Package 'marginaleffects'

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Title Marginal Effects, Marginal Means, Predictions, and Contrasts

Version 0.7.0

Description Compute and plot adjusted predictions, contrasts, marginal effects, and marginal means for over 65 classes of statistical models in R. Conduct linear and non-linear hypothesis tests using the delta method.

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URL https://vincentarelbundock.github.io/marginaleffects/

BugReports https://github.com/vincentarelbundock/marginaleffects/issues

RoxygenNote 7.2.1

VignetteBuilder knitr

Depends R (>= 3.5.0)

Imports checkmate, data.table, generics, insight (>= 0.18.0), methods

Suggests AER, afex, aod, bench, betareg, BH, bife, biglm, brglm2, brms, brmsmargins, broom, conflicted, covr, crch, datawizard, dplyr, emmeans, estimatr, fixest (>= 0.10.1), future, future.apply, gam, geepack, ggbeeswarm, ggdag, ggdist, ggplot2, ggrepel, glmx, haven, here, itsadug, ivreg, kableExtra, knitr, lme4, lmerTest, magrittr, margins, MASS, mclogit, mgcv, mhurdle, mice, mlogit, modelbased, modelsummary, nlme, nnet, ordinal, patchwork, pkgdown, plm, prediction, pscl, quantreg, RcppEigen, rlang, rmarkdown, rms, robust, robustbase, robustlmm, rstanarm, rstantools, sampleSelection, sandwich, scam, speedglm, spelling, survey, survival, systemfonts, tidymodels, tidyverse, tinytest, truncreg, tsModel, vdiffr, withr

Collate 'align_J_V.R' 'arg_name_change.R' 'attributes.R' 'backtransform.R' 'comparisons.R' 'complete_levels.R' 'datagrid.R' 'deltamethod.R' 'deprecate_arg.R' 'find_categorical.R' 'find_variable_class.R' 'format_msg.R'

'get_ci.R' 'get_coef.R' 'get_contrast_data.R'
'get_contrast_data_character.R' 'get_contrast_data_factor.R'
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'set_coef.R' 'methods_MASS.R' 'methods_afex.R' 'methods_aod.R'
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'methods_brms.R' 'methods_crch.R' 'methods_fixest.R'
'methods_glmmTMB.R' 'methods_glmx.R' 'methods_lme4.R'
'methods_mclogit.R' 'methods_mgcv.R' 'methods_mhurdle.R'
'methods_mlogit.R' 'methods_ordinal.R' 'methods_plm.R'
'methods_pscl.R' 'methods_quantreg.R' 'methods_robustlmm.R'
'methods_rstanarm.R' 'methods_sampleSelection.R'
'methods_scam.R' 'methods_stats.R' 'methods_survival.R'
'methods_tobit1.R' 'myTryCatch.R' 'package.R' 'plot.R'
'plot_cap.R' 'plot_cco.R' 'plot_cme.R' 'posteriordraws.R'
'predictions.R' 'sanitize_conf_level.R' 'sanitize_hypothesis.R'
'sanitize_interaction.R' 'sanitize_newdata.R'
'sanitize_transform_pre.R' 'sanitize_type.R'
'sanitize_variables.R' 'sanity.R' 'sanity_dots.R' 'summary.R'
'tidy.R' 'type_dictionary.R' 'unpack_matrix_cols.R'
'utils_cjdt.R' 'warn_once.R'

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R topics documented:

`comparisons` *Contrasts Between Adjusted Predictions*

Description

Difference, ratio, or function of adjusted predictions, calculated for meaningfully different predictor values. The `tidy()` and `summary()` functions can be used to aggregate and summarize the output of `comparisons()`. To learn more, read the contrasts vignette, visit the package website, or scroll down this page for a full list of vignettes:

- https://vincentarelbundock.github.io/marginaleffects/articles/contrasts.html
- https://vincentarelbundock.github.io/marginaleffects/

Usage

```
comparisons(
  model,
  newdata = NULL,
  variables = NULL,
  type = "response",
  vcov = TRUE,
  conf_level = 0.95,
  transform_pre = "difference",
  transform_post = NULL,
  interaction = NULL,
  by = NULL,
  wts = NULL,
  hypothesis = NULL,
  eps = NULL,
  ...
)
```

Arguments

`model` Model object

`newdata` `NULL`, data frame, string, or `datagrid()` call. Determines the predictor values for which to compute contrasts.

- `NULL` (default): Unit-level contrasts for each observed value in the original dataset.
- data frame: Unit-level contrasts for each row of the `newdata` data frame.
- string:
  - "mean": Contrasts at the Mean. Contrasts when each predictor is held at its mean or mode.
  - "median": Contrasts at the Median. Contrasts when each predictor is held at its median or mode.
  - "marginalmeans": Contrasts at Marginal Means.
  - "tukey": Contrasts at Tukey's 5 numbers.
  - "grid": Contrasts on a grid of representative numbers (Tukey's 5 numbers and unique values of categorical predictors).
- `datagrid()` call to specify a custom grid of regressors. For example:
  - `newdata = datagrid(cyl = c(4, 6))`: `cyl` variable equal to 4 and 6 and other regressors fixed at their means or modes.
  - `newdata = datagrid(mpg = fivenum)`: `mpg` variable held at Tukey's five numbers (using the `fivenum` function), and other regressors fixed at their means or modes.
  - See the Examples section and the datagrid documentation.

`variables` `NULL`, character vector, or named list. The subset of variables for which to compute contrasts.

- `NULL`: compute contrasts for all the variables in the model object (can be slow).
- Character vector: subset of variables (usually faster).
- Named list: names identify the subset of variables of interest, and values define the type of contrast to compute. Acceptable values depend on the variable type:
  - Factor or character variables:
    - "reference": Each factor level is compared to the factor reference (base) level
    - "all": All combinations of observed levels
    - "sequential": Each factor level is compared to the previous factor level
    - "pairwise": Each factor level is compared to all other levels
  - Logical variables:
    - NULL: contrast between TRUE and FALSE
  - Numeric variables:
    - Numeric of length 1: Contrast for a gap of `x`, computed at the observed value plus and minus `x / 2`

    - Numeric vector of length 2: Contrast between the 2nd element and the 1st element of the x vector.
    - "iqr": Contrast across the interquartile range of the regressor.
    - "sd": Contrast across one standard deviation around the regressor mean.
    - "2sd": Contrast across two standard deviations around the regressor mean.
    - "minmax": Contrast between the maximum and the minimum values of the regressor.
  - Examples:
    - `variables = list(gear = "pairwise", hp = 10)`
    - `variables = list(gear = "sequential", hp = c(100, 120))`
    - See the Examples section below for more.

`type` string indicates the type (scale) of the predictions used to compute marginal effects or contrasts. This can differ based on the model type, but will typically be a string such as: "response", "link", "probs", or "zero". When an unsupported string is entered, the model-specific list of acceptable values is returned in an error message.

`vcov` Type of uncertainty estimates to report (e.g., for robust standard errors). Acceptable values:

- FALSE: Do not compute standard errors. This can speed up computation considerably.
- TRUE: Unit-level standard errors using the default `vcov(model)` variance-covariance matrix.
- String which indicates the kind of uncertainty estimates to return.
  - Heteroskedasticity-consistent: `"HC"`, `"HC0"`, `"HC1"`, `"HC2"`, `"HC3"`, `"HC4"`, `"HC4m"`, `"HC5"`. See `?sandwich::vcovHC`
  - Heteroskedasticity and autocorrelation consistent: `"HAC"`
  - Mixed-Models degrees of freedom: "satterthwaite", "kenward-roger"
  - Other: `"NeweyWest"`, `"KernHAC"`, `"OPG"`. See the `sandwich` package documentation.
- One-sided formula which indicates the name of cluster variables (e.g., `~unit_id`). This formula is passed to the `cluster` argument of the `sandwich::vcovCL` function.
- Square covariance matrix
- Function which returns a covariance matrix (e.g., `stats::vcov(model)`)

`conf_level` numeric value between 0 and 1. Confidence level to use to build a confidence interval.

`transform_pre` string or function. How should pairs of adjusted predictions be contrasted?

- string: shortcuts to common contrast functions.
  - Supported shortcuts strings: difference, differenceavg, dydx, eyex, eydx, dyex, dydxavg, eyexavg, eydxavg, dyexavg, ratio, ratioavg, lnratio, lnratioavg, lnor, lnoravg, expdydx, expdydxavg

  - See the Transformations section below for definitions of each transformation.
- function: accept two equal-length numeric vectors of adjusted predictions (`hi` and `lo`) and returns a vector of contrasts of the same length, or a unique numeric value.
  - See the Transformations section below for examples of valid functions.

`transform_post` (experimental) A function applied to unit-level estimates and confidence intervals just before the function returns results.

`interaction` TRUE, FALSE, or NULL

- `FALSE`: Contrasts represent the change in adjusted predictions when one predictor changes and all other variables are held constant.
- `TRUE`: Contrasts represent the changes in adjusted predictions when the predictors specified in the `variables` argument are manipulated simultaneously.
- `NULL` (default): Behaves like `TRUE` when the `variables` argument is specified and the model formula includes interactions. Behaves like `FALSE` otherwise.

`by` Character vector of variable names over which to compute group-wise estimates.

`wts` string or numeric: weights to use when computing average contrasts or marginaleffects. These weights only affect the averaging in `tidy()` or `summary()`, and not the unit-level estimates themselves.

- string: column name of the weights variable in `newdata`. When supplying a column name to `wts`, it is recommended to supply the original data (including the weights variable) explicitly to `newdata`.
- numeric: vector of length equal to the number of rows in the original data or in `newdata` (if supplied).

`hypothesis` specify a hypothesis test or custom contrast using a vector, matrix, string, or string formula.

- String:
  - "pairwise": pairwise differences between estimates in each row.
  - "reference": differences between the estimates in each row and the estimate in the first row.
- String formula to specify linear or non-linear hypothesis tests. If the `term` column uniquely identifies rows, terms can be used in the formula. Otherwise, use `b1`, `b2`, etc. to identify the position of each parameter. Examples:
  - `hp = drat`
  - `hp + drat = 12`
  - `b1 + b2 + b3 = 0`
- Numeric vector: Weights to compute a linear combination of (custom contrast between) estimates. Length equal to the number of rows generated by the same function call, but without the `hypothesis` argument.
- Numeric matrix: Each column is a vector of weights, as describe above, used to compute a distinct linear combination of (contrast between) estimates.

- See the Examples section below and the vignette: https://vincentarelbundock.github.io/marginaleffect

`eps` NULL or numeric value which determines the step size to use when calculating numerical derivatives: (f(x+eps)-f(x))/eps. When `eps` is `NULL`, the step size is step to 0.0001 multiplied by the range of the variable with respect to which we are taking the derivative. Changing this value may be necessary to avoid numerical problems in certain models.

`...` Additional arguments are passed to the `predict()` method supplied by the modeling package.These arguments are particularly useful for mixed-effects or bayesian models (see the online vignettes on the `marginaleffects` website). Available arguments can vary from model to model, depending on the range of supported arguments by each modeling package. See the "Model-Specific Arguments" section of the `?marginaleffects` documentation for a non-exhaustive list of available arguments.

Details

A "contrast" is a difference, ratio of function of adjusted predictions, calculated for meaningfully different predictor values (e.g., College graduates vs. Others). Uncertainty estimates are computed using the delta method.

The `newdata` argument can be used to control the kind of contrasts to report:

- Average Contrasts
- Adjusted Risk Ratios
- Adjusted Risk Differences
- Group-Average Contrasts
- Contrasts at the Mean
- Contrasts at User-Specified values (aka Contrasts at Representative values, MER).
- Custom contrasts using arbitrary functions

Vignettes and documentation

Vignettes:

- Adjusted Predictions
- Contrasts
- Marginal Effects
- Marginal Means
- Hypothesis Tests and Custom Contrasts using the Delta Method

Case studies:

- Bayesian Analyses with `brms`
- Causal Inference with the g-Formula
- Elasticity
- Generalized Additive Models

- Mixed effects models
- Multinomial Logit and Discrete Choice Models
- Multiple Imputation

Tips and technical notes:

- 68 Supported Classes of Models
- Index of Functions and Documentation
- Standard Errors
- Tables and Plots
- Performance
- Alternative Software
- Frequently Asked Questions

Model-Specific Arguments

Some model types allow model-specific arguments to modify the nature of marginal effects, predictions, marginal means, and contrasts.

Package	Class	Argument	Documentation
`brms`	`brmsfit`	`ndraws`	brms::posterior_predict
		`re_formula`	
`lme4`	`merMod`	`include_random`	insight::get_predicted
		`re.form`	lme4::predict.merMod
		`allow.new.levels`	lme4::predict.merMod
`glmmTMB`	`glmmTMB`	`re.form`	glmmTMB::predict.glmmTMB
		`allow.new.levels`	glmmTMB::predict.glmmTMB
		`zitype`	glmmTMB::predict.glmmTMB
`mgcv`	`bam`	`exclude`	mgcv::predict.bam
`robustlmm`	`rlmerMod`	`re.form`	robustlmm::predict.rlmerMod
		`allow.new.levels`	robustlmm::predict.rlmerMod

Transformations

The following transformations can be applied by supplying one of the shortcut strings to the `transform_pre` argument. `hi` is a vector of adjusted predictions for the "high" side of the contrast. `lo` is a vector of adjusted predictions for the "low" side of the contrast. `y` is a vector of adjusted predictions for the original data. `x` is the predictor in the original data. `eps` is the step size to use to compute derivatives and elasticities.

Shortcut	Function
difference	\(hi, lo) hi - lo
differenceavg	\(hi, lo) mean(hi) - mean(lo)
dydx	\(hi, lo, eps) (hi - lo)/eps
eyex	\(hi, lo, eps, y, x) (hi - lo)/eps * (x/y)
eydx	\(hi, lo, eps, y, x) ((hi - lo)/eps)/y

dyex	\(hi, lo, eps, x) ((hi - lo)/eps) * x
dydxavg	\(hi, lo, eps) mean((hi - lo)/eps)
eyexavg	\(hi, lo, eps, y, x) mean((hi - lo)/eps * (x/y))
eydxavg	\(hi, lo, eps, y, x) mean(((hi - lo)/eps)/y)
dyexavg	\(hi, lo, eps, x) mean(((hi - lo)/eps) * x)
ratio	\(hi, lo) hi/lo
ratioavg	\(hi, lo) mean(hi)/mean(lo)
lnratio	\(hi, lo) log(hi/lo)
lnratioavg	\(hi, lo) log(mean(hi)/mean(lo))
lnor	\(hi, lo) log((hi/(1 - hi))/(lo/(1 - lo)))
lnoravg	\(hi, lo) log((mean(hi)/(1 - mean(hi)))/(mean(lo)/(1 - mean(lo))))
expdydx	\(hi, lo, eps) ((exp(hi) - exp(lo))/exp(eps))/eps
expdydxavg	\(hi, lo, eps) mean(((exp(hi) - exp(lo))/exp(eps))/eps)

Examples

```
library(marginaleffects)
library(magrittr)

# Linear model
tmp <- mtcars
tmp$am <- as.logical(tmp$am)
mod <- lm(mpg ~ am + factor(cyl), tmp)
comparisons(mod, variables = list(cyl = "reference")) %>% tidy()
comparisons(mod, variables = list(cyl = "sequential")) %>% tidy()
comparisons(mod, variables = list(cyl = "pairwise")) %>% tidy()

# GLM with different scale types
mod <- glm(am ~ factor(gear), data = mtcars)
comparisons(mod, type = "response") %>% tidy()
comparisons(mod, type = "link") %>% tidy()

# Contrasts at the mean
comparisons(mod, newdata = "mean")

# Contrasts between marginal means
comparisons(mod, newdata = "marginalmeans")

# Contrasts at user-specified values
comparisons(mod, newdata = datagrid(am = 0, gear = tmp$gear))
comparisons(mod, newdata = datagrid(am = unique, gear = max))

# Numeric contrasts
mod <- lm(mpg ~ hp, data = mtcars)
comparisons(mod, variables = list(hp = 1)) %>% tidy()
comparisons(mod, variables = list(hp = 5)) %>% tidy()
comparisons(mod, variables = list(hp = c(90, 100))) %>% tidy()
comparisons(mod, variables = list(hp = "iqr")) %>% tidy()
comparisons(mod, variables = list(hp = "sd")) %>% tidy()
```

```
comparisons(mod, variables = list(hp = "minmax")) %>% tidy()

# Adjusted Risk Ratio: see the contrasts vignette
mod <- glm(vs ~ mpg, data = mtcars, family = binomial)
cmp <- comparisons(mod, transform_pre = "lnratioavg")
summary(cmp, transform_avg = exp)

# Adjusted Risk Ratio: Manual specification of the `transform_pre`
cmp <- comparisons(mod, transform_pre = function(hi, lo) log(mean(hi) / mean(lo)))
summary(cmp, transform_avg = exp)
# Interactions between contrasts
mod <- lm(mpg ~ factor(cyl) * factor(gear) + hp, data = mtcars)
cmp <- comparisons(mod, variables = c("cyl", "gear"))
summary(cmp)

# variable-specific contrasts
cmp <- comparisons(mod, variables = list(gear = "sequential", hp = 10))
summary(cmp)

# hypothesis test: is the `hp` marginal effect at the mean equal to the `drat` marginal effect
mod <- lm(mpg ~ wt + drat, data = mtcars)

comparisons(
    mod,
    newdata = "mean",
    hypothesis = "wt = drat")

# same hypothesis test using row indices
comparisons(
    mod,
    newdata = "mean",
    hypothesis = "b1 - b2 = 0")

# same hypothesis test using numeric vector of weights
comparisons(
    mod,
    newdata = "mean",
    hypothesis = c(1, -1))

# two custom contrasts using a matrix of weights
lc <- matrix(c(
    1, -1,
    2, 3),
    ncol = 2)
comparisons(
    mod,
    newdata = "mean",
    hypothesis = lc)
```

datagrid *Generate a data grid of "typical," "counterfactual," or user-specified values for use in the* newdata *argument of the* marginaleffects *or* predictions *functions.*

Description

Generate a data grid of "typical," "counterfactual," or user-specified values for use in the newdata argument of the marginaleffects or predictions functions.

Usage

```
datagrid(
  ...,
  model = NULL,
  newdata = NULL,
  grid_type = "typical",
  FUN_character = Mode,
  FUN_factor = Mode,
  FUN_logical = Mode,
  FUN_numeric = function(x) mean(x, na.rm = TRUE),
  FUN_other = function(x) mean(x, na.rm = TRUE)
)
```

Arguments

...	named arguments with vectors of values or functions for user-specified variables. • Functions are applied to the variable in the model dataset or newdata, and must return a vector of the appropriate type. • Character vectors are automatically transformed to factors if necessary. +The output will include all combinations of these variables (see Examples below.)
model	Model object
newdata	data.frame (one and only one of the model and newdata arguments
grid_type	character • "typical": variables whose values are not explicitly specified by the user in ... are set to their mean or mode, or to the output of the functions supplied to FUN_type arguments. • "counterfactual": the entire dataset is duplicated for each combination of the variable values specified in .... Variables not explicitly supplied to datagrid() are set to their observed values in the original dataset.
FUN_character	the function to be applied to character variables.
FUN_factor	the function to be applied to factor variables.
FUN_logical	the function to be applied to factor variables.
FUN_numeric	the function to be applied to numeric variables.
FUN_other	the function to be applied to other variable types.

Details

If `datagrid` is used in a `marginaleffects` or `predictions` call as the `newdata` argument, the model is automatically inserted in the function call, and users do not need to specify either the `model` or `newdata` arguments. Note that only the variables used to fit the models will be attached to the results. If a user wants to attach other variables as well (e.g., weights or grouping variables), they can supply a data.frame explicitly to the `newdata` argument inside `datagrid()`.

If users supply a model, the data used to fit that model is retrieved using the `insight::get_data` function.

Value

A `data.frame` in which each row corresponds to one combination of the named predictors supplied by the user via the `...` dots. Variables which are not explicitly defined are held at their mean or mode.

Examples

```
# The output only has 2 rows, and all the variables except `hp` are at their
# mean or mode.
datagrid(newdata = mtcars, hp = c(100, 110))

# We get the same result by feeding a model instead of a data.frame
mod <- lm(mpg ~ hp, mtcars)
datagrid(model = mod, hp = c(100, 110))

# Use in `marginaleffects` to compute "Typical Marginal Effects". When used
# in `marginaleffects()` or `predictions()` we do not need to specify the
#`model` or `newdata` arguments.
marginaleffects(mod, newdata = datagrid(hp = c(100, 110)))

# datagrid accepts functions
datagrid(hp = range, cyl = unique, newdata = mtcars)
comparisons(mod, newdata = datagrid(hp = fivenum))

# The full dataset is duplicated with each observation given counterfactual
# values of 100 and 110 for the `hp` variable. The original `mtcars` includes
# 32 rows, so the resulting dataset includes 64 rows.
dg <- datagrid(newdata = mtcars, hp = c(100, 110), grid_type = "counterfactual")
nrow(dg)

# We get the same result by feeding a model instead of a data.frame
mod <- lm(mpg ~ hp, mtcars)
dg <- datagrid(model = mod, hp = c(100, 110), grid_type = "counterfactual")
nrow(dg)
```

`datagridcf` *A "counterfactual" version of the* `datagrid()` *function.*

Description

For each combination of the variable values specified, this function duplicates the entire data frame supplied to `newdata`, or the entire dataset used to fit `model`. This is a convenience shortcut to call the `datagrid()` function with argument `grid_type="counterfactual"`.

Usage

```
datagridcf(..., model = NULL, newdata = NULL)
```

Arguments

`...`	named arguments with vectors of values or functions for user-specified variables. • Functions are applied to the variable in the `model` dataset or `newdata`, and must return a vector of the appropriate type. • Character vectors are automatically transformed to factors if necessary. +The output will include all combinations of these variables (see Examples below.)
`model`	Model object
`newdata`	data.frame (one and only one of the `model` and `newdata` arguments

Examples

```
# Fit a model with 32 observations from the `mtcars` dataset.
nrow(mtcars)

mod <- lm(mpg ~ hp + am, data = mtcars)

# We specify two values for the `am` variable and obtain a counterfactual
# dataset with 64 observations (32 x 2).
dat <- datagridcf(model = mod, am = 0:1)
head(dat)
nrow(dat)

# We specify 2 values for the `am` variable and 3 values for the `hp` variable
# and obtained a dataset with 192 observations (2x3x32), corresponding to the
# full original data, with each possible combination of `hp` and `am`.
dat <- datagridcf(am = 0:1, hp = c(100, 110, 120), newdata = mtcars)
head(dat)
dim(dat)
```

`deltamethod` *Estimate and Standard Error of a Non-Linear Function of Estimated Model Parameters*

Description

`deltamethod` is a function to get a first-order approximate standard error for a nonlinear function of a vector of random variables with known or estimated covariance matrix. `deltamethod` emulates the behavior of the excellent and well-established car::deltaMethod and car::linearHypothesis functions, but it supports more models, requires fewer dependencies, and offers some convenience features like shortcuts for robust standard errors.

Usage

```
deltamethod(
  model,
  hypothesis = NULL,
  FUN = NULL,
  vcov = NULL,
  conf_level = 0.95,
  ...
)
```

Arguments

`model` Model object

`hypothesis` specify a hypothesis test or custom contrast using a vector, matrix, string, or string formula.

- String:
  - "pairwise": pairwise differences between estimates in each row.
  - "reference": differences between the estimates in each row and the estimate in the first row.
- String formula to specify linear or non-linear hypothesis tests. If the `term` column uniquely identifies rows, terms can be used in the formula. Otherwise, use `b1`, `b2`, etc. to identify the position of each parameter. Examples:
  - `hp = drat`
  - `hp + drat = 12`
  - `b1 + b2 + b3 = 0`
- Numeric vector: Weights to compute a linear combination of (custom contrast between) estimates. Length equal to the number of rows generated by the same function call, but without the `hypothesis` argument.
- Numeric matrix: Each column is a vector of weights, as describe above, used to compute a distinct linear combination of (contrast between) estimates.
- See the Examples section below and the vignette: https://vincentarelbundock.github.io/marginaleffec

FUN — a function which accepts a model object and returns a numeric vector or a data.frame with two columns called `term` and `estimate`.

vcov — Type of uncertainty estimates to report (e.g., for robust standard errors). Acceptable values:

- FALSE: Do not compute standard errors. This can speed up computation considerably.
- TRUE: Unit-level standard errors using the default `vcov(model)` variance-covariance matrix.
- String which indicates the kind of uncertainty estimates to return.
  - Heteroskedasticity-consistent: `"HC"`, `"HC0"`, `"HC1"`, `"HC2"`, `"HC3"`, `"HC4"`, `"HC4m"`, `"HC5"`. See `?sandwich::vcovHC`
  - Heteroskedasticity and autocorrelation consistent: `"HAC"`
  - Mixed-Models degrees of freedom: "satterthwaite", "kenward-roger"
  - Other: `"NeweyWest"`, `"KernHAC"`, `"OPG"`. See the `sandwich` package documentation.
- One-sided formula which indicates the name of cluster variables (e.g., `~unit_id`). This formula is passed to the `cluster` argument of the `sandwich::vcovCL` function.
- Square covariance matrix
- Function which returns a covariance matrix (e.g., `stats::vcov(model)`)

conf_level — numeric value between 0 and 1. Confidence level to use to build a confidence interval.

... — Additional arguments are passed to the `predict()` method supplied by the modeling package.These arguments are particularly useful for mixed-effects or bayesian models (see the online vignettes on the `marginaleffects` website). Available arguments can vary from model to model, depending on the range of supported arguments by each modeling package. See the "Model-Specific Arguments" section of the `?marginaleffects` documentation for a non-exhaustive list of available arguments.

Examples

```
library(marginaleffects)
mod <- lm(mpg ~ hp + wt + factor(cyl), data = mtcars)

# When `FUN` and `hypothesis` are `NULL`, `deltamethod()` returns a data.frame of parameters
deltamethod(mod)

# Test of equality between coefficients
deltamethod(mod, "hp = wt")

# Non-linear function
deltamethod(mod, "exp(hp + wt) = 0.1")

# Robust standard errors
deltamethod(mod, "hp = wt", vcov = "HC3")
```

```
# b1, b2, ... shortcuts can be used to identify the position of the
# parameters of interest in the output of FUN
deltamethod(mod, "b2 = b3")

# term names with special characters have to be enclosed in backticks
deltamethod(mod, "`factor(cyl)6` = `factor(cyl)8`")

# The `FUN` argument can be used to compute standard errors for fitted values
mod <- glm(am ~ hp + mpg, data = mtcars, family = binomial)

f <- function(x) predict(x, type = "link", newdata = mtcars)
p <- deltamethod(mod, FUN = f)
head(p)

f <- function(x) predict(x, type = "response", newdata = mtcars)
p <- deltamethod(mod, FUN = f)
head(p)
```

`glance.marginaleffects` *Glance at key characteristics of an object*

Description

Glance at key characteristics of an object

Usage

```
## S3 method for class 'marginaleffects'
glance(x, ...)
```

Arguments

`x`	An object produced by the `marginaleffects` function.
`...`	Additional arguments are passed to the `predict()` method supplied by the modeling package.These arguments are particularly useful for mixed-effects or bayesian models (see the online vignettes on the `marginaleffects` website). Available arguments can vary from model to model, depending on the range of supported arguments by each modeling package. See the "Model-Specific Arguments" section of the `?marginaleffects` documentation for a non-exhaustive list of available arguments.

marginaleffects *Marginal Effects (Slopes)*

Description

Partial derivative (slope) of the regression equation with respect to a regressor of interest. The `tidy()` and `summary()` functions can be used to aggregate and summarize the output of `marginaleffects()`. To learn more, read the marginal effects vignette, visit the package website, or scroll down this page for a full list of vignettes:

- https://vincentarelbundock.github.io/marginaleffects/articles/marginaleffects.html
- https://vincentarelbundock.github.io/marginaleffects/

Usage

```
marginaleffects(
  model,
  newdata = NULL,
  variables = NULL,
  vcov = TRUE,
  conf_level = 0.95,
  type = "response",
  slope = "dydx",
  by = NULL,
  wts = NULL,
  hypothesis = NULL,
  eps = NULL,
  ...
)
```

Arguments

`model`	Model object
`newdata`	`NULL`, data frame, string, or `datagrid()` call. Determines the predictor values for which to compute marginal effects.

- `NULL` (default): Unit-level marginal effects for each observed value in the original dataset.
- data frame: Unit-level marginal effects for each row of the `newdata` data frame.
- string:
  - "mean": Marginal Effects at the Mean. Marginal effects when each predictor is held at its mean or mode.
  - "median": Marginal Effects at the Median. Marginal effects when each predictor is held at its median or mode.

  - "marginalmeans": Marginal Effects at Marginal Means. See Details section below.
  - "tukey": Marginal Effects at Tukey's 5 numbers.
  - "grid": Marginal Effects on a grid of representative numbers (Tukey's 5 numbers and unique values of categorical predictors).
- `datagrid()` call to specify a custom grid of regressors. For example:
  - `newdata = datagrid(cyl = c(4, 6))`: `cyl` variable equal to 4 and 6 and other regressors fixed at their means or modes.
  - See the Examples section and the `datagrid()` documentation.

`variables` `NULL` or character vector. The subset of variables for which to compute marginal effects.

- `NULL`: compute contrasts for all the variables in the model object (can be slow).
- Character vector: subset of variables (usually faster).

`vcov` Type of uncertainty estimates to report (e.g., for robust standard errors). Acceptable values:

- FALSE: Do not compute standard errors. This can speed up computation considerably.
- TRUE: Unit-level standard errors using the default `vcov(model)` variance-covariance matrix.
- String which indicates the kind of uncertainty estimates to return.
  - Heteroskedasticity-consistent: `"HC"`, `"HC0"`, `"HC1"`, `"HC2"`, `"HC3"`, `"HC4"`, `"HC4m"`, `"HC5"`. See `?sandwich::vcovHC`
  - Heteroskedasticity and autocorrelation consistent: `"HAC"`
  - Mixed-Models degrees of freedom: "satterthwaite", "kenward-roger"
  - Other: `"NeweyWest"`, `"KernHAC"`, `"OPG"`. See the `sandwich` package documentation.
- One-sided formula which indicates the name of cluster variables (e.g., `~unit_id`). This formula is passed to the `cluster` argument of the `sandwich::vcovCL` function.
- Square covariance matrix
- Function which returns a covariance matrix (e.g., `stats::vcov(model)`)

`conf_level` numeric value between 0 and 1. Confidence level to use to build a confidence interval.

`type` string indicates the type (scale) of the predictions used to compute marginal effects or contrasts. This can differ based on the model type, but will typically be a string such as: "response", "link", "probs", or "zero". When an unsupported string is entered, the model-specific list of acceptable values is returned in an error message.

`slope` string indicates the type of slope or (semi-)elasticity to compute:

- "dydx": dY/dX
- "eyex": dY/dX * Y / X
- "eydx": dY/dX * Y

- "dyex": dY/dX / X

`by` Character vector of variable names over which to compute group-wise estimates.

`wts` string or numeric: weights to use when computing average contrasts or marginal-effects. These weights only affect the averaging in `tidy()` or `summary()`, and not the unit-level estimates themselves.

- string: column name of the weights variable in `newdata`. When supplying a column name to `wts`, it is recommended to supply the original data (including the weights variable) explicitly to `newdata`.
- numeric: vector of length equal to the number of rows in the original data or in `newdata` (if supplied).

`hypothesis` specify a hypothesis test or custom contrast using a vector, matrix, string, or string formula.

- String:
  - "pairwise": pairwise differences between estimates in each row.
  - "reference": differences between the estimates in each row and the estimate in the first row.
- String formula to specify linear or non-linear hypothesis tests. If the `term` column uniquely identifies rows, terms can be used in the formula. Otherwise, use `b1`, `b2`, etc. to identify the position of each parameter. Examples:
  - `hp = drat`
  - `hp + drat = 12`
  - `b1 + b2 + b3 = 0`
- Numeric vector: Weights to compute a linear combination of (custom contrast between) estimates. Length equal to the number of rows generated by the same function call, but without the `hypothesis` argument.
- Numeric matrix: Each column is a vector of weights, as describe above, used to compute a distinct linear combination of (contrast between) estimates.
- See the Examples section below and the vignette: https://vincentarelbundock.github.io/marginaleffect

`eps` NULL or numeric value which determines the step size to use when calculating numerical derivatives: (f(x+eps)-f(x))/eps. When `eps` is `NULL`, the step size is step to 0.0001 multiplied by the range of the variable with respect to which we are taking the derivative. Changing this value may be necessary to avoid numerical problems in certain models.

`...` Additional arguments are passed to the `predict()` method supplied by the modeling package.These arguments are particularly useful for mixed-effects or bayesian models (see the online vignettes on the `marginaleffects` website). Available arguments can vary from model to model, depending on the range of supported arguments by each modeling package. See the "Model-Specific Arguments" section of the `?marginaleffects` documentation for a non-exhaustive list of available arguments.

Details

A "marginal effect" is the partial derivative of the regression equation with respect to a variable in the model. This function uses automatic differentiation to compute marginal effects for a vast

array of models, including non-linear models with transformations (e.g., polynomials). Uncertainty estimates are computed using the delta method.

The `newdata` argument can be used to control the kind of marginal effects to report:

- Average Marginal Effects (AME)
- Group-Average Marginal Effects (G-AME)
- Marginal Effects at the Mean (MEM) or
- Marginal Effects at User-Specified values (aka Marginal Effects at Representative values, MER).

See the marginaleffects vignette for worked-out examples of each kind of marginal effect.

Numerical derivatives for the `marginaleffects` function are calculated using a simple epsilon difference approach: $\partial Y/\partial X = (f(X+\varepsilon)-f(X))/\varepsilon$, where f is the `predict()` method associated with the model class, and ε is determined by the `eps` argument.

Warning: Some models are particularly sensitive to `eps`, so it is good practice to try different values of this argument.

Standard errors for the marginal effects are obtained using the Delta method. See the "Standard Errors" vignette on the package website for details (link above).

Value

A `data.frame` with one row per observation (per term/group) and several columns:

- `rowid`: row number of the `newdata` data frame
- `type`: prediction type, as defined by the `type` argument
- `group`: (optional) value of the grouped outcome (e.g., categorical outcome models)
- `term`: the variable whose marginal effect is computed
- `dydx`: marginal effect of the term on the outcome for a given combination of regressor values
- `std.error`: standard errors computed by via the delta method.

Vignettes and documentation

Vignettes:

- Adjusted Predictions
- Contrasts
- Marginal Effects
- Marginal Means
- Hypothesis Tests and Custom Contrasts using the Delta Method

Case studies:

- Bayesian Analyses with `brms`
- Causal Inference with the g-Formula
- Elasticity

- Generalized Additive Models
- Mixed effects models
- Multinomial Logit and Discrete Choice Models
- Multiple Imputation

Tips and technical notes:

- 68 Supported Classes of Models
- Index of Functions and Documentation
- Standard Errors
- Tables and Plots
- Performance
- Alternative Software
- Frequently Asked Questions

Model-Specific Arguments

Some model types allow model-specific arguments to modify the nature of marginal effects, predictions, marginal means, and contrasts.

Package	Class	Argument	Documentation
brms	brmsfit	ndraws	brms::posterior_predict
		re_formula	
lme4	merMod	include_random	insight::get_predicted
		re.form	lme4::predict.merMod
		allow.new.levels	lme4::predict.merMod
glmmTMB	glmmTMB	re.form	glmmTMB::predict.glmmTMB
		allow.new.levels	glmmTMB::predict.glmmTMB
		zitype	glmmTMB::predict.glmmTMB
mgcv	bam	exclude	mgcv::predict.bam
robustlmm	rlmerMod	re.form	robustlmm::predict.rlmerMod
		allow.new.levels	robustlmm::predict.rlmerMod

Examples

```
mod <- glm(am ~ hp * wt, data = mtcars, family = binomial)
mfx <- marginaleffects(mod)
head(mfx)

# Average Marginal Effect (AME)
summary(mfx)
tidy(mfx)
plot(mfx)
```

```
# Marginal Effect at the Mean (MEM)
marginaleffects(mod, newdata = datagrid())

# Marginal Effect at User-Specified Values
# Variables not explicitly included in `datagrid()` are held at their means
marginaleffects(mod,
                newdata = datagrid(hp = c(100, 110)))

# Group-Average Marginal Effects (G-AME)
# Calculate marginal effects for each observation, and then take the average
# marginal effect within each subset of observations with different observed
# values for the `cyl` variable:
mod2 <- lm(mpg ~ hp * cyl, data = mtcars)
mfx2 <- marginaleffects(mod2, variables = "hp", by = "cyl")
summary(mfx2)

# Marginal Effects at User-Specified Values (counterfactual)
# Variables not explicitly included in `datagrid()` are held at their
# original values, and the whole dataset is duplicated once for each
# combination of the values in `datagrid()`
mfx <- marginaleffects(mod,
                       newdata = datagrid(hp = c(100, 110),
                                          grid_type = "counterfactual"))
head(mfx)

# Heteroskedasticity robust standard errors
marginaleffects(mod, vcov = sandwich::vcovHC(mod))

# hypothesis test: is the `hp` marginal effect at the mean equal to the `drat` marginal effect
mod <- lm(mpg ~ wt + drat, data = mtcars)

marginaleffects(
    mod,
    newdata = "mean",
    hypothesis = "wt = drat")

# same hypothesis test using row indices
marginaleffects(
    mod,
    newdata = "mean",
    hypothesis = "b1 - b2 = 0")

# same hypothesis test using numeric vector of weights
marginaleffects(
    mod,
    newdata = "mean",
    hypothesis = c(1, -1))

# two custom contrasts using a matrix of weights
lc <- matrix(c(
    1, -1,
    2, 3),
```

```
    ncol = 2)
marginaleffects(
    mod,
    newdata = "mean",
    hypothesis = lc)
```

`marginalmeans` *Marginal Means*

Description

Marginal means are adjusted predictions, averaged across a grid of categorical predictors, holding other numeric predictors at their means. To learn more, read the marginal means vignette, visit the package website, or scroll down this page for a full list of vignettes:

- https://vincentarelbundock.github.io/marginaleffects/articles/marginalmeans.html
- https://vincentarelbundock.github.io/marginaleffects/

Usage

```
marginalmeans(
  model,
  variables = NULL,
  variables_grid = NULL,
  vcov = TRUE,
  conf_level = 0.95,
  type = "response",
  transform_post = NULL,
  interaction = NULL,
  hypothesis = NULL,
  by = NULL,
  ...
)
```

Arguments

`model`	Model object
`variables`	character vector Categorical predictors over which to compute marginal means. `NULL` calculates marginal means for all logical, character, or factor variables in the dataset used to fit `model`. Set `interaction=TRUE` to compute marginal means at combinations of the predictors specified in the `variables` argument.
`variables_grid`	character vector Categorical predictors used to construct the prediction grid over which adjusted predictions are averaged (character vector). `NULL` creates a grid with all combinations of all categorical predictors. This grid can be very large when there are many variables and many response levels, so it is advisable to

select a limited number of variables in the variables and variables_grid arguments.

vcov — Type of uncertainty estimates to report (e.g., for robust standard errors). Acceptable values:

- FALSE: Do not compute standard errors. This can speed up computation considerably.
- TRUE: Unit-level standard errors using the default vcov(model) variance-covariance matrix.
- String which indicates the kind of uncertainty estimates to return.
  - Heteroskedasticity-consistent: "HC", "HC0", "HC1", "HC2", "HC3", "HC4", "HC4m", "HC5". See ?sandwich::vcovHC
  - Heteroskedasticity and autocorrelation consistent: "HAC"
  - Mixed-Models degrees of freedom: "satterthwaite", "kenward-roger"
  - Other: "NeweyWest", "KernHAC", "OPG". See the sandwich package documentation.
- One-sided formula which indicates the name of cluster variables (e.g., ~unit_id). This formula is passed to the cluster argument of the sandwich::vcovCL function.
- Square covariance matrix
- Function which returns a covariance matrix (e.g., stats::vcov(model))

conf_level — numeric value between 0 and 1. Confidence level to use to build a confidence interval.

type — string indicates the type (scale) of the predictions used to compute marginal effects or contrasts. This can differ based on the model type, but will typically be a string such as: "response", "link", "probs", or "zero". When an unsupported string is entered, the model-specific list of acceptable values is returned in an error message.

transform_post — (experimental) A function applied to unit-level adjusted predictions and confidence intervals just before the function returns results. For bayesian models, this function is applied to individual draws from the posterior distribution, before computing summaries.

interaction — TRUE, FALSE, or NULL

- FALSE: Marginal means are computed for each predictor individually.
- TRUE: Marginal means are computed for each combination of predictors specified in the variables argument.
- NULL (default): Behaves like TRUE when the variables argument is specified and the model formula includes interactions. Behaves like FALSE otherwise.

hypothesis — specify a hypothesis test or custom contrast using a vector, matrix, string, or string formula.

- String:
  - "pairwise": pairwise differences between estimates in each row.
  - "reference": differences between the estimates in each row and the estimate in the first row.

- String formula to specify linear or non-linear hypothesis tests. If the `term` column uniquely identifies rows, terms can be used in the formula. Otherwise, use `b1`, `b2`, etc. to identify the position of each parameter. Examples:
  - `hp = drat`
  - `hp + drat = 12`
  - `b1 + b2 + b3 = 0`
- Numeric vector: Weights to compute a linear combination of (custom contrast between) estimates. Length equal to the number of rows generated by the same function call, but without the `hypothesis` argument.
- Numeric matrix: Each column is a vector of weights, as describe above, used to compute a distinct linear combination of (contrast between) estimates.
- See the Examples section below and the vignette: https://vincentarelbundock.github.io/marginaleffec

`by` character vector of categorical variables included in the `variables_grid`. Marginal means are computed within each subgroup corresponding to combinations of values in the `by` variables. Note that the `by` argument works differently for other functions in the package (`predictions()`, `marginaleffects()`, `comparisons()`), where `by` is used for post-processing in the `tidy()` or `summary()` functions.

`...` Additional arguments are passed to the `predict()` method supplied by the modeling package.These arguments are particularly useful for mixed-effects or bayesian models (see the online vignettes on the `marginaleffects` website). Available arguments can vary from model to model, depending on the range of supported arguments by each modeling package. See the "Model-Specific Arguments" section of the `?marginaleffects` documentation for a non-exhaustive list of available arguments.

Details

This function begins by calling the `predictions` function to obtain a grid of predictors, and adjusted predictions for each cell. The grid includes all combinations of the categorical variables listed in the `variables` and `variables_grid` arguments, or all combinations of the categorical variables used to fit the model if `variables_grid` is `NULL`. In the prediction grid, numeric variables are held at their means.

After constructing the grid and filling the grid with adjusted predictions, `marginalmeans` computes marginal means for the variables listed in the `variables` argument, by average across all categories in the grid.

`marginalmeans` can only compute standard errors for linear models, or for predictions on the link scale, that is, with the `type` argument set to "link".

The `marginaleffects` website compares the output of this function to the popular `emmeans` package, which provides similar but more advanced functionality: https://vincentarelbundock.github.io/marginaleffects/

Value

Data frame of marginal means with one row per variable-value combination.

Vignettes and documentation

Vignettes:

- Adjusted Predictions
- Contrasts
- Marginal Effects
- Marginal Means
- Hypothesis Tests and Custom Contrasts using the Delta Method

Case studies:

- Bayesian Analyses with `brms`
- Causal Inference with the g-Formula
- Elasticity
- Generalized Additive Models
- Mixed effects models
- Multinomial Logit and Discrete Choice Models
- Multiple Imputation

Tips and technical notes:

- 68 Supported Classes of Models
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- Standard Errors
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- Alternative Software
- Frequently Asked Questions

Model-Specific Arguments

Some model types allow model-specific arguments to modify the nature of marginal effects, predictions, marginal means, and contrasts.

Package	Class	Argument	Documentation
`brms`	`brmsfit`	`ndraws`	brms::posterior_predict
		`re_formula`	
`lme4`	`merMod`	`include_random`	insight::get_predicted
		`re.form`	lme4::predict.merMod
		`allow.new.levels`	lme4::predict.merMod
`glmmTMB`	`glmmTMB`	`re.form`	glmmTMB::predict.glmmTMB
		`allow.new.levels`	glmmTMB::predict.glmmTMB
		`zitype`	glmmTMB::predict.glmmTMB
`mgcv`	`bam`	`exclude`	mgcv::predict.bam
`robustlmm`	`rlmerMod`	`re.form`	robustlmm::predict.rlmerMod
		`allow.new.levels`	robustlmm::predict.rlmerMod

Examples

```
library(marginaleffects)

# Convert numeric variables to categorical before fitting the model
dat <- mtcars
dat$cyl <- as.factor(dat$cyl)
dat$am <- as.logical(dat$am)
mod <- lm(mpg ~ hp + cyl + am, data = dat)

# Compute and summarize marginal means
mm <- marginalmeans(mod)
summary(mm)

# Marginal means by subgroup
dat <- mtcars
dat$carb <- factor(dat$carb)
dat$cyl <- factor(dat$cyl)
dat$am <- as.logical(dat$am)
mod <- lm(mpg ~ carb + cyl + am, dat)
marginalmeans(mod, variables = "cyl", by = "am")

# Contrast between marginal means (carb2 - carb1), or "is the 1st marginal means equal to the 2nd?"
# see the vignette on "Hypothesis Tests and Custom Contrasts" on the `marginaleffects` website.
lc <- c(-1, 1, 0, 0, 0, 0)
marginalmeans(mod, variables = "carb", hypothesis = "b2 = b1")

marginalmeans(mod, variables = "carb", hypothesis = lc)

# Multiple custom contrasts
lc <- matrix(c(
    -2, 1, 1, 0, -1, 1,
    -1, 1, 0, 0, 0, 0
    ), ncol = 2)
marginalmeans(mod, variables = "carb", hypothesis = lc)
```

---

plot.marginaleffects *Point-range plot of average marginal effects*

Description

Uses the ggplot2 package to draw a point-range plot of the average marginal effects computed by tidy.

Usage

```
## S3 method for class 'marginaleffects'
plot(x, conf_level = 0.95, ...)
```

Arguments

x	An object produced by the marginaleffects function.
conf_level	numeric value between 0 and 1. Confidence level to use to build a confidence interval.
...	Additional arguments are passed to the predict() method supplied by the modeling package.These arguments are particularly useful for mixed-effects or bayesian models (see the online vignettes on the marginaleffects website). Available arguments can vary from model to model, depending on the range of supported arguments by each modeling package. See the "Model-Specific Arguments" section of the ?marginaleffects documentation for a non-exhaustive list of available arguments.

Details

The tidy function calculates average marginal effects by taking the mean of all the unit-level marginal effects computed by the marginaleffects function.

The standard error of the average marginal effects is obtained by taking the mean of each column of the Jacobian. . Then, we use this "Jacobian at the mean" in the Delta method to obtained standard errors.

In Bayesian models (e.g., brms), we compute Average Marginal Effects by applying the mean function twice. First, we apply it to all marginal effects for each posterior draw, thereby estimating one Average (or Median) Marginal Effect per iteration of the MCMC chain. Second, we take the mean and quantile function to the results of Step 1 to obtain the Average (or Median) Marginal Effect and its associated interval.

Value

A ggplot2 object

Examples

```
mod <- glm(am ~ hp + wt, data = mtcars)
mfx <- marginaleffects(mod)
plot(mfx)
```

---

plot_cap *Plot Conditional Adjusted Predictions*

Description

This function plots adjusted predictions (y-axis) against values of one or more predictors (x-axis and colors).

Usage

```
plot_cap(
  model,
  condition = NULL,
  type = "response",
  vcov = NULL,
  conf_level = 0.95,
  transform_post = NULL,
  draw = TRUE,
  ...
)
```

Arguments

model	Model object
condition	String or vector of two strings. The first is a variable name to be displayed on the x-axis. The second is a variable whose values will be displayed in different colors. Other numeric variables are held at their means. Other categorical variables are held at their modes. Other numeric variables are held at their means.
type	string indicates the type (scale) of the predictions used to compute marginal effects or contrasts. This can differ based on the model type, but will typically be a string such as: "response", "link", "probs", or "zero". When an unsupported string is entered, the model-specific list of acceptable values is returned in an error message.
vcov	Type of uncertainty estimates to report (e.g., for robust standard errors). Acceptable values: • FALSE: Do not compute standard errors. This can speed up computation considerably. • TRUE: Unit-level standard errors using the default `vcov(model)` variance-covariance matrix. • String which indicates the kind of uncertainty estimates to return. – Heteroskedasticity-consistent: `"HC"`, `"HC0"`, `"HC1"`, `"HC2"`, `"HC3"`, `"HC4"`, `"HC4m"`, `"HC5"`. See `?sandwich::vcovHC` – Heteroskedasticity and autocorrelation consistent: `"HAC"` – Mixed-Models degrees of freedom: "satterthwaite", "kenward-roger" – Other: `"NeweyWest"`, `"KernHAC"`, `"OPG"`. See the `sandwich` package documentation. • One-sided formula which indicates the name of cluster variables (e.g., `~unit_id`). This formula is passed to the `cluster` argument of the `sandwich::vcovCL` function. • Square covariance matrix • Function which returns a covariance matrix (e.g., `stats::vcov(model)`)
conf_level	numeric value between 0 and 1. Confidence level to use to build a confidence interval.

transform_post	(experimental) A function applied to unit-level adjusted predictions and confidence intervals just before the function returns results. For bayesian models, this function is applied to individual draws from the posterior distribution, before computing summaries.
draw	TRUE returns a ggplot2 plot. FALSE returns a data.frame of the underlying data.
...	Additional arguments are passed to the predict() method supplied by the modeling package.These arguments are particularly useful for mixed-effects or bayesian models (see the online vignettes on the marginaleffects website). Available arguments can vary from model to model, depending on the range of supported arguments by each modeling package. See the "Model-Specific Arguments" section of the ?marginaleffects documentation for a non-exhaustive list of available arguments.

Value

A ggplot2 object

Examples

```
mod <- lm(mpg ~ hp + wt, data = mtcars)
plot_cap(mod, condition = "wt")

mod <- lm(mpg ~ hp * wt * am, data = mtcars)
plot_cap(mod, condition = c("hp", "wt"))
```

---

plot_cco *Plot Conditional Contrasts*

Description

This function plots contrasts (y-axis) against values of predictor(s) variable(s) (x-axis and colors). This is especially useful in models with interactions, where the values of contrasts depend on the values of "condition" variables.

Usage

```
plot_cco(
  model,
  effect = NULL,
  condition = NULL,
  type = "response",
  vcov = NULL,
  conf_level = 0.95,
  transform_pre = "difference",
  transform_post = NULL,
```

```
  draw = TRUE,
  ...
)
```

Arguments

model	Model object
effect	Name of the variable whose contrast we want to plot on the y-axis
condition	String or vector of two strings. The first is a variable name to be displayed on the x-axis. The second is a variable whose values will be displayed in different colors. Other numeric variables are held at their means. Other categorical variables are held at their modes.
type	string indicates the type (scale) of the predictions used to compute marginal effects or contrasts. This can differ based on the model type, but will typically be a string such as: "response", "link", "probs", or "zero". When an unsupported string is entered, the model-specific list of acceptable values is returned in an error message.
vcov	Type of uncertainty estimates to report (e.g., for robust standard errors). Acceptable values: • FALSE: Do not compute standard errors. This can speed up computation considerably. • TRUE: Unit-level standard errors using the default `vcov(model)` variance-covariance matrix. • String which indicates the kind of uncertainty estimates to return. – Heteroskedasticity-consistent: `"HC"`, `"HC0"`, `"HC1"`, `"HC2"`, `"HC3"`, `"HC4"`, `"HC4m"`, `"HC5"`. See `?sandwich::vcovHC` – Heteroskedasticity and autocorrelation consistent: `"HAC"` – Mixed-Models degrees of freedom: "satterthwaite", "kenward-roger" – Other: `"NeweyWest"`, `"KernHAC"`, `"OPG"`. See the `sandwich` package documentation. • One-sided formula which indicates the name of cluster variables (e.g., `~unit_id`). This formula is passed to the `cluster` argument of the `sandwich::vcovCL` function. • Square covariance matrix • Function which returns a covariance matrix (e.g., `stats::vcov(model)`)
conf_level	numeric value between 0 and 1. Confidence level to use to build a confidence interval.
transform_pre	string or function. How should pairs of adjusted predictions be contrasted? • string: shortcuts to common contrast functions. – Supported shortcuts strings: difference, differenceavg, dydx, eyex, eydx, dyex, dydxavg, eyexavg, eydxavg, dyexavg, ratio, ratioavg, lnratio, lnratioavg, lnor, lnoravg, expdydx, expdydxavg – See the Transformations section below for definitions of each transformation.

- function: accept two equal-length numeric vectors of adjusted predictions (`hi` and `lo`) and returns a vector of contrasts of the same length, or a unique numeric value.
  - See the Transformations section below for examples of valid functions.

`transform_post` (experimental) A function applied to unit-level estimates and confidence intervals just before the function returns results.

`draw` `TRUE` returns a `ggplot2` plot. `FALSE` returns a `data.frame` of the underlying data.

`...` Additional arguments are passed to the `predict()` method supplied by the modeling package.These arguments are particularly useful for mixed-effects or bayesian models (see the online vignettes on the `marginaleffects` website). Available arguments can vary from model to model, depending on the range of supported arguments by each modeling package. See the "Model-Specific Arguments" section of the `?marginaleffects` documentation for a non-exhaustive list of available arguments.

Value

A `ggplot2` object

Examples

```
mod <- lm(mpg ~ hp * wt, data = mtcars)
plot_cco(mod, effect = "hp", condition = "wt")

mod <- lm(mpg ~ hp * wt * am, data = mtcars)
plot_cco(mod, effect = "hp", condition = c("wt", "am"))
```

---

plot_cme *Plot Conditional Marginal Effects*

Description

This function plots marginal effects (y-axis) against values of predictor(s) variable(s) (x-axis and colors). This is especially useful in models with interactions, where the values of marginal effects depend on the values of "condition" variables.

Usage

```
plot_cme(
  model,
  effect = NULL,
  condition = NULL,
  type = "response",
  vcov = NULL,
  conf_level = 0.95,
```

```
  draw = TRUE,
  ...
)
```

Arguments

model	Model object
effect	Name of the variable whose marginal effect we want to plot on the y-axis
condition	String or vector of two strings. The first is a variable name to be displayed on the x-axis. The second is a variable whose values will be displayed in different colors. Other numeric variables are held at their means. Other categorical variables are held at their modes.
type	string indicates the type (scale) of the predictions used to compute marginal effects or contrasts. This can differ based on the model type, but will typically be a string such as: "response", "link", "probs", or "zero". When an unsupported string is entered, the model-specific list of acceptable values is returned in an error message.
vcov	Type of uncertainty estimates to report (e.g., for robust standard errors). Acceptable values: • FALSE: Do not compute standard errors. This can speed up computation considerably. • TRUE: Unit-level standard errors using the default `vcov(model)` variance-covariance matrix. • String which indicates the kind of uncertainty estimates to return. – Heteroskedasticity-consistent: `"HC"`, `"HC0"`, `"HC1"`, `"HC2"`, `"HC3"`, `"HC4"`, `"HC4m"`, `"HC5"`. See `?sandwich::vcovHC` – Heteroskedasticity and autocorrelation consistent: `"HAC"` – Mixed-Models degrees of freedom: "satterthwaite", "kenward-roger" – Other: `"NeweyWest"`, `"KernHAC"`, `"OPG"`. See the `sandwich` package documentation. • One-sided formula which indicates the name of cluster variables (e.g., `~unit_id`). This formula is passed to the `cluster` argument of the `sandwich::vcovCL` function. • Square covariance matrix • Function which returns a covariance matrix (e.g., `stats::vcov(model)`)
conf_level	numeric value between 0 and 1. Confidence level to use to build a confidence interval.
draw	`TRUE` returns a `ggplot2` plot. `FALSE` returns a `data.frame` of the underlying data.
...	Additional arguments are passed to the `predict()` method supplied by the modeling package.These arguments are particularly useful for mixed-effects or bayesian models (see the online vignettes on the `marginaleffects` website). Available arguments can vary from model to model, depending on the range of supported arguments by each modeling package. See the "Model-Specific Arguments" section of the `?marginaleffects` documentation for a non-exhaustive list of available arguments.

Value

A ggplot2 object

Examples

```
mod <- lm(mpg ~ hp * wt, data = mtcars)
plot_cme(mod, effect = "hp", condition = "wt")

mod <- lm(mpg ~ hp * wt * am, data = mtcars)
plot_cme(mod, effect = "hp", condition = c("wt", "am"))
```

---

posteriordraws *Extract posterior draws from a* predictions*,* comparisons*, or* marginaleffects *object derived from Bayesian models.*

Description

Extract posterior draws from a predictions, comparisons, or marginaleffects object derived from Bayesian models.

Usage

```
posteriordraws(x)
```

Arguments

x	An object produced by the marginaleffects, comparisons, or predictions functions

Value

A data.frame with drawid and draw columns.

---

predictions *Adjusted Predictions*

Description

Outcome predicted by a fitted model on a specified scale for a given combination of values of the predictor variables, such as their observed values, their means, or factor levels (a.k.a. "reference grid"). The tidy() and summary() functions can be used to aggregate the output of predictions(). To learn more, read the predictions vignette, visit the package website, or scroll down this page for a full list of vignettes:

- https://vincentarelbundock.github.io/marginaleffects/articles/predictions.html
- https://vincentarelbundock.github.io/marginaleffects/

Usage

```
predictions(
  model,
  newdata = NULL,
  variables = NULL,
  vcov = TRUE,
  conf_level = 0.95,
  type = "response",
  by = NULL,
  wts = NULL,
  transform_post = NULL,
  hypothesis = NULL,
  ...
)
```

Arguments

`model`	Model object
`newdata`	A data frame over which to compute quantities of interest. • `NULL`: adjusted predictions for each observed value in the original dataset. • "mean": Marginal Effects at the Mean. Marginal effects when each predictor is held at its mean or mode. • "median": Marginal Effects at the Median. Marginal effects when each predictor is held at its median or mode. • "marginalmeans": Marginal Effects at Marginal Means. See Details section below. • "tukey": Marginal Effects at Tukey's 5 numbers. • "grid": Marginal Effects on a grid of representative numbers (Tukey's 5 numbers and unique values of categorical predictors). • The `datagrid()` function can be used to specify a custom grid of regressors. For example: – `newdata = datagrid()`: contrast at the mean – `newdata = datagrid(cyl = c(4, 6))`: `cyl` variable equal to 4 and 6 and other regressors fixed at their means or modes. – See the Examples section and the `datagrid()` documentation for more.
`variables`	Named list of variables with values to create a counterfactual grid of predictions. The entire dataset replicated for each unique combination of the variables in this list. See the Examples section below. Warning: This can use a lot of memory if there are many variables and values, and when the dataset is large.
`vcov`	Type of uncertainty estimates to report (e.g., for robust standard errors). Acceptable values: • FALSE: Do not compute standard errors. This can speed up computation considerably. • TRUE: Unit-level standard errors using the default `vcov(model)` variance-covariance matrix.

- String which indicates the kind of uncertainty estimates to return.
  - Heteroskedasticity-consistent: "HC", "HC0", "HC1", "HC2", "HC3", "HC4", "HC4m", "HC5". See ?sandwich::vcovHC
  - Heteroskedasticity and autocorrelation consistent: "HAC"
  - Mixed-Models degrees of freedom: "satterthwaite", "kenward-roger"
  - Other: "NeweyWest", "KernHAC", "OPG". See the sandwich package documentation.
- One-sided formula which indicates the name of cluster variables (e.g., ~unit_id). This formula is passed to the cluster argument of the sandwich::vcovCL function.
- Square covariance matrix
- Function which returns a covariance matrix (e.g., stats::vcov(model))

conf_level — numeric value between 0 and 1. Confidence level to use to build a confidence interval.

type — string indicates the type (scale) of the predictions used to compute marginal effects or contrasts. This can differ based on the model type, but will typically be a string such as: "response", "link", "probs", or "zero". When an unsupported string is entered, the model-specific list of acceptable values is returned in an error message.

by — Character vector of variable names over which to compute group-wise estimates.

wts — string or numeric: weights to use when computing average contrasts or marginal-effects. These weights only affect the averaging in tidy() or summary(), and not the unit-level estimates themselves.

- string: column name of the weights variable in newdata. When supplying a column name to wts, it is recommended to supply the original data (including the weights variable) explicitly to newdata.
- numeric: vector of length equal to the number of rows in the original data or in newdata (if supplied).

transform_post — (experimental) A function applied to unit-level adjusted predictions and confidence intervals just before the function returns results. For bayesian models, this function is applied to individual draws from the posterior distribution, before computing summaries.

hypothesis — specify a hypothesis test or custom contrast using a vector, matrix, string, or string formula.

- String:
  - "pairwise": pairwise differences between estimates in each row.
  - "reference": differences between the estimates in each row and the estimate in the first row.
- String formula to specify linear or non-linear hypothesis tests. If the term column uniquely identifies rows, terms can be used in the formula. Otherwise, use b1, b2, etc. to identify the position of each parameter. Examples:
  - hp = drat
  - hp + drat = 12
  - b1 + b2 + b3 = 0

- Numeric vector: Weights to compute a linear combination of (custom contrast between) estimates. Length equal to the number of rows generated by the same function call, but without the `hypothesis` argument.
- Numeric matrix: Each column is a vector of weights, as describe above, used to compute a distinct linear combination of (contrast between) estimates.
- See the Examples section below and the vignette: https://vincentarelbundock.github.io/marginaleffect

`...` Additional arguments are passed to the `predict()` method supplied by the modeling package.These arguments are particularly useful for mixed-effects or bayesian models (see the online vignettes on the `marginaleffects` website). Available arguments can vary from model to model, depending on the range of supported arguments by each modeling package. See the "Model-Specific Arguments" section of the ?`marginaleffects` documentation for a non-exhaustive list of available arguments.

Details

The `newdata` argument, the `tidy()` function, and `datagrid()` function can be used to control the kind of predictions to report:

- Average Predictions
- Predictions at the Mean
- Predictions at User-Specified values (aka Predictions at Representative values).

When possible, `predictions()` delegates the computation of confidence intervals to the `insight::get_predicted()` function, which uses back transformation to produce adequate confidence intervals on the scale specified by the `type` argument. When this is not possible, `predictions()` uses the Delta Method to compute standard errors around adjusted predictions.

Value

A `data.frame` with one row per observation and several columns:

- `rowid`: row number of the `newdata` data frame
- `type`: prediction type, as defined by the `type` argument
- `group`: (optional) value of the grouped outcome (e.g., categorical outcome models)
- `predicted`: predicted outcome
- `std.error`: standard errors computed by the `insight::get_predicted` function or, if unavailable, via `marginaleffects` delta method functionality.
- `conf.low`: lower bound of the confidence interval (or equal-tailed interval for bayesian models)
- `conf.high`: upper bound of the confidence interval (or equal-tailed interval for bayesian models)

Vignettes and documentation

Vignettes:

- Adjusted Predictions
- Contrasts
- Marginal Effects
- Marginal Means
- Hypothesis Tests and Custom Contrasts using the Delta Method

Case studies:

- Bayesian Analyses with `brms`
- Causal Inference with the g-Formula
- Elasticity
- Generalized Additive Models
- Mixed effects models
- Multinomial Logit and Discrete Choice Models
- Multiple Imputation

Tips and technical notes:

- 68 Supported Classes of Models
- Index of Functions and Documentation
- Standard Errors
- Tables and Plots
- Performance
- Alternative Software
- Frequently Asked Questions

Model-Specific Arguments

Some model types allow model-specific arguments to modify the nature of marginal effects, predictions, marginal means, and contrasts.

Package	Class	Argument	Documentation
`brms`	`brmsfit`	`ndraws`	brms::posterior_predict
		`re_formula`	
`lme4`	`merMod`	`include_random`	insight::get_predicted
		`re.form`	lme4::predict.merMod
		`allow.new.levels`	lme4::predict.merMod
`glmmTMB`	`glmmTMB`	`re.form`	glmmTMB::predict.glmmTMB
		`allow.new.levels`	glmmTMB::predict.glmmTMB
		`zitype`	glmmTMB::predict.glmmTMB
`mgcv`	`bam`	`exclude`	mgcv::predict.bam
`robustlmm`	`rlmerMod`	`re.form`	robustlmm::predict.rlmerMod
		`allow.new.levels`	robustlmm::predict.rlmerMod

Examples

```
# Adjusted Prediction for every row of the original dataset
mod <- lm(mpg ~ hp + factor(cyl), data = mtcars)
pred <- predictions(mod)
head(pred)

# Adjusted Predictions at User-Specified Values of the Regressors
predictions(mod, newdata = datagrid(hp = c(100, 120), cyl = 4))

# Average Adjusted Predictions (AAP)
library(dplyr)
mod <- lm(mpg ~ hp * am * vs, mtcars)

pred <- predictions(mod, newdata = datagrid(am = 0, grid_type = "counterfactual")) %>%
    summarize(across(c(predicted, std.error), mean))

predictions(mod, newdata = datagrid(am = 0:1, grid_type = "counterfactual")) %>%
    group_by(am) %>%
    summarize(across(c(predicted, std.error), mean))

# Conditional Adjusted Predictions
plot_cap(mod, condition = "hp")

# Counterfactual predictions with the `variables` argument
# the `mtcars` dataset has 32 rows

mod <- lm(mpg ~ hp + am, data = mtcars)
p <- predictions(mod)
head(p)
nrow(p)

# counterfactual predictions obtained by replicating the entire for different
# values of the predictors
p <- predictions(mod, variables = list(hp = c(90, 110)))
nrow(p)


# hypothesis test: is the prediction in the 1st row equal to the prediction in the 2nd row
mod <- lm(mpg ~ wt + drat, data = mtcars)

predictions(
    mod,
    newdata = datagrid(wt = 2:3),
    hypothesis = "b1 = b2")

# same hypothesis test using row indices
predictions(
    mod,
    newdata = datagrid(wt = 2:3),
    hypothesis = "b1 - b2 = 0")

# same hypothesis test using numeric vector of weights
```

```
predictions(
    mod,
    newdata = datagrid(wt = 2:3),
    hypothesis = c(1, -1))

# two custom contrasts using a matrix of weights
lc <- matrix(c(
    1, -1,
    2, 3),
    ncol = 2)
predictions(
    mod,
    newdata = datagrid(wt = 2:3),
    hypothesis = lc)
```

`summary.comparisons` *Summarize a* `comparisons` *object*

Description

Summarize a `comparisons` object

Usage

```
## S3 method for class 'comparisons'
summary(object, conf_level = 0.95, transform_avg = NULL, ...)
```

Arguments

`object`	An object produced by the `comparisons` function
`conf_level`	numeric value between 0 and 1. Confidence level to use to build a confidence interval.
`transform_avg`	(experimental) A function applied to the estimates and confidence intervals *after* the unit-level estimates have been averaged.
`...`	Additional arguments are passed to the `predict()` method supplied by the modeling package.These arguments are particularly useful for mixed-effects or bayesian models (see the online vignettes on the `marginaleffects` website). Available arguments can vary from model to model, depending on the range of supported arguments by each modeling package. See the "Model-Specific Arguments" section of the ?`marginaleffects` documentation for a non-exhaustive list of available arguments.

Value

Data frame of summary statistics for an object produced by the `comparisons` function

Examples

```
mod <- lm(mpg ~ hp * wt + factor(gear), data = mtcars)
con <- comparisons(mod)

# average marginal effects
summary(con)
```

`summary.marginaleffects` *Summarize a* `marginaleffects` *object*

Description

Summarize a `marginaleffects` object

Usage

```
## S3 method for class 'marginaleffects'
summary(object, conf_level = 0.95, ...)
```

Arguments

`object`	An object produced by the `marginaleffects` function
`conf_level`	numeric value between 0 and 1. Confidence level to use to build a confidence interval.
`...`	Additional arguments are passed to the `predict()` method supplied by the modeling package.These arguments are particularly useful for mixed-effects or bayesian models (see the online vignettes on the `marginaleffects` website). Available arguments can vary from model to model, depending on the range of supported arguments by each modeling package. See the "Model-Specific Arguments" section of the ?`marginaleffects` documentation for a non-exhaustive list of available arguments.

Value

Data frame of summary statistics for an object produced by the `marginaleffects` function

Examples

```
mod <- lm(mpg ~ hp * wt + factor(gear), data = mtcars)
mfx <- marginaleffects(mod)

# average marginal effects
summary(mfx)
```

summary.marginalmeans *Summarize a* marginalmeans *object*

Description

Summarize a marginalmeans object

Usage

```
## S3 method for class 'marginalmeans'
summary(object, conf_level = 0.95, ...)
```

Arguments

object	An object produced by the marginalmeans function
conf_level	numeric value between 0 and 1. Confidence level to use to build a confidence interval.
...	Additional arguments are passed to the predict() method supplied by the modeling package.These arguments are particularly useful for mixed-effects or bayesian models (see the online vignettes on the marginaleffects website). Available arguments can vary from model to model, depending on the range of supported arguments by each modeling package. See the "Model-Specific Arguments" section of the ?marginaleffects documentation for a non-exhaustive list of available arguments.

Value

Data frame of summary statistics for an object produced by the marginalmeans function

summary.predictions *Summarize a* predictions *object*

Description

Summarize a predictions object

Usage

```
## S3 method for class 'predictions'
summary(object, ...)
```

Arguments

object	An object produced by the predictions function
...	Additional arguments are passed to the predict() method supplied by the modeling package.These arguments are particularly useful for mixed-effects or bayesian models (see the online vignettes on the marginaleffects website). Available arguments can vary from model to model, depending on the range of supported arguments by each modeling package. See the "Model-Specific Arguments" section of the ?marginaleffects documentation for a non-exhaustive list of available arguments.

Value

Data frame of summary statistics for an object produced by the predictions function

---

tidy.comparisons *Tidy a* comparisons *object*

Description

Calculate average contrasts by taking the mean of all the unit-level contrasts computed by the predictions function.

Usage

```
## S3 method for class 'comparisons'
tidy(x, conf_level = 0.95, transform_avg = NULL, ...)
```

Arguments

x	An object produced by the comparisons function.
conf_level	numeric value between 0 and 1. Confidence level to use to build a confidence interval.
transform_avg	(experimental) A function applied to the estimates and confidence intervals *after* the unit-level estimates have been averaged.
...	Additional arguments are passed to the predict() method supplied by the modeling package.These arguments are particularly useful for mixed-effects or bayesian models (see the online vignettes on the marginaleffects website). Available arguments can vary from model to model, depending on the range of supported arguments by each modeling package. See the "Model-Specific Arguments" section of the ?marginaleffects documentation for a non-exhaustive list of available arguments.

Details

To compute standard errors around the average marginaleffects, we begin by applying the mean function to each column of the Jacobian. Then, we use this matrix in the Delta method to obtained standard errors.

In Bayesian models (e.g., `brms`), we compute Average Marginal Effects by applying the mean function twice. First, we apply it to all marginal effects for each posterior draw, thereby estimating one Average (or Median) Marginal Effect per iteration of the MCMC chain. Second, we calculate the mean and the `quantile` function to the results of Step 1 to obtain the Average Marginal Effect and its associated interval.

Value

A "tidy" `data.frame` of summary statistics which conforms to the `broom` package specification.

Examples

```
mod <- lm(mpg ~ factor(gear), data = mtcars)
contr <- comparisons(mod, variables = list(gear = "sequential"))
tidy(contr)
```

`tidy.deltamethod` *Tidy a* `deltamethod` *object*

Description

Tidy a `deltamethod` object

Usage

```
## S3 method for class 'deltamethod'
tidy(x, ...)
```

Arguments

`x`	An object produced by the `marginaleffects` function.
`...`	Additional arguments are passed to the `predict()` method supplied by the modeling package.These arguments are particularly useful for mixed-effects or bayesian models (see the online vignettes on the `marginaleffects` website). Available arguments can vary from model to model, depending on the range of supported arguments by each modeling package. See the "Model-Specific Arguments" section of the `?marginaleffects` documentation for a non-exhaustive list of available arguments.

`tidy.marginaleffects` *Tidy a* `marginaleffects` *object*

Description

Tidy a `marginaleffects` object

Usage

```
## S3 method for class 'marginaleffects'
tidy(x, conf_level = 0.95, ...)
```

Arguments

`x`	An object produced by the `marginaleffects` function.
`conf_level`	numeric value between 0 and 1. Confidence level to use to build a confidence interval.
`...`	Additional arguments are passed to the `predict()` method supplied by the modeling package.These arguments are particularly useful for mixed-effects or bayesian models (see the online vignettes on the `marginaleffects` website). Available arguments can vary from model to model, depending on the range of supported arguments by each modeling package. See the "Model-Specific Arguments" section of the `?marginaleffects` documentation for a non-exhaustive list of available arguments.

Details

The `tidy` function calculates average marginal effects by taking the mean of all the unit-level marginal effects computed by the `marginaleffects` function.

The standard error of the average marginal effects is obtained by taking the mean of each column of the Jacobian. . Then, we use this "Jacobian at the mean" in the Delta method to obtained standard errors.

In Bayesian models (e.g., `brms`), we compute Average Marginal Effects by applying the mean function twice. First, we apply it to all marginal effects for each posterior draw, thereby estimating one Average (or Median) Marginal Effect per iteration of the MCMC chain. Second, we take the `mean` and `quantile` function to the results of Step 1 to obtain the Average (or Median) Marginal Effect and its associated interval.

Value

A "tidy" `data.frame` of summary statistics which conforms to the `broom` package specification.

Examples

```
mod <- lm(mpg ~ hp * wt + factor(gear), data = mtcars)
mfx <- marginaleffects(mod)

# average marginal effects
tidy(mfx)
```

`tidy.marginalmeans` *Tidy a* `marginalmeans` *object*

Description

Tidy a `marginalmeans` object

Usage

```
## S3 method for class 'marginalmeans'
tidy(x, conf_level = 0.95, ...)
```

Arguments

`x`	An object produced by the `marginalmeans` function.
`conf_level`	numeric value between 0 and 1. Confidence level to use to build a confidence interval.
`...`	Additional arguments are passed to the `predict()` method supplied by the modeling package.These arguments are particularly useful for mixed-effects or bayesian models (see the online vignettes on the `marginaleffects` website). Available arguments can vary from model to model, depending on the range of supported arguments by each modeling package. See the "Model-Specific Arguments" section of the `?marginaleffects` documentation for a non-exhaustive list of available arguments.

Value

A "tidy" `data.frame` of summary statistics which conforms to the `broom` package specification.

`tidy.predictions` *Tidy a* `predictions` *object*

Description

Calculate average adjusted predictions by taking the mean of all the unit-level adjusted predictions computed by the `predictions` function.

Usage

```
## S3 method for class 'predictions'
tidy(x, conf_level = 0.95, ...)
```

Arguments

`x`	An object produced by the `predictions` function.
`conf_level`	numeric value between 0 and 1. Confidence level to use to build a confidence interval.
`...`	Additional arguments are passed to the `predict()` method supplied by the modeling package.These arguments are particularly useful for mixed-effects or bayesian models (see the online vignettes on the `marginaleffects` website). Available arguments can vary from model to model, depending on the range of supported arguments by each modeling package. See the "Model-Specific Arguments" section of the `?marginaleffects` documentation for a non-exhaustive list of available arguments.

Value

A "tidy" `data.frame` of summary statistics which conforms to the `broom` package specification.

Examples

```
mod <- lm(mpg ~ hp * wt + factor(gear), data = mtcars)
mfx <- predictions(mod)
tidy(mfx)
```

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