

Package ‘RoBMA’

June 1, 2023

Title Robust Bayesian Meta-Analyses

Version 3.0.0

Maintainer František Bartoš <f.bartos96@gmail.com>

Description A framework for estimating ensembles of meta-analytic models (assuming either presence or absence of the effect, heterogeneity, and publication bias). The RoBMA framework uses Bayesian model-averaging to combine the competing meta-analytic models into a model ensemble, weights the posterior parameter distributions based on posterior model probabilities and uses Bayes factors to test for the presence or absence of the individual components (e.g., effect vs. no effect; Bartoš et al., 2022, <doi:10.1002/jrsm.1594>; Maier, Bartoš & Wagenmakers, 2022, <doi:10.1037/met0000405>). Users can define a wide range of non-informative or informative prior distributions for the effect size, heterogeneity, and publication bias components (including selection models and PET-PEESE). The package provides convenient functions for summary, visualizations, and fit diagnostics.

URL <https://fbartos.github.io/RoBMA/>

BugReports <https://github.com/FBartos/RoBMA/issues>

License GPL-3

Encoding UTF-8

LazyData true

RoxygenNote 7.2.3

SystemRequirements JAGS >= 4.3.1 (<https://mcmc-jags.sourceforge.io/>)

NeedsCompilation yes

Depends R (>= 4.0.0)

Imports BayesTools (>= 0.2.14), runjags, rjags, stats, graphics, mvtnorm, scales, Rdpack, rlang, ggplot2

Suggests parallel, metaBMA, metafor, weightr, fixest, metadat, testthat, vdiff, knitr, rmarkdown, covr

LinkingTo mvtnorm

RdMacros Rdpack

VignetteBuilder knitr

Author František Bartoš [aut, cre] (<<https://orcid.org/0000-0002-0018-5573>>),
 Maximilian Maier [aut] (<<https://orcid.org/0000-0002-9873-6096>>),
 Eric-Jan Wagenmakers [ths] (<<https://orcid.org/0000-0003-1596-1034>>),
 Joris Goosen [ctb],
 Matthew Denwood [cph] (Original copyright holder of some modified code
 where indicated.),
 Martyn Plummer [cph] (Original copyright holder of some modified code
 where indicated.)

Repository CRAN

Date/Publication 2023-06-01 10:10:02 UTC

R topics documented:

RoBMA-package	3
Anderson2010	4
Bem2011	5
check_RoBMA	5
check_setup	6
check_setup.reg	8
combine_data	12
contr.meandif	14
contr.orthonormal	15
diagnostics	15
effect_sizes	18
forest	19
interpret	21
is.RoBMA	21
Kroupova2021	22
Lui2015	22
marginal_plot	23
marginal_summary	24
plot.RoBMA	25
plot_models	27
Poulsen2006	28
print.marginal_summary.RoBMA	29
print.RoBMA	30
print.summary.RoBMA	30
prior	31
prior_factor	32
prior_informed	34
prior_none	36
prior_PEESE	37
prior_PET	38
prior_weightfunction	39

RoBMA	40
RoBMA.reg	46
RoBMA_control	51
RoBMA_options	52
sample_sizes	53
standard_errors	54
summary.RoBMA	56
update.RoBMA	57
weighted_multivariate_normal	61
weighted_normal	61
Index	64

 RoBMA-package

RoBMA: Robust Bayesian meta-analysis

Description

RoBMA: Bayesian model-averaged meta-analysis with adjustments for publication bias and ability to specify informed prior distributions and draw inference with inclusion Bayes factors.

User guide

See Bartoš et al. (2022), Maier et al. (2022), and Bartoš et al. (2022) for details regarding the RoBMA methodology.

More details regarding customization of the model ensembles are provided in the **Reproducing BMA**, **BMA in Medicine**, and **Fitting Custom Meta-Analytic Ensembles** vignettes. Please, use the "Issues" section in the GitHub repository to ask any further questions.

Author(s)

František Bartoš <f.bartos96@gmail.com>

References

Bartoš F, Maier M, Quintana DS, Wagenmakers E (2022). “Adjusting for publication bias in JASP and R — Selection models, PET-PEESE, and robust Bayesian meta-analysis.” *Advances in Methods and Practices in Psychological Science*, **5**(3), 1–19. doi:10.1177/25152459221109259.

Bartoš F, Maier M, Wagenmakers E, Doucouliagos H, Stanley TD (2022). “Robust Bayesian meta-analysis: Model-averaging across complementary publication bias adjustment methods.” *Research Synthesis Methods*. doi:10.1002/jrsm.1594.

Maier M, Bartoš F, Wagenmakers E (2022). “Robust Bayesian Meta-Analysis: Addressing Publication Bias with Model-Averaging.” *Psychological Methods*. doi:10.1037/met0000405.

See Also

Useful links:

- <https://fbartos.github.io/RoBMA/>
- Report bugs at <https://github.com/FBartos/RoBMA/issues>

Anderson2010

27 experimental studies from Anderson et al. (2010) that meet the best practice criteria

Description

The data set contains correlation coefficients, sample sizes, and labels for 27 experimental studies focusing on the effect of violent video games on aggressive behavior. The full original data can be found at <https://github.com/Joe-Hilgard/Anderson-meta>.

Usage

Anderson2010

Format

A data.frame with 3 columns and 23 observations.

Value

a data.frame.

References

Anderson CA, Shibuya A, Ihori N, Swing EL, Bushman BJ, Sakamoto A, Rothstein HR, Saleem M (2010). "Violent video game effects on aggression, empathy, and prosocial behavior in Eastern and Western countries: A meta-analytic review." *Psychological Bulletin*, **136**(2), 151. doi:[10.1037/a0018251](https://doi.org/10.1037/a0018251).

Bem2011	<i>9 experimental studies from Bem (2011) as described in Bem et al. (2011)</i>
---------	---

Description

The data set contains Cohen's d effect sizes, standard errors, and labels for 9 experimental studies of precognition from the infamous Bem (2011) as analyzed in his later meta-analysis (Bem et al. 2011).

Usage

Bem2011

Format

A data.frame with 3 columns and 9 observations.

Value

a data.frame.

References

Bem DJ (2011). "Feeling the future: experimental evidence for anomalous retroactive influences on cognition and affect." *Journal of Personality and Social Psychology*, **100**(3), 407. doi:10.1037/a0021524.

Bem DJ, Utts J, Johnson WO (2011). "Must psychologists change the way they analyze their data?" *Journal of Personality and Social Psychology*, **101**(4), 716. doi:10.1037/a0024777.

check_RoBMA	<i>Check fitted RoBMA object for errors and warnings</i>
-------------	--

Description

Checks fitted RoBMA object for warnings and errors and prints them to the console.

Usage

```
check_RoBMA(fit)
```

Arguments

`fit` a fitted RoBMA object.

Value

check_RoBMA returns a vector of error and warning messages.

check_setup	<i>Prints summary of "RoBMA" ensemble implied by the specified priors</i>
-------------	---

Description

check_setup prints summary of "RoBMA" ensemble implied by the specified prior distributions. It is useful for checking the ensemble configuration prior to fitting all of the models.

Usage

```
check_setup(
  model_type = NULL,
  priors_effect = prior(distribution = "normal", parameters = list(mean = 0, sd = 1)),
  priors_heterogeneity = prior(distribution = "invgamma", parameters = list(shape = 1,
    scale = 0.15)),
  priors_bias = list(prior_weightfunction(distribution = "two.sided", parameters =
    list(alpha = c(1, 1), steps = c(0.05))), prior_weights = 1/12),
  prior_weightfunction(distribution = "two.sided", parameters = list(alpha = c(1, 1,
    1), steps = c(0.05, 0.1))), prior_weights = 1/12), prior_weightfunction(distribution =
  "one.sided", parameters = list(alpha = c(1, 1), steps = c(0.05))), prior_weights =
  1/12), prior_weightfunction(distribution = "one.sided", parameters = list(alpha =
    c(1, 1, 1), steps = c(0.025, 0.05))), prior_weights = 1/12),

  prior_weightfunction(distribution = "one.sided", parameters = list(alpha = c(1, 1,
    1), steps = c(0.05, 0.5))), prior_weights = 1/12), prior_weightfunction(distribution =
  "one.sided", parameters = list(alpha = c(1, 1, 1, 1), steps = c(0.025, 0.05, 0.5))),
  prior_weights = 1/12), prior_PET(distribution = "Cauchy", parameters = list(0, 1),
  truncation = list(0, Inf), prior_weights = 1/4), prior_PEESE(distribution = "Cauchy",
  parameters = list(0, 5), truncation = list(0, Inf), prior_weights = 1/4)),
  priors_effect_null = prior(distribution = "point", parameters = list(location = 0)),
  priors_heterogeneity_null = prior(distribution = "point", parameters = list(location =
    0)),
  priors_bias_null = prior_none(),
  priors_hierarchical = prior("beta", parameters = list(alpha = 1, beta = 1)),
  priors_hierarchical_null = NULL,
  models = FALSE,
  silent = FALSE
)
```

Arguments

model_type	string specifying the RoBMA ensemble. Defaults to NULL. The other options are "PSMA", "PP", and "2w" which override settings passed to the priors_effect, priors_heterogeneity, priors_effect_null, priors_heterogeneity_null,
------------	--

- priors_bias_null, and priors_effect. See details for more information about the different model types.
- priors_effect list of prior distributions for the effect size (μ) parameter that will be treated as belonging to the alternative hypothesis. Defaults to a standard normal distribution `prior(distribution = "normal", parameters = list(mean = 0, sd = 1))`.
- priors_heterogeneity list of prior distributions for the heterogeneity tau parameter that will be treated as belonging to the alternative hypothesis. Defaults to `prior(distribution = "invgamma", parameters = list(shape = 1, scale = .15))` that is based on heterogeneities estimates from psychology (van Erp et al. 2017).
- priors_bias list of prior distributions for the publication bias adjustment component that will be treated as belonging to the alternative hypothesis. Defaults to `list(prior_weightfunction(distribution = "two.sided", parameters = list(alpha = c(1, 1), steps = c(0.05))), prior_weights = 1/12), prior_weightfunction(distribution = "two.sided", parameters = list(alpha = c(1, 1, 1), steps = c(0.05, 0.10))), prior_weights = 1/12), prior_weightfunction(distribution = "one.sided", parameters = list(alpha = c(1, 1), steps = c(0.05))), prior_weights = 1/12), prior_weightfunction(distribution = "one.sided", parameters = list(alpha = c(1, 1, 1), steps = c(0.025, 0.05))), prior_weights = 1/12), prior_weightfunction(distribution = "one.sided", parameters = list(alpha = c(1, 1, 1), steps = c(0.05, 0.5))), prior_weights = 1/12), prior_weightfunction(distribution = "one.sided", parameters = list(alpha = c(1, 1, 1, 1), steps = c(0.025, 0.05, 0.5))), prior_weights = 1/12), prior_PET(distribution = "Cauchy", parameters = list(0, 1), truncation = list(0, Inf), prior_weights = 1/4), prior_PEESE(distribution = "Cauchy", parameters = list(0, 5), truncation = list(0, Inf), prior_weights = 1/4)`, corresponding to the RoBMA-PSMA model introduced by Bartoš et al. (2022).
- priors_effect_null list of prior distributions for the effect size (μ) parameter that will be treated as belonging to the null hypothesis. Defaults to a point null hypothesis at zero, `prior(distribution = "point", parameters = list(location = 0))`.
- priors_heterogeneity_null list of prior distributions for the heterogeneity tau parameter that will be treated as belonging to the null hypothesis. Defaults to a point null hypothesis at zero (a fixed effect meta-analytic model), `prior(distribution = "point", parameters = list(location = 0))`.
- priors_bias_null list of prior weight functions for the omega parameter that will be treated as belonging to the null hypothesis. Defaults to no publication bias adjustment, `prior_none()`.
- priors_hierarchical list of prior distributions for the correlation of random effects (ρ) parameter that will be treated as belonging to the alternative hypothesis. This setting allows users to fit a hierarchical (three-level) meta-analysis when `study_ids` are supplied. Note that this is an experimental feature and see News for more details. Defaults to a beta distribution `prior(distribution = "beta", parameters = list(alpha = 1, beta = 1))`.
- priors_hierarchical_null list of prior distributions for the correlation of random effects (ρ) parameter that will be treated as belonging to the null hypothesis. Defaults to NULL.

models should the models' details be printed.
 silent do not print the results.

Value

check_setup invisibly returns list of summary tables.

See Also

[check_setup.reg\(\)](#) [RoBMA\(\)](#)

check_setup.reg	<i>Prints summary of "RoBMA.reg" ensemble implied by the specified priors and formula</i>
-----------------	---

Description

check_setup prints summary of "RoBMA.reg" ensemble implied by the specified prior distributions. It is useful for checking the ensemble configuration prior to fitting all of the models.

Usage

```
check_setup.reg(
  formula,
  data,
  test_predictors = TRUE,
  study_names = NULL,
  study_ids = NULL,
  transformation = if (any(colnames(data) != "y")) "fishers_z" else "none",
  prior_scale = if (any(colnames(data) != "y")) "cohens_d" else "none",
  standardize_predictors = TRUE,
  effect_direction = "positive",
  priors = NULL,
  model_type = NULL,
  priors_effect = prior(distribution = "normal", parameters = list(mean = 0, sd = 1)),
  priors_heterogeneity = prior(distribution = "invgamma", parameters = list(shape = 1,
    scale = 0.15)),
  priors_bias = list(prior_weightfunction(distribution = "two.sided", parameters =
    list(alpha = c(1, 1), steps = c(0.05)), prior_weights = 1/12),
  prior_weightfunction(distribution = "two.sided", parameters = list(alpha = c(1, 1,
  1), steps = c(0.05, 0.1)), prior_weights = 1/12), prior_weightfunction(distribution =
  "one.sided", parameters = list(alpha = c(1, 1), steps = c(0.05)), prior_weights =
  1/12), prior_weightfunction(distribution = "one.sided", parameters = list(alpha =
  c(1, 1, 1), steps = c(0.025, 0.05)), prior_weights = 1/12),

  prior_weightfunction(distribution = "one.sided", parameters = list(alpha = c(1, 1,
  1), steps = c(0.05, 0.5)), prior_weights = 1/12), prior_weightfunction(distribution =
```



```

"one.sided", parameters = list(alpha = c(1, 1, 1, 1), steps = c(0.025, 0.05, 0.5)),
prior_weights = 1/12), prior_PET(distribution = "Cauchy", parameters = list(0, 1),
truncation = list(0, Inf), prior_weights = 1/4), prior_PEESE(distribution = "Cauchy",
parameters = list(0, 5), truncation = list(0, Inf), prior_weights = 1/4)),
priors_effect_null = prior(distribution = "point", parameters = list(location = 0)),
priors_heterogeneity_null = prior(distribution = "point", parameters = list(location =
0)),
priors_bias_null = prior_none(),
priors_hierarchical = prior("beta", parameters = list(alpha = 1, beta = 1)),
priors_hierarchical_null = NULL,
prior_covariates = prior("normal", parameters = list(mean = 0, sd = 0.25)),
prior_covariates_null = prior("spike", parameters = list(location = 0)),
prior_factors = prior_factor("mnormal", parameters = list(mean = 0, sd = 0.25),
contrast = "meandif"),
prior_factors_null = prior("spike", parameters = list(location = 0)),
models = FALSE,
silent = FALSE,
...
)

```

Arguments

formula	a formula for the meta-regression model
data	a data object created by the <code>combine_data</code> function. This is an alternative input entry to specifying the <code>d</code> , <code>r</code> , <code>y</code> , etc... directly. I.e., you cannot pass the <code>data.frame</code> and reference to the columns.
test_predictors	vector of predictor names that will be test (i.e., assigned both the null and alternative prior distributions). Defaults to TRUE, all predictors are tested using the default prior distributions (i.e., <code>prior_covariates</code> , <code>prior_covariates_null</code> , <code>prior_factors</code> , and <code>prior_factors_null</code>). To only estimate and adjust for the effect of predictors use FALSE. If priors is specified, any settings in <code>test_predictors</code> is overridden.
study_names	an optional argument with the names of the studies
study_ids	an optional argument specifying dependency between the studies (for using a multilevel model). Defaults to NULL for studies being independent.
transformation	transformation to be applied to the supplied effect sizes before fitting the individual models. Defaults to "fishers_z". We highly recommend using "fishers_z" transformation since it is the only variance stabilizing measure and does not bias PET and PEESE style models. The other options are "cohens_d", correlation coefficient "r" and "logOR". Supplying "none" will treat the effect sizes as unstandardized and refrain from any transformations.
prior_scale	a scale used to define priors. Defaults to "cohens_d". Other options are "fishers_z", correlation coefficient "r", and "logOR". The prior scale does not need to match the effect sizes measure - the samples from prior distributions are internally transformed to match the transformation of the data. The <code>prior_scale</code> corresponds to the scale of default output, but can be changed within the summary function.

standardize_predictors	whether continuous predictors should be standardized prior to estimating the model. Defaults to TRUE.
effect_direction	the expected direction of the effect. The one-sided selection sets the weights omega to 1 to significant results in the expected direction. Defaults to "positive" (another option is "negative").
priors	named list of prior distributions for each predictor (with names corresponding to the predictors). It allows users to specify both the null and alternative hypothesis prior distributions for each predictor by assigning the corresponding element of the named list with another named list (with "null" and "alt"). If only one prior is specified for a given parameter, it is assumed to correspond to the alternative hypotheses and the default null hypothesis is specified (i.e., prior_covariates_null or prior_factors_null). If a named list with only one named prior distribution is provided (either "null" or "alt"), only this prior distribution is used and no default distribution is filled in. Parameters without specified prior distributions are assumed to be only adjusted for using the default alternative hypothesis prior distributions (i.e., prior_covariates or prior_factors). If priors is specified, test_predictors is ignored.
model_type	string specifying the RoBMA ensemble. Defaults to NULL. The other options are "PSMA", "PP", and "2w" which override settings passed to the priors_effect, priors_heterogeneity, priors_effect_null, priors_heterogeneity_null, priors_bias_null, and priors_effect. See details for more information about the different model types.
priors_effect	list of prior distributions for the effect size (mu) parameter that will be treated as belonging to the alternative hypothesis. Defaults to a standard normal distribution prior(distribution = "normal", parameters = list(mean = 0, sd = 1)).
priors_heterogeneity	list of prior distributions for the heterogeneity tau parameter that will be treated as belonging to the alternative hypothesis. Defaults to prior(distribution = "invgamma", parameters = list(shape = 1, scale = .15)) that is based on heterogeneities estimates from psychology (van Erp et al. 2017).
priors_bias	list of prior distributions for the publication bias adjustment component that will be treated as belonging to the alternative hypothesis. Defaults to list(prior_weightfunction(distribution = "two.sided", parameters = list(alpha = c(1, 1), steps = c(0.05))), prior_weights = 1/12), prior_weightfunction(distribution = "two.sided", parameters = list(alpha = c(1, 1, 1), steps = c(0.05, 0.10))), prior_weights = 1/12), prior_weightfunction(distribution = "one.sided", parameters = list(alpha = c(1, 1), steps = c(0.05))), prior_weights = 1/12), prior_weightfunction(distribution = "one.sided", parameters = list(alpha = c(1, 1, 1), steps = c(0.025, 0.05))), prior_weights = 1/12), prior_weightfunction(distribution = "one.sided", parameters = list(alpha = c(1, 1, 1), steps = c(0.05, 0.5))), prior_weights = 1/12), prior_weightfunction(distribution = "one.sided", parameters = list(alpha = c(1, 1, 1, 1), steps = c(0.025, 0.05, 0.5))), prior_weights = 1/12), prior_PET(distribution = "Cauchy", parameters = list(0, 1), truncation = list(0, Inf), prior_weights = 1/4), prior_PEESE(distribution = "Cauchy", parameters = list(0, 5), truncation = list(0, Inf), prior_weights = 1/4)), corresponding to the RoBMA-PSMA model introduced by Bartoš et al. (2022).

priors_effect_null	list of prior distributions for the effect size (μ) parameter that will be treated as belonging to the null hypothesis. Defaults to a point null hypotheses at zero, <code>prior(distribution = "point", parameters = list(location = 0))</code> .
priors_heterogeneity_null	list of prior distributions for the heterogeneity tau parameter that will be treated as belonging to the null hypothesis. Defaults to a point null hypotheses at zero (a fixed effect meta-analytic models), <code>prior(distribution = "point", parameters = list(location = 0))</code> .
priors_bias_null	list of prior weight functions for the omega parameter that will be treated as belonging to the null hypothesis. Defaults no publication bias adjustment, <code>prior_none()</code> .
priors_hierarchical	list of prior distributions for the correlation of random effects (ρ) parameter that will be treated as belonging to the alternative hypothesis. This setting allows users to fit a hierarchical (three-level) meta-analysis when <code>study_ids</code> are supplied. Note that this is an experimental feature and see News for more details. Defaults to a beta distribution <code>prior(distribution = "beta", parameters = list(alpha = 1, beta = 1))</code> .
priors_hierarchical_null	list of prior distributions for the correlation of random effects (ρ) parameter that will be treated as belonging to the null hypothesis. Defaults to NULL.
prior_covariates	a prior distributions for the regression parameter of continuous covariates on the effect size under the alternative hypothesis (unless set explicitly in priors). Defaults to a relatively wide normal distribution <code>prior(distribution = "normal", parameters = list(mean = 0, sd = 0.25))</code> .
prior_covariates_null	a prior distributions for the regression parameter of continuous covariates on the effect size under the null hypothesis (unless set explicitly in priors). Defaults to a no effect prior ("spike", <code>parameters = list(location = 0)</code>).
prior_factors	a prior distributions for the regression parameter of categorical covariates on the effect size under the alternative hypothesis (unless set explicitly in priors). Defaults to a relatively wide multivariate normal distribution specifying differences from the mean contrasts <code>prior_factor("mnormal", parameters = list(mean = 0, sd = 0.25), contrast = "meandif")</code> .
prior_factors_null	a prior distributions for the regression parameter of categorical covariates on the effect size under the null hypothesis (unless set explicitly in priors). Defaults to a no effect prior ("spike", <code>parameters = list(location = 0)</code>).
models	should the models' details be printed.
silent	do not print the results.
...	additional arguments.

Value

`check_setup.reg` invisibly returns list of summary tables.

See Also

[check_setup\(\)](#) [RoBMA.reg\(\)](#)

combine_data

Combines different effect sizes into a common metric

Description

combine_data combines different effect sizes into a common measure specified in transformation. Either a data.frame data with columns named corresponding to the arguments or vectors with individual values can be passed.

Usage

```
combine_data(
  d = NULL,
  r = NULL,
  z = NULL,
  logOR = NULL,
  t = NULL,
  y = NULL,
  se = NULL,
  v = NULL,
  n = NULL,
  lCI = NULL,
  uCI = NULL,
  study_names = NULL,
  study_ids = NULL,
  weight = NULL,
  data = NULL,
  transformation = "fishers_z",
  return_all = FALSE
)
```

Arguments

d	a vector of effect sizes measured as Cohen's d
r	a vector of effect sizes measured as correlations
z	a vector of effect sizes measured as Fisher's z
logOR	a vector of effect sizes measured as log odds ratios
t	a vector of t/z-statistics
y	a vector of unspecified effect sizes (note that effect size transformations are unavailable with this type of input)
se	a vector of standard errors of the effect sizes

v	a vector of variances of the effect sizes
n	a vector of overall sample sizes
lCI	a vector of lower bounds of confidence intervals
uCI	a vector of upper bounds of confidence intervals
study_names	an optional argument with the names of the studies
study_ids	an optional argument specifying dependency between the studies (for using a multilevel model). Defaults to NULL for studies being independent.
weight	specifies likelihood weights of the individual estimates. Notes that this is an untested experimental feature.
data	a data frame with column names corresponding to the variable names used to supply data individually
transformation	transformation to be applied to the supplied effect sizes before fitting the individual models. Defaults to "fishers_z". We highly recommend using "fishers_z" transformation since it is the only variance stabilizing measure and does not bias PET and PEESE style models. The other options are "cohens_d", correlation coefficient "r" and "logOR". Supplying "none" will treat the effect sizes as unstandardized and refrain from any transformations.
return_all	whether data frame containing all filled values should be returned. Defaults to FALSE

Details

The aim of the function is to combine different, already calculated, effect size measures. In order to obtain effect size measures from raw values, e.g, mean differences, standard deviations, and sample sizes, use [escalc](#) function.

The function checks the input values and in transforming the input into a common effect size measure in the following fashion:

1. obtains missing standard errors by squaring variances
2. obtains missing standard errors from confidence intervals (after transformation to Fisher's z scale for d and r).
3. obtains missing sample sizes (or standard errors for logOR) from t-statistics and effect sizes
4. obtains missing standard errors from sample sizes and effect sizes
5. obtains missing sample sizes from standard errors and effect sizes
6. obtains missing t-statistics from sample sizes and effect sizes (or standard errors and effect sizes for logOR)
7. changes the effect sizes direction to be positive
8. transforms effect sizes into the common effect size
9. transforms standard errors into the common metric

If the transforms is NULL or an unstandardized effect size y is supplied, steps 4-9 are skipped.

Value

combine_data returns a data.frame.

See Also

[RoBMA\(\)](#), [check_setup\(\)](#), [effect_sizes\(\)](#), [standard_errors\(\)](#), and [sample_sizes\(\)](#)

contr.meandif

Mean difference contrast matrix

Description

Return a matrix of mean difference contrasts. This is an adjustment to the `contr.orthonormal` that ascertains that the prior distributions on difference between the grand mean and factor level are identical independent of the number of factor levels (which does not hold for the orthonormal contrast). Furthermore, the contrast is re-scaled so the specified prior distribution exactly corresponds to the prior distribution on difference between each factor level and the grand mean – this is approximately twice the scale of `contr.orthonormal`.

Usage

```
contr.meandif(n, contrasts = TRUE)
```

Arguments

<code>n</code>	a vector of levels for a factor, or the number of levels
<code>contrasts</code>	logical indicating whether contrasts should be computed

Value

A matrix with `n` rows and `k` columns, with $k = n - 1$ if `contrasts = TRUE` and $k = n$ if `contrasts = FALSE`.

References

There are no references for Rd macro `\insertAllCites` on this help page.

Examples

```
contr.meandif(c(1, 2))  
contr.meandif(c(1, 2, 3))
```

contr.orthonormal	<i>Orthornomal contrast matrix</i>
-------------------	------------------------------------

Description

Return a matrix of orthornomal contrasts. Code is based on `stanova::contr.bayes` and corresponding to description by Rouder et al. (2012)

Usage

```
contr.orthonormal(n, contrasts = TRUE)
```

Arguments

n	a vector of levels for a factor, or the number of levels
contrasts	logical indicating whether contrasts should be computed

Value

A matrix with n rows and k columns, with $k = n - 1$ if `contrasts = TRUE` and $k = n$ if `contrasts = FALSE`.

References

Rouder JN, Morey RD, Speckman PL, Province JM (2012). "Default Bayes factors for ANOVA designs." *Journal of Mathematical Psychology*, **56**(5), 356–374. doi:10.1016/j.jmp.2012.08.001.

Examples

```
contr.orthonormal(c(1, 2))  
contr.orthonormal(c(1, 2, 3))
```

diagnostics	<i>Checks a fitted RoBMA object</i>
-------------	-------------------------------------

Description

`diagnostics` creates visual checks of individual models convergence. Numerical overview of individual models can be obtained by `summary(object, type = "models", diagnostics = TRUE)`, or even more detailed information by `summary(object, type = "individual")`.

Usage

```

diagnostics(
  fit,
  parameter,
  type,
  plot_type = "base",
  show_models = NULL,
  lags = 30,
  title = is.null(show_models) | length(show_models) > 1,
  ...
)

diagnostics_autocorrelation(
  fit,
  parameter = NULL,
  plot_type = "base",
  show_models = NULL,
  lags = 30,
  title = is.null(show_models) | length(show_models) > 1,
  ...
)

diagnostics_trace(
  fit,
  parameter = NULL,
  plot_type = "base",
  show_models = NULL,
  title = is.null(show_models) | length(show_models) > 1,
  ...
)

diagnostics_density(
  fit,
  parameter = NULL,
  plot_type = "base",
  show_models = NULL,
  title = is.null(show_models) | length(show_models) > 1,
  ...
)

```

Arguments

<code>fit</code>	a fitted RoBMA object
<code>parameter</code>	a parameter to be plotted. Either "mu", "tau", "omega", "PET", or "PEESE".
<code>type</code>	type of MCMC diagnostic to be plotted. Options are "chains" for the chains' trace plots, "autocorrelation" for autocorrelation of the chains, and "densities" for the overlaying densities of the individual chains. Can be abbreviated to first letters.

plot_type	whether to use a base plot "base" or ggplot2 "ggplot" for plotting. Defaults to "base".
show_models	MCMC diagnostics of which models should be plotted. Defaults to NULL which plots MCMC diagnostics for a specified parameter for every model that is part of the ensemble.
lags	number of lags to be shown for type = "autocorrelation". Defaults to 30.
title	whether the model number should be displayed in title. Defaults to TRUE when more than one model is selected.
...	additional arguments to be passed to par if plot_type = "base".

Details

The visualization functions are based on [stan_plot](#) function and its color schemes.

Value

diagnostics returns either NULL if plot_type = "base" or an object/list of objects (depending on the number of parameters to be plotted) of class 'ggplot2' if plot_type = "ggplot2".

See Also

[RoBMA\(\)](#), [summary.RoBMA\(\)](#)

Examples

```
## Not run:
# using the example data from Anderson et al. 2010 and fitting the default model
# (note that the model can take a while to fit)
fit <- RoBMA(r = Anderson2010$r, n = Anderson2010$n, study_names = Anderson2010$labels)

### ggplot2 version of all of the plots can be obtained by adding 'model_type = "ggplot"
# diagnostics function allows to visualize diagnostics of a fitted RoBMA object, for example,
# the trace plot for the mean parameter in each model model
diagnostics(fit, parameter = "mu", type = "chain")

# in order to show the trace plot only for the 11th model, add show_models parameter
diagnostics(fit, parameter = "mu", type = "chain", show_models = 11)

# furthermore, the autocorrelations
diagnostics(fit, parameter = "mu", type = "autocorrelation")

# and overlying densities for each plot can also be visualize
diagnostics(fit, parameter = "mu", type = "densities")

## End(Not run)
```

effect_sizes

Effect size transformations

Description

Functions for transforming between different effect size measures.

Usage

d2r(d)

d2z(d)

d2logOR(d)

d2OR(d)

r2d(r)

r2z(r)

r2logOR(r)

r2OR(r)

z2r(z)

z2d(z)

z2logOR(z)

z2OR(z)

logOR2r(logOR)

logOR2z(logOR)

logOR2d(logOR)

logOR2OR(logOR)

OR2r(OR)

OR2z(OR)

OR2logOR(OR)

OR2d(OR)

Arguments

d	Cohen's d.
r	correlation coefficient.
z	Fisher's z.
logOR	log(odds ratios).
OR	odds ratios.

Details

All transformations are based on (Borenstein et al. 2011). In case that a direct transformation is not available, the transformations are chained to provide the effect size of interest.

References

Borenstein M, Hedges LV, Higgins JP, Rothstein HR (2011). *Introduction to meta-analysis*. John Wiley & Sons.

See Also

[standard_errors\(\)](#), [sample_sizes\(\)](#)

forest	<i>Forest plot for a RoBMA object</i>
--------	---------------------------------------

Description

forest creates a forest plot for a "RoBMA" object.

Usage

```
forest(  
  x,  
  conditional = FALSE,  
  plot_type = "base",  
  output_scale = NULL,  
  order = NULL,  
  ...  
)
```

Arguments

x	a fitted RoBMA object
conditional	whether conditional estimates should be plotted. Defaults to FALSE which plots the model-averaged estimates. Note that both "weightfunction" and "PET-PEESE" are always ignoring the other type of publication bias adjustment.
plot_type	whether to use a base plot "base" or ggplot2 "ggplot" for plotting. Defaults to "base".
output_scale	transform the effect sizes and the meta-analytic effect size estimate to a different scale. Defaults to NULL which returns the same scale as the model was estimated on.
order	order of the studies. Defaults to NULL - ordering as supplied to the fitting function. Studies can be ordered either "increasing" or "decreasing" by effect size, or by labels "alphabetical".
...	list of additional graphical arguments to be passed to the plotting function. Supported arguments are lwd, lty, col, col.fill, xlab, ylab, main, xlim, ylim to adjust the line thickness, line type, line color, fill color, x-label, y-label, title, x-axis range, and y-axis range respectively.

Value

forest returns either NULL if plot_type = "base" or an object object of class 'ggplot2' if plot_type = "ggplot2".

Examples

```
## Not run:
# using the example data from Anderson et al. 2010 and fitting the default model
# (note that the model can take a while to fit)
fit <- RoBMA(r = Anderson2010$r, n = Anderson2010$n, study_names = Anderson2010$labels)

### ggplot2 version of all of the plots can be obtained by adding 'model_type = "ggplot"'
# the forest function creates a forest plot for a fitted RoBMA object, for example,
# the forest plot for the individual studies and the model-averaged effect size estimate
forest(fit)

# the conditional effect size estimate
forest(fit, conditional = TRUE)

# or transforming the effect size estimates to Fisher's z
forest(fit, output_scale = "fishers_z")

## End(Not run)
```

interpret	<i>Interprets results of a RoBMA model.</i>
-----------	---

Description

interpret creates a brief textual summary of a fitted RoBMA object.

Usage

```
interpret(object, output_scale = NULL)
```

Arguments

object	a fitted RoBMA object
output_scale	transform the meta-analytic estimates to a different scale. Defaults to NULL which returns the same scale as the model was estimated on.

Value

interpret returns a character.

is.RoBMA	<i>Reports whether x is a RoBMA object</i>
----------	--

Description

Reports whether x is a RoBMA object

Usage

```
is.RoBMA(x)
```

```
is.RoBMA.reg(x)
```

Arguments

x	an object to test
---	-------------------

Value

returns a boolean.

Kroupova2021	<i>881 estimates from 69 studies of a relationship between employment and educational outcomes collected by Kroupova et al. (2021)</i>
--------------	--

Description

The data set contains partial correlation coefficients, standard errors, study labels, samples sizes, type of the educational outcome, intensity of the employment, gender of the student population, study location, study design, whether the study controlled for endogeneity, and whether the study controlled for motivation. The original data set including additional variables and the publication can be found at <http://meta-analysis.cz/students>. (Note that some standard errors and employment intensities are missing.)

Usage

Kroupova2021

Format

A data.frame with 11 columns and 881 observations.

Value

a data.frame.

References

Kroupova K, Havranek T, Irsova Z (2021). "Student employment and education: A meta-analysis." *CEPR Discussion Paper*. <https://www.ssrn.com/abstract=3928863>.

Lui2015	<i>18 studies of a relationship between acculturation mismatch and intergenerational cultural conflict collected by Lui (2015)</i>
---------	--

Description

The data set contains correlation coefficients r , sample sizes n , and labels for each study assessing the relationship between acculturation mismatch (that is the result of the contrast between the collectivist cultures of Asian and Latin immigrant groups and the individualist culture in the United States) and intergenerational cultural conflict (Lui 2015) which was used as an example in Bartoš et al. (2022).

Usage

Lui2015

Format

A data.frame with 3 columns and 18 observations.

Value

a data.frame.

References

Bartoš F, Maier M, Quintana DS, Wagenmakers E (2022). “Adjusting for publication bias in JASP and R — Selection models, PET-PEESE, and robust Bayesian meta-analysis.” *Advances in Methods and Practices in Psychological Science*, **5**(3), 1–19. doi:10.1177/25152459221109259.

Lui PP (2015). “Intergenerational cultural conflict, mental health, and educational outcomes among Asian and Latino/a Americans: Qualitative and meta-analytic review.” *Psychological Bulletin*, **141**(2), 404–446. doi:10.1037/a0038449.

marginal_plot	<i>Plots marginal estimates of a fitted RoBMA regression object</i>
---------------	---

Description

marginal_plot allows to visualize prior and posterior distributions of marginal estimates of a RoBMA regression model.

Usage

```
marginal_plot(
  x,
  parameter,
  conditional = FALSE,
  plot_type = "base",
  prior = FALSE,
  output_scale = NULL,
  dots_prior = NULL,
  ...
)
```

Arguments

x	a fitted RoBMA regression object
parameter	regression parameter to be plotted
conditional	whether conditional marginal estimates should be plotted. Defaults to FALSE which plots the model-averaged estimates.
plot_type	whether to use a base plot "base" or ggplot2 "ggplot" for plotting. Defaults to "base".

prior	whether prior distribution should be added to figure. Defaults to FALSE.
output_scale	transform the effect sizes and the meta-analytic effect size estimate to a different scale. Defaults to NULL which returns the same scale as the model was estimated on.
dots_prior	list of additional graphical arguments to be passed to the plotting function of the prior distribution. Supported arguments are lwd, lty, col, and col.fill, to adjust the line thickness, line type, line color, and fill color of the prior distribution respectively.
...	list of additional graphical arguments to be passed to the plotting function. Supported arguments are lwd, lty, col, col.fill, xlab, ylab, main, xlim, ylim to adjust the line thickness, line type, line color, fill color, x-label, y-label, title, x-axis range, and y-axis range respectively.

Value

plot.RoBMA returns either NULL if plot_type = "base" or an object object of class 'ggplot2' if plot_type = "ggplot2".

See Also

[RoBMA\(\)](#)

marginal_summary	<i>Summarize marginal estimates of a fitted RoBMA regression object</i>
------------------	---

Description

marginal_summary creates summary tables for marginal estimates of a RoBMA regression model.

Usage

```
marginal_summary(
  object,
  conditional = FALSE,
  output_scale = NULL,
  probs = c(0.025, 0.975),
  logBF = FALSE,
  BF01 = FALSE
)
```

Arguments

object	a fitted RoBMA regression object
conditional	show the conditional estimates (assuming that the alternative is true).
output_scale	transform the meta-analytic estimates to a different scale. Defaults to NULL which returns the same scale as the model was estimated on.

probs	quantiles of the posterior samples to be displayed. Defaults to <code>c(.025, .975)</code>
logBF	show log of Bayes factors. Defaults to <code>FALSE</code> .
BF01	show Bayes factors in support of the null hypotheses. Defaults to <code>FALSE</code> .

Value

`marginal_summary` returns a list of tables of class `'BayesTools_table'`.

See Also

[RoBMA\(\)](#), [summary.RoBMA\(\)](#), [diagnostics\(\)](#), [check_RoBMA\(\)](#)

<code>plot.RoBMA</code>	<i>Plots a fitted RoBMA object</i>
-------------------------	------------------------------------

Description

`plot.RoBMA` allows to visualize different "RoBMA" object parameters in various ways. See `type` for the different model types.

Usage

```
## S3 method for class 'RoBMA'
plot(
  x,
  parameter = "mu",
  conditional = FALSE,
  plot_type = "base",
  prior = FALSE,
  output_scale = NULL,
  rescale_x = FALSE,
  show_data = TRUE,
  dots_prior = NULL,
  ...
)
```

Arguments

<code>x</code>	a fitted RoBMA object
<code>parameter</code>	a parameter to be plotted. Defaults to "mu" (for the effect size). The additional options are "tau" (for the heterogeneity), "weightfunction" (for the estimated weightfunction), or "PET-PEESE" (for the PET-PEESE regression).
<code>conditional</code>	whether conditional estimates should be plotted. Defaults to <code>FALSE</code> which plots the model-averaged estimates. Note that both "weightfunction" and "PET-PEESE" are always ignoring the other type of publication bias adjustment.

plot_type	whether to use a base plot "base" or ggplot2 "ggplot" for plotting. Defaults to "base".
prior	whether prior distribution should be added to figure. Defaults to FALSE.
output_scale	transform the effect sizes and the meta-analytic effect size estimate to a different scale. Defaults to NULL which returns the same scale as the model was estimated on.
rescale_x	whether the x-axis of the "weightfunction" should be re-scaled to make the x-ticks equally spaced. Defaults to FALSE.
show_data	whether the study estimates and standard errors should be show in the "PET-PEESE" plot. Defaults to TRUE.
dots_prior	list of additional graphical arguments to be passed to the plotting function of the prior distribution. Supported arguments are lwd, lty, col, and col.fill, to adjust the line thickness, line type, line color, and fill color of the prior distribution respectively.
...	list of additional graphical arguments to be passed to the plotting function. Supported arguments are lwd, lty, col, col.fill, xlab, ylab, main, xlim, ylim to adjust the line thickness, line type, line color, fill color, x-label, y-label, title, x-axis range, and y-axis range respectively.

Value

plot.RoBMA returns either NULL if plot_type = "base" or an object object of class 'ggplot2' if plot_type = "ggplot2".

See Also

[RoBMA\(\)](#)

Examples

```
## Not run:
# using the example data from Anderson et al. 2010 and fitting the default model
# (note that the model can take a while to fit)
fit <- RoBMA(r = Anderson2010$r, n = Anderson2010$n, study_names = Anderson2010$labels)

### ggplot2 version of all of the plots can be obtained by adding 'model_type = "ggplot"'
# the 'plot' function allows to visualize the results of a fitted RoBMA object, for example;
# the model-averaged effect size estimate
plot(fit, parameter = "mu")

# and show both the prior and posterior distribution
plot(fit, parameter = "mu", prior = TRUE)

# conditional plots can be obtained by specifying
plot(fit, parameter = "mu", conditional = TRUE)

# plotting function also allows to visualize the weight function
plot(fit, parameter = "weightfunction")
```

```

# re-scale the x-axis
plot(fit, parameter = "weightfunction", rescale_x = TRUE)

# or visualize the PET-PEESE regression line
plot(fit, parameter = "PET-PEESE")

## End(Not run)

```

plot_models

Models plot for a RoBMA object

Description

plot_models plots individual models' estimates for a "RoBMA" object.

Usage

```

plot_models(
  x,
  parameter = "mu",
  conditional = FALSE,
  output_scale = NULL,
  plot_type = "base",
  order = "decreasing",
  order_by = "model",
  ...
)

```

Arguments

x	a fitted RoBMA object
parameter	a parameter to be plotted. Defaults to "mu" (for the effect size). The additional option is "tau" (for the heterogeneity).
conditional	whether conditional estimates should be plotted. Defaults to FALSE which plots the model-averaged estimates. Note that both "weightfunction" and "PET-PEESE" are always ignoring the other type of publication bias adjustment.
output_scale	transform the effect sizes and the meta-analytic effect size estimate to a different scale. Defaults to NULL which returns the same scale as the model was estimated on.
plot_type	whether to use a base plot "base" or ggplot2 "ggplot" for plotting. Defaults to "base".
order	how the models should be ordered. Defaults to "decreasing" which orders them in decreasing order in accordance to order_by argument. The alternative is "increasing".

`order_by` what feature should be use to order the models. Defaults to "model" which orders the models according to their number. The alternatives are "estimate" (for the effect size estimates), "probability" (for the posterior model probability), and "BF" (for the inclusion Bayes factor).

... list of additional graphical arguments to be passed to the plotting function. Supported arguments are `lwd`, `lty`, `col`, `col.fill`, `xlab`, `ylab`, `main`, `xlim`, `ylim` to adjust the line thickness, line type, line color, fill color, x-label, y-label, title, x-axis range, and y-axis range respectively.

Value

`plot_models` returns either NULL if `plot_type = "base"` or an object object of class 'ggplot2' if `plot_type = "ggplot2"`.

Examples

```
## Not run:
# using the example data from Anderson et al. 2010 and fitting the default model
# (note that the model can take a while to fit)
fit <- RoBMA(r = Anderson2010$r, n = Anderson2010$n, study_names = Anderson2010$labels)

### ggplot2 version of all of the plots can be obtained by adding 'model_type = "ggplot2"'
# the plot_models function creates a plot for of the individual models' estimates, for example,
# the effect size estimates from the individual models can be obtained with
plot_models(fit)

# and effect size estimates from only the conditional models
plot_models(fit, conditional = TRUE)

## End(Not run)
```

Poulsen2006	<i>5 studies with a tactile outcome assessment from Poulsen et al. (2006) of the effect of potassium-containing toothpaste on dentine hypersensitivity</i>
-------------	--

Description

The data set contains Cohen's d effect sizes, standard errors, and labels for 5 studies assessing the tactile outcome from a meta-analysis of the effect of potassium-containing toothpaste on dentine hypersensitivity (Poulsen et al. 2006) which was used as an example in Bartoš et al. (2021).

Usage

```
Poulsen2006
```

Format

A data.frame with 3 columns and 5 observations.

Value

a data.frame.

References

Bartoš F, Gronau QF, Timmers B, Otte WM, Ly A, Wagenmakers E (2021). “Bayesian model-averaged meta-analysis in medicine.” *Statistics in Medicine*. doi:10.1002/sim.9170.

Poulsen S, Errboe M, Mevil YL, Glenny A (2006). “Potassium containing toothpastes for dentine hypersensitivity.” *Cochrane Database of Systematic Reviews*. doi:10.1002/14651858.cd001476.pub2.

`print.marginal_summary.RoBMA`

Prints marginal_summary object for RoBMA method

Description

Prints marginal_summary object for RoBMA method

Usage

```
## S3 method for class 'marginal_summary.RoBMA'  
print(x, ...)
```

Arguments

<code>x</code>	a summary of a RoBMA object
<code>...</code>	additional arguments

Value

`print.marginal_summary.RoBMA` invisibly returns the print statement.

See Also

[RoBMA\(\)](#)

print.RoBMA *Prints a fitted RoBMA object*

Description

Prints a fitted RoBMA object

Usage

```
## S3 method for class 'RoBMA'  
print(x, ...)
```

Arguments

x a fitted RoBMA object.
... additional arguments.

Value

print.RoBMA invisibly returns the print statement.

See Also

[RoBMA\(\)](#)

print.summary.RoBMA *Prints summary object for RoBMA method*

Description

Prints summary object for RoBMA method

Usage

```
## S3 method for class 'summary.RoBMA'  
print(x, ...)
```

Arguments

x a summary of a RoBMA object
... additional arguments

Value

print.summary.RoBMA invisibly returns the print statement.

See Also[RoBMA\(\)](#)

prior	<i>Creates a prior distribution</i>
-------	-------------------------------------

Description

prior creates a prior distribution. The prior can be visualized by the plot function.

Usage

```
prior(
  distribution,
  parameters,
  truncation = list(lower = -Inf, upper = Inf),
  prior_weights = 1
)
```

Arguments

distribution	name of the prior distribution. The possible options are "point" for a point density characterized by a location parameter. "normal" for a normal distribution characterized by a mean and sd parameters. "lognormal" for a lognormal distribution characterized by a meanlog and sdlog parameters. "cauchy" for a Cauchy distribution characterized by a location and scale parameters. Internally converted into a generalized t-distribution with df = 1. "t" for a generalized t-distribution characterized by a location, scale, and df parameters. "gamma" for a gamma distribution characterized by either shape and rate, or shape and scale parameters. The later is internally converted to the shape and rate parametrization "invgamma" for an inverse-gamma distribution characterized by a shape and scale parameters. The JAGS part uses a 1/gamma distribution with a shape and rate parameter. "beta" for a beta distribution characterized by an alpha and beta parameters. "exp" for an exponential distribution characterized by either rate or scale parameter. The later is internally converted to rate. "uniform" for a uniform distribution defined on a range from a to b
parameters	list of appropriate parameters for a given distribution.
truncation	list with two elements, lower and upper, that define the lower and upper truncation of the distribution. Defaults to list(lower = -Inf, upper = Inf). The truncation is automatically set to the bounds of the support.

`prior_weights` prior odds associated with a given distribution. The value is passed into the model fitting function, which creates models corresponding to all combinations of prior distributions for each of the model parameters and sets the model priors odds to the product of its prior distributions.

Value

`prior` and `prior_none` return an object of class `'prior'`. A named list containing the distribution name, parameters, and prior weights.

See Also

[plot.prior\(\)](#), [Normal](#), [Lognormal](#), [Cauchy](#), [Beta](#), [Exponential](#), [LocationScaleT](#), [InvGamma](#).

Examples

```
# create a standard normal prior distribution
p1 <- prior(distribution = "normal", parameters = list(mean = 1, sd = 1))

# create a half-normal standard normal prior distribution
p2 <- prior(distribution = "normal", parameters = list(mean = 1, sd = 1),
truncation = list(lower = 0, upper = Inf))

# the prior distribution can be visualized using the plot function
# (see ?plot.prior for all options)
plot(p1)
```

<code>prior_factor</code>	<i>Creates a prior distribution for factors</i>
---------------------------	---

Description

`prior_factor` creates a prior distribution for fitting models with factor predictors. (Note that results across different operating systems might vary due to differences in JAGS numerical precision.)

Usage

```
prior_factor(
  distribution,
  parameters,
  truncation = list(lower = -Inf, upper = Inf),
  prior_weights = 1,
  contrast = "meandif"
)
```


Arguments

distribution	<p>name of the prior distribution. The possible options are</p> <p>"point" for a point density characterized by a location parameter.</p> <p>"normal" for a normal distribution characterized by a mean and sd parameters.</p> <p>"lognormal" for a lognormal distribution characterized by a meanlog and sdlog parameters.</p> <p>"cauchy" for a Cauchy distribution characterized by a location and scale parameters. Internally converted into a generalized t-distribution with df = 1.</p> <p>"t" for a generalized t-distribution characterized by a location, scale, and df parameters.</p> <p>"gamma" for a gamma distribution characterized by either shape and rate, or shape and scale parameters. The later is internally converted to the shape and rate parametrization</p> <p>"invgamma" for an inverse-gamma distribution characterized by a shape and scale parameters. The JAGS part uses a 1/gamma distribution with a shape and rate parameter.</p> <p>"beta" for a beta distribution characterized by an alpha and beta parameters.</p> <p>"exp" for an exponential distribution characterized by either rate or scale parameter. The later is internally converted to rate.</p> <p>"uniform" for a uniform distribution defined on a range from a to b</p>
parameters	list of appropriate parameters for a given distribution.
truncation	list with two elements, lower and upper, that define the lower and upper truncation of the distribution. Defaults to <code>list(lower = -Inf, upper = Inf)</code> . The truncation is automatically set to the bounds of the support.
prior_weights	prior odds associated with a given distribution. The value is passed into the model fitting function, which creates models corresponding to all combinations of prior distributions for each of the model parameters and sets the model priors odds to the product of its prior distributions.
contrast	<p>type of contrast for the prior distribution. The possible options are</p> <p>"meandif" for contrast centered around the grand mean with equal marginal distributions, making the prior distribution exchangeable across factor levels. In contrast to "orthonormal", the marginal distributions are identical regardless of the number of factor levels and the specified prior distribution corresponds to the difference from grand mean for each factor level. Only supports <code>distribution = "mnormal"</code> and <code>distribution = "mt"</code> which generates the corresponding multivariate normal/t distributions.</p> <p>"orthonormal" for contrast centered around the grand mean with equal marginal distributions, making the prior distribution exchangeable across factor levels. Only supports <code>distribution = "mnormal"</code> and <code>distribution = "mt"</code> which generates the corresponding multivariate normal/t distributions.</p> <p>"treatment" for contrasts using the first level as a comparison group and setting equal prior distribution on differences between the individual factor levels and the comparison level.</p>

"independent" for contrasts specifying dependent prior distribution for each factor level (note that this leads to an overparameterized model if the intercept is included).

Value

return an object of class 'prior'.

See Also

[prior\(\)](#)

Examples

```
# create an orthonormal prior distribution
p1 <- prior_factor(distribution = "mnormal", contrast = "orthonormal",
  parameters = list(mean = 0, sd = 1))
```

prior_informed	<i>Creates an informed prior distribution based on research</i>
----------------	---

Description

prior_informed creates an informed prior distribution based on past research. The prior can be visualized by the plot function.

Usage

```
prior_informed(name, parameter = NULL, type = "smd")
```

Arguments

name	<p>name of the prior distribution. There are many options based on prior psychological or medical research. For psychology, the possible options are</p> <p>"van Erp" for an informed prior distribution for the heterogeneity parameter tau of meta-analytic effect size estimates based on standardized mean differences (van Erp et al. 2017),</p> <p>"Oosterwijk" for an informed prior distribution for the effect sizes expected in social psychology based on prior elicitation with dr. Oosterwijk (Gronau et al. 2017).</p> <p>For medicine, the possible options are based on Bartoš et al. (2021) who developed empirical prior distributions for the effect size and heterogeneity parameters of the continuous standardized outcomes based on the Cochrane database of systematic reviews. Use "Cochrane" for a prior distribution based on the whole database or call <code>print(prior_informed_medicine_names)</code> to inspect the names of all 46 subfields and set the appropriate parameter and type.</p>
------	--

parameter	parameter name describing what prior distribution is supposed to be produced in cases where the name corresponds to multiple prior distributions. Relevant only for the empirical medical prior distributions.
type	prior type describing what prior distribution is supposed to be produced in cases where the name and parameter correspond to multiple prior distributions. Relevant only for the empirical medical prior distributions.

Details

Further details can be found in van Erp et al. (2017), Gronau et al. (2017), and Bartoš et al. (2021).

Value

prior_informed returns an object of class 'prior'.

References

Bartoš F, Gronau QF, Timmers B, Otte WM, Ly A, Wagenmakers E (2021). “Bayesian model-averaged meta-analysis in medicine.” *Statistics in Medicine*. doi:10.1002/sim.9170.

Gronau QF, Van Erp S, Heck DW, Cesario J, Jonas KJ, Wagenmakers E (2017). “A Bayesian model-averaged meta-analysis of the power pose effect with informed and default priors: The case of felt power.” *Comprehensive Results in Social Psychology*, 2(1), 123–138. doi:10.1080/23743603.2017.1326760.

van Erp S, Verhagen J, Grasman RP, Wagenmakers E (2017). “Estimates of between-study heterogeneity for 705 meta-analyses reported in Psychological Bulletin from 1990–2013.” *Journal of Open Psychology Data*, 5(1). doi:10.5334/jopd.33.

See Also

[prior\(\)](#), [prior_informed_medicine_names](#)

Examples

```
# prior distribution representing expected effect sizes in social psychology
# based on prior elicitation with dr. Oosterwijk
p1 <- prior_informed("Oosterwijk")

# the prior distribution can be visualized using the plot function
# (see ?plot.prior for all options)
plot(p1)

# empirical prior distribution for the standardized mean differences from the oral health
# medical subfield based on meta-analytic effect size estimates from the
# Cochrane database of systematic reviews
p2 <- prior_informed("Oral Health", parameter = "effect", type = "smd")
print(p2)
```

prior_none	<i>Creates a prior distribution</i>
------------	-------------------------------------

Description

prior creates a prior distribution. The prior can be visualized by the plot function.

Usage

```
prior_none(prior_weights = 1)
```

Arguments

prior_weights prior odds associated with a given distribution. The value is passed into the model fitting function, which creates models corresponding to all combinations of prior distributions for each of the model parameters and sets the model priors odds to the product of its prior distributions.

Value

prior and prior_none return an object of class 'prior'. A named list containing the distribution name, parameters, and prior weights.

See Also

[plot.prior\(\)](#), [Normal](#), [Lognormal](#), [Cauchy](#), [Beta](#), [Exponential](#), [LocationScaleT](#), [InvGamma](#).

Examples

```
# create a standard normal prior distribution
p1 <- prior(distribution = "normal", parameters = list(mean = 1, sd = 1))

# create a half-normal standard normal prior distribution
p2 <- prior(distribution = "normal", parameters = list(mean = 1, sd = 1),
truncation = list(lower = 0, upper = Inf))

# the prior distribution can be visualized using the plot function
# (see ?plot.prior for all options)
plot(p1)
```

prior_PEESE *Creates a prior distribution for PET or PEESE models*

Description

prior creates a prior distribution for fitting a PET or PEESE style models in RoBMA. The prior distribution can be visualized by the plot function.

Usage

```
prior_PEESE(
  distribution,
  parameters,
  truncation = list(lower = 0, upper = Inf),
  prior_weights = 1
)
```

Arguments

distribution	name of the prior distribution. The possible options are "point" for a point density characterized by a location parameter. "normal" for a normal distribution characterized by a mean and sd parameters. "lognormal" for a lognormal distribution characterized by a meanlog and sdlog parameters. "cauchy" for a Cauchy distribution characterized by a location and scale parameters. Internally converted into a generalized t-distribution with df = 1. "t" for a generalized t-distribution characterized by a location, scale, and df parameters. "gamma" for a gamma distribution characterized by either shape and rate, or shape and scale parameters. The later is internally converted to the shape and rate parametrization "invgamma" for an inverse-gamma distribution characterized by a shape and scale parameters. The JAGS part uses a 1/gamma distribution with a shape and rate parameter. "beta" for a beta distribution characterized by an alpha and beta parameters. "exp" for an exponential distribution characterized by either rate or scale parameter. The later is internally converted to rate. "uniform" for a uniform distribution defined on a range from a to b
parameters	list of appropriate parameters for a given distribution.
truncation	list with two elements, lower and upper, that define the lower and upper truncation of the distribution. Defaults to list(lower = -Inf, upper = Inf). The truncation is automatically set to the bounds of the support.

`prior_weights` prior odds associated with a given distribution. The value is passed into the model fitting function, which creates models corresponding to all combinations of prior distributions for each of the model parameters and sets the model priors odds to the product of its prior distributions.

Value

`prior_PET` and `prior_PEESE` return an object of class 'prior'.

See Also

[plot.prior\(\)](#), [prior\(\)](#)

Examples

```
# create a half-Cauchy prior distribution
# (PET and PEESE specific functions automatically set lower truncation at 0)
p1 <- prior_PET(distribution = "Cauchy", parameters = list(location = 0, scale = 1))

plot(p1)
```

`prior_PET`

Creates a prior distribution for PET or PEESE models

Description

`prior` creates a prior distribution for fitting a PET or PEESE style models in RoBMA. The prior distribution can be visualized by the `plot` function.

Usage

```
prior_PET(
  distribution,
  parameters,
  truncation = list(lower = 0, upper = Inf),
  prior_weights = 1
)
```

Arguments

`distribution` name of the prior distribution. The possible options are

- "point" for a point density characterized by a location parameter.
- "normal" for a normal distribution characterized by a mean and sd parameters.
- "lognormal" for a lognormal distribution characterized by a meanlog and sdlog parameters.
- "cauchy" for a Cauchy distribution characterized by a location and scale parameters. Internally converted into a generalized t-distribution with `df = 1`.

	"t" for a generalized t-distribution characterized by a location, scale, and df parameters.
	"gamma" for a gamma distribution characterized by either shape and rate, or shape and scale parameters. The later is internally converted to the shape and rate parametrization
	"invgamma" for an inverse-gamma distribution characterized by a shape and scale parameters. The JAGS part uses a 1/gamma distribution with a shape and rate parameter.
	"beta" for a beta distribution characterized by an alpha and beta parameters.
	"exp" for an exponential distribution characterized by either rate or scale parameter. The later is internally converted to rate.
	"uniform" for a uniform distribution defined on a range from a to b
parameters	list of appropriate parameters for a given distribution.
truncation	list with two elements, lower and upper, that define the lower and upper truncation of the distribution. Defaults to <code>list(lower = -Inf, upper = Inf)</code> . The truncation is automatically set to the bounds of the support.
prior_weights	prior odds associated with a given distribution. The value is passed into the model fitting function, which creates models corresponding to all combinations of prior distributions for each of the model parameters and sets the model priors odds to the product of its prior distributions.

Value

prior_PET and prior_PEESE return an object of class 'prior'.

See Also

[plot.prior\(\)](#), [prior\(\)](#)

Examples

```
# create a half-Cauchy prior distribution
# (PET and PEESE specific functions automatically set lower truncation at 0)
p1 <- prior_PET(distribution = "Cauchy", parameters = list(location = 0, scale = 1))

plot(p1)
```

prior_weightfunction *Creates a prior distribution for a weight function*

Description

prior_weightfunction creates a prior distribution for fitting a RoBMA selection model. The prior can be visualized by the plot function.

Usage

```
prior_weightfunction(distribution, parameters, prior_weights = 1)
```

Arguments

distribution name of the prior distribution. The possible options are
 "two.sided" for a two-sided weight function characterized by a vector steps and vector alpha parameters. The alpha parameter determines an alpha parameter of Dirichlet distribution which cumulative sum is used for the weights omega.
 "one.sided" for a one-sided weight function characterized by either a vector steps and vector alpha parameter, leading to a monotonic one-sided function, or by a vector steps, vector alpha1, and vector alpha2 parameters leading non-monotonic one-sided weight function. The alpha / alpha1 and alpha2 parameters determine an alpha parameter of Dirichlet distribution which cumulative sum is used for the weights omega.

parameters list of appropriate parameters for a given distribution.

prior_weights prior odds associated with a given distribution. The model fitting function usually creates models corresponding to all combinations of prior distributions for each of the model parameters, and sets the model priors odds to the product of its prior distributions.

Value

prior_weightfunction returns an object of class 'prior'.

See Also

[plot.prior\(\)](#)

Examples

```
p1 <- prior_weightfunction("one-sided", parameters = list(steps = c(.05, .10), alpha = c(1, 1, 1)))

# the prior distribution can be visualized using the plot function
# (see ?plot.prior for all options)
plot(p1)
```

Description

RoBMA is used to estimate a Robust Bayesian Meta-Analysis. The interface allows a complete customization of the ensemble with different prior (or list of prior) distributions for each component.

Usage

```

RoBMA(
  d = NULL,
  r = NULL,
  logOR = NULL,
  z = NULL,
  y = NULL,
  se = NULL,
  v = NULL,
  n = NULL,
  lCI = NULL,
  uCI = NULL,
  t = NULL,
  study_names = NULL,
  study_ids = NULL,
  data = NULL,
  weight = NULL,
  transformation = if (is.null(y)) "fishers_z" else "none",
  prior_scale = if (is.null(y)) "cohens_d" else "none",
  effect_direction = "positive",
  model_type = NULL,
  priors_effect = prior(distribution = "normal", parameters = list(mean = 0, sd = 1)),
  priors_heterogeneity = prior(distribution = "invgamma", parameters = list(shape = 1,
    scale = 0.15)),
  priors_bias = list(prior_weightfunction(distribution = "two.sided", parameters =
    list(alpha = c(1, 1), steps = c(0.05))), prior_weights = 1/12),
    prior_weightfunction(distribution = "two.sided", parameters = list(alpha = c(1, 1,
    1), steps = c(0.05, 0.1))), prior_weights = 1/12), prior_weightfunction(distribution =
    "one.sided", parameters = list(alpha = c(1, 1), steps = c(0.05))), prior_weights =
    1/12), prior_weightfunction(distribution = "one.sided", parameters = list(alpha =
    c(1, 1, 1), steps = c(0.025, 0.05))), prior_weights = 1/12),

    prior_weightfunction(distribution = "one.sided", parameters = list(alpha = c(1, 1,
    1), steps = c(0.05, 0.5))), prior_weights = 1/12), prior_weightfunction(distribution =
    "one.sided", parameters = list(alpha = c(1, 1, 1, 1), steps = c(0.025, 0.05, 0.5))),
    prior_weights = 1/12), prior_PET(distribution = "Cauchy", parameters = list(0, 1),
    truncation = list(0, Inf), prior_weights = 1/4), prior_PEESE(distribution = "Cauchy",
    parameters = list(0, 5), truncation = list(0, Inf), prior_weights = 1/4)),
  priors_effect_null = prior(distribution = "point", parameters = list(location = 0)),
  priors_heterogeneity_null = prior(distribution = "point", parameters = list(location =
    0)),
  priors_bias_null = prior_none(),
  priors_hierarchical = prior("beta", parameters = list(alpha = 1, beta = 1)),
  priors_hierarchical_null = NULL,
  chains = 3,
  sample = 5000,
  burnin = 2000,
  adapt = 500,

```

```

thin = 1,
parallel = FALSE,
autofit = TRUE,
autofit_control = set_autofit_control(),
convergence_checks = set_convergence_checks(),
save = "all",
seed = NULL,
silent = TRUE,
...
)

```

Arguments

<code>d</code>	a vector of effect sizes measured as Cohen's d
<code>r</code>	a vector of effect sizes measured as correlations
<code>logOR</code>	a vector of effect sizes measured as log odds ratios
<code>z</code>	a vector of effect sizes measured as Fisher's z
<code>y</code>	a vector of unspecified effect sizes (note that effect size transformations are unavailable with this type of input)
<code>se</code>	a vector of standard errors of the effect sizes
<code>v</code>	a vector of variances of the effect sizes
<code>n</code>	a vector of overall sample sizes
<code>lCI</code>	a vector of lower bounds of confidence intervals
<code>uCI</code>	a vector of upper bounds of confidence intervals
<code>t</code>	a vector of t/z -statistics
<code>study_names</code>	an optional argument with the names of the studies
<code>study_ids</code>	an optional argument specifying dependency between the studies (for using a multilevel model). Defaults to <code>NULL</code> for studies being independent.
<code>data</code>	a data object created by the <code>combine_data</code> function. This is an alternative input entry to specifying the <code>d</code> , <code>r</code> , <code>y</code> , etc... directly. I.e., you cannot pass the <code>data.frame</code> and reference to the columns.
<code>weight</code>	specifies likelihood weights of the individual estimates. Notes that this is an untested experimental feature.
<code>transformation</code>	transformation to be applied to the supplied effect sizes before fitting the individual models. Defaults to <code>"fishers_z"</code> . We highly recommend using <code>"fishers_z"</code> transformation since it is the only variance stabilizing measure and does not bias PET and PEESE style models. The other options are <code>"cohens_d"</code> , correlation coefficient <code>"r"</code> and <code>"logOR"</code> . Supplying <code>"none"</code> will treat the effect sizes as unstandardized and refrain from any transformations.
<code>prior_scale</code>	a scale used to define priors. Defaults to <code>"cohens_d"</code> . Other options are <code>"fishers_z"</code> , correlation coefficient <code>"r"</code> , and <code>"logOR"</code> . The prior scale does not need to match the effect sizes measure - the samples from prior distributions are internally transformed to match the transformation of the data. The <code>prior_scale</code> corresponds to the scale of default output, but can be changed within the summary function.

<code>effect_direction</code>	the expected direction of the effect. The one-sided selection sets the weights ω to 1 to significant results in the expected direction. Defaults to "positive" (another option is "negative").
<code>model_type</code>	string specifying the RoBMA ensemble. Defaults to NULL. The other options are "PSMA", "PP", and "2w" which override settings passed to the <code>priors_effect</code> , <code>priors_heterogeneity</code> , <code>priors_effect_null</code> , <code>priors_heterogeneity_null</code> , <code>priors_bias_null</code> , and <code>priors_effect</code> . See details for more information about the different model types.
<code>priors_effect</code>	list of prior distributions for the effect size (μ) parameter that will be treated as belonging to the alternative hypothesis. Defaults to a standard normal distribution <code>prior(distribution = "normal", parameters = list(mean = 0, sd = 1))</code> .
<code>priors_heterogeneity</code>	list of prior distributions for the heterogeneity τ parameter that will be treated as belonging to the alternative hypothesis. Defaults to <code>prior(distribution = "invgamma", parameters = list(shape = 1, scale = .15))</code> that is based on heterogeneities estimates from psychology (van Erp et al. 2017).
<code>priors_bias</code>	list of prior distributions for the publication bias adjustment component that will be treated as belonging to the alternative hypothesis. Defaults to <code>list(prior_weightfunction(distribution = "two.sided", parameters = list(alpha = c(1, 1), steps = c(0.05))), prior_weights = 1/12), prior_weightfunction(distribution = "two.sided", parameters = list(alpha = c(1, 1, 1), steps = c(0.05, 0.10))), prior_weights = 1/12), prior_weightfunction(distribution = "one.sided", parameters = list(alpha = c(1, 1), steps = c(0.05))), prior_weights = 1/12), prior_weightfunction(distribution = "one.sided", parameters = list(alpha = c(1, 1, 1), steps = c(0.025, 0.05))), prior_weights = 1/12), prior_weightfunction(distribution = "one.sided", parameters = list(alpha = c(1, 1, 1), steps = c(0.05, 0.5))), prior_weights = 1/12), prior_weightfunction(distribution = "one.sided", parameters = list(alpha = c(1, 1, 1, 1), steps = c(0.025, 0.05, 0.5))), prior_weights = 1/12), prior_PET(distribution = "Cauchy", parameters = list(0, 1), truncation = list(0, Inf), prior_weights = 1/4), prior_PEESE(distribution = "Cauchy", parameters = list(0, 5), truncation = list(0, Inf), prior_weights = 1/4)</code> , corresponding to the RoBMA-PSMA model introduced by Bartoš et al. (2022).
<code>priors_effect_null</code>	list of prior distributions for the effect size (μ) parameter that will be treated as belonging to the null hypothesis. Defaults to a point null hypothesis at zero, <code>prior(distribution = "point", parameters = list(location = 0))</code> .
<code>priors_heterogeneity_null</code>	list of prior distributions for the heterogeneity τ parameter that will be treated as belonging to the null hypothesis. Defaults to a point null hypothesis at zero (a fixed effect meta-analytic models), <code>prior(distribution = "point", parameters = list(location = 0))</code> .
<code>priors_bias_null</code>	list of prior weight functions for the ω parameter that will be treated as belonging to the null hypothesis. Defaults no publication bias adjustment, <code>prior_none()</code> .
<code>priors_hierarchical</code>	list of prior distributions for the correlation of random effects (ρ) parameter that will be treated as belonging to the alternative hypothesis. This setting allows

	users to fit a hierarchical (three-level) meta-analysis when <code>study_ids</code> are supplied. Note that this is an experimental feature and see News for more details. Defaults to a beta distribution prior (<code>distribution = "beta"</code> , <code>parameters = list(alpha = 1, beta = 1)</code>).
<code>priors_hierarchical_null</code>	list of prior distributions for the correlation of random effects (<code>rho</code>) parameter that will be treated as belonging to the null hypothesis. Defaults to <code>NULL</code> .
<code>chains</code>	a number of chains of the MCMC algorithm.
<code>sample</code>	a number of sampling iterations of the MCMC algorithm. Defaults to <code>5000</code> .
<code>burnin</code>	a number of burnin iterations of the MCMC algorithm. Defaults to <code>2000</code> .
<code>adapt</code>	a number of adaptation iterations of the MCMC algorithm. Defaults to <code>500</code> .
<code>thin</code>	a thinning of the chains of the MCMC algorithm. Defaults to <code>1</code> .
<code>parallel</code>	whether the individual models should be fitted in parallel. Defaults to <code>FALSE</code> . The implementation is not completely stable and might cause a connection error.
<code>autofit</code>	whether the model should be fitted until the convergence criteria (specified in <code>autofit_control</code>) are satisfied. Defaults to <code>TRUE</code> .
<code>autofit_control</code>	allows to pass autofit control settings with the <code>set_autofit_control()</code> function. See <code>?set_autofit_control</code> for options and default settings.
<code>convergence_checks</code>	automatic convergence checks to assess the fitted models, passed with <code>set_convergence_checks()</code> function. See <code>?set_convergence_checks</code> for options and default settings.
<code>save</code>	whether all models posterior distributions should be kept after obtaining a model-averaged result. Defaults to <code>"all"</code> which does not remove anything. Set to <code>"min"</code> to significantly reduce the size of final object, however, some model diagnostics and further manipulation with the object will not be possible.
<code>seed</code>	a seed to be set before model fitting, marginal likelihood computation, and posterior mixing for reproducibility of results. Defaults to <code>NULL</code> - no seed is set.
<code>silent</code>	whether all print messages regarding the fitting process should be suppressed. Defaults to <code>TRUE</code> . Note that <code>parallel = TRUE</code> also suppresses all messages.
<code>...</code>	additional arguments.

Details

The default settings of the RoBMA 2.0 package corresponds to the RoBMA-PSMA ensemble proposed by Bartoš et al. (2022). The previous versions of the package (i.e., RoBMA < 2.0) used specifications proposed by Maier et al. (2022) (this specification can be easily obtained by setting `model_type = "2w"`). The RoBMA-PP specification from Bartoš et al. (2022) can be obtained by setting `model_type = "PP"`.

The `vignette("CustomEnsembles", package = "RoBMA")` and `vignette("ReproducingBMA", package = "RoBMA")` vignettes describe how to use `RoBMA()` to fit custom meta-analytic ensembles (see `prior()`, `prior_weightfunction()`, `prior_PET()`, and `prior_PEESE()` for more information about prior distributions).

The `RoBMA` function first generates models from a combination of the provided priors for each of the model parameters. Then, the individual models are fitted using `autorun.jags` function. A

marginal likelihood is computed using `bridge_sampler` function. The individual models are then combined into an ensemble using the posterior model probabilities using `BayesTools` package.

Generic `summary.RoBMA()`, `print.RoBMA()`, and `plot.RoBMA()` functions are provided to facilitate manipulation with the ensemble. A visual check of the individual model diagnostics can be obtained using the `diagnostics()` function. The fitted model can be further updated or modified by `update.RoBMA()` function.

Value

RoBMA returns an object of class 'RoBMA'.

References

Bartoš F, Maier M, Wagenmakers E, Doucouliagos H, Stanley TD (2022). “Robust Bayesian meta-analysis: Model-averaging across complementary publication bias adjustment methods.” *Research Synthesis Methods*. doi:10.1002/jrsm.1594.

Maier M, Bartoš F, Wagenmakers E (2022). “Robust Bayesian Meta-Analysis: Addressing Publication Bias with Model-Averaging.” *Psychological Methods*. doi:10.1037/met0000405.

van Erp S, Verhagen J, Grasman RP, Wagenmakers E (2017). “Estimates of between-study heterogeneity for 705 meta-analyses reported in Psychological Bulletin from 1990–2013.” *Journal of Open Psychology Data*, 5(1). doi:10.5334/jopd.33.

See Also

`summary.RoBMA()`, `update.RoBMA()`, `check_setup()`

Examples

```
## Not run:
# using the example data from Bem 2011 and fitting the default (RoBMA-PSMA) model
fit <- RoBMA(d = Bem2011$d, se = Bem2011$se, study_names = Bem2011$study)

# in order to speed up the process, we can turn the parallelization on
fit <- RoBMA(d = Bem2011$d, se = Bem2011$se, study_names = Bem2011$study, parallel = TRUE)

# we can get a quick overview of the model coefficients just by printing the model
fit

# a more detailed overview using the summary function (see '?summary.RoBMA' for all options)
summary(fit)

# the model-averaged effect size estimate can be visualized using the plot function
# (see ?plot.RoBMA for all options)
plot(fit, parameter = "mu")

# forest plot can be obtained with the forest function (see ?forest for all options)
forest(fit)

# plot of the individual model estimates can be obtained with the plot_models function
```

```

# (see ?plot_models for all options)
plot_models(fit)

# diagnostics for the individual parameters in individual models can be obtained using diagnostics
# function (see 'diagnostics' for all options)
diagnostics(fit, parameter = "mu", type = "chains")

# the RoBMA-PP can be fitted with addition of the 'model_type' argument
fit_PP <- RoBMA(d = Bem2011$d, se = Bem2011$se, study_names = Bem2011$study, model_type = "PP")

# as well as the original version of RoBMA (with two weightfunctions)
fit_original <- RoBMA(d = Bem2011$d, se = Bem2011$se, study_names = Bem2011$study,
                    model_type = "2w")

# or different prior distribution for the effect size (e.g., a half-normal distribution)
# (see 'vignette("CustomEnsembles")' for a detailed guide on specifying a custom model ensemble)
fit <- RoBMA(d = Bem2011$d, se = Bem2011$se, study_names = Bem2011$study,
            priors_effect = prior("normal", parameters = list(0, 1),
                                truncation = list(0, Inf)))

## End(Not run)

```

RoBMA.reg

Estimate a Robust Bayesian Meta-Analysis Meta-Regression

Description

RoBMA is used to estimate a Robust Bayesian Meta-Analysis. The interface allows a complete customization of the ensemble with different prior (or list of prior) distributions for each component.

Usage

```

RoBMA.reg(
  formula,
  data,
  test_predictors = TRUE,
  study_names = NULL,
  study_ids = NULL,
  transformation = if (any(colnames(data) != "y")) "fishers_z" else "none",
  prior_scale = if (any(colnames(data) != "y")) "cohens_d" else "none",
  standardize_predictors = TRUE,
  effect_direction = "positive",
  priors = NULL,
  model_type = NULL,
  priors_effect = prior(distribution = "normal", parameters = list(mean = 0, sd = 1)),
  priors_heterogeneity = prior(distribution = "invgamma", parameters = list(shape = 1,
  scale = 0.15)),
  priors_bias = list(prior_weightfunction(distribution = "two.sided", parameters =

```

```

    list(alpha = c(1, 1), steps = c(0.05)), prior_weights = 1/12),
  prior_weightfunction(distribution = "two.sided", parameters = list(alpha = c(1, 1,
  1), steps = c(0.05, 0.1)), prior_weights = 1/12), prior_weightfunction(distribution =
  "one.sided", parameters = list(alpha = c(1, 1), steps = c(0.05)), prior_weights =
  1/12), prior_weightfunction(distribution = "one.sided", parameters = list(alpha =
  c(1, 1, 1), steps = c(0.025, 0.05)), prior_weights = 1/12),

  prior_weightfunction(distribution = "one.sided", parameters = list(alpha = c(1, 1,
  1), steps = c(0.05, 0.5)), prior_weights = 1/12), prior_weightfunction(distribution =
  "one.sided", parameters = list(alpha = c(1, 1, 1, 1), steps = c(0.025, 0.05, 0.5)),
  prior_weights = 1/12), prior_PET(distribution = "Cauchy", parameters = list(0, 1),
  truncation = list(0, Inf), prior_weights = 1/4), prior_PEESE(distribution = "Cauchy",
  parameters = list(0, 5), truncation = list(0, Inf), prior_weights = 1/4)),
  priors_effect_null = prior(distribution = "point", parameters = list(location = 0)),
  priors_heterogeneity_null = prior(distribution = "point", parameters = list(location =
  0)),
  priors_bias_null = prior_none(),
  priors_hierarchical = prior("beta", parameters = list(alpha = 1, beta = 1)),
  priors_hierarchical_null = NULL,
  prior_covariates = prior("normal", parameters = list(mean = 0, sd = 0.25)),
  prior_covariates_null = prior("spike", parameters = list(location = 0)),
  prior_factors = prior_factor("mnormal", parameters = list(mean = 0, sd = 0.25),
  contrast = "meandif"),
  prior_factors_null = prior_factor("spike", parameters = list(location = 0), contrast =
  "meandif"),
  chains = 3,
  sample = 5000,
  burnin = 2000,
  adapt = 500,
  thin = 1,
  parallel = FALSE,
  autofit = TRUE,
  autofit_control = set_autofit_control(),
  convergence_checks = set_convergence_checks(),
  save = "all",
  seed = NULL,
  silent = TRUE,
  ...
)

```

Arguments

formula	a formula for the meta-regression model
data	a data object created by the <code>combine_data</code> function. This is an alternative input entry to specifying the <code>d</code> , <code>r</code> , <code>y</code> , etc... directly. I.e., you cannot pass the <code>data.frame</code> and reference to the columns.
test_predictors	vector of predictor names that will be test (i.e., assigned both the null and alternative prior distributions). Defaults to TRUE, all predictors are tested using the

	default prior distributions (i.e., <code>prior_covariates</code> , <code>prior_covariates_null</code> , <code>prior_factors</code> , and <code>prior_factors_null</code>). To only estimate and adjust for the effect of predictors use <code>FALSE</code> . If priors is specified, any settings in <code>test_predictors</code> is overridden.
<code>study_names</code>	an optional argument with the names of the studies
<code>study_ids</code>	an optional argument specifying dependency between the studies (for using a multilevel model). Defaults to <code>NULL</code> for studies being independent.
<code>transformation</code>	transformation to be applied to the supplied effect sizes before fitting the individual models. Defaults to <code>"fishers_z"</code> . We highly recommend using <code>"fishers_z"</code> transformation since it is the only variance stabilizing measure and does not bias PET and PEESE style models. The other options are <code>"cohens_d"</code> , correlation coefficient <code>"r"</code> and <code>"logOR"</code> . Supplying <code>"none"</code> will treat the effect sizes as unstandardized and refrain from any transformations.
<code>prior_scale</code>	a scale used to define priors. Defaults to <code>"cohens_d"</code> . Other options are <code>"fishers_z"</code> , correlation coefficient <code>"r"</code> , and <code>"logOR"</code> . The prior scale does not need to match the effect sizes measure - the samples from prior distributions are internally transformed to match the transformation of the data. The <code>prior_scale</code> corresponds to the scale of default output, but can be changed within the summary function.
<code>standardize_predictors</code>	whether continuous predictors should be standardized prior to estimating the model. Defaults to <code>TRUE</code> .
<code>effect_direction</code>	the expected direction of the effect. The one-sided selection sets the weights ω to 1 to significant results in the expected direction. Defaults to <code>"positive"</code> (another option is <code>"negative"</code>).
<code>priors</code>	named list of prior distributions for each predictor (with names corresponding to the predictors). It allows users to specify both the null and alternative hypothesis prior distributions for each predictor by assigning the corresponding element of the named list with another named list (with <code>"null"</code> and <code>"alt"</code>). If only one prior is specified for a given parameter, it is assumed to correspond to the alternative hypotheses and the default null hypothesis is specified (i.e., <code>prior_covariates_null</code> or <code>prior_factors_null</code>). If a named list with only one named prior distribution is provided (either <code>"null"</code> or <code>"alt"</code>), only this prior distribution is used and no default distribution is filled in. Parameters without specified prior distributions are assumed to be only adjusted for using the default alternative hypothesis prior distributions (i.e., <code>prior_covariates</code> or <code>prior_factors</code>). If <code>priors</code> is specified, <code>test_predictors</code> is ignored.
<code>model_type</code>	string specifying the RoBMA ensemble. Defaults to <code>NULL</code> . The other options are <code>"PSMA"</code> , <code>"PP"</code> , and <code>"2w"</code> which override settings passed to the <code>priors_effect</code> , <code>priors_heterogeneity</code> , <code>priors_effect_null</code> , <code>priors_heterogeneity_null</code> , <code>priors_bias_null</code> , and <code>priors_effect</code> . See details for more information about the different model types.
<code>priors_effect</code>	list of prior distributions for the effect size (μ) parameter that will be treated as belonging to the alternative hypothesis. Defaults to a standard normal distribution <code>prior(distribution = "normal", parameters = list(mean = 0, sd = 1))</code> .

- `priors_heterogeneity`
list of prior distributions for the heterogeneity tau parameter that will be treated as belonging to the alternative hypothesis. Defaults to `prior(distribution = "invgamma", parameters = list(shape = 1, scale = .15))` that is based on heterogeneities estimates from psychology (van Erp et al. 2017).
- `priors_bias`
list of prior distributions for the publication bias adjustment component that will be treated as belonging to the alternative hypothesis. Defaults to `list(prior_weightfunction(distribution = "two.sided", parameters = list(alpha = c(1, 1), steps = c(0.05))), prior_weights = 1/12), prior_weightfunction(distribution = "two.sided", parameters = list(alpha = c(1, 1, 1), steps = c(0.05, 0.10))), prior_weights = 1/12), prior_weightfunction(distribution = "one.sided", parameters = list(alpha = c(1, 1), steps = c(0.05))), prior_weights = 1/12), prior_weightfunction(distribution = "one.sided", parameters = list(alpha = c(1, 1, 1), steps = c(0.025, 0.05))), prior_weights = 1/12), prior_weightfunction(distribution = "one.sided", parameters = list(alpha = c(1, 1, 1), steps = c(0.05, 0.5))), prior_weights = 1/12), prior_weightfunction(distribution = "one.sided", parameters = list(alpha = c(1, 1, 1), steps = c(0.025, 0.05, 0.5))), prior_weights = 1/12), prior_PET(distribution = "Cauchy", parameters = list(0, 1), truncation = list(0, Inf), prior_weights = 1/4), prior_PEESE(distribution = "Cauchy", parameters = list(0, 5), truncation = list(0, Inf), prior_weights = 1/4)), corresponding to the RoBMA-PSMA model introduced by Bartoš et al. (2022).`
- `priors_effect_null`
list of prior distributions for the effect size (mu) parameter that will be treated as belonging to the null hypothesis. Defaults to a point null hypotheses at zero, `prior(distribution = "point", parameters = list(location = 0))`.
- `priors_heterogeneity_null`
list of prior distributions for the heterogeneity tau parameter that will be treated as belonging to the null hypothesis. Defaults to a point null hypotheses at zero (a fixed effect meta-analytic models), `prior(distribution = "point", parameters = list(location = 0))`.
- `priors_bias_null`
list of prior weight functions for the omega parameter that will be treated as belonging to the null hypothesis. Defaults no publication bias adjustment, `prior_none()`.
- `priors_hierarchical`
list of prior distributions for the correlation of random effects (rho) parameter that will be treated as belonging to the alternative hypothesis. This setting allows users to fit a hierarchical (three-level) meta-analysis when `study_ids` are supplied. Note that this is an experimental feature and see News for more details. Defaults to a beta distribution `prior(distribution = "beta", parameters = list(alpha = 1, beta = 1))`.
- `priors_hierarchical_null`
list of prior distributions for the correlation of random effects (rho) parameter that will be treated as belonging to the null hypothesis. Defaults to NULL.
- `prior_covariates`
a prior distributions for the regression parameter of continuous covariates on the effect size under the alternative hypothesis (unless set explicitly in priors). Defaults to a relatively wide normal distribution `prior(distribution = "normal", parameters = list(mean = 0, sd = 0.25))`.

<code>prior_covariates_null</code>	a prior distributions for the regression parameter of continuous covariates on the effect size under the null hypothesis (unless set explicitly in priors). Defaults to a no effect prior("spike", parameters = list(location = 0)).
<code>prior_factors</code>	a prior distributions for the regression parameter of categorical covariates on the effect size under the alternative hypothesis (unless set explicitly in priors). Defaults to a relatively wide multivariate normal distribution specifying differences from the mean contrasts <code>prior_factor("mnormal", parameters = list(mean = 0, sd = 0.25), contrast = "meandif")</code> .
<code>prior_factors_null</code>	a prior distributions for the regression parameter of categorical covariates on the effect size under the null hypothesis (unless set explicitly in priors). Defaults to a no effect prior("spike", parameters = list(location = 0)).
<code>chains</code>	a number of chains of the MCMC algorithm.
<code>sample</code>	a number of sampling iterations of the MCMC algorithm. Defaults to 5000.
<code>burnin</code>	a number of burnin iterations of the MCMC algorithm. Defaults to 2000.
<code>adapt</code>	a number of adaptation iterations of the MCMC algorithm. Defaults to 500.
<code>thin</code>	a thinning of the chains of the MCMC algorithm. Defaults to 1.
<code>parallel</code>	whether the individual models should be fitted in parallel. Defaults to FALSE. The implementation is not completely stable and might cause a connection error.
<code>autofit</code>	whether the model should be fitted until the convergence criteria (specified in <code>autofit_control</code>) are satisfied. Defaults to TRUE.
<code>autofit_control</code>	allows to pass autofit control settings with the <code>set_autofit_control()</code> function. See <code>?set_autofit_control</code> for options and default settings.
<code>convergence_checks</code>	automatic convergence checks to assess the fitted models, passed with <code>set_convergence_checks()</code> function. See <code>?set_convergence_checks</code> for options and default settings.
<code>save</code>	whether all models posterior distributions should be kept after obtaining a model-averaged result. Defaults to "all" which does not remove anything. Set to "min" to significantly reduce the size of final object, however, some model diagnostics and further manipulation with the object will not be possible.
<code>seed</code>	a seed to be set before model fitting, marginal likelihood computation, and posterior mixing for reproducibility of results. Defaults to NULL - no seed is set.
<code>silent</code>	whether all print messages regarding the fitting process should be suppressed. Defaults to TRUE. Note that <code>parallel = TRUE</code> also suppresses all messages.
<code>...</code>	additional arguments.

Details

See [RoBMA\(\)](#) for more details.

Note that these default prior distributions are relatively wide and more informed prior distributions for testing for the presence of moderation should be considered.

Value

RoBMA.reg returns an object of class 'RoBMA.reg'.

References

Bartoš F, Maier M, Wagenmakers E, Doucouliagos H, Stanley TD (2022). “Robust Bayesian meta-analysis: Model-averaging across complementary publication bias adjustment methods.” *Research Synthesis Methods*. doi:10.1002/jrsm.1594.

van Erp S, Verhagen J, Grasman RP, Wagenmakers E (2017). “Estimates of between-study heterogeneity for 705 meta-analyses reported in Psychological Bulletin from 1990–2013.” *Journal of Open Psychology Data*, 5(1). doi:10.5334/jopd.33.

See Also

[RoBMA\(\)](#) [summary.RoBMA\(\)](#), [update.RoBMA\(\)](#), [check_setup.reg\(\)](#)

RoBMA_control *Control MCMC fitting process*

Description

Controls settings for the autofit process of the MCMC JAGS sampler (specifies termination criteria), and values for the convergence checks.

Usage

```
set_autofit_control(  
  max_Rhat = 1.05,  
  min_ESS = 500,  
  max_error = NULL,  
  max_SD_error = NULL,  
  max_time = list(time = 60, unit = "mins"),  
  sample_extend = 1000  
)  
  
set_convergence_checks(  
  max_Rhat = 1.05,  
  min_ESS = 500,  
  max_error = NULL,  
  max_SD_error = NULL,  
  remove_failed = FALSE,  
  balance_probability = TRUE  
)
```

Arguments

max_Rhat	maximum value of the R-hat diagnostic. Defaults to 1.05.
min_ESS	minimum estimated sample size. Defaults to 500.
max_error	maximum value of the MCMC error. Defaults to NULL. Be aware that PEESE publication bias adjustment can have estimates on different scale than the rest of the output, resulting in relatively large max MCMC error.
max_SD_error	maximum value of the proportion of MCMC error of the estimated SD of the parameter. Defaults to NULL.
max_time	list with the time and unit specifying the maximum autofitting process per model. Passed to <code>difftime</code> function (possible units are "secs", "mins", "hours", "days", "weeks", "years"). Defaults to <code>list(time = 60, unit = "mins")</code> .
sample_extend	number of samples to extend the fitting process if the criteria are not satisfied. Defaults to 1000.
remove_failed	whether models not satisfying the convergence checks should be removed from the inference. Defaults to FALSE - only a warning is raised.
balance_probability	whether prior model probability should be balanced across the combinations of models with the same H0/H1 for effect / heterogeneity / bias in the case of non-convergence. Defaults to TRUE.

Value

`set_autofit_control` returns a list of autofit control settings and `set_convergence_checks` returns a list of convergence checks settings.

See Also

[RoBMA](#), [update.RoBMA](#)

RoBMA_options

Options for the RoBMA package

Description

A placeholder object and functions for the RoBMA package. (adapted from the runjags R package).

Usage

`RoBMA.options(...)`

`RoBMA.get_option(name)`

Arguments

... named option(s) to change - for a list of available options, see details below.
 name the name of the option to get the current value of - for a list of available options, see details below.

Value

The current value of all available RoBMA options (after applying any changes specified) is returned invisibly as a named list.

<code>sample_sizes</code>	<i>Sample sizes to standard errors calculations</i>
---------------------------	---

Description

Functions for transforming between standard errors and sample sizes (assuming equal sample sizes per group).

Usage

`se_d(d, n)`

`n_d(d, se)`

`se_r(r, n)`

`n_r(r, se)`

`se_z(n)`

`n_z(se)`

Arguments

d Cohen's d
 n sample size of the corresponding effect size
 se standard error of the corresponding effect size
 r correlation coefficient

Details

Calculations for Cohen's d, Fisher's z, and log(OR) are based on (Borenstein et al. 2011). Calculations for correlation coefficient were modified to make the standard error corresponding to the computed on Fisher's z scale under the same sample size (in order to make all other transformations consistent). In case that a direct transformation is not available, the transformations are chained to provide the effect size of interest.

Note that sample size and standard error calculation for log(OR) is not available. The standard error is highly dependent on the odds within the groups and sample sizes for individual events are required. Theoretically, the sample size could be obtained by transforming the effect size and standard error to a different measure and obtaining the sample size using corresponding function, however, it leads to a very poor approximation and it is not recommended.

References

Borenstein M, Hedges LV, Higgins JP, Rothstein HR (2011). *Introduction to meta-analysis*. John Wiley & Sons.

See Also

[effect_sizes\(\)](#), [standard_errors\(\)](#)

standard_errors

Standard errors transformations

Description

Functions for transforming between standard errors of different effect size measures.

Usage

`se_d2se_logOR(se_d, logOR)`

`se_d2se_r(se_d, d)`

`se_r2se_d(se_r, r)`

`se_logOR2se_d(se_logOR, logOR)`

`se_d2se_z(se_d, d)`

`se_r2se_z(se_r, r)`

`se_r2se_logOR(se_r, r)`

`se_logOR2se_r(se_logOR, logOR)`

`se_logOR2se_z(se_logOR, logOR)`

`se_z2se_d(se_z, z)`

`se_z2se_r(se_z, z)`

`se_z2se_logOR(se_z, z)`

Arguments

se_d	standard error of Cohen's d
logOR	log(odds ratios)
d	Cohen's d
se_r	standard error of correlation coefficient
r	correlation coefficient
se_logOR	standard error of log(odds ratios)
se_z	standard error of Fisher's z
z	Fisher's z

Details

Transformations for Cohen's d, Fisher's z, and log(OR) are based on (Borenstein et al. 2011). Calculations for correlation coefficient were modified to make the standard error corresponding to the computed on Fisher's z scale under the same sample size (in order to make all other transformations consistent). In case that a direct transformation is not available, the transformations are chained to provide the effect size of interest.

It is important to keep in mind that the transformations are only approximations to the true values. From our experience, `se_d2se_z` works well for values of $se(\text{Cohen's } d) < 0.5$. Do not forget that the effect sizes are standardized and variance of Cohen's $d = 1$. Therefore, a standard error of study cannot be larger unless the participants provided negative information (of course, the variance is dependent on the effect size as well, and, can therefore be larger).

When setting prior distributions, do NOT attempt to transform a standard normal distribution on Cohen's d (mean = 0, sd = 1) to a normal distribution on Fisher's z with mean 0 and $sd = se_d^2 se_z(0, 1)$. The approximation does NOT work well in this range of values. Instead, approximate the sd of distribution on Fisher's z using samples in this way: `sd(d2z(rnorm(10000, 0, 1)))` or, specify the distribution on Cohen's d directly.

References

Borenstein M, Hedges LV, Higgins JP, Rothstein HR (2011). *Introduction to meta-analysis*. John Wiley & Sons.

See Also

[effect_sizes\(\)](#), [sample_sizes\(\)](#)

summary.RoBMA	<i>Summarize fitted RoBMA object</i>
---------------	--------------------------------------

Description

summary.RoBMA creates summary tables for a RoBMA object.

Usage

```
## S3 method for class 'RoBMA'
summary(
  object,
  type = "ensemble",
  conditional = FALSE,
  output_scale = NULL,
  probs = c(0.025, 0.975),
  logBF = FALSE,
  BF01 = FALSE,
  short_name = FALSE,
  remove_spike_0 = FALSE,
  ...
)
```

Arguments

object	a fitted RoBMA object
type	whether to show the overall RoBMA results ("ensemble"), an overview of the individual models ("models"), an overview of the individual models MCMC diagnostics ("diagnostics"), or a detailed summary of the individual models ("individual"). Can be abbreviated to first letters.
conditional	show the conditional estimates (assuming that the alternative is true). Defaults to FALSE. Only available for type == "ensemble".
output_scale	transform the meta-analytic estimates to a different scale. Defaults to NULL which returns the same scale as the model was estimated on.
probs	quantiles of the posterior samples to be displayed. Defaults to c(.025, .975)
logBF	show log of Bayes factors. Defaults to FALSE.
BF01	show Bayes factors in support of the null hypotheses. Defaults to FALSE.
short_name	whether priors names should be shortened to the first (couple) of letters. Defaults to FALSE.
remove_spike_0	whether spike prior distributions with location at zero should be omitted from the summary. Defaults to FALSE.
...	additional arguments

Value

summary.RoBMA returns a list of tables of class 'BayesTools_table'.

Note

See [diagnostics\(\)](#) for visual convergence checks of the individual models.

See Also

[RoBMA\(\)](#), [diagnostics\(\)](#), [check_RoBMA\(\)](#)

Examples

```
## Not run:
# using the example data from Anderson et al. 2010 and fitting the default model
# (note that the model can take a while to fit)
fit <- RoBMA(r = Anderson2010$r, n = Anderson2010$n, study_names = Anderson2010$labels)

# summary can provide many details about the model
summary(fit)

# estimates from the conditional models can be obtained with
summary(fit, conditional = TRUE)

# overview of the models and their prior and posterior probability, marginal likelihood,
# and inclusion Bayes factor can be obtained with
summary(fit, type = "models")

# diagnostics overview, containing the maximum R-hat, minimum ESS, maximum MCMC error, and
# maximum MCMC error / sd across parameters for each individual model can be obtained with
summary(fit, type = "diagnostics")

# summary of individual models and their parameters can be further obtained by
summary(fit, type = "individual")

## End(Not run)
```

update.RoBMA

Updates a fitted RoBMA object

Description

update.RoBMA can be used to

1. add an additional model to an existing "RoBMA" object by specifying either a null or alternative prior for each parameter and the prior odds of the model (prior_weights), see the vignette("CustomEnsembles") vignette,

2. change the prior odds of fitted models by specifying a vector `prior_weights` of the same length as the fitted models,
3. refitting models that failed to converge with updated settings of control parameters,
4. or changing the convergence criteria and recalculating the ensemble results by specifying new control argument and setting `refit_failed == FALSE`.

Usage

```
## S3 method for class 'RoBMA'
update(
  object,
  refit_failed = TRUE,
  prior_effect = NULL,
  prior_heterogeneity = NULL,
  prior_bias = NULL,
  prior_hierarchical = NULL,
  prior_weights = NULL,
  prior_effect_null = NULL,
  prior_heterogeneity_null = NULL,
  prior_bias_null = NULL,
  prior_hierarchical_null = NULL,
  study_names = NULL,
  chains = NULL,
  adapt = NULL,
  burnin = NULL,
  sample = NULL,
  thin = NULL,
  autofit = NULL,
  parallel = NULL,
  autofit_control = NULL,
  convergence_checks = NULL,
  save = "all",
  seed = NULL,
  silent = TRUE,
  ...
)
```

Arguments

<code>object</code>	a fitted RoBMA object
<code>refit_failed</code>	whether failed models should be refitted. Relevant only if new priors or <code>prior_weights</code> are not supplied. Defaults to TRUE.
<code>prior_effect</code>	prior distribution for the effect size (μ) parameter that will be treated as belonging to the alternative hypothesis. Defaults to NULL.
<code>prior_heterogeneity</code>	prior distribution for the heterogeneity τ parameter that will be treated as belonging to the alternative hypothesis. Defaults to NULL.

<code>prior_bias</code>	prior distribution for the publication bias adjustment component that will be treated as belonging to the alternative hypothesis. Defaults to NULL.
<code>prior_hierarchical</code>	prior distribution for the correlation of random effects (ρ) parameter that will be treated as belonging to the alternative hypothesis. This setting allows users to fit a hierarchical (three-level) meta-analysis when <code>study_ids</code> are supplied. Note that this is an experimental feature and see News for more details. Defaults to a beta distribution <code>prior(distribution = "beta", parameters = list(alpha = 1, beta = 1))</code> .
<code>prior_weights</code>	either a single value specifying prior model weight of a newly specified model using <code>priors</code> argument, or a vector of the same length as already fitted models to update their prior weights.
<code>prior_effect_null</code>	prior distribution for the effect size (μ) parameter that will be treated as belonging to the null hypothesis. Defaults to NULL.
<code>prior_heterogeneity_null</code>	prior distribution for the heterogeneity τ parameter that will be treated as belonging to the null hypothesis. Defaults to NULL.
<code>prior_bias_null</code>	prior distribution for the publication bias adjustment component that will be treated as belonging to the null hypothesis. Defaults to NULL.
<code>prior_hierarchical_null</code>	prior distribution for the correlation of random effects (ρ) parameter that will be treated as belonging to the null hypothesis. Defaults to NULL.
<code>study_names</code>	an optional argument with the names of the studies
<code>chains</code>	a number of chains of the MCMC algorithm.
<code>adapt</code>	a number of adaptation iterations of the MCMC algorithm. Defaults to 500.
<code>burnin</code>	a number of burnin iterations of the MCMC algorithm. Defaults to 2000.
<code>sample</code>	a number of sampling iterations of the MCMC algorithm. Defaults to 5000.
<code>thin</code>	a thinning of the chains of the MCMC algorithm. Defaults to 1.
<code>autofit</code>	whether the model should be fitted until the convergence criteria (specified in <code>autofit_control</code>) are satisfied. Defaults to TRUE.
<code>parallel</code>	whether the individual models should be fitted in parallel. Defaults to FALSE. The implementation is not completely stable and might cause a connection error.
<code>autofit_control</code>	allows to pass autofit control settings with the <code>set_autofit_control()</code> function. See <code>?set_autofit_control</code> for options and default settings.
<code>convergence_checks</code>	automatic convergence checks to assess the fitted models, passed with <code>set_convergence_checks()</code> function. See <code>?set_convergence_checks</code> for options and default settings.
<code>save</code>	whether all models posterior distributions should be kept after obtaining a model-averaged result. Defaults to "all" which does not remove anything. Set to "min" to significantly reduce the size of final object, however, some model diagnostics and further manipulation with the object will not be possible.

seed	a seed to be set before model fitting, marginal likelihood computation, and posterior mixing for reproducibility of results. Defaults to NULL - no seed is set.
silent	whether all print messages regarding the fitting process should be suppressed. Defaults to TRUE. Note that parallel = TRUE also suppresses all messages.
...	additional arguments.

Details

See [RoBMA\(\)](#) for more details.

Value

RoBMA returns an object of class 'RoBMA'.

See Also

[RoBMA\(\)](#), [summary.RoBMA\(\)](#), [prior\(\)](#), [check_setup\(\)](#)

Examples

```
## Not run:
# using the example data from Bem 2011 and fitting the default (RoBMA-PSMA) model
fit <- RoBMA(d = Bem2011$d, se = Bem2011$se, study_names = Bem2011$study)

# the update function allows us to change the prior model weights of each model
fit1 <- update(fit, prior_weights = c(0, rep(1, 35)))

# add an additional model with different priors specification
# (see '?prior' for more information)
fit2 <- update(fit,
  priors_effect_null = prior("point", parameters = list(location = 0)),
  priors_heterogeneity = prior("normal",
    parameters = list(mean = 0, sd = 1),
    truncation = list(lower = 0, upper = Inf)),
  priors_bias = prior_weightfunction("one-sided",
    parameters = list(cuts = c(.05, .10, .20),
      alpha = c(1, 1, 1, 1))))

# refit the models with an increased number of sample iterations
fit3 <- update(fit, sample = 10000)

## End(Not run)
```

 weighted_multivariate_normal

Weighted multivariate normal distribution

Description

Density function for the weighted multivariate normal distribution with mean, covariance matrix `sigma`, critical values `crit_x`, and weights `omega`.

Arguments

<code>x</code>	quantiles.
<code>p</code>	vector of probabilities.
<code>mean</code>	mean
<code>sigma</code>	covariance matrix.
<code>crit_x</code>	vector of critical values defining steps.
<code>omega</code>	vector of weights defining the probability of observing a t-statistics between each of the two steps.
<code>type</code>	type of weight function (defaults to "two.sided").
<code>log, log.p</code>	logical; if TRUE, probabilities <code>p</code> are given as $\log(p)$.

Value

`.dwmnorm_fast` returns a density of the multivariate weighted normal distribution.

See Also

[Normal](#), [weighted_normal](#)

 weighted_normal

Weighted normal distribution

Description

Density, distribution function, quantile function and random generation for the weighted normal distribution with mean, standard deviation `sd`, steps `steps` (or critical values) `crit_x`, and weights `omega`.

Usage

```
dwnorm(  
  x,  
  mean,  
  sd,  
  steps = if (!is.null(crit_x)) NULL,  
  omega,  
  crit_x = if (!is.null(steps)) NULL,  
  type = "two.sided",  
  log = FALSE  
)
```

```
pwnorm(  
  q,  
  mean,  
  sd,  
  steps = if (!is.null(crit_x)) NULL,  
  omega,  
  crit_x = if (!is.null(steps)) NULL,  
  type = "two.sided",  
  lower.tail = TRUE,  
  log.p = FALSE  
)
```

```
qwnorm(  
  p,  
  mean,  
  sd,  
  steps = if (!is.null(crit_x)) NULL,  
  omega,  
  crit_x = if (!is.null(steps)) NULL,  
  type = "two.sided",  
  lower.tail = TRUE,  
  log.p = FALSE  
)
```

```
rwnorm(  
  n,  
  mean,  
  sd,  
  steps = if (!is.null(crit_x)) NULL,  
  omega,  
  crit_x = if (!is.null(steps)) NULL,  
  type = "two.sided"  
)
```

Arguments

x, q	vector of quantiles.
mean	mean
sd	standard deviation.
steps	vector of steps for the weight function.
omega	vector of weights defining the probability of observing a t-statistics between each of the two steps.
crit_x	vector of critical values defining steps (if steps are not supplied).
type	type of weight function (defaults to "two.sided").
log, log.p	logical; if TRUE, probabilities p are given as $\log(p)$.
lower.tail	logical; if TRUE (default), probabilities are $P[X \leq x]$, otherwise, $P[X \geq x]$.
p	vector of probabilities.
n	number of observations. If $\text{length}(n) > 1$, the length is taken to be the number required.

Details

The mean, sd, steps, omega can be supplied as a vectors (mean, sd) or matrices (steps, omega) with length / number of rows equal to $x/q/p$. Otherwise, they are recycled to the length of the result.

Value

dwnorm gives the density, dwnorm gives the distribution function, qwnorm gives the quantile function, and rwnorm generates random deviates.

See Also

[Normal](#)

Index

* datasets

Anderson2010, 4
Bem2011, 5
Kroupova2021, 22
Lui2015, 22
Poulsen2006, 28

* package

RoBMA-package, 3
_PACKAGE (RoBMA-package), 3

Anderson2010, 4
autorun.jags, 44

BayesTools, 45
Bem2011, 5
Beta, 32, 36
bridge_sampler, 45

Cauchy, 32, 36
check_RoBMA, 5
check_RoBMA(), 25, 57
check_setup, 6
check_setup(), 12, 14, 45, 60
check_setup.reg, 8
check_setup.reg(), 8, 51
combine_data, 12
contr.meandif, 14
contr.orthonormal, 15

d2logOR (effect_sizes), 18
d2OR (effect_sizes), 18
d2r (effect_sizes), 18
d2z (effect_sizes), 18
diagnostics, 15
diagnostics(), 25, 45, 57
diagnostics_autocorrelation
 (diagnostics), 15
diagnostics_density (diagnostics), 15
diagnostics_trace (diagnostics), 15
difftime, 52

dwnorm (weighted_normal), 61

effect_sizes, 18
effect_sizes(), 14, 54, 55
escalc, 13
Exponential, 32, 36

forest, 19

interpret, 21
InvGamma, 32, 36
is.RoBMA, 21

Kroupova2021, 22

LocationScaleT, 32, 36
Lognormal, 32, 36
logOR2d (effect_sizes), 18
logOR2OR (effect_sizes), 18
logOR2r (effect_sizes), 18
logOR2z (effect_sizes), 18
Lui2015, 22

marginal_plot, 23
marginal_summary, 24

n_d (sample_sizes), 53
n_r (sample_sizes), 53
n_z (sample_sizes), 53
Normal, 32, 36, 61, 63

OR2d (effect_sizes), 18
OR2logOR (effect_sizes), 18
OR2r (effect_sizes), 18
OR2z (effect_sizes), 18

par, 17
plot.prior(), 32, 36, 38–40
plot.RoBMA, 25
plot.RoBMA(), 45
plot_models, 27

- Poulsen2006, 28
- print.marginal_summary.RoBMA, 29
- print.RoBMA, 30
- print.RoBMA(), 45
- print.summary.RoBMA, 30
- prior, 31
- prior(), 34, 35, 38, 39, 44, 60
- prior_factor, 32
- prior_informed, 34
- prior_informed_medicine_names, 35
- prior_none, 36
- prior_PEESE, 37
- prior_PEESE(), 44
- prior_PET, 38
- prior_PET(), 44
- prior_weightfunction, 39
- prior_weightfunction(), 44
- pwnorm(weighted_normal), 61

- qwnorm(weighted_normal), 61

- r2d(effect_sizes), 18
- r2logOR(effect_sizes), 18
- r2OR(effect_sizes), 18
- r2z(effect_sizes), 18
- RoBMA, 40, 52
- RoBMA(), 8, 14, 17, 24–26, 29–31, 44, 50, 51, 57, 60
- RoBMA-package, 3
- RoBMA.get_option(RoBMA_options), 52
- RoBMA.options(RoBMA_options), 52
- RoBMA.package(RoBMA-package), 3
- RoBMA.reg, 46
- RoBMA.reg(), 12
- RoBMA_control, 51
- RoBMA_options, 52
- RoBMA_package(RoBMA-package), 3
- rwnorm(weighted_normal), 61

- sample_sizes, 53
- sample_sizes(), 14, 19, 55
- se_d(sample_sizes), 53
- se_d2se_logOR(standard_errors), 54
- se_d2se_r(standard_errors), 54
- se_d2se_z(standard_errors), 54
- se_logOR2se_d(standard_errors), 54
- se_logOR2se_r(standard_errors), 54
- se_logOR2se_z(standard_errors), 54
- se_r(sample_sizes), 53
- se_r2se_d(standard_errors), 54
- se_r2se_logOR(standard_errors), 54
- se_r2se_z(standard_errors), 54
- se_z(sample_sizes), 53
- se_z2se_d(standard_errors), 54
- se_z2se_logOR(standard_errors), 54
- se_z2se_r(standard_errors), 54
- set_autofit_control(RoBMA_control), 51
- set_autofit_control(), 44, 50, 59
- set_autofit_control_(RoBMA_control), 51
- set_convergence_checks(RoBMA_control), 51
- set_convergence_checks(), 44, 50, 59
- stan_plot, 17
- standard_errors, 54
- standard_errors(), 14, 19, 54
- summary.RoBMA, 56
- summary.RoBMA(), 17, 25, 45, 51, 60

- update.RoBMA, 52, 57
- update.RoBMA(), 45, 51

- weighted_multivariate_normal, 61
- weighted_normal, 61, 61

- z2d(effect_sizes), 18
- z2logOR(effect_sizes), 18
- z2OR(effect_sizes), 18
- z2r(effect_sizes), 18