

Package ‘insight’

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Type Package

Title Easy Access to Model Information for Various Model Objects

Description A tool to provide an easy, intuitive and consistent access to information contained in various R models, like model formulas, model terms, information about random effects, data that was used to fit the model or data from response variables. 'insight' mainly revolves around two types of functions: Functions that find (the names of) information, starting with 'find_', and functions that get the underlying data, starting with 'get_'. The package has a consistent syntax and works with many different model objects, where otherwise functions to access these information are missing.

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Maintainer Daniel Lüdtke <d.luedtke@uke.de>

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URL <https://easystats.github.io/insight/>

BugReports <https://github.com/easystats/insight/issues>

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Author Daniel Lüdtke [aut, cre] (<<https://orcid.org/0000-0002-8895-3206>>),
Dominique Makowski [aut, ctb] (<<https://orcid.org/0000-0001-5375-9967>>)

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all_models_equal	<i>Checks if all objects are models of same class</i>
------------------	---

Description

Small helper that checks if all objects are *supported* (regression) model objects and of same class.

Usage

```
all_models_equal(..., verbose = FALSE)
```

Arguments

... A list of objects.
 verbose Toggle off warnings.

Value

A logical, TRUE if x are all supported model objects of same class.

Examples

```
library(lme4)
data(mtcars)
data(sleepstudy)

m1 <- lm(mpg ~ wt + cyl + vs, data = mtcars)
m2 <- lm(mpg ~ wt + cyl, data = mtcars)
m3 <- lmer(Reaction ~ Days + (1 | Subject), data = sleepstudy)
m4 <- glm(formula = vs ~ wt, family = binomial(), data = mtcars)

all_models_equal(m1, m2)
all_models_equal(m1, m2, m3)
all_models_equal(m1, m4, m2, m3, verbose = TRUE)
all_models_equal(m1, m4, mtcars, m2, m3, verbose = TRUE)
```

clean_names	<i>Get clean names of model terms</i>
-------------	---------------------------------------

Description

This function "cleans" names of model terms (or a character vector with such names) by removing patterns like log() or as.factor() etc.

Usage

```
clean_names(x)
```

Arguments

x A fitted model, or a character vector.

Value

The "cleaned" variable names as character vector, i.e. pattern like s() for splines or log() are removed from the model terms.

Note

If x is a regression model, this function is equal to calling find_terms().

Examples

```
# example from ?stats::glm
counts <- c(18, 17, 15, 20, 10, 20, 25, 13, 12)
outcome <- c(gl(3, 1, 9))
treatment <- gl(3, 3)
m <- glm(counts ~ log(outcome) + as.factor(treatment), family = poisson())
clean_names(m)
```

download_model	<i>Download circus models</i>
----------------	-------------------------------

Description

Downloads pre-compiled models from the *circus*-repository. The *circus*-repository contains a variety of fitted models to help the systematic testing of other packages

Usage

```
download_model(name, url = NULL)
```

Arguments

name	Model name.
url	String with the URL from where to download the model data. Optional, and should only be used in case the repository-URL is changing. By default, models are downloaded from https://raw.githubusercontent.com/easystats/circus/master/data/ .

Details

The code that generated the model is available at the <https://easystats.github.io/circus/reference/index.html>.

Value

A model from the *circus*-repository.

References

<https://easystats.github.io/circus/>

find_algorithm	<i>Find sampling algorithm and optimizers</i>
----------------	---

Description

Returns information on the sampling or estimation algorithm as well as optimization functions, or for Bayesian model information on chains, iterations and warmup-samples.

Usage

```
find_algorithm(x, ...)
```

Arguments

x	A fitted model.
...	Currently not used.

Value

A list with elements depending on the model.

For frequentist models:

- `algorithm`, for instance "OLS" or "ML"
- `optimizer`, name of optimizing function, only applies to specific models (like gam)

For frequentist mixed models:

- `algorithm`, for instance "REML" or "ML"
- `optimizer`, name of optimizing function

For Bayesian models:

- `algorithm`, the algorithm
- `chains`, number of chains
- `iterations`, number of iterations per chain
- `warmup`, number of warmups per chain

Examples

```
library(lme4)
data(sleepstudy)
m <- lmer(Reaction ~ Days + (1 | Subject), data = sleepstudy)
find_algorithm(m)

## Not run:
library(rstanarm)
m <- stan_lmer(Reaction ~ Days + (1 | Subject), data = sleepstudy)
find_algorithm(m)
## End(Not run)
```

find_formula	<i>Find model formula</i>
--------------	---------------------------

Description

Returns the formula(s) for the different parts of a model (like fixed or random effects, zero-inflated component, ...).

Usage

```
find_formula(x, ...)
```

Arguments

x	A fitted model.
...	Currently not used.

Value

A list of formulas that describe the model. For simple models, only one list-element, conditional, is returned. For more complex models, the returned list may have following elements:

- conditional, the "fixed effects" part from the model
- random, the "random effects" part from the model (or the id for gee-models and similar)
- zero_inflated, the "fixed effects" part from the zero-inflation component of the model
- zero_inflated_random, the "random effects" part from the zero-inflation component of the model
- dispersion, the dispersion formula
- instruments, for fixed-effects regressions like ivreg, felm or plm, the instrumental variables
- cluster, for fixed-effects regressions like felm, the cluster specification
- correlation, for models with correlation-component like gls, the formula that describes the correlation structure
- slopes, for fixed-effects individual-slope models like feis, the formula for the slope parameters

Note

For models of class lme or gls the correlation-component is only returned, when it is explicitly defined as named argument (form), e.g. corAR1(form = ~1 | Mare)

Examples

```
data(mtcars)
m <- lm(mpg ~ wt + cyl + vs, data = mtcars)
find_formula(m)
```

find_parameters	<i>Find names of model parameters</i>
-----------------	---------------------------------------

Description

Returns the names of model parameters, like they typically appear in the `summary()` output. For Bayesian models, the parameter names equal the column names of the posterior samples after coercion from `as.data.frame()`.

Usage

```
find_parameters(x, flatten = FALSE, ...)
```

```
## S3 method for class 'brmsfit'
find_parameters(x, flatten = FALSE,
  parameters = NULL, ...)
```

```
## S3 method for class 'stanreg'
find_parameters(x, flatten = FALSE,
  parameters = NULL, ...)
```

```
## S3 method for class 'stanmvreg'
find_parameters(x, flatten = FALSE,
  parameters = NULL, ...)
```

Arguments

<code>x</code>	A fitted model.
<code>flatten</code>	Logical, if TRUE, the values are returned as character vector, not as list. Duplicated values are removed.
<code>...</code>	Currently not used.
<code>parameters</code>	Regular expression pattern that describes the parameters that should be returned.

Value

A list of parameter names. For simple models, only one list-element, `conditional`, is returned. For more complex models, the returned list may have following elements:

- `conditional`, the "fixed effects" part from the model
- `random`, the "random effects" part from the model
- `zero_inflated`, the "fixed effects" part from the zero-inflation component of the model
- `zero_inflated_random`, the "random effects" part from the zero-inflation component of the model
- `dispersion`, the dispersion parameters
- `simplex`, simplex parameters of monotonic effects (**brms** only)

- smooth_terms, the smooth parameters
- within, the within-subject effects of Anovas (aov()) with error term
- between, the between-subjects effects of Anovas (aov()) with error term

Examples

```
data(mtcars)
m <- lm(mpg ~ wt + cyl + vs, data = mtcars)
find_parameters(m)
```

find_predictors	<i>Find names of model predictors</i>
-----------------	---------------------------------------

Description

Returns the names of the predictor variables for the different parts of a model (like fixed or random effects, zero-inflated component, ...). Unlike [find_parameters](#), the names from `find_predictors()` match the original variable names from the data that was used to fit the model.

Usage

```
find_predictors(x, effects = c("fixed", "random", "all"),
  component = c("all", "conditional", "zi", "zero_inflated",
    "dispersion", "instruments", "correlation"), flatten = FALSE)
```

Arguments

x	A fitted model.
effects	Should variables for fixed effects, random effects or both be returned? Only applies to mixed models. May be abbreviated.
component	Should all predictor variables, predictor variables for the conditional model, the zero-inflated part of the model, the dispersion term or the instrumental variables be returned? Applies to models with zero-inflated and/or dispersion formula, or to models with instrumental variable (so called fixed-effects regressions). May be abbreviated.
flatten	Logical, if TRUE, the values are returned as character vector, not as list. Duplicated values are removed.

Value

A list of character vectors that represent the name(s) of the predictor variables. Depending on the combination of the arguments `effects` and `component`, the returned list has following elements:

- conditional, the "fixed effects" terms from the model
- random, the "random effects" terms from the model
- zero_inflated, the "fixed effects" terms from the zero-inflation component of the model

- zero_inflated_random, the "random effects" terms from the zero-inflation component of the model
- dispersion, the dispersion terms
- instruments, for fixed-effects regressions like ivreg, fe1m or plm, the instrumental variables
- correlation, for models with correlation-component like gls, the variables used to describe the correlation structure

Examples

```
data(mtcars)
m <- lm(mpg ~ wt + cyl + vs, data = mtcars)
find_predictors(m)
```

find_random	<i>Find names of random effects</i>
-------------	-------------------------------------

Description

Return the name of the grouping factors from mixed effects models.

Usage

```
find_random(x, split_nested = FALSE, flatten = FALSE)
```

Arguments

x	A fitted mixed model.
split_nested	Logical, if TRUE, terms from nested random effects will be returned as separated elements, not as single string with colon. See 'Examples'.
flatten	Logical, if TRUE, the values are returned as character vector, not as list. Duplicated values are removed.

Value

A list of character vectors that represent the name(s) of the random effects (grouping factors). Depending on the model, the returned list has following elements:

- random, the "random effects" terms from the conditional part of model
- zero_inflated_random, the "random effects" terms from the zero-inflation component of the model

Examples

```

library(lme4)
data(sleepstudy)
sleepstudy$mygrp <- sample(1:5, size = 180, replace = TRUE)
sleepstudy$mysubgrp <- NA
for (i in 1:5) {
  filter_group <- sleepstudy$mygrp == i
  sleepstudy$mysubgrp[filter_group] <-
    sample(1:30, size = sum(filter_group), replace = TRUE)
}

m <- lmer(
  Reaction ~ Days + (1 | mygrp / mysubgrp) + (1 | Subject),
  data = sleepstudy
)

find_random(m)
find_random(m, split_nested = TRUE)

```

find_random_slopes *Find names of random slopes*

Description

Return the name of the random slopes from mixed effects models.

Usage

```
find_random_slopes(x)
```

Arguments

x A fitted mixed model.

Value

A list of character vectors with the name(s) of the random slopes, or NULL if model has no random slopes. Depending on the model, the returned list has following elements:

- random, the random slopes from the conditional part of model
- zero_inflated_random, the random slopes from the zero-inflation component of the model

Examples

```

library(lme4)
data(sleepstudy)

m <- lmer(Reaction ~ Days + (1 + Days | Subject), data = sleepstudy)
find_random_slopes(m)

```

find_response	<i>Find name of the response variable</i>
---------------	---

Description

Returns the name(s) of the response variable(s) from a model object.

Usage

```
find_response(x, combine = TRUE)
```

Arguments

x	A fitted model.
combine	Logical, if TRUE and the response is a matrix-column, the name of the response matches the notation in formula, and would for instance also contain patterns like "cbind(...)". Else, the original variable names from the matrix-column are returned. See 'Examples'.

Value

The name(s) of the response variable(s) from x as character vector.

Examples

```
library(lme4)
data(cbpp)
cbpp$trials <- cbpp$size - cbpp$incidence
m <- glm(cbind(incidence, trials) ~ period, data = cbpp, family = binomial)

find_response(m, combine = TRUE)
find_response(m, combine = FALSE)
```

find_terms	<i>Find names of all model terms</i>
------------	--------------------------------------

Description

Returns a list with the names of all model terms, including response value and random effects.

Usage

```
find_terms(x, effects = c("all", "fixed", "random"),
  component = c("all", "conditional", "zi", "zero_inflated",
    "dispersion", "instruments"), flatten = FALSE)
```

Arguments

x	A fitted model.
effects	Should variables for fixed effects, random effects or both be returned? Only applies to mixed models. May be abbreviated.
component	Should all predictor variables, predictor variables for the conditional model, the zero-inflated part of the model, the dispersion term or the instrumental variables be returned? Applies to models with zero-inflated and/or dispersion formula, or to models with instrumental variable (so called fixed-effects regressions). May be abbreviated.
flatten	Logical, if TRUE, the values are returned as character vector, not as list. Duplicated values are removed.

Value

A list with (depending on the model) following elements (character vectors):

- response, the name of the response variable
- conditional, the names of the predictor variables from the *conditional* model (as opposed to the zero-inflated part of a model)
- random, the names of the random effects (grouping factors)
- zero_inflated, the names of the predictor variables from the *zero-inflated* part of the model
- zero_inflated_random, the names of the random effects (grouping factors)
- dispersion, the name of the dispersion terms
- instruments, the names of instrumental variables

Note

The difference to [find_variables](#) is that `find_terms()` returns each term only once, while `find_variables()` may return a variable multiple times in case of multiple transformations.

Examples

```
library(lme4)
data(cbpp)
data(sleepstudy)
# some data preparation...
cbpp$trials <- cbpp$size - cbpp$incidence
sleepstudy$mygrp <- sample(1:5, size = 180, replace = TRUE)
sleepstudy$mysubgrp <- NA
for (i in 1:5) {
  filter_group <- sleepstudy$mygrp == i
  sleepstudy$mysubgrp[filter_group] <-
    sample(1:30, size = sum(filter_group), replace = TRUE)
}

m1 <- glmer(
  cbind(incidence, size - incidence) ~ period + (1 | herd),
```

```

    data = cbpp,
    family = binomial
  )
  find_terms(m1)

m2 <- lmer(
  Reaction ~ Days + (1 | mygrp / mysubgrp) + (1 | Subject),
  data = sleepstudy
)
find_terms(m2)
find_terms(m2, flatten = TRUE)

```

find_variables	<i>Find names of all variables</i>
----------------	------------------------------------

Description

Returns a list with the names of all variables, including response value and random effects, "as is". This means, on-the-fly transformations like `log()`, `I()`, `as.factor()` etc. are preserved.

Usage

```
find_variables(x, flatten = FALSE, ...)
```

Arguments

<code>x</code>	A fitted model.
<code>flatten</code>	Logical, if TRUE, the values are returned as character vector, not as list. Duplicated values are removed.
<code>...</code>	Currently not used.

Value

A list with (depending on the model) following elements (character vectors):

- `response`, the name of the response variable
- `conditional`, the names of the predictor variables from the *conditional* model (as opposed to the zero-inflated part of a model)
- `random`, the names of the random effects (grouping factors)
- `zero_inflated`, the names of the predictor variables from the *zero-inflated* part of the model
- `zero_inflated_random`, the names of the random effects (grouping factors)
- `dispersion`, the name of the dispersion terms
- `instruments`, the names of instrumental variables

Note

The difference to `find_terms` is that `find_variables()` may return a variable multiple times in case of multiple transformations (see examples below), while `find_terms()` returns each term only once.

Examples

```
library(lme4)
data(sleepstudy)
m <- lmer(
  log(Reaction) ~ Days + I(Days^2) + (1 + Days + exp(Days) | Subject),
  data = sleepstudy
)

find_variables(m)
```

`get_data`*Get the data that was used to fit the model*

Description

This functions tries to get the data that was used to fit the model and returns it as data frame.

Usage

```
get_data(x, ...)
```

S3 method for class 'hurdle'

```
get_data(x, component = c("all", "conditional", "zi",
  "zero_inflated", "dispersion"), ...)
```

S3 method for class 'glmmTMB'

```
get_data(x, effects = c("all", "fixed", "random"),
  component = c("all", "conditional", "zi", "zero_inflated",
  "dispersion"), ...)
```

S3 method for class 'merMod'

```
get_data(x, effects = c("all", "fixed", "random"), ...)
```

S3 method for class 'rmerMod'

```
get_data(x, effects = c("all", "fixed", "random"),
  ...)
```

S3 method for class 'mixed'

```
get_data(x, effects = c("all", "fixed", "random"), ...)
```

```

## S3 method for class 'clmm'
get_data(x, effects = c("all", "fixed", "random"), ...)

## S3 method for class 'lme'
get_data(x, effects = c("all", "fixed", "random"), ...)

## S3 method for class 'gee'
get_data(x, effects = c("all", "fixed", "random"), ...)

## S3 method for class 'rqss'
get_data(x, effects = c("all", "fixed", "random"), ...)

## S3 method for class 'MixMod'
get_data(x, effects = c("all", "fixed", "random"),
  component = c("all", "conditional", "zi", "zero_inflated",
    "dispersion"), ...)

## S3 method for class 'brmsfit'
get_data(x, effects = c("all", "fixed", "random"),
  component = c("all", "conditional", "zi", "zero_inflated"), ...)

## S3 method for class 'stanreg'
get_data(x, effects = c("all", "fixed", "random"), ...)

## S3 method for class 'MCMCglmm'
get_data(x, effects = c("all", "fixed", "random"),
  ...)

```

Arguments

x	A fitted model.
...	Currently not used.
component	Should all predictor variables, predictor variables for the conditional model, the zero-inflated part of the model, the dispersion term or the instrumental variables be returned? Applies to models with zero-inflated and/or dispersion formula, or to models with instrumental variable (so called fixed-effects regressions). May be abbreviated.
effects	Should model data for fixed effects, random effects or both be returned? Only applies to mixed models.

Value

The data that was used to fit the model.

Note

Unlike `model.frame()`, which may contain transformed variables (e.g. if `poly()` or `scale()` was used inside the formula to specify the model), `get_data()` aims at returning the "original", untransformed data.

Examples

```
data(cbpp, package = "lme4")
cbpp$trials <- cbpp$size - cbpp$incidence
m <- glm(cbind(incidence, trials) ~ period, data = cbpp, family = binomial)
head(get_data(m))
```

get_parameters	<i>Get model parameters</i>
----------------	-----------------------------

Description

Returns the point estimates (or posterior samples for Bayesian models) from a model.

Usage

```
get_parameters(x, ...)

## S3 method for class 'gam'
get_parameters(x, component = c("all", "conditional",
  "smooth_terms"), ...)

## S3 method for class 'vgam'
get_parameters(x, component = c("all", "conditional",
  "smooth_terms"), ...)

## S3 method for class 'Gam'
get_parameters(x, component = c("all", "conditional",
  "smooth_terms"), ...)

## S3 method for class 'zeroinfl'
get_parameters(x, component = c("all", "conditional",
  "zi", "zero_inflated"), ...)

## S3 method for class 'gamm'
get_parameters(x, component = c("all", "conditional",
  "smooth_terms"), ...)

## S3 method for class 'hurdle'
get_parameters(x, component = c("all", "conditional",
  "zi", "zero_inflated"), ...)

## S3 method for class 'coxme'
get_parameters(x, effects = c("fixed", "random"), ...)

## S3 method for class 'merMod'
get_parameters(x, effects = c("fixed", "random"), ...)
```



```

## S3 method for class 'rmlmerMod'
get_parameters(x, effects = c("fixed", "random"), ...)

## S3 method for class 'mixed'
get_parameters(x, effects = c("fixed", "random"), ...)

## S3 method for class 'lme'
get_parameters(x, effects = c("fixed", "random"), ...)

## S3 method for class 'MixMod'
get_parameters(x, effects = c("fixed", "random"),
  component = c("all", "conditional", "zi", "zero_inflated",
    "dispersion"), ...)

## S3 method for class 'glmmTMB'
get_parameters(x, effects = c("fixed", "random"),
  component = c("all", "conditional", "zi", "zero_inflated",
    "dispersion"), ...)

## S3 method for class 'brmsfit'
get_parameters(x, effects = c("fixed", "random",
  "all"), component = c("all", "conditional", "zi", "zero_inflated",
  "dispersion", "simplex", "smooth_terms"), parameters = NULL, ...)

## S3 method for class 'stanreg'
get_parameters(x, effects = c("fixed", "random",
  "all"), parameters = NULL, ...)

## S3 method for class 'BFBayesFactor'
get_parameters(x, iterations = 4000,
  progress = FALSE, ...)

## S3 method for class 'stanmvreg'
get_parameters(x, effects = c("fixed", "random",
  "all"), parameters = NULL, ...)

```

Arguments

x	A fitted model.
...	Currently not used.
component	Should all predictor variables, predictor variables for the conditional model, the zero-inflated part of the model, the dispersion term or the instrumental variables be returned? Applies to models with zero-inflated and/or dispersion formula, or to models with instrumental variable (so called fixed-effects regressions). May be abbreviated.
effects	Should variables for fixed effects, random effects or both be returned? Only applies to mixed models. May be abbreviated.

parameters	Regular expression pattern that describes the parameters that should be returned.
iterations	Number of posterior draws.
progress	Display progress.

Value

- for non-Bayesian models and if `effects = "fixed"`, a data frame with two columns: the parameter names and the related point estimates
- if `effects = "random"`, a list of data frames with the random effects (as returned by `ranef()`)
- for Bayesian models, the posterior samples from the requested parameters as data frame.
- for Anova (`aov()`) with error term, a list of parameters for the conditional, the within-subject and the between-subjects parameters
- for models with smooth terms or zero-inflation component, a data frame with three columns: the parameter names, the related point estimates and the component

Examples

```
data(mtcars)
m <- lm(mpg ~ wt + cyl + vs, data = mtcars)
get_parameters(m)
```

get_predictors	<i>Get the data from predictor variables</i>
----------------	--

Description

Returns the data from all predictor variables (fixed effects).

Usage

```
get_predictors(x)
```

Arguments

`x` A fitted model.

Value

The data from all predictor variables, as data frame.

Examples

```
m <- lm(mpg ~ wt + cyl + vs, data = mtcars)
head(get_predictors(m))
```

get_priors	<i>Get summary of priors used for a model</i>
------------	---

Description

Provides a summary of the prior distributions used for the parameters in a given model.

Usage

```
get_priors(x, ...)
```

Arguments

x	A Bayesian model.
...	Currently not used.

Value

A data frame with a summary of the prior distributions used for the parameters in a given model.

Examples

```
## Not run:  
library(rstanarm)  
model <- stan_glm(Sepal.Width ~ Species * Petal.Length, data=iris)  
get_priors(model)  
## End(Not run)
```

get_random	<i>Get the data from random effects terms</i>
------------	---

Description

Returns the data from all random effects terms.

Usage

```
get_random(x)
```

Arguments

x	A fitted mixed model.
---	-----------------------

Value

The data from all random effects terms, as data frame. Or NULL if model has no random effects.

Examples

```

library(lme4)
data(sleepstudy)
# prepare some data...
sleepstudy$mygrp <- sample(1:5, size = 180, replace = TRUE)
sleepstudy$mysubgrp <- NA
for (i in 1:5) {
  filter_group <- sleepstudy$mygrp == i
  sleepstudy$mysubgrp[filter_group] <-
    sample(1:30, size = sum(filter_group), replace = TRUE)
}

m <- lmer(
  Reaction ~ Days + (1 | mygrp / mysubgrp) + (1 | Subject),
  data = sleepstudy
)

head(get_random(m))

```

get_response

Get the values from the response variable

Description

Returns the values the response variable(s) from a model object. If the model is a multivariate response model, a data frame with values from all response variables is returned.

Usage

```
get_response(x, resp = NULL)
```

Arguments

x	A fitted model.
resp	Optional names of response variables for which to extract values.

Value

The values of the response variable, as vector, or a data frame if x has more than one defined response variable.

Examples

```

library(lme4)
data(cbpp)
data(mtcars)
cbpp$trials <- cbpp$size - cbpp$incidence

m <- glm(cbind(incidence, trials) ~ period, data = cbpp, family = binomial)

```

```

head(get_response(m))
get_response(m, resp = "incidence")

m <- lm(mpg ~ wt + cyl + vs, data = mtcars)
get_response(m)

```

get_variance

Get variance components from random effects models

Description

This function extracts the different variance components of a mixed model and returns the result as list. Functions like `get_variance_residual(x)` or `get_variance_fixed(x)` are shortcuts for `get_variance(x, component = "residual")` etc.

Usage

```

get_variance(x, component = c("all", "fixed", "random", "residual",
  "distribution", "dispersion", "intercept", "slope", "rho01"),
  verbose = TRUE, ...)

get_variance_residual(x, ...)

get_variance_fixed(x, ...)

get_variance_random(x, ...)

get_variance_distribution(x, ...)

get_variance_dispersion(x, ...)

get_variance_intercept(x, ...)

get_variance_slope(x, ...)

get_correlation_slope_intercept(x, ...)

```

Arguments

x	A mixed effects model.
component	Character value, indicating the variance component that should be returned. By default, all variance components are returned. The distribution-specific ("distribution") and residual ("residual") variance are the most computational intensive components, and hence may take a few seconds to calculate.
verbose	Toggle off warnings.
...	Currently not used.

Details

This function returns different variance components from mixed models, which are needed, for instance, to calculate r-squared measures or the intraclass-correlation coefficient (ICC).

Fixed effects variance The fixed effects variance, σ_f^2 , is the variance of the matrix-multiplication $\beta * X$ (parameter vector by model matrix).

Random effects variance The random effect variance, σ_i^2 , represents the *mean* random effect variance of the model. Since this variance reflect the "average" random effects variance for mixed models, it is also appropriate for models with more complex random effects structures, like random slopes or nested random effects. Details can be found in *Johnson 2014*, in particular equation 10.

Distribution-specific variance The distribution-specific variance, σ_d^2 , depends on the model family. For Gaussian models, it is σ^2 (i.e. $\text{sigma}(\text{model})^2$). For models with binary outcome, it is $\pi^2/3$ for logit-link and 1 for probit-link. For all other models, the distribution-specific variance is based on lognormal approximation, $\log(1 + \text{var}(x)/\mu^2)$ (see *Nakagawa et al. 2017*). The expected variance of a zero-inflated model is computed according to *Zuur et al. 2012*, p277.

Variance for the additive overdispersion term The variance for the additive overdispersion term, σ_e^2 , represents “the excess variation relative to what is expected from a certain distribution” (*Nakagawa et al. 2017*). In (most? many?) cases, this will be \emptyset .

Residual variance The residual variance, σ_e^2 , is simply $\sigma_d^2 + \sigma_e^2$.

Random intercept variance The random intercept variance, or *between-subject* variance (τ_{00}), is obtained from `VarCorr()`. It indicates how much groups or subjects differ from each other, while the residual variance σ_e^2 indicates the *within-subject* variance.

Random slope variance The random slope variance (τ_{11}) is obtained from `VarCorr()`. This measure is only available for mixed models with random slopes.

Random slope-intercept correlation The random slope-intercept correlation (ρ_{01}) is obtained from `VarCorr()`. This measure is only available for mixed models with random intercepts and slopes.

Value

A list with following elements:

- `var.fixed`, variance attributable to the fixed effects
- `var.random`, (mean) variance of random effects
- `var.residual`, residual variance (sum of dispersion and distribution)
- `var.distribution`, distribution-specific variance
- `var.dispersion`, variance due to additive dispersion
- `var.intercept`, the random-intercept-variance, or between-subject-variance (τ_{00})
- `var.slope`, the random-slope-variance (τ_{11})
- `cor.slope_intercept`, the random-slope-intercept-correlation (ρ_{01})

Note

This function supports models of class `merMod` (including models from **blme**), `glmmTMB`, `MixMod`, `lme`, `mixed`, `rlmerMod` or `stanreg`. Support for objects of class `MixMod` (**GLMMadaptiv**) or `lme` (**nlme**) is experimental and may not work for all models.

References

- Johnson, P. C. D. (2014). Extension of Nakagawa & Schielzeth's R2 GLMM to random slopes models. *Methods in Ecology and Evolution*, 5(9), 944–946. doi: [10.1111/2041210X.12225](https://doi.org/10.1111/2041210X.12225)
- Nakagawa, S., Johnson, P. C. D., & Schielzeth, H. (2017). The coefficient of determination R2 and intra-class correlation coefficient from generalized linear mixed-effects models revisited and expanded. *Journal of The Royal Society Interface*, 14(134), 20170213. doi: [10.1098/rsif.2017.0213](https://doi.org/10.1098/rsif.2017.0213)
- Zuur, A. F., Savel'ev, A. A., & Ieno, E. N. (2012). *Zero inflated models and generalized linear mixed models with R*. Newburgh, United Kingdom: Highland Statistics.

Examples

```
## Not run:
library(lme4)
data(sleepstudy)
m <- lmer(Reaction ~ Days + (1 + Days | Subject), data = sleepstudy)

get_variance(m)
get_variance_fixed(m)
get_variance_residual(m)
## End(Not run)
```

has_intercept	<i>Checks if model has an intercept</i>
---------------	---

Description

Checks if model has an intercept.

Usage

```
has_intercept(x)
```

Arguments

x A model object.

Value

TRUE if x has an intercept, FALSE otherwise.

Examples

```
model <- lm(mpg ~ 0 + gear, data = mtcars)
has_intercept(model)

model <- lm(mpg ~ gear, data = mtcars)
has_intercept(model)

library(lme4)
model <- lmer(Reaction ~ 0 + Days + (Days | Subject), data = sleepstudy)
has_intercept(model)

model <- lmer(Reaction ~ Days + (Days | Subject), data = sleepstudy)
has_intercept(model)
```

is_model

Checks if an object is a (supported) regression model object

Description

Small helper that checks if a model is a *supported* (regression) model object.

Usage

```
is_model(x)
```

Arguments

x An object.

Details

This function returns TRUE if x is a model object that works with the package's functions. A list of supported models can also be found here: <https://github.com/easystats/insight>.

Value

A logical, TRUE if x is a (supported) model object.

Examples

```
data(mtcars)
m <- lm(mpg ~ wt + cyl + vs, data = mtcars)

is_model(m)
is_model(mtcars)
```

is_multivariate	<i>Checks if an object stems from a multivariate response model</i>
-----------------	---

Description

Small helper that checks if a model is a multivariate response model, i.e. a model with multiple outcomes.

Usage

```
is_multivariate(x)
```

Arguments

x A model object, or an object returned by a function from this package.

Value

A logical, TRUE if either x is a model object and is a multivariate response model, or TRUE if a return value from a function of **insight** is from a multivariate response model.

Examples

```
## Not run:
library(rstanarm)
data("pbclong")
model <- stan_mvmer(
  formula = list(
    logBili ~ year + (1 | id),
    albumin ~ sex + year + (year | id)
  ),
  data = pbclong,
  chains = 1, cores = 1, seed = 12345, iter = 1000
)

f <- find_formula(model)
is_multivariate(model)
is_multivariate(f)

## End(Not run)
```

is_nullmodel	<i>Checks if model is a null-model (intercept-only)</i>
--------------	---

Description

Checks if model is a null-model (intercept-only), i.e. if the conditional part of the model has no predictors.

Usage

```
is_nullmodel(x)
```

Arguments

x A model object.

Value

TRUE if x is a null-model, FALSE otherwise.

Examples

```
model <- lm(mpg ~ 1, data = mtcars)
is_nullmodel(model)

model <- lm(mpg ~ gear, data = mtcars)
is_nullmodel(model)

library(lme4)
model <- lmer(Reaction ~ 1 + (Days | Subject), data = sleepstudy)
is_nullmodel(model)

model <- lmer(Reaction ~ Days + (Days | Subject), data = sleepstudy)
is_nullmodel(model)
```

link_function	<i>Get link-function from model object</i>
---------------	--

Description

Returns the link-function from a model object.

Usage

```
link_function(x, ...)
```

Arguments

x A fitted model.
... Currently not used.

Value

A function, describing the link-function from a model-object. For multivariate-response models, a list of functions is returned.

Examples

```
# example from ?stats::glm
counts <- c(18, 17, 15, 20, 10, 20, 25, 13, 12)
outcome <- gl(3, 1, 9)
treatment <- gl(3, 3)
m <- glm(counts ~ outcome + treatment, family = poisson())

link_function(m)(.3)
# same as
log(.3)
```

link_inverse *Get link-inverse function from model object*

Description

Returns the link-inverse function from a model object.

Usage

```
link_inverse(x, ...)
```

Arguments

x A fitted model.
... Currently not used.

Value

A function, describing the inverse-link function from a model-object. For multivariate-response models, a list of functions is returned.

Examples

```
# example from ?stats::glm
counts <- c(18, 17, 15, 20, 10, 20, 25, 13, 12)
outcome <- gl(3, 1, 9)
treatment <- gl(3, 3)
m <- glm(counts ~ outcome + treatment, family = poisson())

link_inverse(m)(.3)
# same as
exp(.3)
```

model_info

Access information from model objects

Description

Retrieve information from model objects.

Usage

```
model_info(x, ...)
```

Arguments

x	A fitted model.
...	Currently not used.

Details

model_info() returns a list with information about the model for many different model objects. Following information is returned, where all values starting with is_ are logicals.

- is_binomial: family is binomial (but not negative binomial)
- is_poisson: family is poisson
- is_negbin: family is negative binomial
- is_count: model is a count model (i.e. family is either poisson or negative binomial)
- is_beta: family is beta
- is_exponential: family is exponential (e.g. Gamma or Weibull)
- is_logit: model has logit link
- is_progit: model has probit link
- is_linear: family is gaussian
- is_tweedie: family is tweedie
- is_ordinal: family is ordinal or cumulative link
- is_categorical: family is categorical link

- `is_censored`: model is a censored model
- `is_zeroinf`: model has zero-inflation component
- `is_zero_inflated`: alias for `is_zeroinf`
- `is_mixed`: model is a mixed effects model (with random effects)
- `is_multivariate`: model is a multivariate response model (currently only works for *brmsfit* objects)
- `is_trial`: model response contains additional information about the trials
- `is_bayesian`: model is a Bayesian model
- `is_anova`: model is an Anova object
- `link_function`: the link-function
- `family`: the family-object
- `n_obs`: number of observations
- `model_terms`: a list with all model terms, including terms such as random effects or from zero-inflated model parts.

Value

A list with information about the model, like family, link-function etc. (see 'Details').

Examples

```
library(glmTMB)
data("Salamanders")
m <- glmTMB(
  count ~ spp + cover + mined + (1 | site),
  ziformula = ~ spp + mined,
  dispformula = ~DOY,
  data = Salamanders,
  family = nbinom2
)

model_info(m)
```

n_obs

Get number of observations from a model

Description

This method returns the number of observation that were used to fit the model, as numeric value.

Usage

```
n_obs(x, ...)
```

```
## S3 method for class 'svyolr'
n_obs(x, weighted = FALSE, ...)
```

Arguments

<code>x</code>	A fitted model.
<code>...</code>	Currently not used.
<code>weighted</code>	For survey designs, returns the weighted sample size.

Value

The number of observations used to fit the model, or NULL if this information is not available.

Examples

```
data(mtcars)
m <- lm(mpg ~ wt + cyl + vs, data = mtcars)
n_obs(m)
```

<code>print_color</code>	<i>Coloured console output</i>
--------------------------	--------------------------------

Description

Convenient function that allows coloured output in the console. Mainly implemented to reduce package dependencies.

Usage

```
print_color(text, color)

print_colour(text, colour)
```

Arguments

<code>text</code>	The text to print.
<code>color, colour</code>	Character vector, indicating the colour for printing. May be one of "red", "yellow", "green", "blue", "violet", "cyan" or "grey". Formatting is also possible with "bold" or "italic".

Details

This function prints text directly to the console using `cat()`, so no string is returned.

Value

Nothing.

Examples

```
print_color("I'm blue dabedi dabedei", "blue")
```

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