

# Package ‘collin’

May 8, 2026

**Title** Visualization the Effects of Collinearity in Distributed Lag Models and Other Linear Models

**Version** 0.0.4

**Description** Tool to assessing whether the results of a study could be influenced by collinearity. Simulations under a given hypothesized truth regarding effects of an exposure on the outcome are used and the resulting curves of lagged effects are visualized. A user’s manual is provided, which includes detailed examples (e.g. a cohort study looking for windows of vulnerability to air pollution, a time series study examining the linear association of air pollution with hospital admissions, and a time series study examining the non-linear association between temperature and mortality). The methods are described in Basagana and Barrera-Gomez (2021) <[doi:10.1093/ije/dyab179](https://doi.org/10.1093/ije/dyab179)>.

**Depends** R (>= 4.1)

**License** GPL-3

**Encoding** UTF-8

**LazyData** true

**Imports** dlnm, graphics, grDevices, MASS, mgcv, nlme, stats, utils, VGAM

**Suggests** knitr, rmarkdown, splines, xtable

**RoxygenNote** 7.2.3

**VignetteBuilder** knitr

**NeedsCompilation** no

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**Repository** CRAN

**Date/Publication** 2023-09-19 09:00:06 UTC

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collindlnm	<i>Simulates effects from a distributed lag model pattern.</i>
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### Description

Simulates results from a distributed lag model under an hypothetical effect pattern provided by the user, which can be linear or non-linear. The output is the passed to the plot method to visualize consequences of collinearity.

### Usage

```
collindlnm(
  model,
  x,
  cb,
  at = 1,
  cen = 0,
  effect,
  type = c("coef", "risk"),
  shape = c("linear", "nonlinear"),
  nsim = 100,
  verbose = TRUE,
  seed = NULL
)
```

### Arguments

model	a model that includes a crossbasis. Currently, models allowed are those of class "glm" or "lme", if shape = "linear"; or "glm", if shape = "nonlinear".
x	if shape = "linear", a matrix that includes the values of the predictor under study, in the first column, and the lagged values, up to the maximum lag considered, as the subsequent columns. If shape = "nonlinear", a numeric vector or 1-column matrix including the original (i.e. lag 0) values of the predictor.
cb	an object of class "crossbasis". The crossbasis included in model.

at	the increase(s) in the predictor under study to be considered to report the effects of the variable. If shape = "linear", at must be a single number. If shape = "nonlinear", at must be a numeric vector with at least two different values.
cen	a number. Reference value of the predictor under study, used to calculate effects. If shape = "linear", the value of cen is irrelevant (and it is internally set to 0).
effect	a vector or a matrix, depending on shape, including the hypothetical effect of the predictor under analysis. If shape = "linear", a vector including the linear effect at each lag (including lag 0). If shape = "nonlinear", a matrix including the effect at each lag (including lag 0) (columns) and for each value in at (rows).
type	a character. If type = "coef" (default), effect is supposed to be in the linear predictor scale (i.e. it is considered as regression coefficients in model). If type = "risk", effect is supposed to be in terms of relative risks (i.e. exp(coef), as ORs or RRs in logistic or Poisson families, respectively). If model is of class "lme", then it must be type = "coef" (default).
shape	the shape of the relationship between the linear predictor of the model and the outcome. Default is "linear".
nsim	number of simulations. Default is 100.
verbose	a logical value indicating output status messages. Default is TRUE.
seed	a number. Seed for reproducibility of results. Default is NULL (no seed).

**Value**

A list including the results of the simulations to be passed to the plot method.

**See Also**

[crossbasis](#), [glm](#), [lme](#).

**Examples**

```
# For detailed examples:
browseVignettes("collin")
```

---

lagpad

*Function to get a vector lagged.*

---

**Description**

Function to get a vector lagged.

**Usage**

```
lagpad(x, k)
```

**Arguments**

**x** numeric vector to be lagged.  
**k** number of lags to be applied.

**Value**

A lagged vector.

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 mempm25

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*Working memory test scores and air pollution.*


---

**Description**

Simulated data for repeated measures of working memory test scores and residential PM<sub>2.5</sub> levels in 2,221 children.

**Usage**

mempm25

**Format**

A data frame with 8,884 rows and 17 variables:

**id** individual identifier

**session** test session identifier

**school** school identifier

**sex** sex of individual

**agecen** age of individual, centered at the mean, in years

**educ** maternal education

**resses** residential neighborhood socioeconomic status indicator

**pm25y0** estimated average concentration of PM<sub>2.5</sub> ( $\mu\text{g}/\text{m}^3$ ) at residence address during pregnancy

**pm25y1** estimated average concentration of PM<sub>2.5</sub> ( $\mu\text{g}/\text{m}^3$ ) at residence address during year 1

**pm25y2** estimated average concentration of PM<sub>2.5</sub> ( $\mu\text{g}/\text{m}^3$ ) at residence address during year 2

**pm25y3** estimated average concentration of PM<sub>2.5</sub> ( $\mu\text{g}/\text{m}^3$ ) at residence address during year 3

**pm25y4** estimated average concentration of PM<sub>2.5</sub> ( $\mu\text{g}/\text{m}^3$ ) at residence address during year 4

**pm25y5** estimated average concentration of PM<sub>2.5</sub> ( $\mu\text{g}/\text{m}^3$ ) at residence address during year 5

**pm25y6** estimated average concentration of PM<sub>2.5</sub> ( $\mu\text{g}/\text{m}^3$ ) at residence address during year 6

**pm25y7** estimated average concentration of PM<sub>2.5</sub> ( $\mu\text{g}/\text{m}^3$ ) at residence address during year 7

**wei** weight of the observation

**wmemo** working memory test score

## Details

This is a synthetic dataset generated with the synthpop package, based on a cohort study of children examining the association between  $PM_{2.5}$  concentrations during the prenatal period and the first seven postnatal years on cognitive tests taken at age 8 (see ‘References’).

## Source

See ‘References’.

## References

Rivas I *et al.* Association between Early Life Exposure to Air Pollution and Working Memory and Attention. *Environmental Health Perspectives*. 2019;127(5):57002. doi: 10.1289/EHP3169.

## Examples

```
# correlation of air pollution levels between two different periods:
pm25yearly <- mempm25[, grep("pm25", names(mempm25))]
print(cor(pm25yearly, use = "complete.obs"), digits = 2)
```

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plot.collindlnmlinear *Visualizes effects of collinearity in distributed lag model under an hypothetical linear effect pattern.*

---

## Description

Visualize the results from a distributed lag model under an hypothetical linear effect pattern provided by the user, generated using the function `collindlnm`.

## Usage

```
## S3 method for class 'collindlnmlinear'
plot(x, lags = NULL, ...)
```

## Arguments

x	an object of class "collindlnmlinear", which is generated by the function <code>collindlnm</code> with shape = "linear".
lags	a number or a numeric vector indicating at what lags the results will be visualized. Default (NULL) shows all lags.
...	other parameters to be passed through to plot function.

## Value

A plot showing a comparison between the results under the fitted model and the results under the hypothetical true effect.

**See Also**

[collindlnm](#), [plot.collindlnmnonlinear](#).

**Examples**

```
# For detailed examples:
browseVignettes("collin")
```

---

```
plot.collindlnmnonlinear
```

*Visualize effects of collinearity in distributed lag model under an hypothetical non-linear effect pattern.*

---

**Description**

Visualize the results from a distributed lag model under an hypothetical non-linear effect pattern provided by the user, generated using the function [collindlnm](#). The number of plots shown is equal to the number of values passed by `at` in the function [collindlnm](#). The way in which these plots are displayed is controlled by the user through the argument `show`.

**Usage**

```
## S3 method for class 'collindlnmnonlinear'
plot(
  x,
  lags = NULL,
  show = c("manual", "auto", "sequence"),
  addlegend = TRUE,
  varlegend = NULL,
  ...
)
```

**Arguments**

<code>x</code>	an object of class "collindlnmnonlinear", which is generated by the function <a href="#">collindlnm</a> with <code>shape = "nonlinear"</code> .
<code>lags</code>	a number or a numeric vector indicating at what lags the results will be visualized. Default (NULL) shows all lags.
<code>show</code>	character indicating how the multiple plots will be shown. If <code>show = "manual"</code> , then it is expected that the user have previously set the graphical parameters to arrange them (i.e. setting <code>mfrow</code> ) with <a href="#">par</a> . If <code>show = "auto"</code> , then the arrangement of the plots (i.e. the value of <code>mfrow</code> ) is automatically set. If <code>show = "sequence"</code> , then the plots are sequentially overlaid.
<code>addlegend</code>	logical indicating whether a legend indicating at what value (of <code>at</code> passed in <a href="#">collindlnm</a> ) the results correspond to.
<code>varlegend</code>	character indicating the label for the explored variable to be shown in the legend.
<code>...</code>	other parameters to be passed through to plot function.

**Value**

A plot showing a comparison between results under the fitted model and the results under the hypothetical true effect, for each of the different values of the variable of interest where effects were explored.

**See Also**

[collindlnm](#), [plot.collindlnmlinear](#).

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rhospno2

*Respiratory hospital admissions and air pollution.*

---

**Description**

Simulated data for daily measures of hospital admissions for respiratory causes count and ambient air NO<sub>2</sub> concentrations during 10 years.

**Usage**

```
rhospno2
```

**Format**

A data frame with 3,652 rows and 7 variables:

**date** date of the observation

**t** numerical indicator of date

**year** year indicator

**dow** day of week

**temp** ambient temperature in Celsius degrees

**no2** NO<sub>2</sub> concentration in  $\mu\text{g}/\text{m}^3$

**hresp** number of hospital admissions for respiratory causes

**Details**

This is a synthetic dataset generated with the `synthpop` package, based on true data on daily number of hospital admissions for respiratory causes and ambient air NO<sub>2</sub> concentrations in the city of Barcelona (Spain) for years 2006-2015.

**Examples**

```
# time series:
par(las = 1, mfrow = c(3, 1))
with(rhospno2, plot(date, hresp, type = "l", lwd = 0.5))
with(rhospno2, plot(date, no2, type = "l", lwd = 0.5))
with(rhospno2, plot(date, temp, type = "l", lwd = 0.5))
```

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simulatedlrm	<i>simulatedllm generic.</i>
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### Description

Simulation procedure internally called by the [collindlrm](#) function for a given hypothetical effect.

### Usage

```
simulatedlrm(x)

## S3 method for class 'linearlme'
simulatedlrm(x)

## S3 method for class 'linearglm'
simulatedlrm(x)

## S3 method for class 'nonlinearglm'
simulatedlrm(x)
```

### Arguments

x                    an object internally generated by the [collindlrm](#) function.

### Methods (by class)

- `simulatedlrm(linearlme)`: case of a hypothetical linear effect in a model of class "lme".
- `simulatedlrm(linearglm)`: case of a hypothetical linear effect in a model of class "glm".
- `simulatedlrm(nonlinearglm)`: case of a hypothetical non-linear effect in a model of class "glm".

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