

Evidence Synthesis / Meta-Analysis

Software for Meta-Analysis

Guido Knapp¹, Gerta Rücker², Guido Schwarzer²

¹ Department of Statistics, TU Dortmund University

² Center for Medical Biometry and Medical Informatics, University of Freiburg

sc@imbi.uni-freiburg.de

DAGStat 2016, Göttingen, 14 March 2016



Statistical Software for Meta-Analysis

- ▶ Review Manager:
 - ▶ Programme for Cochrane Reviews (<http://www.cochrane.org/>)
 - ▶ Standard methods for meta-analysis implemented
 - ▶ Word Processor, Reference Manager, Statistical Analysis
 - ▶ Online Submission of Protocols and Reviews
- ▶ Comprehensive Meta-Analysis:
 - ▶ Commercial Programme for Meta-Analysis
 - ▶ Excel-like
- ▶ SPSS:
 - ▶ Macros for standard methods and meta-regression (<http://mason.gmu.edu/~dwilsonb/ma.html>)
- ▶ WinBUGS:
 - ▶ Bayesian software
 - ▶ Especially used for network meta-analysis

Statistical Software for Meta-Analysis

► SAS:

- Standard methods for meta-analysis (SAS Institute Inc. et al., 1999)
- SAS macros for meta-analysis (IQWiG, Germany)
- Generalised Linear Mixed Models (**PROC NL MIXED**)

► Stata (Palmer and Sterne, 2016):

- Standard methods for meta-analysis
- Investigation of bias (tests, trim and fill method)
- Multivariate meta-analysis (**mvmeta** command)
- Network meta-analysis (<http://www.mtm.uoi.gr/index.php/stata-routines-for-network-meta-analysis>)

► R:

- Overview of R packages for meta-analysis:
<https://cran.rstudio.com/web/views/MetaAnalysis.html>
- Use-R! book by Schwarzer et al. (2015)
- see also next slides

R packages for meta-analysis on CRAN

- ▶ **rmeta** (Lumley, 2012)
 - ▶ Fixed effect and random effects meta-analysis (Mantel-Haenszel, Peto, DerSimonian-Laird)
- ▶ **metafor** (Viechtbauer, 2010, 2015)
 - ▶ Tests for funnel plot asymmetry / Trim and fill method
 - ▶ General linear (mixed-effects) model approach for meta-regression
 - ▶ Multivariate meta-analysis
- ▶ **meta** (Schwarzer, 2007, 2015)
 - ▶ Tests for funnel plot asymmetry / Trim and fill method
 - ▶ Import data from RevMan 5 / Link to R package metafor

R packages for meta-analysis on CRAN

- ▶ **rmeta** (Lumley, 2012)
 - ▶ Fixed effect and random effects meta-analysis (Mantel-Haenszel, Peto, DerSimonian-Laird)
- ▶ **metafor** (Viechtbauer, 2010, 2015)
 - ▶ Tests for funnel plot asymmetry / Trim and fill method
 - ▶ General linear (mixed-effects) model approach for meta-regression
 - ▶ Multivariate meta-analysis
- ▶ **meta** (Schwarzer, 2007, 2015)
 - ▶ Tests for funnel plot asymmetry / Trim and fill method
 - ▶ Import data from RevMan 5 / Link to R package metafor
- ▶ **mvmeta** (Gasparrini, 2015)
 - ▶ Multivariate meta-analysis and meta-regression on multiple outcomes
- ▶ **metasens** (Schwarzer et al., 2016; Carpenter et al., 2009)
 - ▶ Advanced methods to model and adjust for bias in meta-analysis
 - ▶ Add-on package to R package **meta** / replaces R package **copas**
- ▶ **netmeta** (Rücker et al., 2015)
 - ▶ Network meta-analysis
 - ▶ Add-on package to R package **meta**

R package **meta**

Function	Comment
metabin	Meta-analysis of binary outcome data
metacont	Meta-analysis of continuous outcome data
metagen	Generic inverse variance meta-analysis
metacor	Meta-analysis of correlations
metainc	Meta-analysis of incidence rates
metaprop	Meta-analysis of single proportions

R package **meta**

Function	Comment
metabin	Meta-analysis of binary outcome data
metacont	Meta-analysis of continuous outcome data
metagen	Generic inverse variance meta-analysis
metacor	Meta-analysis of correlations
metainc	Meta-analysis of incidence rates
metaprop	Meta-analysis of single proportions
read.rm5	Import RevMan 5 data files (csv-files with special format)
metacr	Meta-analysis of outcome data from Cochrane review

R package **meta**

Function	Comment
metabin	Meta-analysis of binary outcome data
metacont	Meta-analysis of continuous outcome data
metagen	Generic inverse variance meta-analysis
metacor	Meta-analysis of correlations
metainc	Meta-analysis of incidence rates
metaprop	Meta-analysis of single proportions
read.rm5	Import RevMan 5 data files (csv-files with special format)
metacr	Meta-analysis of outcome data from Cochrane review
forest	Forest plot

R package **meta**

Function	Comment
metabin	Meta-analysis of binary outcome data
metacont	Meta-analysis of continuous outcome data
metagen	Generic inverse variance meta-analysis
metacor	Meta-analysis of correlations
metainc	Meta-analysis of incidence rates
metaprop	Meta-analysis of single proportions
read.rm5	Import RevMan 5 data files (csv-files with special format)
metacr	Meta-analysis of outcome data from Cochrane review
forest	Forest plot
funnel	Plot to assess funnel plot asymmetry
metabias	Test for funnel plot asymmetry
trimfill	Trim and fill method for meta-analysis

R package **meta**

Function	Comment
metabin	Meta-analysis of binary outcome data
metacont	Meta-analysis of continuous outcome data
metagen	Generic inverse variance meta-analysis
metacor	Meta-analysis of correlations
metainc	Meta-analysis of incidence rates
metaprop	Meta-analysis of single proportions
read.rm5	Import RevMan 5 data files (csv-files with special format)
metacr	Meta-analysis of outcome data from Cochrane review
forest	Forest plot
funnel	Plot to assess funnel plot asymmetry
metabias	Test for funnel plot asymmetry
trimfill	Trim and fill method for meta-analysis
metareg	Meta-regression (wrapper function to R package metafor)
...	Cumulative meta-analysis / Influence analysis in meta-analysis

R package **metafor**

Function	Comment
escalc	Compute outcomes (<u>e</u> ffect <u>s</u> ize <u>c</u> alculation)
rma	<u>R</u> andom-effects <u>m</u> eta- <u>a</u> nalysis and meta-regression (includes fixed effect model)
rma.mh	Mantel-Haenszel method (for binary outcome)
rma.peto	Peto method (for binary outcome)

R package **metafor**

Function	Comment
escalc	Compute outcomes (<u>e</u> ffect <u>s</u> ize <u>c</u> alculation)
rma	<u>R</u> andom-effects <u>m</u> eta- <u>a</u> nalysis and meta-regression (includes fixed effect model)
rma.mh	Mantel-Haenszel method (for binary outcome)
rma.peto	Peto method (for binary outcome)
forest	Forest plot

R package **metafor**

Function	Comment
escalc	Compute outcomes (<u>e</u> ffect <u>s</u> ize <u>c</u> alculation)
rma	<u>R</u> andom-effects <u>m</u> eta- <u>a</u> nalysis and meta-regression (includes fixed effect model)
rma.mh	Mantel-Haenszel method (for binary outcome)
rma.peto	Peto method (for binary outcome)
forest	Forest plot
funnel	Plot to assess funnel plot asymmetry
regtest	Regression test for funnel plot asymmetry
ranktest	Rank test for funnel plot asymmetry
trimfill	Trim and fill method for meta-analysis

R package **metafor**

Function	Comment
escalc	Compute outcomes (<u>e</u> ffect <u>s</u> ize <u>c</u> alculation)
rma	<u>R</u> andom-effects <u>m</u> eta- <u>a</u> nalysis and meta-regression (includes fixed effect model)
rma.mh	Mantel-Haenszel method (for binary outcome)
rma.peto	Peto method (for binary outcome)
forest	Forest plot
funnel	Plot to assess funnel plot asymmetry
regtest	Regression test for funnel plot asymmetry
ranktest	Rank test for funnel plot asymmetry
trimfill	Trim and fill method for meta-analysis
rma.glmm	Generalised linear mixed model
rma.mv	Multivariate meta-analysis (includes network meta-analysis)

R package **metafor**

Function	Comment
escalc	Compute outcomes (<u>e</u> ffect <u>s</u> ize <u>c</u> alculation)
rma	<u>R</u> andom-effects <u>m</u> eta- <u>a</u> nalysis and meta-regression (includes fixed effect model)
rma.mh	Mantel-Haenszel method (for binary outcome)
rma.peto	Peto method (for binary outcome)
forest	Forest plot
funnel	Plot to assess funnel plot asymmetry
regtest	Regression test for funnel plot asymmetry
ranktest	Rank test for funnel plot asymmetry
trimfill	Trim and fill method for meta-analysis
rma.glmm	Generalised linear mixed model
rma.mv	Multivariate meta-analysis (includes network meta-analysis)
...	Cumulative meta-analysis / Influence analysis in meta-analysis

References

- Carpenter, J., Rücker, G., and Schwarzer, G. (2009). copas: An R package for fitting the Copas selection model. *The R Journal*, 1(2):31–36.
- Gasparrini, A. (2015). *mvmeta: Multivariate and univariate meta-analysis and meta-regression*. R package version 0.4.7.
- Lumley, T. (2012). *rmeta: Meta-analysis*. R package version 2.16.
- Palmer, T. M. and Sterne, J. A. C., editors (2016). *Meta-Analysis in Stata: An Updated Collection from the Stata Journal*. Stata Press, 2nd edition.
- Rücker, G., Schwarzer, G., Krahn, U., and König, J. (2015). *netmeta: Network meta-Analysis with R*. R package version 0.8-0.
- SAS Institute Inc., Wang, M. C., and Bushman, B. J., editors (1999). *Integrating Results through Meta-Analytic Review Using SAS*. SAS Institute.
- Schwarzer, G. (2007). meta: An R package for meta-analysis. *R News*, 7(3):40–45.
- Schwarzer, G. (2015). *meta: General Package for Meta-Analysis*. R package version 4.3-2.
- Schwarzer, G., Carpenter, J., and Rücker, G. (2016). *metasens: Advanced statistical methods to model and adjust for bias in meta-analysis*. R package version 0.3-0.
- Schwarzer, G., Carpenter, J. R., and Rücker, G. (2015). *Meta-Analysis with R*. Use R! Springer International Publishing, Switzerland.
- Viechtbauer, W. (2010). Conducting meta-analyses in R with the metafor package. *Journal of Statistical Software*, 36(3):1–48.
- Viechtbauer, W. (2015). *metafor: Meta-Analysis Package for R*. R package version 1.9-8.