approximate threshold point range to start, then threshpt finds optimal threshold point within the given approximate range using grid search method (see details).

Usage

```
threshpt(formula = formula, family = family, data = data, expvar = expvar,
startrng = startrng, endrng = endrng, searchunit = searchunit, ...)
```

Arguments

formula	An object of class formula, which is same as the formula in the glm.
family	Family of distribution which is same as the family in the glm syntax.
data	Data to be used
expvar	Main exposure variable (X)
startrng	Approximate starting point
endrng	Approximate ending point
searchunit	Unit to search for a threshold point
...	Not used

Details

threshpt() estimates a optimal threshold point based on grid search method which finds the point that produces minimum deviance among the equally spaced grid points. This method widely used in environmetal epidemiologic studies.

Value

threshpt returns a optimal threshold and estimates/etandard errors/p-values for the coefficients of a fitted model with optimal threshold.

Author(s)

Youn-Hee Lim, Il-Sang Ohn, and Ho Kim

References

Lerman P. Fitting segmented regression models by grid search. Applied Statistics, 23(1):77-84, 1980.
Kim H, Ha JS, and Park J. High temperature, heat index, and mortality in 6 major cities in south korea. Archives of environmental & occupational health, 61(6):265-270, 2006.
Kim SY, Lee JT, Hong YC, Ahn KJ, and Kim H. Determining the threshold effect of ozone on daily mortality: an analysis of ozone and mortality in seoul, korea, 1995-1999. Environmental research, 94(2):113-119, 2004.
Stafoggia M et al. Short-term associations between fine and coarse particulate matter and hospitalizations in Southern Europe: results from the MED-PARTICLES project. Environmental health perspective, 121(8):932-938, 2013.

See Also

modTempEff

Examples

```
# read the Seoul data set and create lag variables
data(mort)
seoul = read6city(mort, 11)
seoul_lag = lagdata(seoul, c("meantemp", "mintemp", "meanpm10", "meanhumi"), 5)

# find a optimal threshold and conduct piecewise linear regression
mythresh = threshpt(nonacc ~ meantemp_m3 + meanpm10_m2 +  meanhumi + ns(sn, 4*10) + factor(dow),
     expvar = "meantemp_m3", family = "poisson", data = seoul_lag,
     startrng = 23, endrng = 33, searchunit = 0.2)
mythresh
```

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