

# Package ‘lmodel2’

December 5, 2024

**Title** Model II Regression

**Version** 1.7-4

**Description** Computes model II simple linear regression using ordinary least squares (OLS), major axis (MA), standard major axis (SMA), and ranged major axis (RMA).

**BugReports** <https://github.com/vegandevs/lmodel2/issues>

**License** GPL-2

**LazyLoad** yes

**NeedsCompilation** no

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**Repository** CRAN

**Date/Publication** 2024-12-05 08:40:02 UTC

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lmodel2                      *Model II regression*

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## Description

This function computes model II simple linear regression using the following methods: ordinary least squares (OLS), major axis (MA), standard major axis (SMA), and ranged major axis (RMA). The model only accepts one response and one explanatory variable.

**Usage**

```
lmodel2(formula, data = NULL, range.y=NULL, range.x=NULL, nperm=0)
```

**Arguments**

formula	A formula specifying the bivariate model, as in <a href="#">lm</a> and <a href="#">aov</a> .
data	A data frame containing the two variables specified in the formula.
range.y, range.x	Parametres for ranged major axis regression (RMA). If range.y = NULL and range.x = NULL, RMA will not be computed. If only one of them is NULL, the program will stop. If range.y = "relative": variable y has a true zero (relative-scale variable). If range.y = "interval": variable y possibly includes negative values (interval-scale variable). If range.x = "relative": variable x has a true zero (relative-scale variable). If range.x = "interval": variable x possibly includes negative values (interval-scale variable)
nperm	Number of permutations for the tests. If nperm = 0, tests will not be computed.

**Details**

Model II regression should be used when the two variables in the regression equation are random, i.e. not controlled by the researcher. Model I regression using least squares underestimates the slope of the linear relationship between the variables when they both contain error. Ordinary least squares (OLS) is, however, appropriate in some cases as a model II regression model; see the "Model II User's guide, R edition" which you can read using command `vignette("mod2user")`.

The model II regression methods of ordinary least squares (OLS), major axis (MA), standard major axis (SMA), and ranged major axis (RMA) are described in Legendre and Legendre (2012, Section 10.3.2). OLS, MA, and SMA are also described in Sokal and Rohlf (1995). The PDF document "Model II User's guide, R edition" provided with this function contains a tutorial for model II regression, and can be read with command `vignette("mod2user")`.

The `plot` function plots the data points together with one of the regression lines, specified by `method="OLS"`, `method="MA"` (default), `method="SMA"`, or `method="RMA"`, and its 95 percent confidence interval.

**Value**

The default output provides the regression output. It draws information from a list, produced by function `lmodel2`, which contains the following elements:

y	The response variable.
x	The explanatory variable.
regression.results	A table with rows corresponding to the four regression methods. Column 1 gives the method name, followed by the intercept and slope estimates, the angle between the regression line and the abscissa, and the permutational probability (one-tailed, for the tail corresponding to the sign of the slope estimate).
confidence.intervals	A table with rows corresponding to the four regression methods. The method name is followed by the parametric 95 the intercept and slope estimates.

eigenvalues	Eigenvalues of the bivariate dispersion, computed during major axis regression.
H	The H statistic used for computing the confidence interval of the major axis slope. Notation following Sokal and Rohlf (1995).
n	Number of objects.
r	Correlation coefficient.
rsquare	Coefficient of determination (R-square) of the OLS regression.
P.param	2-tailed parametric P-value for the test of r and the OLS slope.
theta	Angle between the two OLS regression lines, $lm(y \sim x)$ and $lm(x \sim y)$ .
nperm	Number of permutations for the permutation tests.
epsilon	Any value smaller than epsilon is considered to be zero.
info.slope	Information about the slope notation when $r = 0$ .
info.CI	Information about the confidence limits notation when the slope is infinite.
call	Call of the function.

### Note

The package exports only the main functions `lmodel2`, `plot.lmodel2` and `lines.lmodel2`. Much of the work is done by internal functions which are not directly visible, but you can use triple colon to see or directly use these functions (e.g., `lmodel2:::print.lmodel2`). Internal functions that perform essential parts of the analysis are `MA.reg`, `SMA.reg`, `CLma`, `CLsma` and `permutest.lmodel2`.

### Author(s)

Pierre Legendre, Departement de Sciences Biologiques, Universite de Montreal

### References

- Legendre, P. and L. Legendre. 2012. Numerical ecology, 3rd English edition. Elsevier Science BV, Amsterdam.
- Sokal, R. R. and F. J. Rohlf. 1995. Biometry – The principles and practice of statistics in biological research. 3rd edition. W. H. Freeman, New York.

### See Also

A tutorial (file “Model II User’s guide, R edition”) is provided with this function, and can be read within R session using command `vignette("mod2user", package="lmodel2")`.

### Examples

```
## The example data files are described in more detail in the
## \dQuote{Model II User's guide, R edition} tutorial.

## Example 1 (surgical unit data)
data(mod2ex1)
Ex1.res <- lmodel2(Predicted_by_model ~ Survival, data=mod2ex1, nperm=99)
Ex1.res
```

```

plot(Ex1.res)

## Example 2 (eagle rays and Macomona)
data(mod2ex2)
Ex2.res <- lmodel2(Prey ~ Predators, data=mod2ex2, "relative", "relative", 99)
Ex2.res
op <- par(mfrow = c(1,2))
plot(Ex2.res, "SMA")
plot(Ex2.res, "RMA")
par(op)

## Example 3 (cabezon spawning)
op <- par(mfrow = c(1,2))
data(mod2ex3)
Ex3.res <- lmodel2(No_eggs ~ Mass, data=mod2ex3, "relative", "relative", 99)
Ex3.res
plot(Ex3.res, "SMA")
plot(Ex3.res, "RMA")
par(op)

## Example 4 (highly correlated random variables)
op <- par(mfrow=c(1,2))
data(mod2ex4)
Ex4.res <- lmodel2(y ~ x, data=mod2ex4, "interval", "interval", 99)
Ex4.res
plot(Ex4.res, "OLS")
plot(Ex4.res, "MA")
par(op)

# Example 5 (uncorrelated random variables)
data(mod2ex5)
Ex5.res <- lmodel2(random_y ~ random_x, data=mod2ex5, "interval", "interval", 99)
Ex5.res
op <- par(mfrow = c(2,2))
plot(Ex5.res, "OLS")
plot(Ex5.res, "MA")
plot(Ex5.res, "SMA")
plot(Ex5.res, "RMA")
par(op)

## Example 6 where cor(y,x) = 0 by construct (square grid of points)

y0 = rep(c(1,2,3,4,5),5)
x0 = c(rep(1,5),rep(2,5),rep(3,5),rep(4,5),rep(5,5))
plot(x0, y0)
Ex6 = as.data.frame(cbind(x0,y0))
zero.res = lmodel2(y0 ~ x0, data=Ex6, "relative", "relative")
print(zero.res)
op <- par(mfrow = c(1,2))
plot(zero.res, "OLS")
plot(zero.res, "MA")
par(op)

```

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`mod2ex1`*Example Data Sets for Model II Regression*

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**Description**

These example data sets for model II regression are discussed in the [vignette](#) “Model II Regression User Guide”.

**Usage**

```
data(mod2ex1)
```

**Format**

See [vignette](#) “Model II Regression User Guide”.

**Examples**

```
data(mod2ex1)
```

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