Package ‘leiv’

October 13, 2022

Version 2.0-7
Type Package
Title Bivariate Linear Errors-In-Variables Estimation
Date 2015-01-11
Maintainer David Leonard <davidsleonard@outlook.com>
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
Author David Leonard [aut, cre]
NeedsCompilation no
Repository CRAN
Date/Publication 2015-01-11 16:53:08

R topics documented:

leiv .................................................. 2
leiv-internal ........................................ 5

Index 6
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 \texttt{integrate}).
abs.tol  the absolute accuracy requested (see \texttt{integrate}).
x       a \texttt{leiv} object.
digits  controls formatting of \texttt{numeric} objects.
plotType specifies the type of plot; if \texttt{plotType = "density"} (the default) then the posterior density of the slope is plotted; if \texttt{plotType = "scatter"} then a scatter plot with the fitted line.
xlim, ylim  \texttt{x limits c(x1,x2) and y limits c(y1,y2) of the plot.}
xlab, ylab  labels for the \texttt{x} and \texttt{y} axes of the plot.
col, lwd  color and width of plotted lines.
... additional argument(s) for generic methods.

Details
Use \texttt{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
\texttt{leiv} returns an object of class \texttt{"leiv"} with the following components:
slope    the (posterior median) slope estimate.
intercept the (maximum likelihood) intercept estimate.
slopeInt the shortest \((100*\text{level})\%\) probability interval of the slope.
interceptInt the shortest \((100*\text{level})\%\) probability interval of the intercept.
density  the posterior probability density function.
n       the number of \((x,y)\) pairs.
cor     the sample correlation \texttt{cor(x,y)}.
sdRatio  the ratio \texttt{sd(y)/sd(x)}.
xMean    the sample mean \texttt{mean(x)}.
yMean    the sample mean \texttt{mean(y)}.
call     the matched call.
probIntCalc the logical probability interval request.
level    the probability level of the probability interval.
x       the \texttt{x} data.
y       the \texttt{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 
\[
\min(50\cdot\text{Machine}$\cdot$double.eps, 0.5e-28)
\] 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


See Also

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

Examples

```r
## 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)
```
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

\[
p50(p, \text{interval}, \text{subdivisions} = 100, \\
rel.tol = .Machine$double.eps^0.25, \\
abs.tol = rel.tol)
\]

\[
\text{probInt}(p, \text{interval}, \text{level}, \text{subdivisions} = 100, \\
rel.tol = .Machine$double.eps^0.25, \\
abs.tol = rel.tol)
\]

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. \( \text{rel.tol} \) cannot be less than \( \max(50*.\text{Machine$double.\text{eps}}, 0.5e^{-28}) \) if \( \text{abs.tol} \leq 0 \).

See Also

- leiv for general information; integrate for control parameters.
Index

* models
  leiv, 2
* regression
  leiv, 2

as.data.frame, 2
formula, 2
integrate, 2–5
leiv, 2, 5
leiv-class (leiv), 2
leiv-internal, 5
leiv-package (leiv), 2
lm, 2, 4
numeric, 3
optimize, 5

p50 (leiv-internal), 5
plot, ANY, ANY-method (leiv), 2
plot, leiv, missing-method (leiv), 2
plot-methods (leiv), 2
print, ANY-method (leiv), 2
print, leiv-method (leiv), 2
print-methods (leiv), 2
probInt (leiv-internal), 5

unirout, 5