



SYNTHESIS OF DEPENDENT EFFECT SIZES: VERSATILE MODELS THROUGH METAFOR AND CLUBSANDWICH

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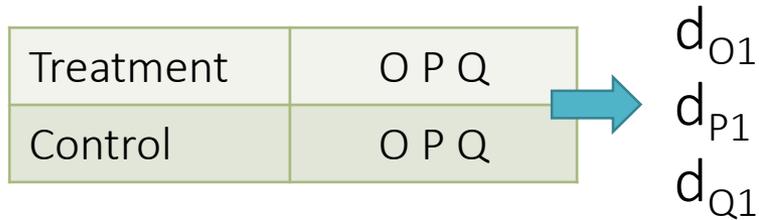
joint work with Elizabeth Tipton, Northwestern University

Paper: <https://doi.org/10.31222/osf.io/vyfcj>

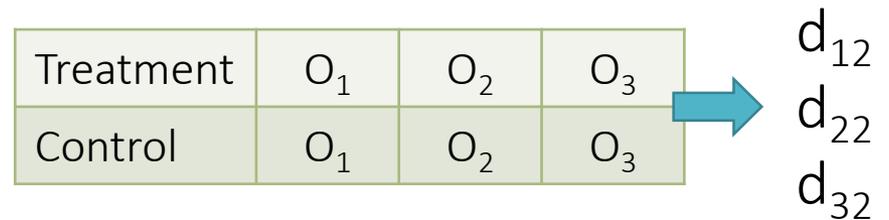
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Dependent effect sizes are very common

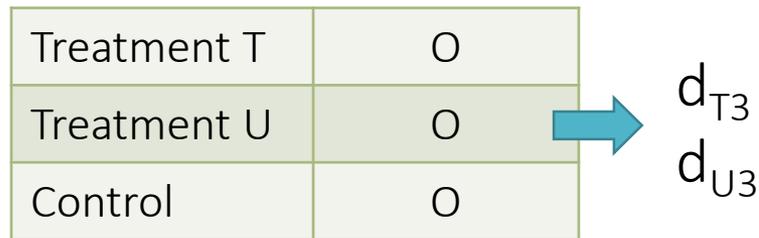
Multiple outcomes measured on common set of participants



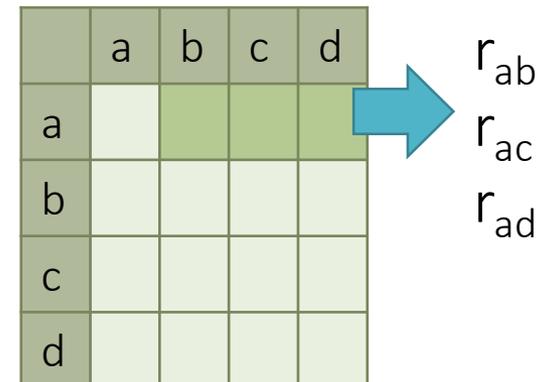
Outcome measured at multiple follow-up times

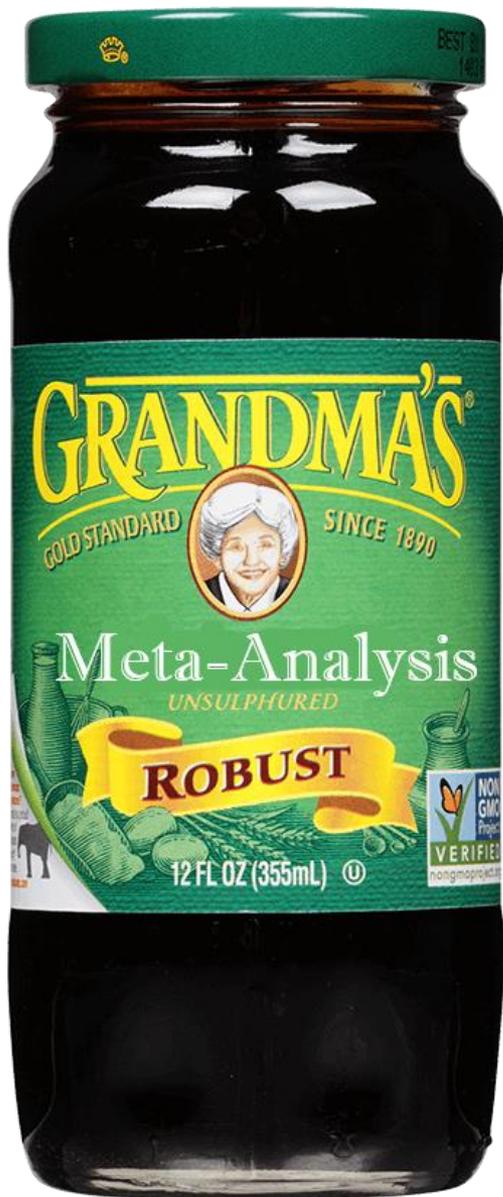


Multiple treatment conditions compared to a common control



Multiple correlations from a common sample





Robust Variance Estimation (RVE)

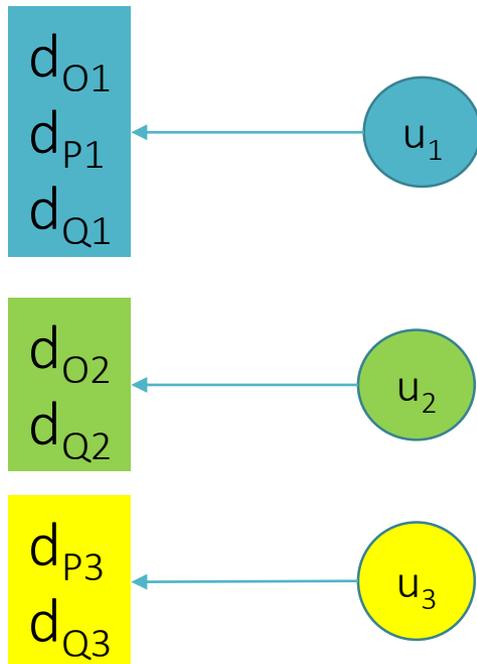
(Hedges, Tipton, & Johnson, 2010)

- Meta-analysis/meta-regression method using “sandwich” variance estimators.
- SEs, hypothesis tests, confidence intervals are robust to mistaken assumptions about the dependence structure of effect sizes within independent studies.
- RVE uses a “working model” to approximate the dependence structure.
 - It doesn't have to be correct.
 - But getting closer to the true dependence structure improves precision.

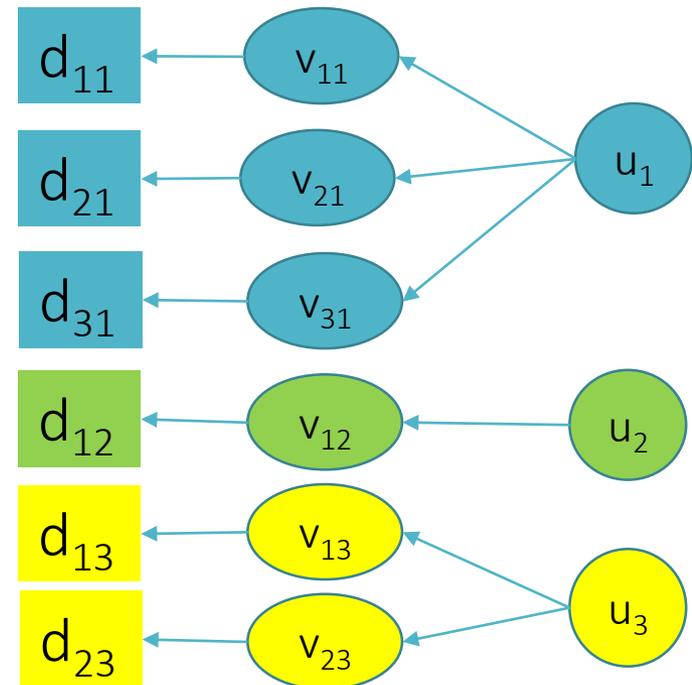
Working models in `robumeta`

- `robumeta` package (Fisher, Tipton, & Hou, 2017) is the most popular implementation of RVE.
- Two available working models.

Correlated Effects



Hierarchical Effects

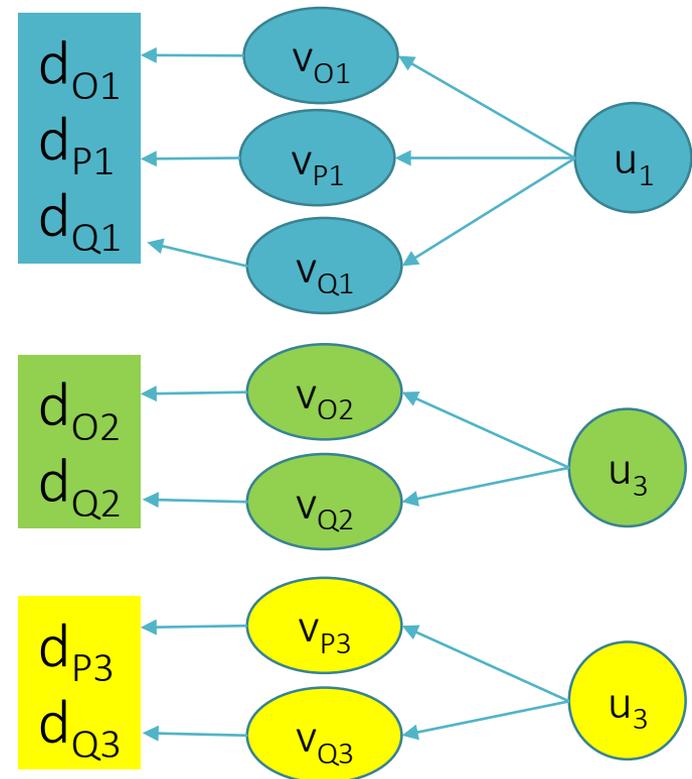


Working models in metafor

- `rma.mv()` from the `metafor` package (Viechtbauer, 2010) provides a versatile set of multi-level and multi-variate models.
- These can be treated as working models, combined with RVE.

Correlated + Hierarchical Effects Model

- Allows for correlated effect size estimates.
- Allows for within-study heterogeneity in true effects.





RVE with clubSandwich

- `clubSandwich` package (Pustejovsky, 2020) provides robust standard errors, hypothesis tests, confidence intervals for many types of models.
- Supports `rma.mv()` models from `metafor`.
- Includes small-sample corrections for more accurate inference.

Workflow

```
library(metafor)
library(clubSandwich)
TSL15 <- readRDS("Tanner-Smith-Lipsey-2015-subset.rds")

# Create a sampling variance-covariance matrix
V_mat <- impute_covariance_matrix(TSL15$V,
                                  cluster = TSL15$studyid,
                                  r = 0.6)

# fit working model in metafor
mod <- rma.mv(es ~ 0 + dv_cat, V = V_mat,
              random = ~ 1 | studyid / esid,
              data = TSL15)

# clustered SEs and CIs
conf_int(mod, vcov = "CR2")
```

Why metafor + clubSandwich

- Using a better approximation to the real dependence structure will give you *more precise estimates* of average effects/meta-regression coefficients.
- More flexible working models provide *better descriptions of heterogeneity* (e.g., within- and between-study variance).
- Using RVE provides protection against model misspecification.

More details, examples, code, simulation evidence:

Pustejovsky, J. E., & Tipton, E. (2020). Meta-Analysis with Robust Variance Estimation: Expanding the Range of Working Models. <https://doi.org/10.31222/osf.io/vyfcj>