Package: leiv (via r-universe)

September 2, 2024

Version 2.0-7

Type Package

Title Bivariate Linear Errors-In-Variables Estimation

Date 2015-01-11

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Depends R (>= 2.9.0)

Imports methods, stats, graphics

Suggests grDevices

Description Estimate the slope and intercept of a bivariate linear relationship by calculating a posterior density that is invariant to interchange and scaling of the coordinates.

License GPL (>= 2)

URL http://www.r-project.org

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NeedsCompilation no

Date/Publication 2015-01-11 16:53:08

Repository https://davidsleonard.r-universe.dev

RemoteUrl https://github.com/cran/leiv

RemoteRef HEAD

RemoteSha 756d6a3dc88bea4c8d9b8eed8d660ce519a534f2

Contents

leiv *Bivariate Linear Errors-In-Variables Estimation*

Description

Generates a linear errors-in-variables object.

Usage

```
leiv(formula, data, subset, prior = NULL,
      n = NULL, cor = NULL, sdRatio = NULL, xMean = 0, yMean = 0,
      probIntCalc = FALSE, level = 0.95, subdivisions = 100,
      rel.tol = .Machine$double.eps^0.25, abs.tol = 0.1*rel.tol, ...)

## S4 method for signature 'leiv'
print(x, digits = max(3, getOption("digits") - 3), ...)
## S4 method for signature 'leiv,missing'
plot(x, plotType = "density", xlim = NULL, ylim = NULL,
     xlab = NULL, ylab = NULL, col = NULL, lwd = NULL, ...)
```

Arguments

formula	an optional object of class "formula" (or one that can be coerced to that class): a symbolic description of the model to be fitted. The details of model specification are given in the 'Details' section of the documentation for lm. An intercept is always included and integrated out as a nuisance parameter: y ~ x, y ~ 0 + x, and y ~ x - 1 are equivalent. If not provided, the sufficient statistics n, cor, and sdRatio must be provided.
data	an optional data frame (or object coercible by as.data.frame to a data frame) containing the variables in the model. If not found in data, the variables are taken from environment(formula), typically the environment from which leiv is called.
subset	an optional vector specifying a subset of observations to be used in the fitting process.
prior	an optional object of class leiv to use as the prior density of the scale invariant slope; otherwise the rotationally invariant Cauchy density is used.
n	an optional sample size (if formula is missing).
cor, sdRatio	optional sample correlation cor(x,y) and ratio sd(y)/sd(x) (if formula is missing).
xMean, yMean	optional sample means mean(x) and mean(y) (if formula is missing).
probIntCalc	logical; if TRUE returns the shortest (100*level)% probability intervals; if FALSE (the default) no probability intervals are returned.
level	the probability level requested (if probIntCalc = TRUE).
subdivisions	the maximum number of subintervals (see integrate).

rel.tol	the relative accuracy requested (see integrate).
abs.tol	the absolute accuracy requested (see integrate).
x	a leiv object.
digits	controls formating of numeric objects.
plotType	specifies the type of plot; if plotType = "density" (the default) then the posterior density of the slope is plotted; if plotType = "scatter" then a scatter plot with the fitted line.
xlim, ylim	x limits c(x1,x2) and y limits c(y1,y2) of the plot.
xlab, ylab	labels for the x and y axes of the plot.
col, lwd	color and width of plotted lines.
...	additional argument(s) for generic methods.

Details

Use leiv to estimate the slope and intercept of a bivariate linear relationship when both variables are observed with error. The method is exact when the true values and the errors are normally distributed. The posterior density depends on the data only through the correlation coefficient and ratio of standard deviations; it is invariant to interchange and scaling of the coordinates.

Value

leiv returns an object of class "leiv" with the following components:

slope	the (posterior median) slope estimate.
intercept	the (maximum likelihood) intercept estimate.
slopeInt	the shortest (100*level)% probability interval of the slope.
interceptInt	the shortest (100*level)% probability interval of the intercept.
density	the posterior probability density function.
n	the number of (x,y) pairs.
cor	the sample correlation cor(x,y).
sdRatio	the ratio sd(y)/sd(x).
xMean	the sample mean mean(x).
yMean	the sample mean mean(y).
call	the matched call.
probIntCalc	the logical probability interval request.
level	the probability level of the probability interval.
x	the x data.
y	the y data.

Note

Numerical integration is used to normalize the posterior density. When the data is nearly linear, normalization using the default tolerance parameters may fail. Specifying `abs.tol = 1e-6` (or smaller) may help, but expect a longer run time. In general, `rel.tol` cannot be less than `max(50*.Machine$double.eps, 0.5e-28)` if `abs.tol <= 0`. In addition, when using a sharply peaked `leiv` object as a prior density, normalization may fail. In this case, an alternative is to first fit using the default Cauchy prior, then multiply by the appropriate ratio of prior densities and tackle the normalization outside of the `leiv` environment.

Author(s)

David Leonard

References

Leonard, David. (2011). "Estimating a Bivariate Linear Relationship." *Bayesian Analysis*, 6:727-754. DOI:10.1214/11-BA627.

Zellner, Arnold. (1971). *An Introduction to Bayesian Inference in Econometrics*, Chapter 5. John Wiley & Sons.

See Also

`lm` for formula syntax; `integrate` for control parameters.

Examples

```
## generate artificial data
set.seed(1123)
n <- 20
X <- rnorm(n, mean=5, sd=4) # true x
x <- X + rnorm(n, mean=0, sd=5) # observed x
Y <- 2 + X # true y
y <- Y + rnorm(n, mean=0, sd=3) # observed y

## fit with default options
fit <- leiv(y ~ x)
print(fit)
plot(fit) # density plot
dev.new()
plot(fit,plotType="scatter")

## calculate a density to use as an informative prior density of
## the scale invariant slope in a subsequent fit
fit0 <- leiv(n=10, cor=0.5, sdRatio=1.0)
print(fit0)

## refit the data using the informative prior density
fit1 <- leiv(y ~ x, prior=fit0, abs.tol=1e-6)
print(fit1)
```

leiv-internal *Probability Density Utilities*

Description

p50 calculates the median of the leiv posterior probability density. probInt calculates the shortest probability interval of the leiv posterior probability density for a given probability level.

Usage

```
p50(p, interval, subdivisions = 100,
      rel.tol = .Machine$double.eps^0.25,
      abs.tol = rel.tol)

probInt(p, interval, level, subdivisions = 100,
      rel.tol = .Machine$double.eps^0.25,
      abs.tol = rel.tol)
```

Arguments

p	a normalized probability density function.
interval	a vector containing the endpoints of the interval to be searched.
level	the probability level requested.
subdivisions	the maximum number of subintervals (see integrate).
rel.tol	the relative accuracy requested (see integrate).
abs.tol	the absolute accuracy requested (see integrate, optimize and uniroot).

Details

Internal functions for integrating the posterior density returned by the function leiv. These functions are not meant to be called by the user.

Value

p50 returns a numeric scalar. probInt returns a 2-dimensional numeric vector of interval endpoints.

Note

p must accept a vector of inputs and produce a vector of function evaluations at those points. rel.tol cannot be less than max(50*.Machine$double.eps, 0.5e-28) if abs.tol <= 0.

See Also

leiv for general information; integrate for control parameters.

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