Package 'pecanr'

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Title Partial Eta-Squared for Crossed and Nested Linear Mixed Models

Version 0.1.2

Description Computes partial eta-squared effect sizes for fixed effects in linear mixed models fitted with the 'lme4' package. Supports crossed and nested random effects structures with any number of grouping factors. Random slope variances are translated to the outcome scale using a variance decomposition approach, correctly accounting for predictor scaling and interaction terms. Both general and operative effect sizes are provided. Methods are based on Correll, Mellinger, McClelland, and Judd (2020) <doi:10.1016/j.tics.2019.12.009>, Correll, Mellinger, and Pedersen (2022) <doi:10.3758/s13428-021-01687-2>, and Rights and Sterba (2019) <doi:10.1037/met0000184>.

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URL `https://github.com/bcohen0901/pecanr`

BugReports `https://github.com/bcohen0901/pecanr/issues`

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RoxygenNote 7.3.3

Imports lme4

Suggests spelling, testthat (>= 3.0.0)

Config/testthat/edition 3

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NeedsCompilation no

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Contents

batch_eta2p *Batch Calculate Partial Eta-Squared for Multiple Effects*

Description

Calculates partial eta-squared for all fixed effects in a model.

Usage

```
batch_eta2p(
  model,
  data,
  design = c("crossed", "nested"),
  subj_var = NULL,
  item_var = NULL,
  cross_vars = NULL,
  nest_vars = NULL,
  operative = FALSE,
  verbose = FALSE
)
```

Arguments

`model`	A fitted model object from `lme4::lmer()`.
`data`	Data frame used to fit the model.
`design`	Character string: either `"crossed"` or `"nested"`.
`subj_var`	Character string specifying the subject/participant grouping variable. Retained for backward compatibility; prefer `cross_vars`.
`item_var`	Character string specifying the item/stimulus grouping variable. Retained for backward compatibility; prefer `cross_vars`.
`cross_vars`	Character vector of ALL crossed grouping variable names (e.g., `c("subject", "item", "rater")`). Supersedes `subj_var` and `item_var` when provided. Supports any number of crossed factors.
`nest_vars`	Character vector specifying nesting variables from lowest to highest level (required for nested designs).
`operative`	Logical. If TRUE, calculates operative effect size (excludes variance components that don't contribute to SE). Default is FALSE.
`verbose`	Logical. If TRUE, prints detailed results. Default is TRUE.

Value

A data frame with one row per effect containing eta-squared values and variance components.

eta2p *Partial Eta-Squared for Linear Mixed Models*

Description

Calculates partial eta-squared effect sizes for fixed effects in linear mixed models with crossed or nested random effects.

Usage

```
eta2p(
  model,
  effect,
  data,
  design = c("crossed", "nested"),
  subj_var = NULL,
  item_var = NULL,
  cross_vars = NULL,
  nest_vars = NULL,
  effect_level = NULL,
  var_x = NULL,
  operative = FALSE,
  verbose = TRUE
)
```

Arguments

`model`	A fitted model object from `lme4::lmer()`.
`effect`	Character string specifying the fixed effect to analyze. Must match a name in `fixef(model)`.
`data`	Data frame used to fit the model.
`design`	Character string: either `"crossed"` or `"nested"`.
`subj_var`	Character string specifying the subject/participant grouping variable. Retained for backward compatibility; prefer `cross_vars`.
`item_var`	Character string specifying the item/stimulus grouping variable. Retained for backward compatibility; prefer `cross_vars`.
`cross_vars`	Character vector of ALL crossed grouping variable names (e.g., `c("subject", "item", "rater")`). Supersedes `subj_var` and `item_var` when provided. Supports any number of crossed factors.
`nest_vars`	Character vector specifying nesting variables from lowest to highest level (required for nested designs).

`effect_level` Character string specifying the level at which the effect varies (e.g., "L1", "L2"). If NULL, will be detected automatically.

`var_x` Optional numeric. Pre-computed variance of the predictor (or interaction product). If supplied, overrides the internal `var()` calculation from `data`. Useful when raw data are unavailable but the predictor variance is known (e.g., from design: a +/-1 binary predictor has `var_x = 1`).

`operative` Logical. If TRUE, calculates operative effect size (excludes variance components that don't contribute to SE). Default is FALSE.

`verbose` Logical. If TRUE, prints detailed results. Default is TRUE.

Details

The function implements a variance decomposition approach for computing partial eta-squared in mixed models. Random slope variances are translated to the outcome scale using the formula:

$$\sigma^2_{slope}(Y) = \sigma^2_b \times \sigma^2_X$$

For interaction effects, the variance of the predictor is calculated as the variance of the actual product term (e.g., var(X1 * X2)), not the product of individual variances. This correctly accounts for centering, scaling, and correlation between predictors. The `var_x` argument allows bypassing this computation when the variance is known a priori.

For **general effect sizes** (default), all variance components are included in the denominator. For **operative effect sizes** (`operative = TRUE`), only variance components that contribute to the standard error of the effect are included.

Crossed designs support any number of grouping factors via `cross_vars`. The two-argument form (`subj_var` + `item_var`) is retained for backward compatibility and is equivalent to `cross_vars = c(subj_var, item_var)`.

Value

An object of class `"eta2p_lmm"` containing:

`eta2p` Partial eta-squared value

`variance_effect` Variance explained by the effect

`variance_error` Error variance

`effect` Name of the effect

`design` Design type ("crossed" or "nested")

`operative` Whether operative effect size was calculated

`variance_components` List of individual variance components

`...` Additional design-specific information

References

Correll, J., Mellinger, C., McClelland, G. H., & Judd, C. M. (2020). Avoid Cohen’s ’Small’, ’Medium’, and ’Large’ for Power Analysis. *Trends in Cognitive Sciences*, 24(3), 200-207. doi:10.1016/j.tics.2019.12.009

Correll, J., Mellinger, C., & Pedersen, E. J. (2022). Flexible approaches for estimating partial eta squared in mixed-effects models with crossed random factors. *Behavior Research Methods*, 54, 1626-1642. doi:10.3758/s13428021016872

Rights, J. D., & Sterba, S. K. (2019). Quantifying explained variance in multilevel models: An integrative framework for defining R-squared measures. *Psychological Methods*, 24(3), 309-338. doi:10.1037/met0000184

Examples

```
library(lme4)

# --- Two crossed factors (backward-compatible call) ---
set.seed(42)
crossed_data <- data.frame(
  y         = rnorm(120),
  condition = rep(c(-0.5, 0.5), 60),
  subject   = factor(rep(1:20, each = 6)),
  item      = factor(rep(1:6, 20))
)
model <- lmer(y ~ condition + (1 | subject) + (1 | item),
              data = crossed_data)
eta2p(model, "condition", crossed_data,
      design   = "crossed",
      subj_var = "subject",
      item_var = "item")

# --- Three crossed factors using cross_vars ---
set.seed(42)
three_way_data <- data.frame(
  y         = rnorm(180),
  condition = rep(c(-0.5, 0.5), 90),
  subject   = factor(rep(1:20, each = 9)),
  item      = factor(rep(rep(1:6, each = 3), 10)),
  rater     = factor(rep(1:3, 60))
)
model3 <- lmer(y ~ condition + (1 | subject) + (1 | item) + (1 | rater),
               data = three_way_data)
eta2p(model3, "condition", three_way_data,
      design     = "crossed",
      cross_vars = c("subject", "item", "rater"))

# --- Supply predictor variance directly (var_x) ---
eta2p(model, "condition", crossed_data,
      design     = "crossed",
      cross_vars = c("subject", "item"),
      var_x      = 1)   # +/-1 binary predictor: var = 1 by design
```

Index