Package ‘PublicationBias’

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Type Package

Title Sensitivity Analysis for Publication Bias in Meta-Analyses

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Description Performs sensitivity analysis for publication bias in meta-
analyses (per Mathur & VanderWeele, 2019 [<https://osf.io/s9dp6>]).
These analyses enable statements such as: ``For publication bias to shift the observed point estimate to the null,
'significant' results would need to be at least 30-
fold more likely to be published than negative or 'nonsignificant'
results.'' Comparable statements can be made regarding shifting to a chosen non-
null value or shifting the confidence
interval. Provides a worst-case meta-
analytic point estimate under maximal publication bias obtained simply by conducting
a standard meta-analysis of only the negative and ``nonsignificant'' studies.

License GPL-2

Encoding UTF-8

Imports metafor, stats, dplyr, robumeta, ggplot2, Rdpack, MetaUtility

RdMacros Rdpack

LazyData true

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corrected_meta *Estimate publication bias-corrected meta-analysis*

Description

For a known selection ratio, eta, estimates a publication bias-corrected pooled point estimate and confidence interval. Model options include fixed-effects, robust independent, and robust clustered specifications.

Usage

```
corrected_meta(yi, vi, eta, clustervar = 1:length(yi), model,
  selection.tails = 1, CI.level = 0.95, small = TRUE)
```

Arguments

yi	A vector of point estimates to be meta-analyzed
vi	A vector of estimated variances for the point estimates
eta	The number of times more likely an affirmative study is to be published than a nonaffirmative study. See Details.
clustervar	A character, factor, or numeric vector with the same length as yi. Unique values should indicate unique clusters of point estimates. By default, assumes all point estimates are independent by default.
model	"fixed" for fixed-effects or "robust" for robust random-effects
selection.tails	1 (for one-tailed selection, recommended for its conservatism) or 2 (for two-tailed selection)
CI.level	Confidence interval level (as proportion) for the corrected point estimate
small	Should inference allow for a small meta-analysis? We recommend always using TRUE.

Details

The selection ratio, eta, represents the number of times more likely affirmative studies (i.e., those with a "statistically significant" and positive estimate) are to be published than nonaffirmative studies (i.e., those with a "nonsignificant" or negative estimate).

References

1. Mathur MB & VanderWeele TJ (2019). Sensitivity analysis for publication bias in meta-analyses. Preprint available at XXX.

Examples

```
# calculate effect sizes from example dataset in metafor
require(metafor)
dat = metafor::escalc(measure="RR", ai=tpos, bi=tneg, ci=cpos, di=cneg, data=dat.bcg)

# first fit fixed-effects model without any bias correction
rma( yi, vi, data = dat, method = "FE" )

# notice this is the same as passing eta = 1 to corrected_meta, which makes sense
corrected_meta( yi = dat$yi,
                vi = dat$vi,
                eta = 1,
                model = "fixed",
                selection.tails = 1,
                CI.level = 0.95,
                small = TRUE )

# assume a known selection ratio of 5
# i.e., affirmative results are 5x more likely to be published
#  than nonaffirmative
corrected_meta( yi = dat$yi,
                vi = dat$vi,
                eta = 5,
                model = "fixed",
                selection.tails = 1,
                CI.level = 0.95,
                small = TRUE )

# same selection ratio, but now account for heterogeneity
# and clustering via robust specification
corrected_meta( yi = dat$yi,
                vi = dat$vi,
                eta = 5,
                clustervar = dat$author,
                model = "robust",
                selection.tails = 1,
                CI.level = 0.95,
                small = TRUE )

##### Make sensitivity plot as in Mathur & VanderWeele (2019) #####
# range of parameters to try (more dense at the very small ones)
eta.list = as.list( c( 200, 150, 100, 50, 40, 30, 20, rev( seq(1,15,1) ) ) )
res.list = lapply( eta.list, function(x) {
                    cat("\n Working on eta = ", x)
                    return( corrected_meta( yi = dat$yi,
                                            vi = dat$vi,
                                            eta = x,
                                            model = "robust",
                                            clustervar = dat$author ) )
                                        }
                      )
```

```
# put results for each eta in a dataframe
res.df = as.data.frame( do.call( "rbind", res.list ) )

require(ggplot2)
ggplot( data = res.df, aes( x = eta, y = est ) ) +

  geom_ribbon( data = res.df, aes( x = eta, ymin = lo, ymax = hi ), fill = "gray" ) +

  geom_line( lwd = 1.2 ) +
  xlab( bquote( eta ) ) +
  ylab( bquote( hat(mu)[eta] ) ) +

  theme_classic()
```

---

pval_plot *Plot one-tailed p-values*

Description

Plots the one-tailed p-values. The leftmost red line indicates the cutoff for one-tailed p-values less than 0.025 (corresponding to "affirmative" studies; i.e., those with a positive point estimate and a two-tailed p-value less than 0.05). The rightmost red line indicates one-tailed p-values greater than 0.975 (i.e., studies with a negative point estimate and a two-tailed p-value less than 0.05). If there is a substantial point mass of p-values to the right of the rightmost red line, this suggests that selection may be two-tailed rather than one-tailed.

Usage

```
pval_plot(yi, vi)
```

Arguments

yi	A vector of point estimates to be meta-analyzed. The signs of the estimates should be chosen such that publication bias is assumed to operate in favor of positive estimates.
vi	A vector of estimated variances for the point estimates

References

1. Mathur MB & VanderWeele TJ (2019). Sensitivity analysis for publication bias in meta-analyses. Preprint available at XXX.

Examples

```
# compute meta-analytic effect sizes
require(metafor)
dat = metafor::escalc(measure="RR", ai=tpos, bi=tneg, ci=cpos, di=cneg, data=dat.bcg)
```

```
# flip signs since we think publication bias operates in favor of negative effects
dat$yi = -dat$yi

pval_plot( yi = dat$yi,
           vi = dat$vi )
```

---

significance_funnel *Make significance funnel plot*

Description

Creates a modified funnel plot that distinguishes between affirmative and nonaffirmative studies, helping detect the extent to which the nonaffirmative studies' point estimates are systematically smaller than the entire set of point estimates. By default (`plot.pooled = TRUE`), also plots the fixed-effects pooled point estimate within all studies (black diamond) and within only the nonaffirmative studies (blue diamond). The latter represents a corrected fixed-effects estimate under worst-case publication bias. When the diamonds are distant or if the blue diamond represents a negligible effect size, then formal sensitivity analyses (via `PublicationBias::svalue`) may indicate that the meta-analysis is not robust.

Usage

```
significance_funnel(yi, vi, xmin = min(yi), ymin = min(sqrt(vi)),
  xmax = max(yi), ymax = max(sqrt(vi)), plot.pooled = TRUE)
```

Arguments

`yi`	A vector of point estimates to be meta-analyzed. The signs of the estimates should be chosen such that publication bias is assumed to operate in favor of positive estimates.
`vi`	A vector of estimated variances for the point estimates
`xmin`	x-axis (point estimate) lower limit for plot
`ymin`	y-axis (standard error) lower limit for plot
`xmax`	x-axis (point estimate) upper limit for plot
`ymax`	y-axis (standard error) upper limit for plot
`plot.pooled`	Should the fixed-effects pooled estimates within all studies and within only the nonaffirmative studies be plotted as well?

References

1. Mathur MB & VanderWeele TJ (2019). Sensitivity analysis for publication bias in meta-analyses. Preprint available at XXX.

Examples

```
# compute meta-analytic effect sizes
require(metafor)
dat = metafor::escalc(measure="RR", ai=tpos, bi=tneg, ci=cpos, di=cneg, data=dat.bcg)

# flip signs since we think publication bias operates in favor of negative effects
dat$yi = -dat$yi

significance_funnel( yi = dat$yi,
                     vi = dat$vi,
                     plot.pooled = TRUE )
```

---

svalue — *Estimate publication bias needed to "explain away" results*

Description

Estimates the S-value, defined as the severity of publication bias (i.e., the ratio by which affirmative studies are more likely to be published than nonaffirmative studies) that would be required to shift the pooled point estimate or its confidence interval limit to the value q.

Usage

```
svalue(yi, vi, q, clustervar = 1:length(yi), model, eta.grid = seq(1,
  200, 0.25), CI.level = 0.95, small = TRUE)
```

Arguments

yi	A vector of point estimates to be meta-analyzed
vi	A vector of estimated variances for the point estimates
q	The attenuated value to which to shift the point estimate or CI. Should be specified on the same scale as yi (e.g., if yi is on the log-RR scale, then q should be as well).
clustervar	A character, factor, or numeric vector with the same length as yi. Unique values should indicate unique clusters of point estimates. By default, assumes all point estimates are independent.
model	"fixed" for fixed-effects or "robust" for robust random-effects
eta.grid	A vector of values of eta to try for the grid search. The vector should start at 1 and end at a large number, such as 200. For a more precise estimate of eta, use more closely-spaced values. This argument is only needed when model = "robust".
CI.level	Confidence interval level (as proportion) for the corrected point estimate
small	Should inference allow for a small meta-analysis? We recommend using TRUE even for large meta-analyses.

Details

For example, if the S-value for the point estimate is 30 with q=0, this indicates that affirmative studies (i.e., those with a "statistically significant" and positive estimate) would need to be 30-fold more likely to be published than nonaffirmative studies (i.e., those with a "nonsignificant" or negative estimate) to attenuate the pooled point estimate to q.

References

1. Mathur MB & VanderWeele TJ (2019). Sensitivity analysis for publication bias in meta-analyses. Preprint available at XXX.

Examples

```
# calculate effect sizes from example dataset in metafor
require(metafor)
dat = metafor::escalc(measure="RR", ai=tpos, bi=tneg, ci=cpos, di=cneg, data=dat.bcg)

##### Fixed-Effects Specification #####
# S-values and worst-case meta-analysis under fixed-effects specification
svals.FE.0 = svalue( yi = dat$yi,
                   vi = dat$vi,
                   q = 0,
                   model = "fixed" )

# publication bias required to shift point estimate to 0
svals.FE.0$svals$sval.est

# and to shift CI to include 0
svals.FE.0$svals$sval.ci

# now try shifting to a nonzero value (RR = 0.90)
svals.FE.q = svalue( yi = dat$yi,
                     vi = dat$vi,
                     q = log(.9),
                     model = "fixed" )

# publication bias required to shift point estimate to RR = 0.90
svals.FE.q$svals$sval.est

# and to shift CI to RR = 0.90
svals.FE.q$svals$sval.ci

##### Robust Clustered Specification #####
# takes ~1 min to run due to grid search
## Not run:
  svalue( yi = dat$yi,
          vi = dat$vi,
          q = 0,
          model = "robust" )

## End(Not run)
```

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