Meta-Analysis of the Big-Fish-Little-Pond-Effect in Mathematics Utilizing TIMSS Data

Supplementary Material

28 October 2021

Contents

1 Data preparation

1.1 Install and load relevant R packages

```r
# Install relevant packages
# install.packages("metafor")
# install.packages("metaSEM")
# install.packages("robumeta")
# install.packages("clubSandwich")
# install.packages("tidyverse")
# install.packages("ggplot2")
# install.packages("forestplot")
# install.packages("psych")
# install.packages("ggpubr")
# install.packages("meta")
# install.packages("metaforest")
# install.packages("caret")
# install.packages("zcurve")
# install.packages("PublicationBias")

# Load packages after every reboot of computer
library(metafor)
library(metaSEM)
library(robumeta)
library(clubSandwich)
library(tidyverse)
library(dmetar)
library(ggplot2)
library(forestplot)
library(psych)
library(ggpubr)
library(meta)
library(metaforest)
library(caret)
library(zcurve)
library(PublicationBias)
```

1.2 Attach the data set

```r
# Read in data set
bflpedat <- read.csv2("bflpe-timss.csv", header = TRUE, dec = ",")

# Check the data
head(bflpedat, 5)
```

```
##   ESID StudyID country          country_name pdi idv mas uai   ltowvs      ivr
```

```
## 1    1    2019     AAD            Abu Dhabi  80  38  53  68 23.00000 34.00000
## 2    2    2019     ADU           Dubai, UAE  80  38  53  68 23.00000 34.00000
## 3    3    2019     ALB              Albania  NA  NA  NA  NA 61.46096 14.50893
## 4    4    2019     ARE United Arab Emirates  80  38  53  68 23.00000 34.00000
## 5    5    2019     ARM              Armenia  NA  NA  NA  NA 60.95718       NA
##   year effect_size  std_se pvalue    se        var   HDI    N
## 1 2019      -0.625  -7.046      0 0.089 0.00777350 0.890 4149
## 2 2019      -0.441  -7.164      0 0.062 0.00326685 0.890 4097
## 3 2019      -0.542  -5.237      0 0.104 0.01022060 0.795 2861
## 4 2019      -0.620 -12.260      0 0.051 0.00252562 0.890 4669
## 5 2019      -0.326  -4.775      0 0.068 0.00498966 0.776 1565
```

```
## Number of effect sizes
nrow(bflpedat)
```

```
## [1] 248
```

```
## List of countries
table(bflpedat$country)
```

```
##
## AAD ABA ADU ALB ARE ARM AUS AUT AZE BFL BGR BHR BIH CAB CAN CBC CHL COL COT CQU
##   3   1   4   1   3   5   5   3   2   4   2   3   1   2   2   1   3   1   5   5
## CYP CZE DEU DNK DZA EMA ENG ESP FIN FRA GEO HKG HRV HUN IDN IRL IRN ITA JOR JPN
##   3   4   4   4   1   1   5   3   3   2   4   5   3   5   1   3   5   5   1   5
## KAZ KOR KOS KWT LTU LVA MAR MDA MKD MLT MNE MNG NIR NLD NOR NOX NZL OMN PAK PHL
##   4   3   1   4   5   3   5   1   1   2   1   1   3   5   5   1   5   3   1   2
## POL PRT QAT RMO ROM RUS SAU SCO SGP SLV SRB SVK SVN SWE THA TUN TUR TWN UIN UKR
##   3   3   4   1   1   5   3   2   5   1   3   4   4   4   1   3   3   5   1   1
## UMA UMN USA YEM ZAF
##   1   1   5   3   2
```

```
## Number of studies
length(table(bflpedat$year))
```

```
## [1] 5
```

2 Meta-analytic baseline models

First, we evaluated the possible baseline models for their appropriateness to describe the meta-analytic data structure. The resultant baseline model formed the basis for further moderator analyses.

2.1 Common random-effects models (REM)

2.1.1 REM with variation between effect sizes

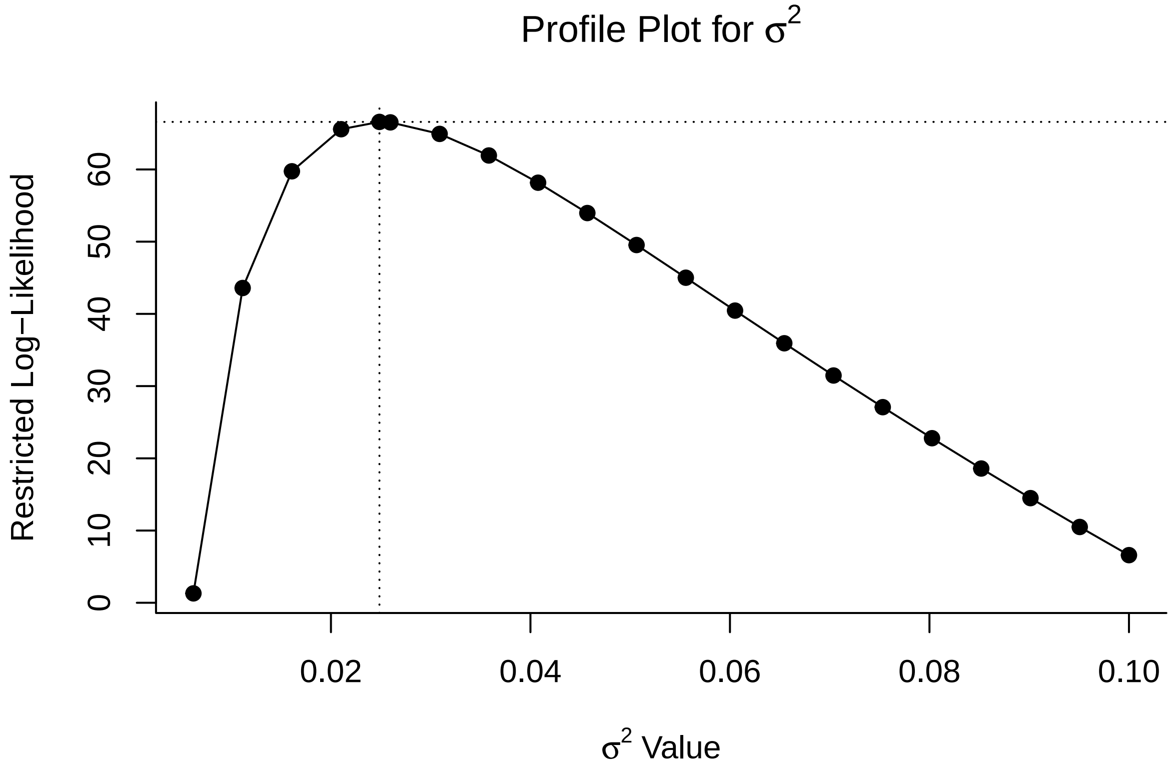
```
# Model specification
REM2e <- rma.mv(effect_size,
                var,
                random = list(~ 1 | ESID),
                data = bflpedat,
                method = "REML")

# Summarize the results
summary(REM2e, digits=4)
```

```
##
## Multivariate Meta-Analysis Model (k = 248; method: REML)
##
##    logLik   Deviance        AIC        BIC       AICc
##   66.5803  -133.1606  -129.1606  -122.1418  -129.1114
##
## Variance Components:
##
##              estim    sqrt  nlvls  fixed  factor
## sigma^2     0.0249  0.1577    248     no    ESID
##
## Test for Heterogeneity:
## Q(df = 247) = 1261.7650, p-val < .0001
##
## Model Results:
##
## estimate      se      zval    pval    ci.lb    ci.ub
##  -0.4580  0.0114  -40.0998  <.0001  -0.4804  -0.4356  ***
##
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

```
# Call for the 95% confidence intervals
confint(REM2e, digits=4)
```

```
##
##          estimate  ci.lb  ci.ub
## sigma^2    0.0249 0.0197 0.0314
## sigma      0.1577 0.1405 0.1773
```

```
# Profile plot
profile.rma.mv(REM2e,sigma2=1)
```



```
# Alternative specification
rma(effect_size, var, data = bflpedat, method = "REML")
```

```
##
## Random-Effects Model (k = 248; tau^2 estimator: REML)
##
## tau^2 (estimated amount of total heterogeneity): 0.0249 (SE = 0.0029)
## tau (square root of estimated tau^2 value):      0.1577
## I^2 (total heterogeneity / total variability):   82.43%
## H^2 (total variability / sampling variability):  5.69
##
## Test for Heterogeneity:
## Q(df = 247) = 1261.7650, p-val < .0001
##
## Model Results:
##
## estimate      se      zval    pval    ci.lb    ci.ub
##  -0.4580  0.0114  -40.0997  <.0001  -0.4804  -0.4356  ***
##
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

```
## RVE standard errors
conf_int(REM2e, vcov = "CR2")
```

```
##      Coef Estimate     SE d.f. Lower 95% CI Upper 95% CI
## 1 intrcpt   -0.458 0.0114  239       -0.481       -0.436
```

2.1.2 REM with variation between TIMSS cycles

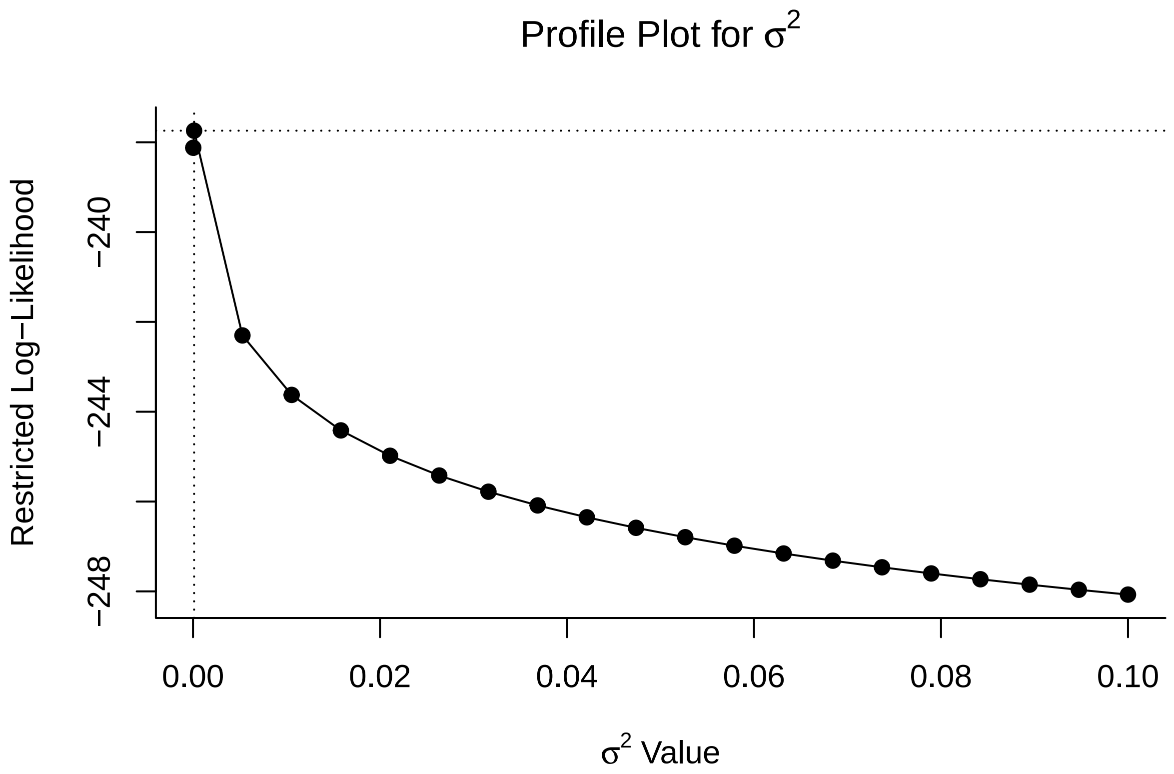
```r
# Model specification
REM2y <- rma.mv(effect_size,
                var,
                random = list(~ 1 | year),
                data = bflpedat,
                method = "REML")

# Summarize the results
summary(REM2y, digits=4)
```

```
##
## Multivariate Meta-Analysis Model (k = 248; method: REML)
##
##    logLik   Deviance        AIC        BIC       AICc
## -237.7424   475.4849   479.4849   486.5037   479.5341
##
## Variance Components:
##
##             estim    sqrt  nlvls  fixed  factor
## sigma^2    0.0001  0.0109      5     no    year
##
## Test for Heterogeneity:
## Q(df = 247) = 1261.7650, p-val < .0001
##
## Model Results:
##
## estimate      se      zval    pval    ci.lb    ci.ub
##  -0.4412  0.0068  -64.7760  <.0001  -0.4545  -0.4278  ***
##
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

```r
# Call for the 95% confidence intervals
confint(REM2y, digits=4)
```

```
##
##         estimate  ci.lb  ci.ub
## sigma^2   0.0001 0.0000 0.0012
## sigma     0.0109 0.0000 0.0346
```

```r
# Profile plot
profile.rma.mv(REM2y,sigma2=1)
```



2.1.3 REM with variation between countries

```
# Model specification
REM2c <- rma.mv(effect_size,
                var,
                random = list(~ 1 | country),
                data = bflpedat,
                method = "REML")

# Summarize the results
summary(REM2c, digits=4)
```

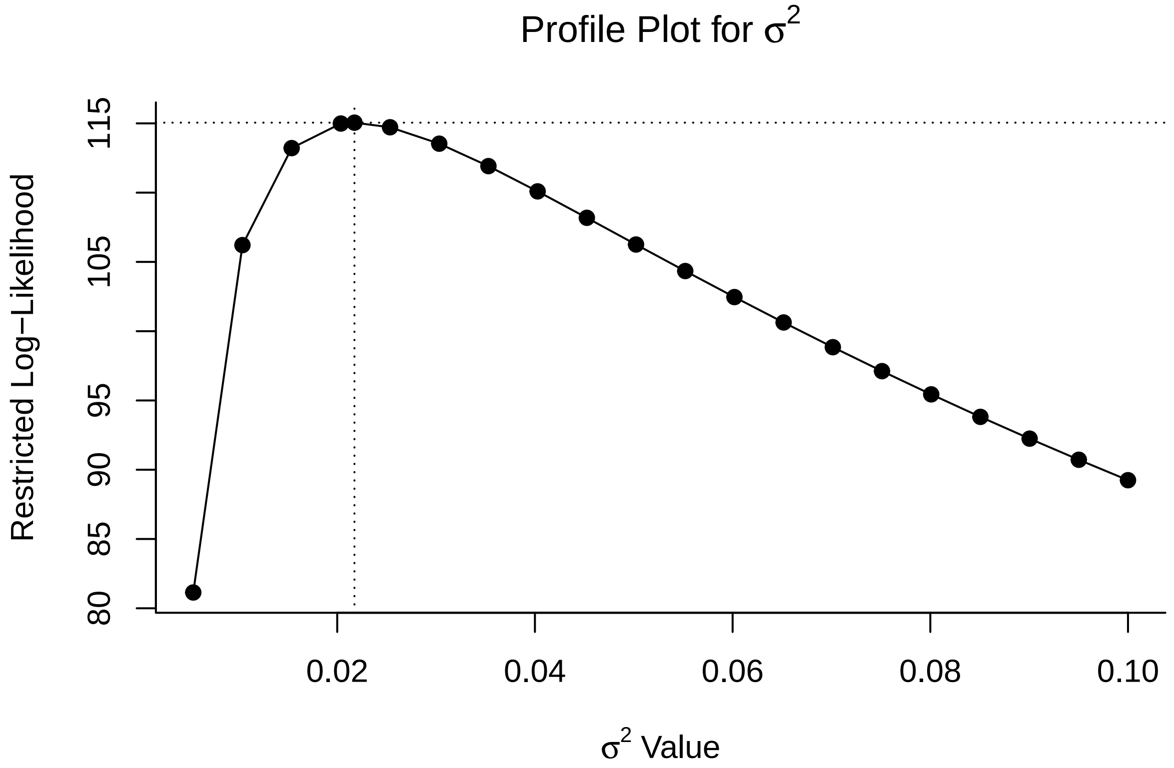
```
##
## Multivariate Meta-Analysis Model (k = 248; method: REML)
##
##    logLik   Deviance        AIC        BIC       AICc
##  115.0510  -230.1020  -226.1020  -219.0832  -226.0528
##
## Variance Components:
##
##              estim    sqrt  nlvls  fixed   factor
## sigma^2    0.0217  0.1475     85     no  country
##
## Test for Heterogeneity:
```

```
## Q(df = 247) = 1261.7650, p-val < .0001
##
## Model Results:
##
## estimate      se      zval    pval    ci.lb    ci.ub
##  -0.4482  0.0175  -25.6637  <.0001  -0.4824  -0.4140  ***
##
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

```
# Call for the 95% confidence intervals
confint(REM2c, digits=4)
```

```
##
##          estimate  ci.lb  ci.ub
## sigma^2    0.0217 0.0153 0.0317
## sigma      0.1475 0.1236 0.1779
```

```
# Profile plot
profile.rma.mv(REM2c,sigma2=1)
```



2.1.4 Fixed-effects model

```
# Model specification
FEM <- rma(effect_size, var, data = bflpedat, method = "FE")
```

```
# Summarize the results
summary(FEM, digits=4)
```

```
##
## Fixed-Effects Model (k = 248)
##
##    logLik   deviance        AIC        BIC       AICc
## -237.0284  1261.7650   476.0569   479.5703   476.0731
##
## I^2 (total heterogeneity / total variability):   80.42%
## H^2 (total variability / sampling variability):  5.11
##
## Test for Heterogeneity:
## Q(df = 247) = 1261.7650, p-val < .0001
##
## Model Results:
##
## estimate      se      zval    pval    ci.lb    ci.ub
##  -0.4400  0.0046  -95.2527  <.0001  -0.4491  -0.4310  ***
##
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

2.2 Multilevel meta-analyses with hierarchical effects

2.2.1 Three-level random-effects model with hierarchical nesting in TIMSS cycles

```
# Estimate the full model of the meta-analysis with three levels

# Define the levels of the meta-analysis
# Level 1: Sampling variation
# Level 2: Effect sizes (ESID)
# Level 3: TIMSS cycle (year)
REM3L <- rma.mv(effect_size,
                var,
                random = list(~ 1 | year/ESID),
                data = bflpedat,
                method = "REML")

# Summarize the results
summary(REM3L, digits=4)
```

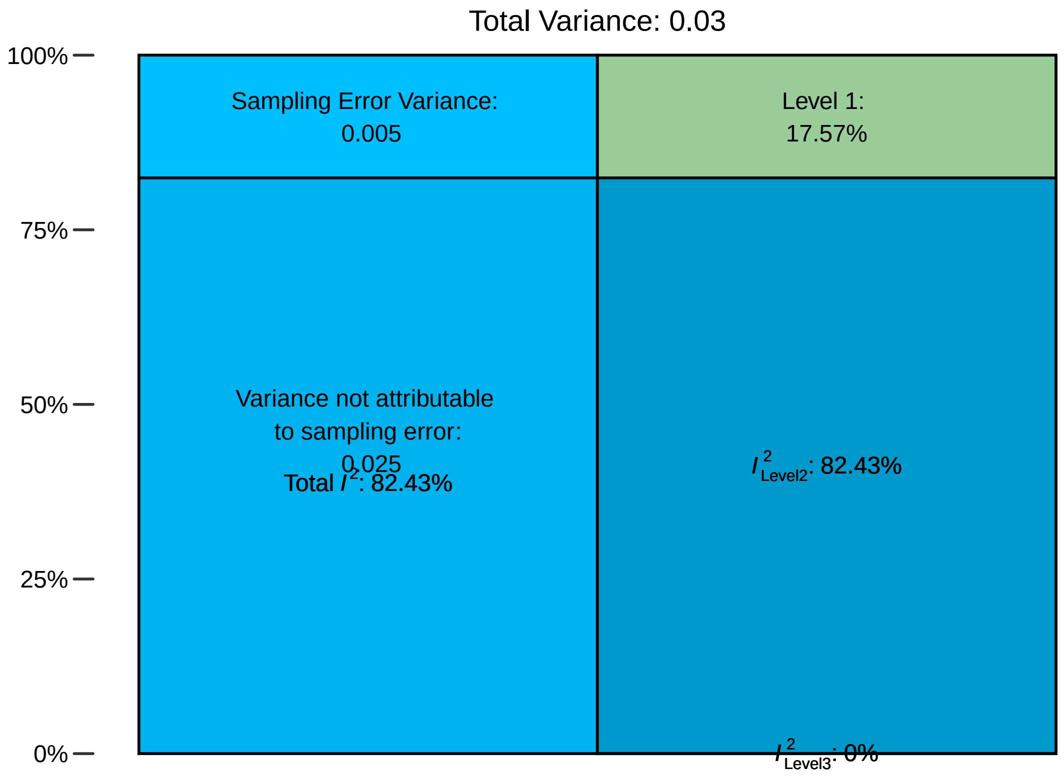
```
##
## Multivariate Meta-Analysis Model (k = 248; method: REML)
##
##    logLik   Deviance        AIC        BIC       AICc
##   66.5803  -133.1606  -127.1606  -116.6324  -127.0618
```

```
##
## Variance Components:
##
##               estim    sqrt  nlvls  fixed     factor
## sigma^2.1  0.0000  0.0000      5     no       year
## sigma^2.2  0.0249  0.1577    248     no  year/ESID
##
## Test for Heterogeneity:
## Q(df = 247) = 1261.7650, p-val < .0001
##
## Model Results:
##
## estimate      se      zval    pval    ci.lb    ci.ub
##  -0.4580  0.0114  -40.0998  <.0001  -0.4804  -0.4356  ***
##
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

```r
# Variance distribution on levels
mlm.variance.distribution(x = REM3L)
```

```
##         % of total variance    I2
## Level 1        1.757307e+01   ---
## Level 2        8.242693e+01 82.43
## Level 3        2.086660e-08     0
## Total I2: 82.43%
```

```r
res3L <- dmetar::var.comp(REM3L)
plot(res3L)
```



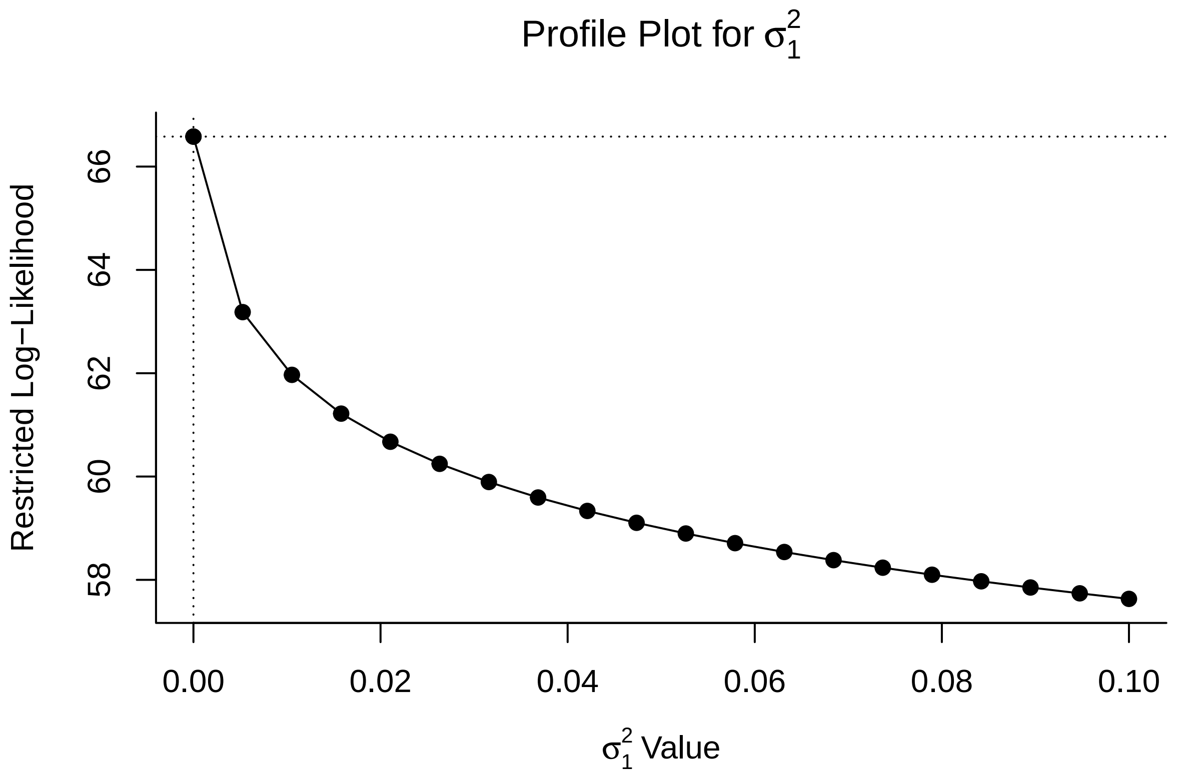
```r
# Call for the 95% confidence intervals
confint(REM3L, digits=4)
```

```
##
##             estimate  ci.lb  ci.ub
## sigma^2.1     0.0000 0.0000 0.0020
## sigma.1       0.0000 0.0000 0.0445
##
##             estimate  ci.lb  ci.ub
## sigma^2.2     0.0249 0.0197 0.0314
## sigma.2       0.1577 0.1405 0.1773
```

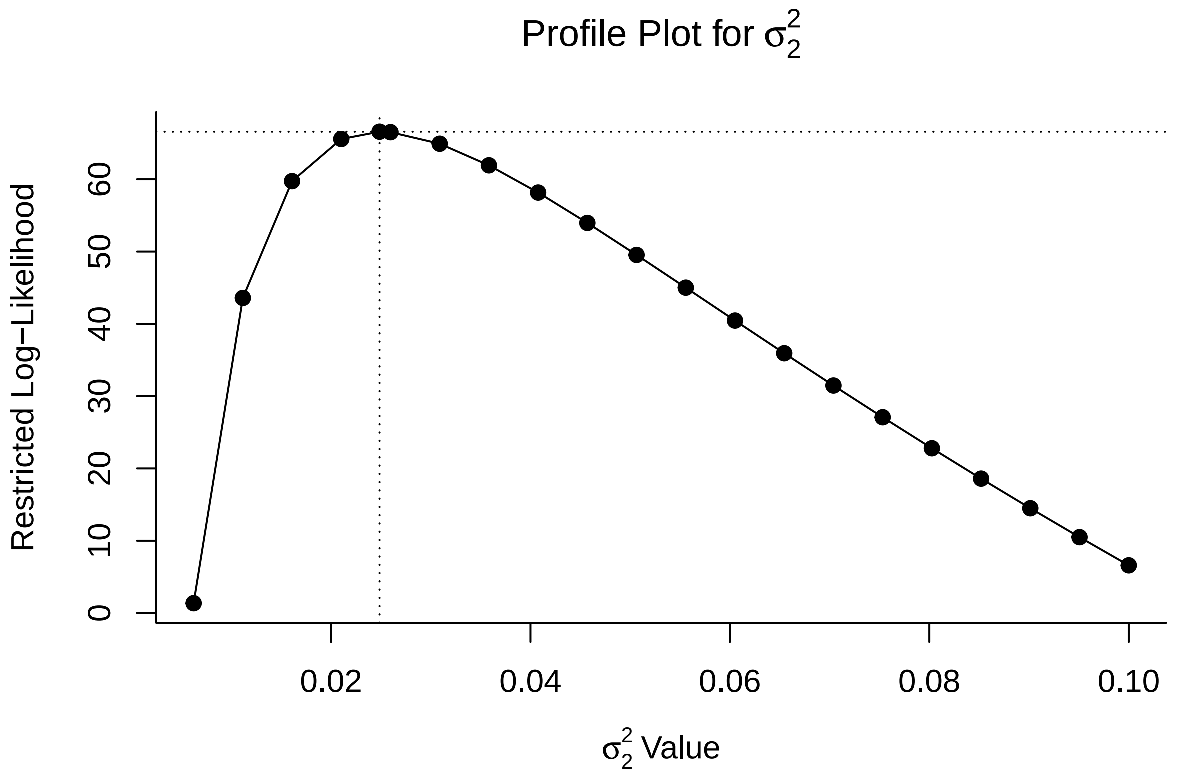
```r
## RVE standard errors
conf_int(REM3L, vcov = "CR2")
```

```
##      Coef Estimate      SE d.f. Lower 95% CI Upper 95% CI
## 1 intrcpt   -0.458 0.00903 3.66       -0.484       -0.432
```

```r
# Profile plots
profile.rma.mv(REM3L,sigma2=1)
```



```
profile.rma.mv(REM3L,sigma2=2)
```



```
# ICC[1]
round(REM3L$sigma2[1] / sum(REM3L$sigma2), 3)
```

```
## [1] 0
```

```r
round(REM3L$sigma2[2] / sum(REM3L$sigma2), 3)
```

```
## [1] 1
```

```r
# Level-specific I2 values
# Source: https://www.metafor-project.org/doku.php/tips:i2_multilevel_multivariate
W <- diag(1/bflpedat$var)
X <- model.matrix(REM3L)
P <- W - W %*% X %*% solve(t(X) %*% W %*% X) %*% t(X) %*% W
## Overall I-squared
100 * sum(REM3L$sigma2) / (sum(REM3L$sigma2) + (REM3L$k-REM3L$p)/sum(diag(P)))
```

```
## [1] 82.42693
```

```r
## I-squared for the different levels
100 * REM3L$sigma2 / (sum(REM3L$sigma2) + (REM3L$k-REM3L$p)/sum(diag(P)))
```

```
## [1] 2.086660e-08 8.242693e+01
```

```r
## Model comparison
## Common REM2e to REM3L
anova(REM2e, REM3L)
```

```
##
##         df       AIC       BIC      AICc  logLik    LRT   pval        QE
## Full     3 -127.1606 -116.6324 -127.0618 66.5803               1261.7650
## Reduced  2 -129.1606 -122.1418 -129.1114 66.5803 0.0000 1.0000 1261.7650
```

2.2.2 Three-level random-effects model with hierarchical nesting in countries

```r
# Estimate the full model of the meta-analysis with three levels

# Define the levels of the meta-analysis
# Level 1: Sampling variation
# Level 2: Effect sizes (ESID)
# Level 3: Countries
REM3Lc <- rma.mv(effect_size,
                var,
                random = list(~ 1 | country/ESID),
                data = bflpedat,
                method = "REML")

# Summarize the results
summary(REM3Lc, digits=4)
```

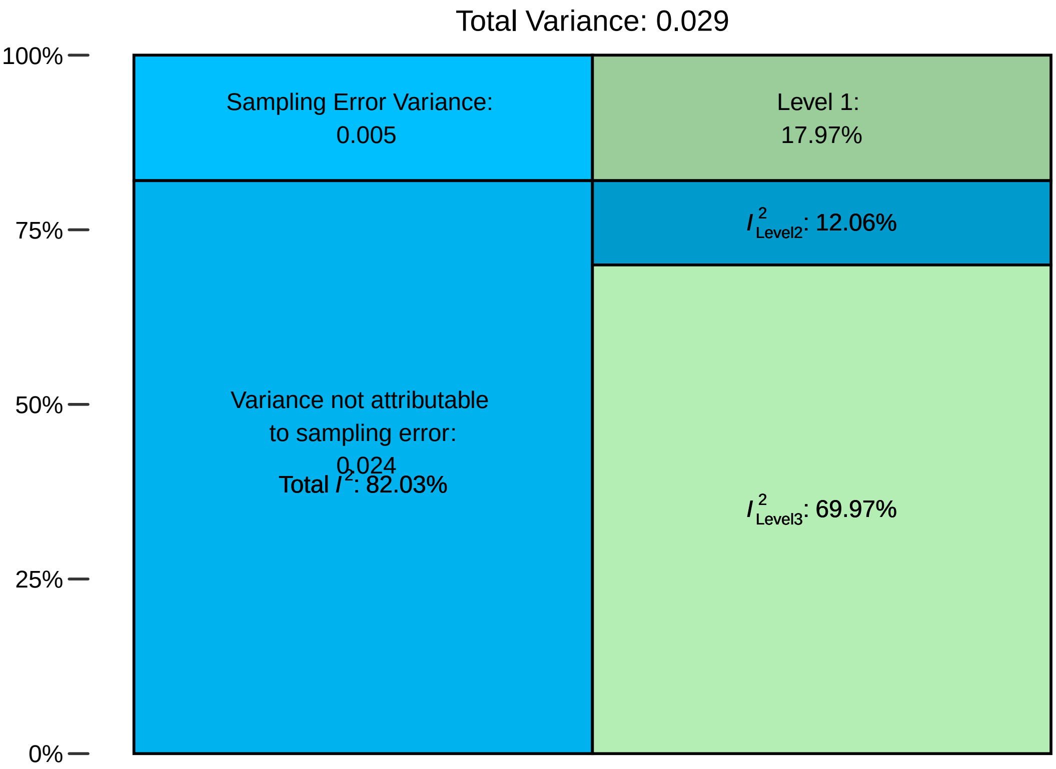
```
##
## Multivariate Meta-Analysis Model (k = 248; method: REML)
##
```

```
##    logLik   Deviance        AIC        BIC       AICc
##  124.6689  -249.3379  -243.3379  -232.8097  -243.2391
##
## Variance Components:
##
##              estim    sqrt  nlvls  fixed        factor
## sigma^2.1  0.0206  0.1437     85     no       country
## sigma^2.2  0.0036  0.0597    248     no  country/ESID
##
## Test for Heterogeneity:
## Q(df = 247) = 1261.7650, p-val < .0001
##
## Model Results:
##
## estimate      se      zval    pval    ci.lb    ci.ub
##  -0.4507  0.0176  -25.5958  <.0001  -0.4852  -0.4162  ***
##
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

```r
# Variance distribution on levels
mlm.variance.distribution(x = REM3Lc)
```

```
##         % of total variance    I2
## Level 1            17.96939   ---
## Level 2            12.06346 12.06
## Level 3            69.96715 69.97
## Total I2: 82.03%
```

```r
res3Lc <- dmetar::var.comp(REM3Lc)
plot(res3Lc)
```



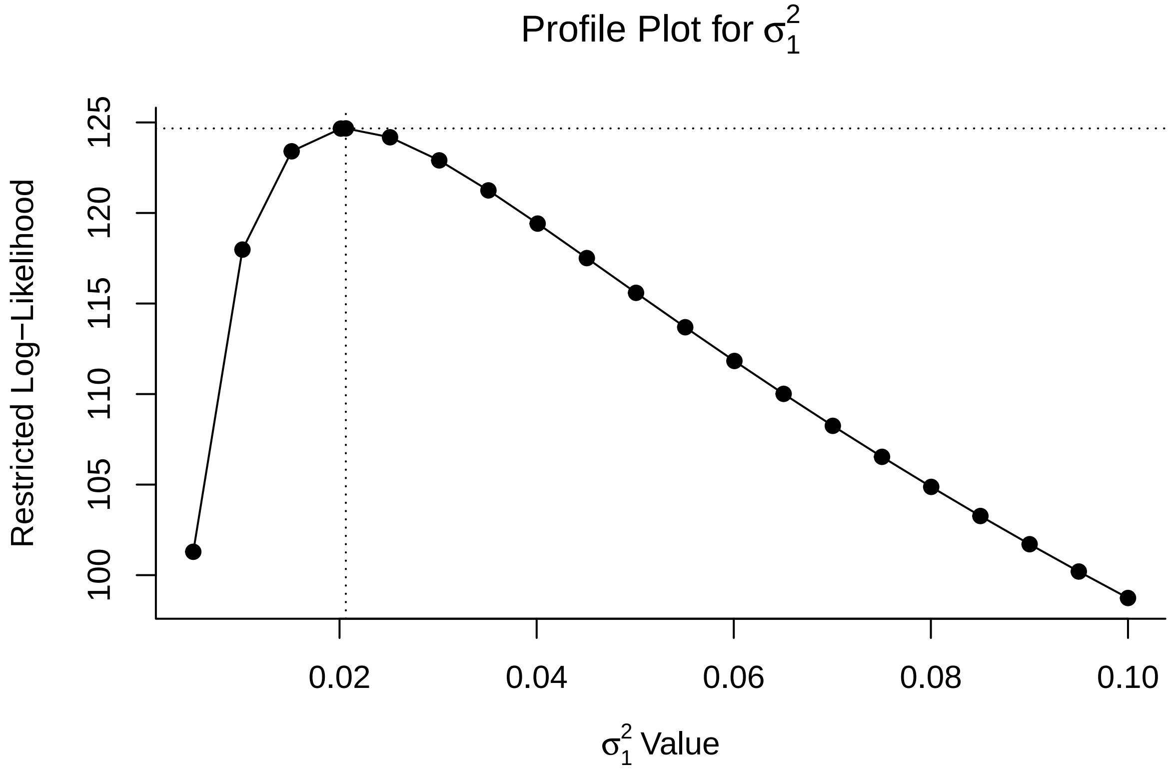
```
# Call for the 95% confidence intervals
confint(REM3Lc, digits=4)
```

```
##
##            estimate  ci.lb  ci.ub
## sigma^2.1   0.0206 0.0141 0.0306
## sigma.1     0.1437 0.1188 0.1750
##
##            estimate  ci.lb  ci.ub
## sigma^2.2   0.0036 0.0017 0.0062
## sigma.2     0.0597 0.0408 0.0787
```

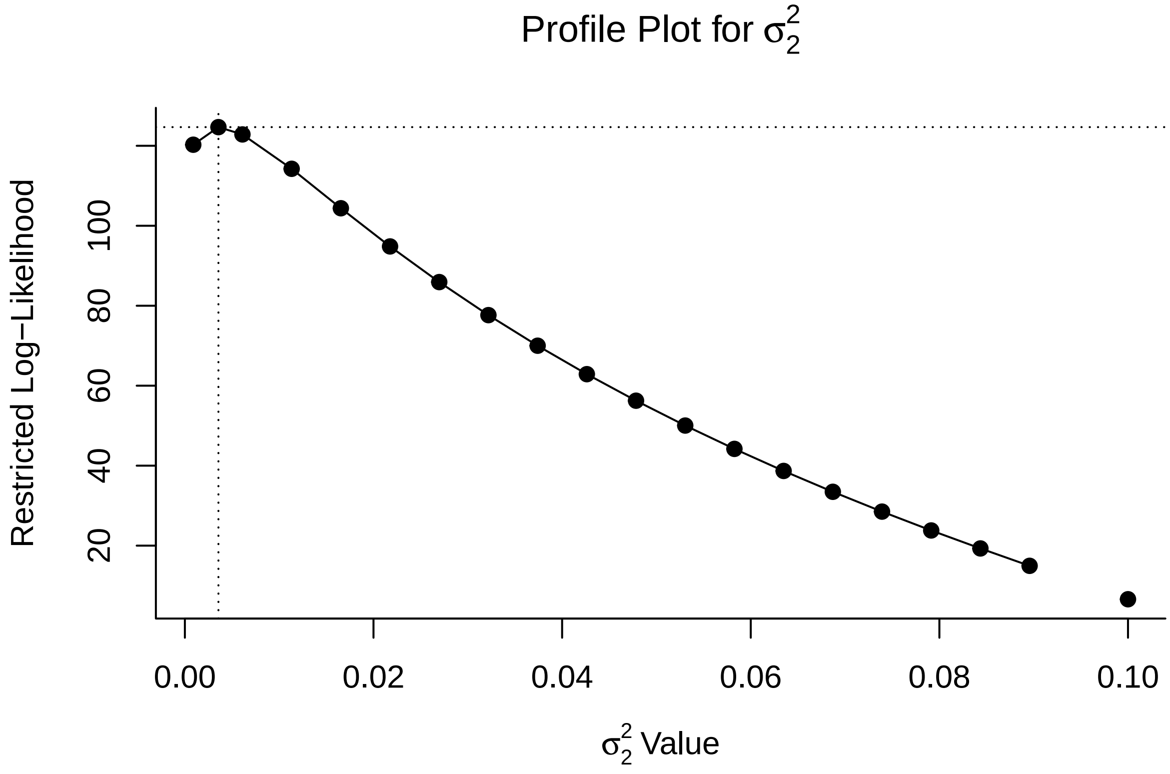
```
## RVE standard errors
conf_int(REM3Lc, vcov = "CR2")
```

```
##      Coef Estimate     SE d.f. Lower 95% CI Upper 95% CI
## 1 intrcpt   -0.451 0.0176 80.5       -0.486       -0.416
```

```
# Profile plots
profile.rma.mv(REM3Lc,sigma2=1)
```



```
profile.rma.mv(REM3Lc,sigma2=2)
```



```
# ICC[1]
round(REM3Lc$sigma2[1] / sum(REM3Lc$sigma2), 3)
```

```
## [1] 0.853
```

```
round(REM3Lc$sigma2[2] / sum(REM3Lc$sigma2), 3)
```

```
## [1] 0.147
```

```
# Level-specific I2 values
# Source: https://www.metafor-project.org/doku.php/tips:i2_multilevel_multivariate
X1 <- model.matrix(REM3Lc)
P1 <- W - W %*% X1 %*% solve(t(X1) %*% W %*% X1) %*% t(X1) %*% W
## Overall I-squared
100 * sum(REM3Lc$sigma2) / (sum(REM3Lc$sigma2) + (REM3Lc$k-REM3Lc$p)/sum(diag(P1)))
```

```
## [1] 82.03061
```

```
## I-squared for the different levels
100 * REM3Lc$sigma2 / (sum(REM3Lc$sigma2) + (REM3Lc$k-REM3Lc$p)/sum(diag(P1)))
```

```
## [1] 69.96715 12.06346
```

```
## Model comparison
## Common REM2e to REM3L
anova(REM2e, REM3Lc)
```

```
##
##         df       AIC       BIC      AICc   logLik      LRT   pval        QE
## Full     3 -243.3379 -232.8097 -243.2391 124.6689                  1261.7650
## Reduced  2 -129.1606 -122.1418 -129.1114  66.5803 116.1773 <.0001 1261.7650
```

2.2.3 Correlated and hierarchical effects model with RVE (`CHE` model)

```
#### For comparison: use cycles to describe correlated effects (CHE)
## Source code: Pustejovsky & Tipton (2021)
## https://doi.org/10.31222/osf.io/vyfcj

## Make a reasoned assumption on the correlations between effects.
## Effects over time are correlated within studies.
## We provide a constant sampling correlation (csc).

### RHO = 0.5 #######################################################
rho <- 0.5

## Define the sampling variance-covariance matrix per study
V_mat <- impute_covariance_matrix(bflpedat$var,
                                  cluster = bflpedat$country,
                                  r = rho,
                                  smooth_vi = TRUE)



## Estimate the full model of the meta-analysis with three levels
```

```
REM3L.csc <- rma.mv(effect_size,
                    V = V_mat,
                    random = list(~ 1 | country/ESID),
                    data = bflpedat,
                    method = "REML")

## Summarize the results
summary(REM3L.csc, digits=4)
```

```
##
## Multivariate Meta-Analysis Model (k = 248; method: REML)
##
##    logLik   Deviance        AIC        BIC       AICc
##  123.1383  -246.2766  -240.2766  -229.7484  -240.1778
##
## Variance Components:
##
##             estim    sqrt  nlvls  fixed        factor
## sigma^2.1  0.0164  0.1282     85     no       country
## sigma^2.2  0.0071  0.0844    248     no  country/ESID
##
## Test for Heterogeneity:
## Q(df = 247) = 940.5129, p-val < .0001
##
## Model Results:
##
## estimate      se      zval    pval    ci.lb    ci.ub
##  -0.4555  0.0175  -26.1019  <.0001  -0.4897  -0.4213  ***
##
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

```
## Confidence intervals
confint(REM3L.csc)
```

```
##
##           estimate  ci.lb  ci.ub
## sigma^2.1   0.0164 0.0102 0.0261
## sigma.1     0.1282 0.1008 0.1615
##
##           estimate  ci.lb  ci.ub
## sigma^2.2   0.0071 0.0050 0.0100
## sigma.2     0.0844 0.0707 0.1000
```

```
## RVE standard errors
clubSandwich::conf_int(REM3L.csc, vcov = "CR2")
```

```
##      Coef Estimate     SE d.f. Lower 95% CI Upper 95% CI
## 1 intrcpt   -0.456 0.0175 79.2        -0.49       -0.421
```

```r
# Level-specific I2 values
# Source: https://www.metafor-project.org/doku.php/tips:i2_multilevel_multivariate
X3 <- model.matrix(REM3L.csc)
P3 <- W - W %*% X3 %*% solve(t(X3) %*% W %*% X) %*% t(X3) %*% W
## Overall I-squared
100 * sum(REM3L.csc$sigma2) / (sum(REM3L.csc$sigma2) + (REM3L.csc$k-REM3L.csc$p)/sum(diag(P3))
```

```
## [1] 81.63377
```

```r
## I-squared for the different levels
100 * REM3L.csc$sigma2 / (sum(REM3L.csc$sigma2) + (REM3L.csc$k-REM3L.csc$p)/sum(diag(P3)))
```

```
## [1] 56.97930 24.65447
```

```r
### RHO = 0.6 #######################################################
## Define the sampling variance-covariance matrix per study
V_mat06 <- impute_covariance_matrix(bflpedat$var,
                                  cluster = bflpedat$country,
                                  r = 0.6,
                                  smooth_vi = TRUE)


## Estimate the full model of the meta-analysis with three levels
REM3L.csc06 <- rma.mv(effect_size,
                      V = V_mat06,
                      random = list(~ 1 | country/ESID),
                      data = bflpedat,
                      method = "REML")

## Summarize the results
summary(REM3L.csc06, digits=4)
```

```
##
## Multivariate Meta-Analysis Model (k = 248; method: REML)
##
##    logLik   Deviance        AIC        BIC       AICc
##  122.0002  -244.0004  -238.0004  -227.4722  -237.9016
##
## Variance Components:
##
##              estim    sqrt  nlvls  fixed        factor
## sigma^2.1   0.0156  0.1249     85     no       country
## sigma^2.2   0.0082  0.0903    248     no  country/ESID
##
## Test for Heterogeneity:
## Q(df = 247) = 1029.7987, p-val < .0001
##
## Model Results:
##
```

```
## estimate      se      zval    pval    ci.lb    ci.ub
##  -0.4553  0.0174  -26.1003  <.0001  -0.4895  -0.4211  ***
##
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

```
## Confidence intervals
confint(REM3L.csc06)
```

```
##
##            estimate  ci.lb  ci.ub
## sigma^2.1    0.0156 0.0093 0.0252
## sigma.1      0.1249 0.0966 0.1588
##
##            estimate  ci.lb  ci.ub
## sigma^2.2    0.0082 0.0060 0.0111
## sigma.2      0.0903 0.0774 0.1053
```

```
## RVE standard errors
clubSandwich::conf_int(REM3L.csc06, vcov = "CR2")
```

```
##      Coef Estimate     SE d.f. Lower 95% CI Upper 95% CI
## 1 intrcpt   -0.455 0.0174 78.9        -0.49       -0.421
```

```
### RHO = 0.7 #######################################################
## Define the sampling variance-covariance matrix per study
V_mat07 <- impute_covariance_matrix(bflpedat$var,
                                  cluster = bflpedat$country,
                                  r = 0.7,
                                  smooth_vi = TRUE)



## Estimate the full model of the meta-analysis with three levels
REM3L.csc07 <- rma.mv(effect_size,
                      V = V_mat07,
                      random = list(~ 1 | country/ESID),
                      data = bflpedat,
                      method = "REML")

## Summarize the results
summary(REM3L.csc07, digits=4)
```

```
##
## Multivariate Meta-Analysis Model (k = 248; method: REML)
##
##    logLik   Deviance        AIC        BIC       AICc
##  120.8722  -241.7443  -235.7443  -225.2162  -235.6456
##
## Variance Components:
##
```

```
##              estim    sqrt  nlvls  fixed        factor
## sigma^2.1  0.0148  0.1215     85     no       country
## sigma^2.2  0.0092  0.0961    248     no  country/ESID
##
## Test for Heterogeneity:
## Q(df = 247) = 1210.0182, p-val < .0001
##
## Model Results:
##
## estimate      se       zval    pval    ci.lb    ci.ub
##  -0.4551  0.0174  -26.0924  <.0001  -0.4892  -0.4209  ***
##
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

```
## Confidence intervals
confint(REM3L.csc07)
```

```
##
##           estimate  ci.lb  ci.ub
## sigma^2.1   0.0148 0.0085 0.0243
## sigma.1     0.1215 0.0923 0.1560
##
##           estimate  ci.lb  ci.ub
## sigma^2.2   0.0092 0.0070 0.0122
## sigma.2     0.0961 0.0835 0.1106
```

```
## RVE standard errors
clubSandwich::conf_int(REM3L.csc07, vcov = "CR2")
```

```
##      Coef Estimate     SE d.f. Lower 95% CI Upper 95% CI
## 1 intrcpt   -0.455 0.0174 78.6        -0.49        -0.42
```

```
### RHO = 0.8 #######################################################
## Define the sampling variance-covariance matrix per study
V_mat08 <- impute_covariance_matrix(bflpedat$var,
                                  cluster = bflpedat$country,
                                  r = 0.8,
                                  smooth_vi = TRUE)



## Estimate the full model of the meta-analysis with three levels
REM3L.csc08 <- rma.mv(effect_size,
                  V = V_mat08,
                   random = list(~ 1 | country/ESID),
                   data = bflpedat,
                   method = "REML")

## Summarize the results
summary(REM3L.csc08, digits=4)
```

```
##
## Multivariate Meta-Analysis Model (k = 248; method: REML)
##
##    logLik   Deviance        AIC        BIC       AICc
##  119.7773  -239.5546  -233.5546  -223.0264  -233.4558
##
## Variance Components:
##
##             estim    sqrt  nlvls  fixed        factor
## sigma^2.1  0.0139  0.1181     85     no       country
## sigma^2.2  0.0103  0.1017    248     no  country/ESID
##
## Test for Heterogeneity:
## Q(df = 247) = 1605.5513, p-val < .0001
##
## Model Results:
##
## estimate      se      zval    pval    ci.lb    ci.ub
##  -0.4548  0.0174  -26.0788  <.0001  -0.4890  -0.4206  ***
##
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

```
## Confidence intervals
confint(REM3L.csc08)
```

```
##
##           estimate  ci.lb  ci.ub
## sigma^2.1   0.0139 0.0077 0.0235
## sigma.1     0.1181 0.0879 0.1533
##
##           estimate  ci.lb  ci.ub
## sigma^2.2   0.0103 0.0080 0.0134
## sigma.2     0.1017 0.0897 0.1158
```

```
## RVE standard errors
clubSandwich::conf_int(REM3L.csc08, vcov = "CR2")
```

```
##      Coef Estimate     SE d.f. Lower 95% CI Upper 95% CI
## 1 intrcpt   -0.455 0.0174 78.3        -0.49        -0.42
```

2.2.4 Four-level cross-classified random-effects model with hierarchical clustering in TIMSS cycles and countries

This model assumes a hierarchical nesting of effect sizes in countries and TIMSS cycles; however, the country and cycle levels are independent.

```
## Cross-classified REM
CCREM4 <- rma.mv(effect_size,
```

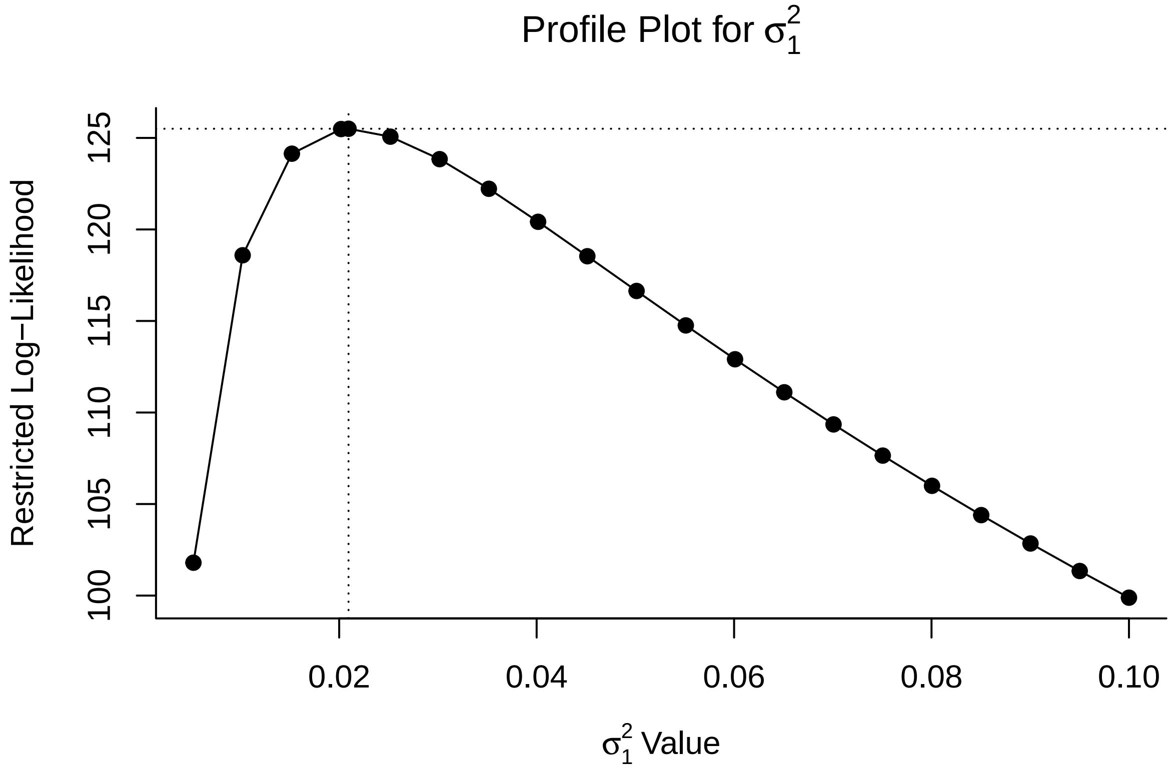
```r
                 var,
                 random = list(~ 1 | country/ESID,
                               ~ 1 | year),
                 data = bflpedat,
                 method = "REML")

## Summarize the results
summary(CCREM4, digits=4)
```

```
##
## Multivariate Meta-Analysis Model (k = 248; method: REML)
##
##    logLik   Deviance        AIC        BIC       AICc
##  125.5016  -251.0032  -243.0032  -228.9656  -242.8379
##
## Variance Components:
##
##              estim    sqrt  nlvls  fixed        factor
## sigma^2.1  0.0209  0.1447     85     no       country
## sigma^2.2  0.0032  0.0568    248     no  country/ESID
## sigma^2.3  0.0002  0.0144      5     no          year
##
## Test for Heterogeneity:
## Q(df = 247) = 1261.7650, p-val < .0001
##
## Model Results:
##
## estimate      se      zval    pval    ci.lb    ci.ub
##  -0.4524  0.0189  -23.9696  <.0001  -0.4893  -0.4154  ***
##
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

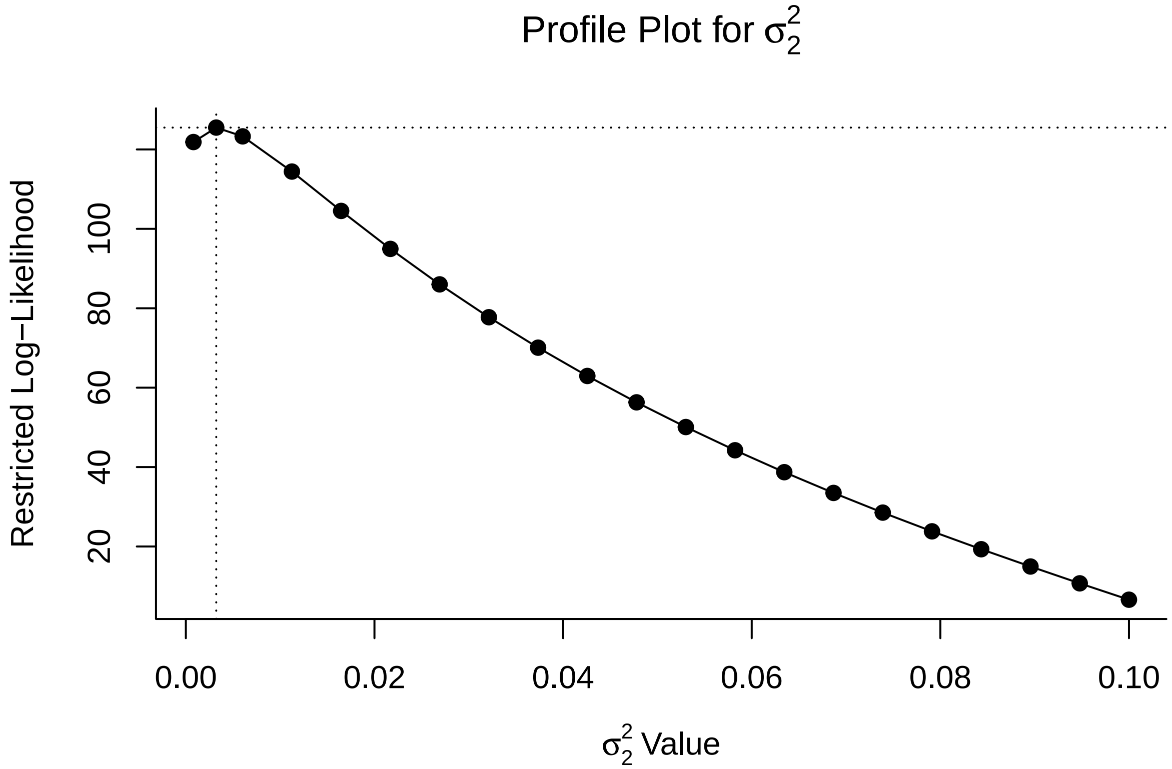
```r
# Call for the 95% confidence intervals
confint(CCREM4, digits=4)
```

```
##
##           estimate  ci.lb  ci.ub
## sigma^2.1   0.0209 0.0144 0.0310
## sigma.1     0.1447 0.1198 0.1762
##
##           estimate  ci.lb  ci.ub
## sigma^2.2   0.0032 0.0014 0.0058
## sigma.2     0.0568 0.0370 0.0763
##
##           estimate  ci.lb  ci.ub
## sigma^2.3   0.0002 0.0000 0.0021
## sigma.3     0.0144 0.0000 0.0460
```

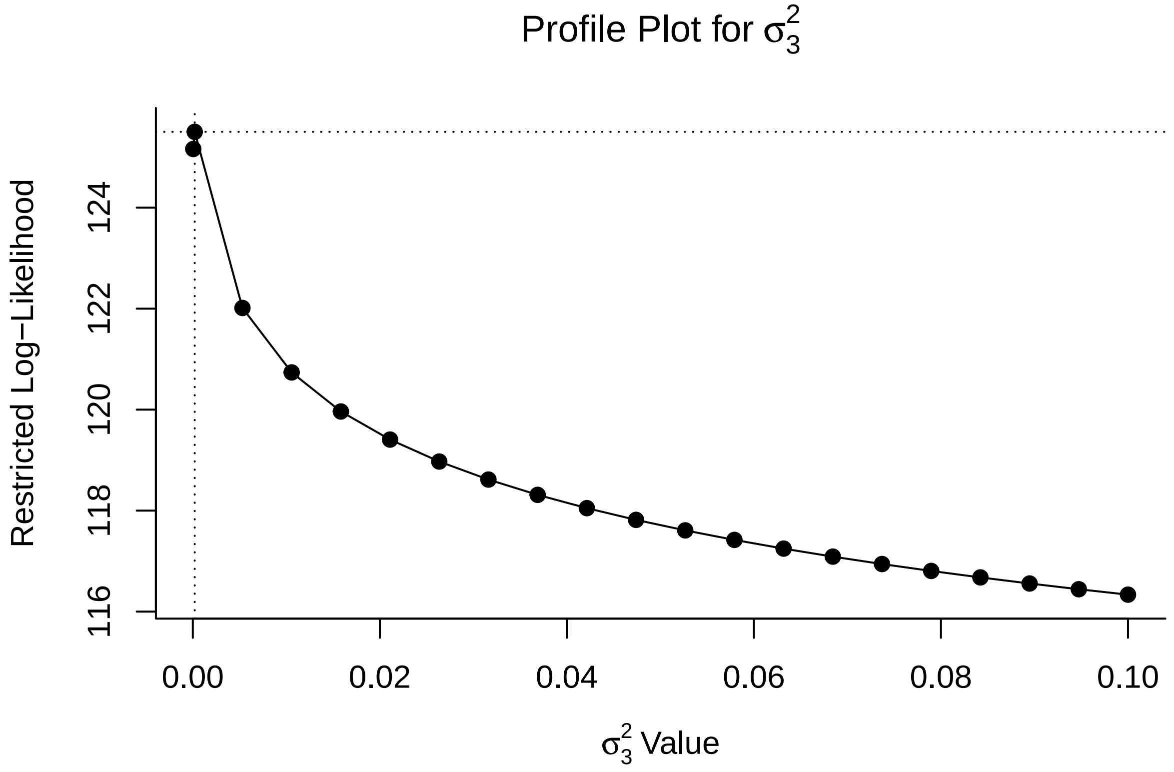
```r
# Profile plots
profile.rma.mv(CCREM4,sigma2=1)
```



```r
profile.rma.mv(CCREM4,sigma2=2)
```



```r
profile.rma.mv(CCREM4,sigma2=3)
```



```r
# ICC[1]
round(CCREM4$sigma2[1] / sum(CCREM4$sigma2), 3)
```

```
## [1] 0.859
```

```r
round(CCREM4$sigma2[2] / sum(CCREM4$sigma2), 3)
```

```
## [1] 0.132
```

```r
round(CCREM4$sigma2[3] / sum(CCREM4$sigma2), 3)
```

```
## [1] 0.008
```

```r
# Level-specific I2 values
X2 <- model.matrix(CCREM4)
P2 <- W - W %*% X2 %*% solve(t(X2) %*% W %*% X2) %*% t(X2) %*% W
## Overall I-squared
100 * sum(CCREM4$sigma2) / (sum(CCREM4$sigma2) + (CCREM4$k-CCREM4$p)/sum(diag(P2)))
```

```
## [1] 82.14006
```

```r
## I-squared for the different levels
100 * CCREM4$sigma2 / (sum(CCREM4$sigma2) + (CCREM4$k-CCREM4$p)/sum(diag(P2)))
```

```
## [1] 70.5762190 10.8686506  0.6951873
```

```
## Model comparisons
## Common REM2e to CCREM4
anova(REM2e, CCREM4)
```

```
##
##          df       AIC       BIC      AICc   logLik      LRT   pval        QE
## Full      4 -243.0032 -228.9656 -242.8379 125.5016                 1261.7650
## Reduced   2 -129.1606 -122.1418 -129.1114  66.5803 117.8426 <.0001 1261.7650
```

```
## REM3L vs. CCREM4
anova(REM3L, CCREM4)
```

```
##
##          df       AIC       BIC      AICc   logLik      LRT   pval        QE
## Full      4 -243.0032 -228.9656 -242.8379 125.5016                 1261.7650
## Reduced   3 -127.1606 -116.6324 -127.0618  66.5803 117.8426 <.0001 1261.7650
```

```
## REM3Lc vs. CCREM4
anova(REM3Lc, CCREM4)
```

```
##
##          df       AIC       BIC      AICc   logLik    LRT   pval        QE
## Full      4 -243.0032 -228.9656 -242.8379 125.5016               1261.7650
## Reduced   3 -243.3379 -232.8097 -243.2391 124.6689 1.6653 0.1969 1261.7650
```

The variance between TIMSS cycles is close to zero, the corresponding confidence interval contains zero, the profile plot supports the zero variance, and the model `CCREM4` does not improve the fit of the meta-analytic baseline model . This could indicate some degree of stability of the BFLPE over time.

2.3 Robust variance estimation (RVE) with hierarchical effects

2.3.1 RVE with hierarchical effects within countries

```
## Model specification and estimation
REM2.rvec <- robu(bflpedat$effect_size ~ 1,
                  data = bflpedat,
                  studynum = bflpedat$country,
                  var.eff.size = bflpedat$var,
                  modelweights = "HIER")

## Summary of the results
print(REM2.rvec)
```

```
## RVE: Hierarchical Effects Model with Small-Sample Corrections
##
## Model: bflpedat$effect_size ~ 1
##
## Number of clusters = 85
```

```
## Number of outcomes = 248 (min = 1 , mean = 2.92 , median = 3 , max = 5 )
## Omega.sq = 0
## Tau.sq = 0.02208545
##
##                Estimate StdErr t-value  dfs P(|t|>) 95% CI.L 95% CI.U Sig
## 1 X.Intercept.   -0.458 0.0192   -23.9 62.8       0   -0.496   -0.419 ***
## ---
## Signif. codes: < .01 *** < .05 ** < .10 *
## ---
## Note: If df < 4, do not trust the results
```

2.3.2 RVE with correlated effects in TIMSS cycles

```
## Model specification and estimation
REM2.rvet <- robu(bflpedat$effect_size ~ 1,
                data = bflpedat,
                studynum = bflpedat$year,
                var.eff.size = bflpedat$var,
                modelweights = "COR",
                rho = 0.5)

## Summary of the results
print(REM2.rvet)
```

```
## RVE: Correlated Effects Model with Small-Sample Corrections
##
## Model: bflpedat$effect_size ~ 1
##
## Number of studies = 5
## Number of outcomes = 248 (min = 29 , mean = 49.6 , median = 55 , max = 64 )
## Rho = 0.5
## I.sq = 76.12715
## Tau.sq = 0.03544564
##
##                Estimate  StdErr t-value  dfs     P(|t|>) 95% CI.L 95% CI.U Sig
## 1 X.Intercept.   -0.458 0.00879   -52.1 3.95 0.000000935   -0.483   -0.434 ***
## ---
## Signif. codes: < .01 *** < .05 ** < .10 *
## ---
## Note: If df < 4, do not trust the results
```

```
## Senstivity analysis
robumeta::sensitivity(REM2.rvet)
```

```
## RVE: Correlated Effects Model with Small-Sample Corrections
## Model: bflpedat$effect_size ~ 1
##
## Sensitivity Analysis
```

```
##
##                              Rho = 0  Rho = 0.2 Rho = 0.4 Rho = 0.6 Rho = 0.8
##  X.Intercept. Coefficient -0.45812 -0.45813  -0.45814  -0.45815  -0.45816
##               Std. Error   0.00878  0.00879   0.00879   0.00879   0.00879
##  Tau.sq       Estimate     0.03423  0.03472   0.03520   0.03569   0.03617
##  Rho = 1
##  -0.4582
##   0.0088
##   0.0367
```

2.4 Conclusions

Some highlights on the results so far:

- Variation exists between effect sizes and countries. A three-level hierarchical structure with the country level as the highest level is indicated.
- Adding the variation between the five TIMSS cycles (model `CCREM4`) did not result in an improved model fit (as compared to model `REM3Lc`). Hence, the country differences are key sources of variation in addition to the variation between effect sizes.

3 Moderator analyses

3.1 Moderation by TIMSS cycle

The model `CCREM4` already indicated a small variation between the TIMSS cycles, after controlling for variation between effect sizes and countries. Alternatively, we may refrain from adding a random component that represents the TIMSS cycles and add smart-coded variables as moderators (resulting in fixed effects) instead.

3.1.1 Three-level mixed-effects meta-regression model

```
# Model specification
MEM3L.cycle <- rma.mv(effect_size ~ 1 + factor(year),
                      var,
                      random = list(~ 1 | country/ESID),
                      data = bflpedat,
                      method = "REML")

# Summarize the results
summary(MEM3L.cycle, digits=4)
```

```
##
## Multivariate Meta-Analysis Model (k = 248; method: REML)
##
##    logLik   Deviance        AIC        BIC       AICc
##  123.1370  -246.2739  -232.2739  -207.8225  -231.7973
##
## Variance Components:
##
##              estim    sqrt  nlvls  fixed        factor
## sigma^2.1   0.0211  0.1453     85     no       country
## sigma^2.2   0.0033  0.0572    248     no  country/ESID
##
## Test for Residual Heterogeneity:
## QE(df = 243) = 1253.3797, p-val < .0001
##
## Test of Moderators (coefficients 2:5):
## QM(df = 4) = 7.7450, p-val = 0.1014
##
## Model Results:
##
##                     estimate      se      zval    pval    ci.lb    ci.ub
## intrcpt              -0.4605  0.0262  -17.5640  <.0001  -0.5119  -0.4091  ***
## factor(year)2007     -0.0002  0.0258   -0.0095  0.9925  -0.0507   0.0502
## factor(year)2011      0.0024  0.0247    0.0966  0.9230  -0.0460   0.0508
## factor(year)2015     -0.0076  0.0242   -0.3129  0.7544  -0.0551   0.0399
```

```
## factor(year)2019    0.0374  0.0238    1.5674  0.1170  -0.0094   0.0841
##
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

```
# Robust confidence intervals
conf_int(MEM3L.cycle, vcov = "CR2")
```

```
##               Coef  Estimate     SE d.f. Lower 95% CI Upper 95% CI
## 1          intrcpt -0.460518 0.0280 40.0      -0.5172      -0.4039
## 2 factor(year)2007 -0.000244 0.0199 27.8      -0.0410       0.0405
## 3 factor(year)2011  0.002385 0.0236 29.7      -0.0458       0.0506
## 4 factor(year)2015 -0.007583 0.0243 28.6      -0.0572       0.0421
## 5 factor(year)2019  0.037358 0.0258 28.5      -0.0156       0.0903
```

```
#### For comparison: use time as a predictor
## Define a new time variable
bflpedat$time <- NA
bflpedat$time[bflpedat$StudyID == "2003"] <- 0
bflpedat$time[bflpedat$StudyID == "2007"] <- 1
bflpedat$time[bflpedat$StudyID == "2011"] <- 2
bflpedat$time[bflpedat$StudyID == "2015"] <- 3
bflpedat$time[bflpedat$StudyID == "2019"] <- 4
bflpedat$timesq <- NA
bflpedat$timesq <- bflpedat$time^2

# Three-level mixed-effects meta-regression model
MEM3L.time <- rma.mv(effect_size ~ 1 + time,
                      var,
                      random = list(~ 1 | country/ESID),
                      data = bflpedat,
                      method = "REML")

# Summarize the results
summary(MEM3L.time, digits=4)
```

```
##
## Multivariate Meta-Analysis Model (k = 248; method: REML)
##
##    logLik   Deviance        AIC        BIC       AICc
##  124.8831  -249.7661  -241.7661  -227.7448  -241.6002
##
## Variance Components:
##
##               estim    sqrt  nlvls  fixed        factor
## sigma^2.1    0.0208  0.1442     85     no       country
## sigma^2.2    0.0035  0.0589    248     no  country/ESID
##
## Test for Residual Heterogeneity:
```

```
## QE(df = 246) = 1259.3479, p-val < .0001
##
## Test of Moderators (coefficient 2):
## QM(df = 1) = 3.0316, p-val = 0.0817
##
## Model Results:
##
##          estimate      se      zval    pval    ci.lb    ci.ub
## intrcpt   -0.4729  0.0218  -21.6867  <.0001  -0.5157  -0.4302  ***
## time       0.0090  0.0052    1.7411  0.0817  -0.0011   0.0191    .
##
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

```
# Robust confidence intervals
conf_int(MEM3L.time, vcov = "CR2")
```

```
##      Coef Estimate      SE d.f. Lower 95% CI Upper 95% CI
## 1 intrcpt -0.47294 0.02747 63.9     -0.52781      -0.4181
## 2    time  0.00899 0.00686 39.1     -0.00488       0.0229
```

```
# Predict the effects for each cycle
predict(MEM3L.time, newmods = c(0,1,2,3,4))
```

```
##
##      pred     se   ci.lb   ci.ub   pi.lb   pi.ub
## 1 -0.4729 0.0218 -0.5157 -0.4302 -0.7813 -0.1646
## 2 -0.4639 0.0192 -0.5016 -0.4262 -0.7716 -0.1563
## 3 -0.4550 0.0178 -0.4899 -0.4200 -0.7623 -0.1476
## 4 -0.4460 0.0179 -0.4810 -0.4110 -0.7533 -0.1386
## 5 -0.4370 0.0193 -0.4748 -0.3991 -0.7447 -0.1293
```

3.1.2 Hierarchical effects model with RVE (HE model)

```
#### For comparison: RVE
MEMRVE.cycle <- robu(bflpedat$effect_size ~ 1 + factor(year),
                data = bflpedat,
                studynum = bflpedat$country,
                var.eff.size = bflpedat$var,
                modelweights = "HIER")

## Summary of the results
print(MEMRVE.cycle)
```

```
## RVE: Hierarchical Effects Model with Small-Sample Corrections
##
## Model: bflpedat$effect_size ~ 1 + factor(year)
##
## Number of clusters = 85
```

```
## Number of outcomes = 248 (min = 1 , mean = 2.92 , median = 3 , max = 5 )
## Omega.sq = 0
## Tau.sq = 0.02216272
##
##                      Estimate StdErr  t-value  dfs           P(|t|>) 95% CI.L
## 1     X.Intercept. -0.45661 0.0356 -12.8102 26.6 0.000000000000689  -0.5298
## 2 factor.year.2007 -0.02336 0.0273  -0.8561 36.1 0.397607012405788  -0.0787
## 3 factor.year.2011 -0.00156 0.0324  -0.0482 39.3 0.961820063218260  -0.0671
## 4 factor.year.2015 -0.01243 0.0337  -0.3687 38.8 0.714328479376139  -0.0806
## 5 factor.year.2019  0.02242 0.0351   0.6395 38.7 0.526237524878630  -0.0485
##   95% CI.U Sig
## 1  -0.3834 ***
## 2   0.0320
## 3   0.0640
## 4   0.0558
## 5   0.0933
## ---
## Signif. codes: < .01 *** < .05 ** < .10 *
## ---
## Note: If df < 4, do not trust the results
```

3.1.3 Subgroup correlated effects model (`SCE` model)

```
#### For comparison: use cycles as subgroups
## Define the sampling variance-covariance matrix per study
V_mats <- impute_covariance_matrix(bflpedat$var,
                                   cluster = bflpedat$country,
                                   r = rho,
                                   smooth_vi = TRUE,
                                   subgroup = bflpedat$StudyID)

## Estimate the full model of the meta-analysis with three levels
REM3L.cscs <- rma.mv(effect_size,
                     V = V_mats,
                     random = list(~ as.factor(StudyID) | country),
                     struct = "DIAG",
                     data = bflpedat,
                     method = "REML")

## Summarize the results
summary(REM3L.cscs, digits=4)
```

```
##
## Multivariate Meta-Analysis Model (k = 248; method: REML)
##
##    logLik   Deviance         AIC         BIC        AICc
##   69.5452  -139.0905   -127.0905   -106.0341   -126.7405
```

```
##
## Variance Components:
##
## outer factor: country            (nlvls = 85)
## inner factor: as.factor(StudyID) (nlvls = 5)
##
##             estim    sqrt  k.lvl  fixed  level
## tau^2.1    0.0269  0.1639     29     no   2003
## tau^2.2    0.0323  0.1797     44     no   2007
## tau^2.3    0.0231  0.1519     55     no   2011
## tau^2.4    0.0290  0.1704     56     no   2015
## tau^2.5    0.0156  0.1249     64     no   2019
##
## Test for Heterogeneity:
## Q(df = 247) = 1195.1589, p-val < .0001
##
## Model Results:
##
## estimate      se      zval    pval    ci.lb    ci.ub
##  -0.4566  0.0112  -40.9372  <.0001  -0.4785  -0.4348  ***
##
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

```
## RVE standard errors
clubSandwich::conf_int(REM3L.cscs, vcov = "CR2")
```

```
##      Coef Estimate     SE d.f. Lower 95% CI Upper 95% CI
## 1 intrcpt   -0.457 0.0186 63.7       -0.494       -0.419
```

Once again, no further indication of significant variation across cycles.

3.2 Moderation by cultural orientation (cycle-invariant, country-specific)

3.2.1 Three-level mixed-effects meta-regression model

```
# Model specification
MEM3L.culture <- rma.mv(effect_size ~ 1 +
                          pdi + idv + mas +
                          uai + ltowvs + ivr,
                      var,
                      random = list(~ 1 | country/ESID),
                      data = bflpedat,  # could also use bflpedat2 (same result)
                      method = "REML")
```

```
## Warning: Rows with NAs omitted from model fitting.
```

```
# Summarize the results
summary(MEM3L.culture, digits=4)
```

```
##
## Multivariate Meta-Analysis Model (k = 206; method: REML)
##
##    logLik   Deviance        AIC        BIC       AICc
##  117.9376  -235.8753  -217.8753  -188.2355  -216.9229
##
## Variance Components:
##
##              estim    sqrt  nlvls  fixed        factor
## sigma^2.1  0.0181  0.1346     65     no       country
## sigma^2.2  0.0035  0.0589    206     no  country/ESID
##
## Test for Residual Heterogeneity:
## QE(df = 199) = 917.6139, p-val < .0001
##
## Test of Moderators (coefficients 2:7):
## QM(df = 6) = 8.5950, p-val = 0.1977
##
## Model Results:
##
##           estimate      se     zval    pval    ci.lb   ci.ub
## intrcpt   -0.1375  0.1804  -0.7620  0.4461  -0.4911  0.2162
## pdi       -0.0024  0.0015  -1.6075  0.1080  -0.0053  0.0005
## idv       -0.0019  0.0012  -1.5869  0.1125  -0.0042  0.0004
## mas       -0.0008  0.0010  -0.8251  0.4093  -0.0027  0.0011
## uai       -0.0010  0.0010  -1.0208  0.3074  -0.0030  0.0010
## ltowvs     0.0003  0.0009   0.2818  0.7781  -0.0015  0.0020
## ivr        0.0004  0.0014   0.2599  0.7949  -0.0024  0.0031
##
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

```
# Robust CIs
conf_int(MEM3L.culture, vcov = "CR2")
```

```
##      Coef  Estimate       SE  d.f. Lower 95% CI Upper 95% CI
## 1 intrcpt -0.137489 0.174135 17.37     -0.50429     0.229315
## 2     pdi -0.002374 0.001550 14.16     -0.00569     0.000947
## 3     idv -0.001885 0.001240 22.78     -0.00445     0.000681
## 4     mas -0.000802 0.001138 15.16     -0.00323     0.001622
## 5     uai -0.001038 0.000899  9.49     -0.00306     0.000979
## 6  ltowvs  0.000256 0.000975 22.82     -0.00176     0.002273
## 7     ivr  0.000369 0.001621 18.53     -0.00303     0.003768
```

```
# Variance inflation factors
vif(MEM3L.culture)
```

```
##
##    pdi    idv    mas    uai ltowvs    ivr
```

```
## 2.8286 2.1597 1.0858 1.3574 1.2558 2.0918
```

```
#### Dealing with missing data in the moderators (listwise)
## Exclude effect sizes with missing data
bflpedat2 <- bflpedat[complete.cases(data.frame(bflpedat$pdi,
                                    bflpedat$idv,
                                    bflpedat$mas,
                                    bflpedat$uai,
                                    bflpedat$ltowvs,
                                    bflpedat$ivr)),]

## Re-estimate the model without the predictors to get accurate R2 values
REM3L.culture <- rma.mv(effect_size ~ 1 ,
                      var,
                      random = list(~ 1 | country/ESID),
                      data = bflpedat2,
                      method = "REML")

# Variance explanations
# Country level
(REM3L.culture$sigma2[1]-MEM3L.culture$sigma2[1])*100/REM3L.culture$sigma2[1]
```

```
## [1] 5.450629
```

```
# Effect size level
(REM3L.culture$sigma2[2]-MEM3L.culture$sigma2[2])*100/REM3L.culture$sigma2[2]
```

```
## [1] -1.057425
```

3.2.2 Three-level mixed-effects meta-regression model with constant sampling correlation

```
#### Dealing with missing data in the moderators (listwise)

## Generate a new sampling covariance matrix
## Define the sampling variance-covariance matrix per study
V_mat2 <- impute_covariance_matrix(bflpedat2$var,
                                   cluster = bflpedat2$country,
                                   r = rho,
                                   smooth_vi = TRUE)


## Re-estimate the model without the predictors to get accurate R2 values
REM3L.csc.culture <- rma.mv(effect_size,
                    V = V_mat2,
                    random = list(~ 1 | country/ESID),
                    data = bflpedat2,
                    method = "REML")
```

```r
## Summarize the results
summary(REM3L.csc.culture, digits=4)
```

```
##
## Multivariate Meta-Analysis Model (k = 206; method: REML)
##
##    logLik   Deviance        AIC        BIC       AICc
##  114.9548  -229.9097  -223.9097  -213.9407  -223.7903
##
## Variance Components:
##
##               estim    sqrt  nlvls  fixed        factor
## sigma^2.1   0.0162  0.1272     65     no       country
## sigma^2.2   0.0065  0.0804    206     no  country/ESID
##
## Test for Heterogeneity:
## Q(df = 205) = 786.9486, p-val < .0001
##
## Model Results:
##
## estimate      se      zval    pval    ci.lb    ci.ub
##  -0.4530  0.0193  -23.4968  <.0001  -0.4908  -0.4152  ***
##
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

```r
#### Mixed-effects meta-regression model
# Model specification
MEM3L.csc.culture <- rma.mv(effect_size ~ 1 +
                          pdi + idv + mas +
                          uai + ltowvs + ivr,
                      V = V_mat2,
                      random = list(~ 1 | country/ESID),
                      data = bflpedat2,
                      method = "REML")

# Summarize the results
summary(MEM3L.csc.culture, digits=4)
```

```
##
## Multivariate Meta-Analysis Model (k = 206; method: REML)
##
##    logLik   Deviance        AIC        BIC       AICc
##  117.1726  -234.3452  -216.3452  -186.7055  -215.3928
##
## Variance Components:
##
##               estim    sqrt  nlvls  fixed        factor
```

```
## sigma^2.1  0.0150  0.1227     65     no       country
## sigma^2.2  0.0065  0.0805    206     no  country/ESID
##
## Test for Residual Heterogeneity:
## QE(df = 199) = 726.9204, p-val < .0001
##
## Test of Moderators (coefficients 2:7):
## QM(df = 6) = 8.9219, p-val = 0.1780
##
## Model Results:
##
##          estimate      se     zval    pval    ci.lb   ci.ub
## intrcpt   -0.1658  0.1824  -0.9092  0.3633  -0.5233  0.1917
## pdi       -0.0024  0.0015  -1.5923  0.1113  -0.0053  0.0005
## idv       -0.0019  0.0012  -1.5831  0.1134  -0.0042  0.0004
## mas       -0.0008  0.0010  -0.8186  0.4130  -0.0027  0.0011
## uai       -0.0010  0.0010  -0.9709  0.3316  -0.0030  0.0010
## ltowvs     0.0005  0.0009   0.4943  0.6211  -0.0014  0.0023
## ivr        0.0006  0.0014   0.4182  0.6758  -0.0022  0.0034
##
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

```
# Robust CIs
conf_int(MEM3L.csc.culture, vcov = "CR2")
```

```
##      Coef  Estimate       SE  d.f. Lower 95% CI Upper 95% CI
## 1 intrcpt -0.165834 0.176671 17.00     -0.53858     0.206912
## 2     pdi -0.002379 0.001563 14.21     -0.00573     0.000968
## 3     idv -0.001871 0.001242 22.44     -0.00444     0.000701
## 4     mas -0.000797 0.001168 15.14     -0.00328     0.001692
## 5     uai -0.000996 0.000899  9.07     -0.00303     0.001034
## 6  ltowvs  0.000460 0.000991 23.08     -0.00159     0.002510
## 7     ivr  0.000598 0.001633 18.46     -0.00283     0.004022
```

```
# Variance inflation factors
vif(MEM3L.csc.culture)
```

```
##
##    pdi    idv    mas    uai ltowvs    ivr
## 2.8254 2.1415 1.0708 1.3850 1.2861 2.1093
```

```
# Variance explanations
# Country level
(REM3L.csc.culture$sigma2[1]-MEM3L.csc.culture$sigma2[1])*100/REM3L.csc.culture$sigma2[1]
```

```
## [1] 6.946436
```

```
# Effect size level
(REM3L.csc.culture$sigma2[2]-MEM3L.csc.culture$sigma2[2])*100/REM3L.csc.culture$sigma2[2]
```

```
## [1] -0.1059797
```

3.3 Moderation by economic development (cycle-specific, country-specific)

3.3.1 Three-level mixed-effects meta-regression model

```
# Model specification
MEM3L.hdi <- rma.mv(effect_size ~ 1 + HDI,
                    var,
                    random = list(~ 1 | country/ESID),
                    data = bflpedat,
                    method = "REML")
```

```
## Warning: Rows with NAs omitted from model fitting.
```

```
# Summarize the results
summary(MEM3L.hdi, digits=4)
```

```
##
## Multivariate Meta-Analysis Model (k = 242; method: REML)
##
##    logLik   Deviance        AIC        BIC       AICc
##  121.0388  -242.0776  -234.0776  -220.1551  -233.9074
##
## Variance Components:
##
##              estim    sqrt  nlvls  fixed        factor
## sigma^2.1   0.0198  0.1406     83     no       country
## sigma^2.2   0.0036  0.0599    242     no  country/ESID
##
## Test for Residual Heterogeneity:
## QE(df = 240) = 1140.0634, p-val < .0001
##
## Test of Moderators (coefficient 2):
## QM(df = 1) = 5.4778, p-val = 0.0193
##
## Model Results:
##
##          estimate      se     zval    pval    ci.lb    ci.ub
## intrcpt   -0.8121  0.1545  -5.2579  <.0001  -1.1148  -0.5094  ***
## HDI        0.4256  0.1818   2.3405  0.0193   0.0692   0.7820    *
##
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

```
# Robust CIs
conf_int(MEM3L.hdi, vcov = "CR2")
```

```
##      Coef Estimate    SE d.f. Lower 95% CI Upper 95% CI
```

```
## 1 intrcpt   -0.812 0.225 36.1      -1.2688       -0.355
## 2     HDI    0.426 0.258 39.1      -0.0955        0.947
```

```
# Variance explanations
# Country level
(REM3Lc$sigma2[1]-MEM3L.hdi$sigma2[1])*100/REM3Lc$sigma2[1]
```

```
## [1] 4.258563
```

```
# Effect size level
(REM3Lc$sigma2[2]-MEM3L.hdi$sigma2[2])*100/REM3Lc$sigma2[2]
```

```
## [1] -0.9532245
```

```
## Note: No missing values occurred in the HDI.
```

3.3.2 Three-level mixed-effects meta-regression model with constant sampling correlation

```
# Model specification
MEM3L.hdi.csc <- rma.mv(effect_size ~ 1 + HDI,
                      V = V_mat,
                      random = list(~ 1 | country/ESID),
                      data = bflpedat,
                      method = "REML")
```

```
## Warning: Rows with NAs omitted from model fitting.
```

```
# Summarize the results
summary(MEM3L.hdi.csc, digits=4)
```

```
##
## Multivariate Meta-Analysis Model (k = 242; method: REML)
##
##    logLik   Deviance        AIC        BIC       AICc
##  121.4148  -242.8295  -234.8295  -220.9070  -234.6593
##
## Variance Components:
##
##              estim    sqrt  nlvls  fixed        factor
## sigma^2.1   0.0145  0.1206     83     no       country
## sigma^2.2   0.0071  0.0842    242     no  country/ESID
##
## Test for Residual Heterogeneity:
## QE(df = 240) = 872.4148, p-val < .0001
##
## Test of Moderators (coefficient 2):
## QM(df = 1) = 9.0647, p-val = 0.0026
##
## Model Results:
```

```
##
##          estimate      se     zval    pval    ci.lb    ci.ub
## intrcpt   -0.9312  0.1582  -5.8877  <.0001  -1.2412  -0.6212  ***
## HDI        0.5585  0.1855   3.0108  0.0026   0.1949   0.9221   **
##
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

```
# Robust CIs
conf_int(MEM3L.hdi.csc, vcov = "CR2")
```

```
##      Coef Estimate    SE d.f. Lower 95% CI Upper 95% CI
## 1 intrcpt   -0.931 0.205 42.4      -1.3455       -0.517
## 2     HDI    0.559 0.235 45.6       0.0862        1.031
```

```
# Variance explanations
# Country level
(REM3L.csc$sigma2[1]-MEM3L.hdi.csc$sigma2[1])*100/REM3L.csc$sigma2[1]
```

```
## [1] 11.55301
```

```
# Effect size level
(REM3L.csc$sigma2[2]-MEM3L.hdi.csc$sigma2[2])*100/REM3L.csc$sigma2[2]
```

```
## [1] 0.2603856
```

4 Selection bias

4.1 Egger's regression test and Precision-Effect Test (PET)

```
## Details: https://wviechtb.github.io/metafor/reference/regtest.html
## Three-level REM with standard error as the predictor
MEM3Lc.pet <- rma.mv(effect_size ~ 1 + sqrt(var),
                      var,
                      random = list(~ 1 | country/ESID),
                      data = bflpedat,
                      method = "REML",
                 tdist = TRUE)

# Summarize the results
summary(MEM3Lc.pet, digits=4)
```

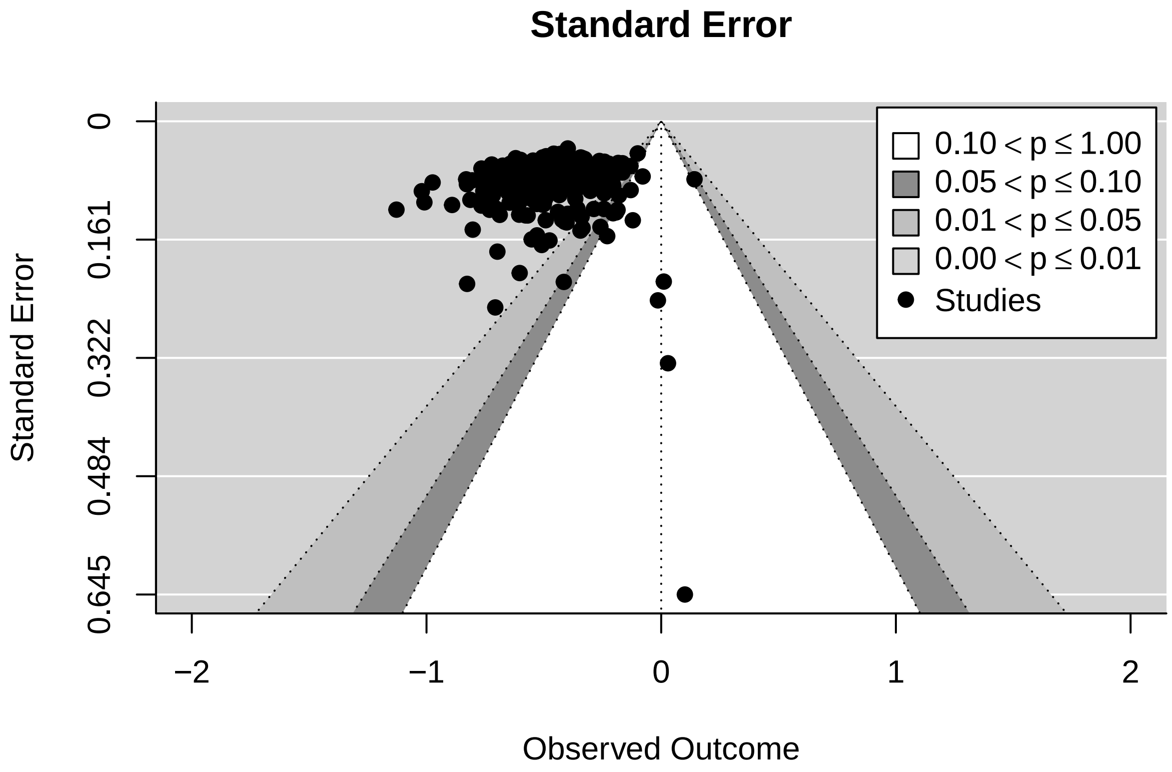
```
##
## Multivariate Meta-Analysis Model (k = 248; method: REML)
##
##    logLik   Deviance        AIC        BIC       AICc
##  128.7794  -257.5588  -249.5588  -235.5375  -249.3928
##
## Variance Components:
##
##             estim    sqrt  nlvls  fixed        factor
## sigma^2.1  0.0212  0.1457     85     no       country
## sigma^2.2  0.0028  0.0528    248     no  country/ESID
##
## Test for Residual Heterogeneity:
## QE(df = 246) = 1211.7570, p-val < .0001
##
## Test of Moderators (coefficient 2):
## F(df1 = 1, df2 = 246) = 9.4099, p-val = 0.0024
##
## Model Results:
##
##            estimate      se      tval   df    pval    ci.lb    ci.ub
## intrcpt     -0.3611  0.0340  -10.6072  246  <.0001  -0.4281  -0.2940  ***
## sqrt(var)   -1.0679  0.3481   -3.0676  246  0.0024  -1.7535  -0.3822   **
##
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

From these mixed-effects meta-regression models, we can conclude that there is evidence on selection bias, due to the significant effect of the standard error as a moderator.

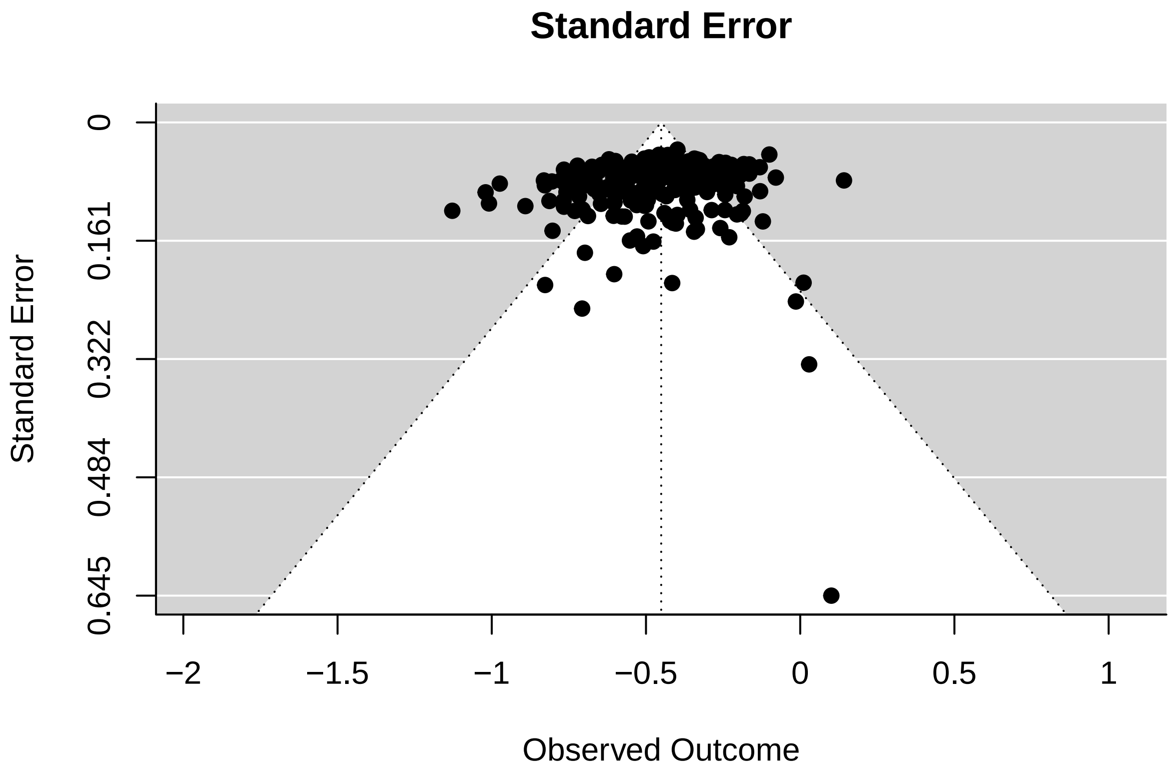
4.2 Funnel Plot Test

Note: In the current data set, sample sizes were missing. They were randomly generated (random numbers in Excel between 1000 and 5000) to illustrate the procedure.

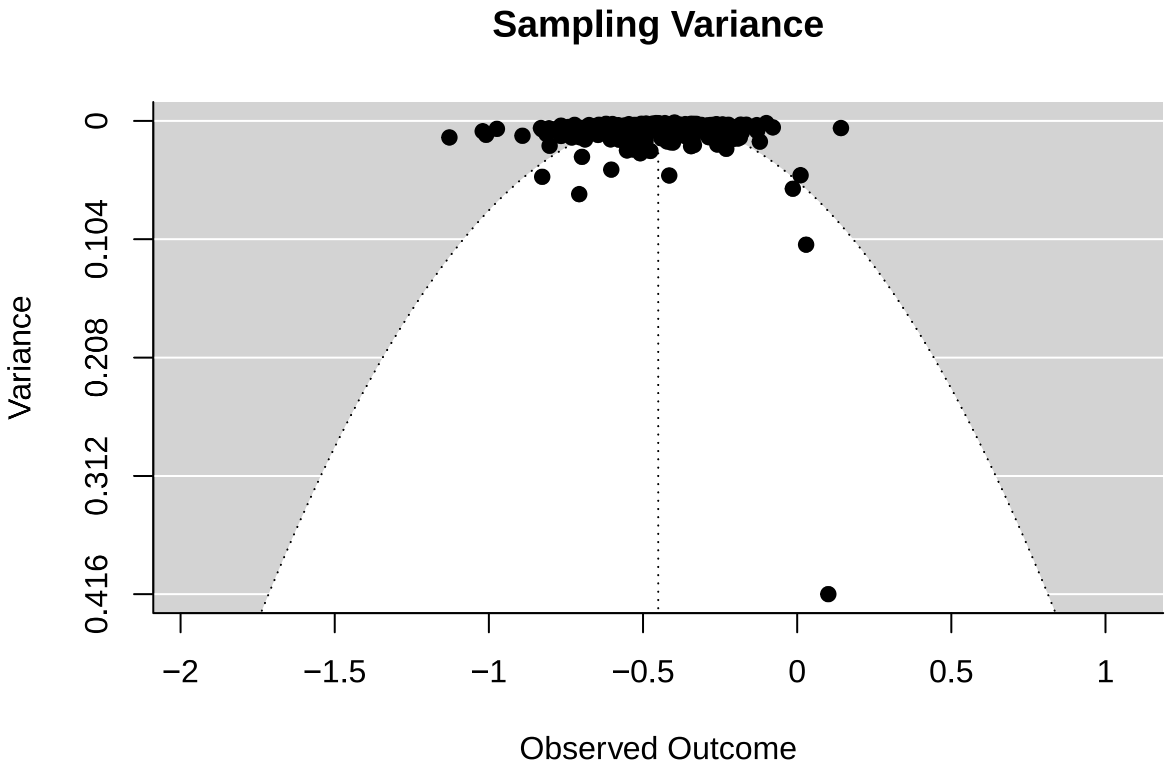
```r
###########
# Contour-enhanced funnel plot
funnel(REM3Lc, main="Standard Error",
       level=c(90, 95, 99),
       shade=c("white", "gray55", "gray75"),
       refline=0,
       legend=TRUE)
```



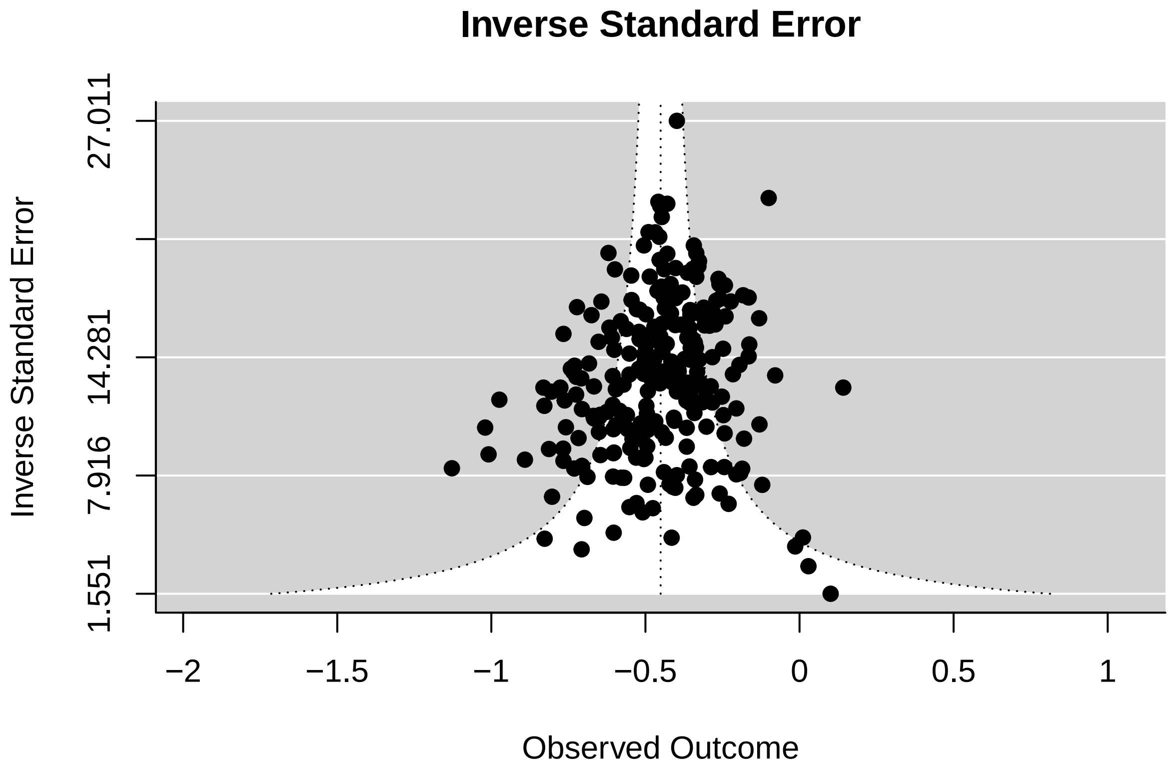
```r
# Funnel plots
funnel(REM3Lc, main="Standard Error")
```



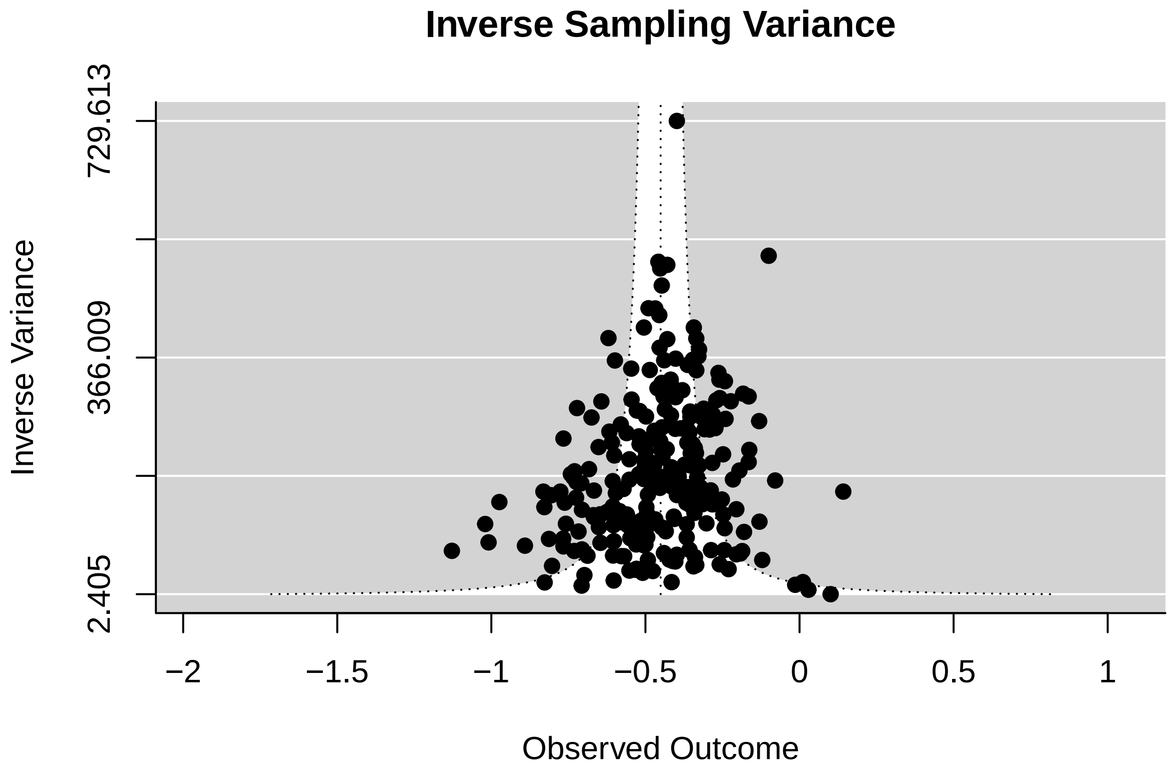
```
funnel(REM3Lc, yaxis="vi", main="Sampling Variance")
```



```
funnel(REM3Lc, yaxis="seinv", main="Inverse Standard Error")
```



```
funnel(REM3Lc, yaxis="vinv", main="Inverse Sampling Variance")
```



```
###########
## Three-level REM with N as the predictor
```

```
MEM3Lc.fpt <- rma.mv(effect_size ~ 1 + bflpedat$N,
                     var,
                     random = list(~ 1 | country/ESID),
                     data = bflpedat,
                     method = "REML",
                     tdist = TRUE)

# Summarize the results
summary(MEM3Lc.fpt, digits=4)
```

```
##
## Multivariate Meta-Analysis Model (k = 248; method: REML)
##
##    logLik   Deviance        AIC        BIC       AICc
##  123.8136  -247.6273  -239.6273  -225.6059  -239.4613
##
## Variance Components:
##
##              estim    sqrt  nlvls  fixed        factor
## sigma^2.1  0.0208  0.1442     85     no       country
## sigma^2.2  0.0036  0.0599    248     no  country/ESID
##
## Test for Residual Heterogeneity:
## QE(df = 246) = 1252.0498, p-val < .0001
##
## Test of Moderators (coefficient 2):
## F(df1 = 1, df2 = 246) = 0.6691, p-val = 0.4142
##
## Model Results:
##
##             estimate      se      tval   df    pval    ci.lb    ci.ub
## intrcpt      -0.4346  0.0265  -16.4067  246  <.0001  -0.4867  -0.3824  ***
## bflpedat$N   -0.0000  0.0000   -0.8180  246  0.4142  -0.0000   0.0000
##
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

From these mixed-effects meta-regression models, we can conclude that there is no evidence on selection bias, due to the insignificant effect of the standard error as a moderator.

4.3 Precision-Effect Estimate with SE (PEESE)

```
## Details: https://wviechtb.github.io/metafor/reference/regtest.html
## Three-level REM with standard error as the predictor
MEM3Lc.peese <- rma.mv(effect_size ~ 1 + var,
                       var,
                       random = list(~ 1 | country/ESID),
```

```
                        data = bflpedat,
                        method = "REML",
                        tdist = TRUE)

# Summarize the results
summary(MEM3Lc.peese, digits=4)
```

```
##
## Multivariate Meta-Analysis Model (k = 248; method: REML)
##
##    logLik   Deviance        AIC         BIC       AICc
##  125.4660  -250.9320  -242.9320  -228.9107  -242.7661
##
## Variance Components:
##
##              estim    sqrt  nlvls  fixed        factor
## sigma^2.1   0.0209  0.1447     85     no       country
## sigma^2.2   0.0034  0.0581    248     no  country/ESID
##
## Test for Residual Heterogeneity:
## QE(df = 246) = 1245.7702, p-val < .0001
##
## Test of Moderators (coefficient 2):
## F(df1 = 1, df2 = 246) = 1.1475, p-val = 0.2851
##
## Model Results:
##
##          estimate      se       tval   df    pval    ci.lb    ci.ub
## intrcpt   -0.4404  0.0201  -21.9349  246  <.0001  -0.4799  -0.4009  ***
## var       -1.2330  1.1511   -1.0712  246  0.2851  -3.5002   1.0342
##
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

No evidence for selection bias.

4.4 Begg's Correlation Test

Note: In the current data set, sample sizes were missing. They were randomly generated (random numbers in Excel between 1000 and 5000) to illustrate the procedure.

```
## Source code: Fernandez-Castilla et al. (2021)
## https://doi.org/10.1080/00220973.2019.1582470

## Define the precision
preci = 1/bflpedat$var
Stand_Var = bflpedat$var - (1/(sum(preci)))
```

```
## Draw from the model REM3Lc
## Define the pooled effect size from a baseline model
pooled_es <- REM3Lc$b[1]
Stand_es <- (bflpedat$effect_size - (pooled_es))/sqrt(Stand_Var)
N <- bflpedat$N
df_cor_N <- data.frame(Stand_es, N)

## Correlation coefficient and test
cor(df_cor_N, method = "kendall" )
```

```
##           Stand_es         N
## Stand_es 1.0000000 0.0252404
## N        0.0252404 1.0000000
```

```
bct <- cor.test(Stand_es, N, method = "kendall")
bct
```

```
## 
##  Kendall's rank correlation tau
## 
## data:  Stand_es and N
## z = 0.592, p-value = 0.5538
## alternative hypothesis: true tau is not equal to 0
## sample estimates:
##       tau 
## 0.0252404
```

Result: No evidence for selection bias (insignificant correlation).

4.5 Trim-and-fill analyses

4.5.1 Trim-and-fill analyses with the estimator R_0^+

```
## Source code: Fernandez-Castilla et al. (2021)
## https://doi.org/10.1080/00220973.2019.1582470

## Create an object d with all observed effect sizes
d <- bflpedat$effect_size

## Create a new function
## see the source code
R0_func<-function(d, pooled_d){
  d_difference1=0
  rank_positive=0
  final_rank=0
  d_difference<- d-pooled_d
  for(i in 1:length(d_difference)){
     d_difference1[i]<- if ( d_difference[i]<0) d_difference[i]*-1
```

```
     else d_difference[i] }
  rank_positive<-rank(d_difference1)
  for(i in 1:length(d_difference)){
     final_rank[i]<- if (d_difference[i]<0) rank_positive[i]*-1
     else rank_positive[i]}
  O=length(d_difference)-(min(final_rank)*-1)
  R0_ps= O-1
  R0=if (R0_ps<0) 0 else  R0_ps
  print(R0)
}

## Obtain the R0+ estimator
R0_func(d, pooled_es)
```

```
## [1] 0
```

Given that $R_0^+ < 3$, there is no evidence for selection bias.

4.5.2 Trim-and-fill analyses with the estimator L_0^+

```
## Source code: Fernandez-Castilla et al. (2021)
## https://doi.org/10.1080/00220973.2019.1582470

## Define a new function
L0_func<-function(d, pooled_d){
  d_difference1=0
  rank_positive=0
  d_difference<- d-pooled_d
  d_difference1=0
  only_positive=0
  final_rank=0
  N_ES<-length(d)
  for(i in 1:length(d_difference)){
    d_difference1[i]<- if ( d_difference[i]<0) d_difference[i]*-1
    else d_difference[i] }
  rank_positive<-rank(d_difference1)
  for(i in 1:length(d_difference)){
    final_rank[i]<- if (d_difference[i]<0) rank_positive[i]*-1
    else rank_positive[i]
    only_positive[i]<- if (final_rank[i]<0) 0
    else final_rank[i]}
  t=sum(only_positive)
  L0_ps=(4*t-N_ES*(N_ES+1))/(2*N_ES-1)
  L0= if (L0_ps<0) 0 else  L0_ps
  print(L0)
}
```

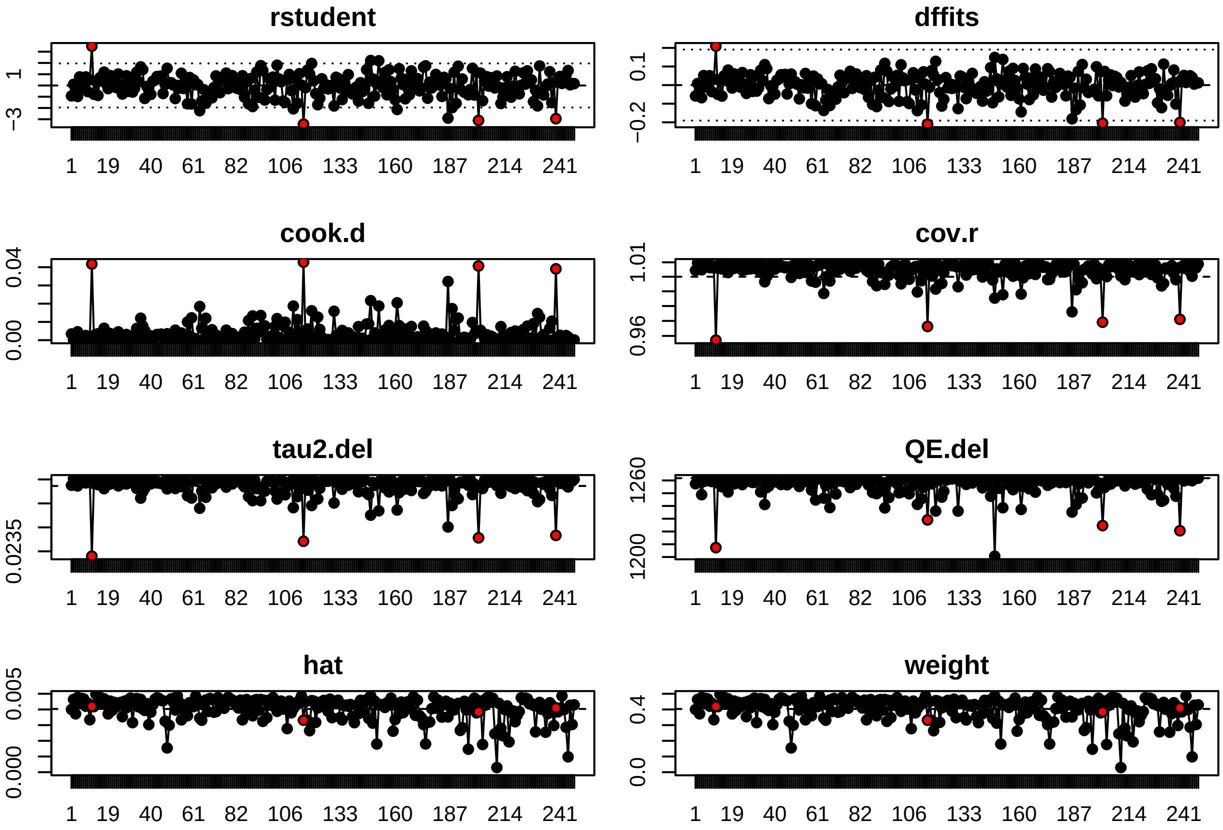
```r
## Obtain the L0+ estimate
L0_func(d, pooled_es)
```

```
## [1] 1.292929
```

Given that $L_0^+ < 2$, there is no evidence for selection bias.

4.6 Influential effect sizes

```r
# Analyses based on the REM with variation between effect sizes
# Plots indicating potential influential effect sizes
inf1 <- influence.rma.uni(rma(effect_size,
                              var,
                              data = bflpedat,
                              method = "REML"))
plot.infl.rma.uni(inf1)
```



```r
# Increase max print options to show all effect sizes
options(max.print = 1000000)
print(inf1)
```

```
##
##      rstudent  dffits cook.d  cov.r tau2.del    QE.del    hat weight    dfbs inf
## 1    -0.9259 -0.0585 0.0034 1.0044   0.0249 1257.3521 0.0040 0.3998 -0.0585
```

```
## 2      0.1017  0.0086 0.0001 1.0096   0.0250 1261.7647 0.0046 0.4638  0.0086
## 3     -0.4484 -0.0264 0.0007 1.0068   0.0250 1260.7458 0.0037 0.3719 -0.0264
## 4     -0.9810 -0.0679 0.0046 1.0048   0.0249 1248.8334 0.0048 0.4764 -0.0679
## 5      0.7651  0.0514 0.0026 1.0065   0.0249 1259.1472 0.0044 0.4370  0.0514
## 6     -0.1677 -0.0099 0.0001 1.0096   0.0250 1261.0269 0.0047 0.4702 -0.0099
## 7      0.0661  0.0062 0.0000 1.0097   0.0250 1261.7490 0.0047 0.4673  0.0062
## 8      0.7620  0.0502 0.0025 1.0063   0.0249 1259.5680 0.0042 0.4207  0.0502
## 9     -0.5461 -0.0352 0.0012 1.0076   0.0250 1259.1251 0.0044 0.4403 -0.0352
## 10     0.5118  0.0306 0.0009 1.0061   0.0249 1261.2775 0.0033 0.3343  0.0306
## 11     3.4910  0.2093 0.0417 0.9572   0.0234 1207.3691 0.0042 0.4194  0.2093    *
## 12    -0.7820 -0.0501 0.0025 1.0058   0.0249 1257.9161 0.0042 0.4181 -0.0501
## 13     0.3707  0.0278 0.0008 1.0097   0.0250 1260.4548 0.0050 0.4973  0.0278
## 14    -0.8863 -0.0592 0.0035 1.0053   0.0249 1255.0120 0.0045 0.4482 -0.0592
## 15     0.6970  0.0492 0.0024 1.0076   0.0249 1257.8482 0.0048 0.4781  0.0492
## 16     0.6839  0.0462 0.0021 1.0070   0.0249 1259.7448 0.0044 0.4373  0.0462
## 17     1.1901  0.0810 0.0065 1.0029   0.0248 1250.9250 0.0047 0.4681  0.0810
## 18     0.1580  0.0121 0.0001 1.0091   0.0250 1261.7464 0.0045 0.4453  0.0121
## 19    -0.2825 -0.0160 0.0003 1.0073   0.0250 1261.2742 0.0037 0.3712 -0.0160
## 20     0.8860  0.0602 0.0036 1.0058   0.0249 1257.2788 0.0045 0.4535  0.0602
## 21     0.2752  0.0187 0.0003 1.0079   0.0250 1261.6398 0.0039 0.3943  0.0187
## 22     0.6905  0.0471 0.0022 1.0071   0.0249 1259.4865 0.0045 0.4456  0.0471
## 23    -0.1919 -0.0110 0.0001 1.0084   0.0250 1261.3445 0.0042 0.4168 -0.0110
## 24     1.0168  0.0675 0.0046 1.0044   0.0249 1256.7076 0.0044 0.4384  0.0675
## 25     0.0587  0.0055 0.0000 1.0092   0.0250 1261.7507 0.0044 0.4447  0.0055
## 26    -0.7608 -0.0448 0.0020 1.0050   0.0249 1259.5262 0.0035 0.3537 -0.0448
## 27    -0.0762 -0.0035 0.0000 1.0093   0.0250 1261.5207 0.0045 0.4529 -0.0035
## 28     0.8603  0.0557 0.0031 1.0054   0.0249 1259.1020 0.0041 0.4112  0.0557
## 29    -0.5182 -0.0341 0.0012 1.0082   0.0250 1258.4224 0.0046 0.4630 -0.0341
## 30     0.6747  0.0474 0.0023 1.0076   0.0250 1258.5318 0.0047 0.4724  0.0475
## 31    -0.5907 -0.0326 0.0011 1.0053   0.0249 1260.6059 0.0032 0.3159 -0.0325
## 32    -0.2542 -0.0154 0.0002 1.0087   0.0250 1260.9988 0.0044 0.4364 -0.0154
## 33     1.1739  0.0801 0.0064 1.0031   0.0248 1250.9528 0.0047 0.4696  0.0801
## 34     0.3393  0.0233 0.0005 1.0082   0.0250 1261.4905 0.0042 0.4165  0.0233
## 35     1.6523  0.1102 0.0120 0.9965   0.0246 1241.1132 0.0046 0.4646  0.1101
## 36     1.4115  0.0884 0.0078 1.0001   0.0247 1254.4008 0.0040 0.4029  0.0884
## 37    -1.1510 -0.0729 0.0053 1.0024   0.0248 1255.5271 0.0039 0.3937 -0.0729
## 38    -0.0807 -0.0038 0.0000 1.0090   0.0250 1261.5598 0.0044 0.4369 -0.0038
## 39    -0.1637 -0.0080 0.0001 1.0062   0.0250 1261.6162 0.0030 0.3032 -0.0080
## 40    -0.7915 -0.0486 0.0024 1.0052   0.0249 1258.8451 0.0038 0.3827 -0.0486
## 41     0.3792  0.0263 0.0007 1.0083   0.0250 1261.3421 0.0043 0.4300  0.0263
## 42     0.4663  0.0332 0.0011 1.0087   0.0250 1260.6187 0.0047 0.4655  0.0332
## 43     0.7972  0.0557 0.0031 1.0068   0.0249 1256.8016 0.0047 0.4744  0.0557
## 44     0.7394  0.0516 0.0027 1.0071   0.0249 1257.9132 0.0047 0.4702  0.0516
## 45     0.8424  0.0576 0.0033 1.0062   0.0249 1257.5271 0.0046 0.4575  0.0576
## 46    -0.7211 -0.0480 0.0023 1.0068   0.0249 1256.5806 0.0046 0.4552 -0.0480
## 47     0.0901  0.0063 0.0000 1.0067   0.0250 1261.7650 0.0033 0.3252  0.0063
## 48     1.5301  0.0594 0.0035 0.9995   0.0248 1258.7155 0.0015 0.1546  0.0595
## 49     0.2254  0.0134 0.0002 1.0061   0.0250 1261.7199 0.0030 0.2992  0.0134
```

```
## 50    0.2398  0.0180 0.0003 1.0095   0.0250 1261.6024 0.0047 0.4681  0.0181
## 51    0.0413  0.0044 0.0000 1.0093   0.0250 1261.7368 0.0045 0.4476  0.0044
## 52   -1.1656 -0.0741 0.0055 1.0022   0.0248 1255.2592 0.0040 0.3961 -0.0741
## 53    0.0003  0.0018 0.0000 1.0101   0.0250 1261.5977 0.0049 0.4866  0.0018
## 54   -0.2389 -0.0145 0.0002 1.0089   0.0250 1260.9884 0.0044 0.4444 -0.0145
## 55    1.0840  0.0625 0.0039 1.0029   0.0249 1259.0671 0.0033 0.3334  0.0625
## 56   -0.2691 -0.0162 0.0003 1.0085   0.0250 1261.0056 0.0043 0.4286 -0.0162
## 57    0.2851  0.0192 0.0004 1.0078   0.0250 1261.6278 0.0039 0.3914  0.0192
## 58   -1.6300 -0.1001 0.0100 0.9970   0.0247 1252.3751 0.0036 0.3597 -0.1002
## 59    0.7121  0.0484 0.0023 1.0069   0.0249 1259.3806 0.0044 0.4434  0.0484
## 60   -1.6442 -0.1111 0.0122 0.9962   0.0246 1244.6586 0.0043 0.4318 -0.1111
## 61    0.4927  0.0331 0.0011 1.0077   0.0250 1261.0144 0.0042 0.4177  0.0331
## 62    0.0673  0.0064 0.0000 1.0100   0.0250 1261.7416 0.0048 0.4839  0.0064
## 63    0.0922  0.0076 0.0001 1.0089   0.0250 1261.7643 0.0043 0.4301  0.0076
## 64   -2.2430 -0.1367 0.0185 0.9885   0.0244 1246.0987 0.0034 0.3446 -0.1369
## 65   -1.3793 -0.0806 0.0065 0.9999   0.0248 1255.9341 0.0033 0.3311 -0.0806
## 66   -0.3700 -0.0235 0.0006 1.0086   0.0250 1260.1513 0.0045 0.4507 -0.0235
## 67   -1.5787 -0.1101 0.0120 0.9970   0.0246 1238.6974 0.0046 0.4605 -0.1100
## 68   -0.6593 -0.0403 0.0016 1.0061   0.0249 1259.5787 0.0039 0.3870 -0.0403
## 69   -0.5284 -0.0351 0.0012 1.0082   0.0250 1257.8170 0.0047 0.4705 -0.0351
## 70   -1.1046 -0.0758 0.0057 1.0033   0.0248 1249.3861 0.0046 0.4625 -0.0757
## 71   -0.1837 -0.0101 0.0001 1.0077   0.0250 1261.4736 0.0038 0.3821 -0.0101
## 72    0.8492  0.0533 0.0028 1.0052   0.0249 1259.6402 0.0039 0.3854  0.0533
## 73    0.1755  0.0138 0.0002 1.0098   0.0250 1261.7165 0.0048 0.4762  0.0138
## 74   -0.6425 -0.0409 0.0017 1.0067   0.0249 1258.9413 0.0042 0.4214 -0.0409
## 75    0.5375  0.0375 0.0014 1.0081   0.0250 1260.3717 0.0045 0.4544  0.0375
## 76    0.5707  0.0375 0.0014 1.0071   0.0250 1260.7738 0.0041 0.4076  0.0375
## 77    1.1011  0.0741 0.0055 1.0038   0.0248 1254.3616 0.0045 0.4546  0.0741
## 78   -0.2841 -0.0181 0.0003 1.0094   0.0250 1260.0104 0.0048 0.4781 -0.0181
## 79    0.2455  0.0184 0.0003 1.0094   0.0250 1261.5911 0.0047 0.4670  0.0184
## 80    0.8748  0.0599 0.0036 1.0060   0.0249 1256.9489 0.0046 0.4603  0.0599
## 81    0.0759  0.0066 0.0000 1.0091   0.0250 1261.7597 0.0044 0.4412  0.0066
## 82   -0.2356 -0.0141 0.0002 1.0087   0.0250 1261.1111 0.0043 0.4320 -0.0141
## 83    0.5103  0.0338 0.0011 1.0074   0.0250 1261.0007 0.0041 0.4094  0.0338
## 84   -0.3617 -0.0232 0.0005 1.0088   0.0250 1259.9851 0.0046 0.4596 -0.0232
## 85    0.8657  0.0504 0.0025 1.0044   0.0249 1260.1215 0.0033 0.3334  0.0504
## 86   -1.0449 -0.0662 0.0044 1.0034   0.0248 1256.3918 0.0040 0.3971 -0.0662
## 87    0.3341  0.0243 0.0006 1.0091   0.0250 1261.3205 0.0046 0.4636  0.0243
## 88   -1.6377 -0.1042 0.0108 0.9967   0.0246 1250.5615 0.0038 0.3848 -0.1042
## 89    0.6127  0.0419 0.0018 1.0075   0.0250 1260.0975 0.0044 0.4433  0.0419
## 90   -1.8741 -0.1158 0.0133 0.9938   0.0246 1249.6006 0.0036 0.3592 -0.1159
## 91   -0.4153 -0.0269 0.0007 1.0086   0.0250 1259.5494 0.0046 0.4598 -0.0269
## 92    1.1901  0.0806 0.0065 1.0028   0.0248 1251.7466 0.0046 0.4634  0.0806
## 93   -1.0535 -0.0666 0.0044 1.0033   0.0248 1256.3911 0.0040 0.3953 -0.0666
## 94    1.7608  0.1169 0.0135 0.9947   0.0246 1238.4428 0.0046 0.4638  0.1168
## 95    1.3289  0.0749 0.0056 1.0009   0.0248 1257.7683 0.0032 0.3239  0.0749
## 96   -1.2904 -0.0887 0.0078 1.0011   0.0248 1246.5563 0.0046 0.4576 -0.0887
## 97   -0.3715 -0.0209 0.0004 1.0066   0.0250 1261.1259 0.0035 0.3475 -0.0209
```

```
## 98    0.6167  0.0429 0.0018 1.0078   0.0250 1259.7163 0.0046 0.4578  0.0429
## 99   -0.1026 -0.0052 0.0000 1.0088   0.0250 1261.5389 0.0043 0.4263 -0.0052
## 100   0.7442  0.0523 0.0027 1.0072   0.0249 1257.3653 0.0048 0.4763  0.0523
## 101  -1.3040 -0.0874 0.0076 1.0009   0.0248 1250.2339 0.0043 0.4349 -0.0874
## 102   1.7989  0.1091 0.0118 0.9951   0.0246 1250.7983 0.0039 0.3877  0.1092
## 103   0.5813  0.0385 0.0015 1.0072   0.0250 1260.6647 0.0041 0.4147  0.0385
## 104   0.3246  0.0234 0.0005 1.0090   0.0250 1261.4111 0.0045 0.4536  0.0234
## 105  -1.3824 -0.0893 0.0079 0.9999   0.0247 1252.3975 0.0040 0.4022 -0.0893
## 106  -1.5118 -0.0995 0.0098 0.9982   0.0247 1249.4927 0.0041 0.4142 -0.0995
## 107   0.5262  0.0285 0.0008 1.0050   0.0249 1261.3484 0.0028 0.2774  0.0285
## 108   0.9808  0.0663 0.0044 1.0049   0.0249 1256.1363 0.0045 0.4534  0.0663
## 109  -0.4468 -0.0265 0.0007 1.0069   0.0250 1260.7057 0.0038 0.3781 -0.0265
## 110  -2.0807 -0.1377 0.0187 0.9895   0.0244 1241.2148 0.0041 0.4051 -0.1377
## 111   0.5470  0.0368 0.0014 1.0075   0.0250 1260.7452 0.0042 0.4228  0.0368
## 112  -1.5772 -0.1066 0.0113 0.9972   0.0246 1245.6218 0.0043 0.4336 -0.1066
## 113   1.0520  0.0713 0.0051 1.0043   0.0249 1254.6888 0.0046 0.4584  0.0713
## 114   0.0369  0.0043 0.0000 1.0101   0.0250 1261.6923 0.0049 0.4859  0.0043
## 115  -3.4342 -0.2099 0.0428 0.9663   0.0237 1229.0576 0.0033 0.3315 -0.2107   *
## 116  -0.1991 -0.0118 0.0001 1.0091   0.0250 1261.1159 0.0045 0.4492 -0.0118
## 117   1.3736  0.0781 0.0061 1.0005   0.0248 1257.3307 0.0033 0.3308  0.0781
## 118   1.0279  0.0529 0.0028 1.0027   0.0249 1259.9617 0.0026 0.2644  0.0529
## 119   1.9523  0.1278 0.0161 0.9915   0.0245 1235.9887 0.0046 0.4564  0.1277
## 120   0.4250  0.0301 0.0009 1.0086   0.0250 1261.0096 0.0045 0.4538  0.0301
## 121  -0.7260 -0.0405 0.0016 1.0047   0.0249 1260.0824 0.0032 0.3178 -0.0405
## 122  -1.7140 -0.1129 0.0126 0.9954   0.0246 1246.8971 0.0041 0.4096 -0.1129
## 123  -1.1379 -0.0767 0.0059 1.0028   0.0248 1251.4504 0.0045 0.4462 -0.0767
## 124   0.5967  0.0406 0.0017 1.0075   0.0250 1260.3101 0.0044 0.4370  0.0406
## 125  -0.2366 -0.0145 0.0002 1.0092   0.0250 1260.8342 0.0046 0.4579 -0.0145
## 126   0.0711  0.0064 0.0000 1.0094   0.0250 1261.7557 0.0045 0.4542  0.0064
## 127  -0.3110 -0.0182 0.0003 1.0076   0.0250 1261.1167 0.0039 0.3889 -0.0182
## 128  -0.0176  0.0005 0.0000 1.0097   0.0250 1261.6239 0.0047 0.4660  0.0005
## 129  -0.2165 -0.0116 0.0001 1.0070   0.0250 1261.4816 0.0035 0.3473 -0.0116
## 130  -1.8239 -0.1267 0.0159 0.9931   0.0245 1235.9697 0.0045 0.4498 -0.1266
## 131   0.7300  0.0491 0.0024 1.0067   0.0249 1259.4227 0.0044 0.4368  0.0491
## 132   0.6296  0.0438 0.0019 1.0077   0.0250 1259.5642 0.0046 0.4593  0.0438
## 133  -0.2327 -0.0126 0.0002 1.0070   0.0250 1261.4463 0.0035 0.3496 -0.0126
## 134  -1.2504 -0.0730 0.0053 1.0011   0.0248 1256.8643 0.0033 0.3328 -0.0730
## 135   0.2509  0.0178 0.0003 1.0085   0.0250 1261.6509 0.0042 0.4232  0.0178
## 136  -0.5385 -0.0342 0.0012 1.0074   0.0250 1259.5220 0.0043 0.4282 -0.0342
## 137   0.9669  0.0630 0.0040 1.0047   0.0249 1258.0104 0.0042 0.4203  0.0630
## 138  -0.3622 -0.0225 0.0005 1.0083   0.0250 1260.5356 0.0043 0.4318 -0.0225
## 139  -0.7513 -0.0443 0.0020 1.0051   0.0249 1259.5636 0.0035 0.3545 -0.0443
## 140  -0.5462 -0.0300 0.0009 1.0054   0.0249 1260.7538 0.0032 0.3157 -0.0300
## 141  -0.1368 -0.0074 0.0001 1.0087   0.0250 1261.4596 0.0043 0.4257 -0.0074
## 142  -1.3893 -0.0863 0.0074 0.9998   0.0247 1254.1811 0.0037 0.3728 -0.0863
## 143   0.2433  0.0181 0.0003 1.0093   0.0250 1261.6168 0.0046 0.4583  0.0181
## 144  -0.5418 -0.0326 0.0011 1.0066   0.0250 1260.2517 0.0038 0.3829 -0.0326
## 145   0.0355  0.0040 0.0000 1.0093   0.0250 1261.7308 0.0045 0.4488  0.0040
```

```
## 146   1.4060  0.0943 0.0089 1.0001   0.0247 1247.5963 0.0046 0.4625  0.0943
## 147  -1.5852 -0.0949 0.0090 0.9977   0.0247 1253.6997 0.0034 0.3428 -0.0949
## 148   2.2183  0.1489 0.0217 0.9853   0.0243 1200.6701 0.0049 0.4872  0.1486
## 149   0.5831  0.0335 0.0011 1.0054   0.0249 1261.1593 0.0031 0.3126  0.0334
## 150  -0.9381 -0.0631 0.0040 1.0049   0.0249 1253.8261 0.0045 0.4526 -0.0631
## 151   0.1596  0.0074 0.0001 1.0037   0.0249 1261.7519 0.0018 0.1793  0.0074
## 152   2.1930  0.1380 0.0187 0.9877   0.0243 1238.5961 0.0043 0.4276  0.1379
## 153   0.3740  0.0260 0.0007 1.0084   0.0250 1261.3536 0.0043 0.4311  0.0260
## 154  -0.1834 -0.0106 0.0001 1.0087   0.0250 1261.3078 0.0043 0.4300 -0.0106
## 155   1.1617  0.0743 0.0055 1.0028   0.0248 1256.5178 0.0041 0.4126  0.0743
## 156  -0.8336 -0.0551 0.0030 1.0057   0.0249 1256.1540 0.0044 0.4422 -0.0551
## 157   1.3926  0.0900 0.0081 1.0003   0.0247 1252.7590 0.0043 0.4284  0.0900
## 158   0.3373  0.0248 0.0006 1.0093   0.0250 1261.2335 0.0047 0.4726  0.0248
## 159  -0.3311 -0.0161 0.0003 1.0051   0.0249 1261.4274 0.0026 0.2613 -0.0161
## 160  -1.2603 -0.0739 0.0054 1.0011   0.0248 1256.7233 0.0034 0.3353 -0.0739
## 161  -2.1365 -0.1443 0.0205 0.9881   0.0244 1237.2252 0.0042 0.4193 -0.1443
## 162   1.4905  0.0895 0.0080 0.9992   0.0247 1255.1225 0.0037 0.3721  0.0895
## 163   0.6508  0.0446 0.0020 1.0074   0.0250 1259.7363 0.0045 0.4476  0.0446
## 164   0.0596  0.0051 0.0000 1.0079   0.0250 1261.7599 0.0038 0.3795  0.0051
## 165  -1.1897 -0.0780 0.0061 1.0021   0.0248 1253.4100 0.0042 0.4202 -0.0780
## 166   0.5514  0.0382 0.0015 1.0079   0.0250 1260.3983 0.0045 0.4481  0.0382
## 167  -0.8264 -0.0523 0.0027 1.0053   0.0249 1257.9725 0.0041 0.4059 -0.0523
## 168   1.2956  0.0868 0.0075 1.0016   0.0248 1250.8266 0.0046 0.4571  0.0868
## 169  -0.1939 -0.0118 0.0001 1.0097   0.0250 1260.6519 0.0048 0.4810 -0.0118
## 170   0.4853  0.0303 0.0009 1.0067   0.0250 1261.2722 0.0036 0.3623  0.0303
## 171   0.6119  0.0426 0.0018 1.0078   0.0250 1259.7055 0.0046 0.4595  0.0426
## 172  -0.4784 -0.0278 0.0008 1.0065   0.0250 1260.7144 0.0036 0.3606 -0.0278
## 173  -0.2417 -0.0131 0.0002 1.0069   0.0250 1261.4374 0.0035 0.3455 -0.0131
## 174   1.6296  0.0880 0.0077 0.9980   0.0247 1256.1627 0.0030 0.3030  0.0881
## 175   1.7439  0.0726 0.0053 0.9982   0.0247 1257.4990 0.0018 0.1798  0.0727
## 176  -1.1364 -0.0645 0.0042 1.0020   0.0248 1257.9778 0.0032 0.3173 -0.0645
## 177   0.2976  0.0180 0.0003 1.0064   0.0250 1261.6535 0.0032 0.3202  0.0179
## 178  -0.2170 -0.0125 0.0002 1.0082   0.0250 1261.3222 0.0041 0.4050 -0.0125
## 179   0.0185  0.0030 0.0000 1.0100   0.0250 1261.6676 0.0048 0.4800  0.0030
## 180   0.9805  0.0629 0.0040 1.0045   0.0249 1258.2915 0.0041 0.4079  0.0629
## 181   0.1250  0.0101 0.0001 1.0095   0.0250 1261.7623 0.0046 0.4602  0.0101
## 182   0.0288  0.0034 0.0000 1.0088   0.0250 1261.7370 0.0042 0.4223  0.0034
## 183  -0.9767 -0.0580 0.0034 1.0035   0.0249 1258.3103 0.0035 0.3511 -0.0580
## 184   0.7241  0.0484 0.0023 1.0066   0.0249 1259.6321 0.0043 0.4298  0.0484
## 185   0.5953  0.0412 0.0017 1.0078   0.0250 1260.0229 0.0045 0.4523  0.0412
## 186  -2.9014 -0.1815 0.0322 0.9761   0.0240 1235.1741 0.0035 0.3521 -0.1819
## 187  -0.2668 -0.0163 0.0003 1.0087   0.0250 1260.9080 0.0044 0.4399 -0.0163
## 188  -1.9774 -0.1324 0.0173 0.9911   0.0245 1241.1185 0.0042 0.4164 -0.1324
## 189   1.1668  0.0732 0.0054 1.0027   0.0248 1257.1059 0.0040 0.3968  0.0732
## 190  -1.5934 -0.1072 0.0114 0.9970   0.0246 1245.9786 0.0043 0.4298 -0.1072
## 191   1.7107  0.1107 0.0121 0.9958   0.0246 1246.1562 0.0044 0.4388  0.1106
## 192  -0.3206 -0.0157 0.0002 1.0052   0.0249 1261.4372 0.0027 0.2661 -0.0157
## 193   0.5739  0.0313 0.0010 1.0050   0.0249 1261.2433 0.0028 0.2834  0.0313
```

```
## 194  -0.6064 -0.0399 0.0016 1.0075   0.0250 1258.0887 0.0045 0.4520 -0.0399
## 195  -0.5627 -0.0346 0.0012 1.0068   0.0250 1259.9634 0.0040 0.3969 -0.0346
## 196  -0.8341 -0.0318 0.0010 1.0018   0.0249 1260.6570 0.0015 0.1463 -0.0318
## 197  -0.3569 -0.0225 0.0005 1.0086   0.0250 1260.3064 0.0045 0.4475 -0.0225
## 198   1.5248  0.0987 0.0097 0.9986   0.0247 1250.1655 0.0043 0.4340  0.0987
## 199  -0.8494 -0.0581 0.0034 1.0060   0.0249 1252.5599 0.0047 0.4722 -0.0581
## 200   1.1605  0.0711 0.0050 1.0026   0.0248 1257.7263 0.0038 0.3782  0.0711
## 201  -3.1071 -0.2050 0.0407 0.9691   0.0238 1224.6105 0.0038 0.3844 -0.2053   *
## 202   1.0943  0.0736 0.0054 1.0038   0.0248 1254.5367 0.0045 0.4539  0.0736
## 203  -1.3586 -0.0577 0.0033 1.0000   0.0248 1258.7124 0.0018 0.1765 -0.0577
## 204   0.3773  0.0260 0.0007 1.0083   0.0250 1261.3646 0.0043 0.4257  0.0260
## 205   0.7840  0.0547 0.0030 1.0069   0.0249 1257.1088 0.0047 0.4731  0.0548
## 206  -0.0603 -0.0025 0.0000 1.0099   0.0250 1261.4166 0.0048 0.4809 -0.0025
## 207   0.6906  0.0471 0.0022 1.0071   0.0249 1259.4798 0.0045 0.4458  0.0471
## 208   0.5715  0.0405 0.0016 1.0082   0.0250 1259.6432 0.0047 0.4713  0.0405
## 209  -0.2209 -0.0101 0.0001 1.0049   0.0249 1261.5975 0.0024 0.2449 -0.0101
## 210   0.8423  0.0145 0.0002 1.0004   0.0249 1261.0609 0.0003 0.0296  0.0145
## 211  -0.1504 -0.0084 0.0001 1.0090   0.0250 1261.3671 0.0044 0.4387 -0.0084
## 212  -1.6019 -0.0864 0.0074 0.9979   0.0247 1255.7146 0.0028 0.2796 -0.0864
## 213  -1.0116 -0.0488 0.0024 1.0021   0.0249 1259.6538 0.0023 0.2313 -0.0488
## 214  -0.2041 -0.0115 0.0001 1.0080   0.0250 1261.3817 0.0040 0.3982 -0.0115
## 215   0.7752  0.0512 0.0026 1.0062   0.0249 1259.4350 0.0042 0.4227  0.0512
## 216  -0.5578 -0.0241 0.0006 1.0033   0.0249 1261.1435 0.0019 0.1930 -0.0241
## 217  -1.0432 -0.0646 0.0042 1.0033   0.0248 1257.0681 0.0038 0.3797 -0.0646
## 218  -0.0544 -0.0020 0.0000 1.0081   0.0250 1261.6730 0.0039 0.3908 -0.0020
## 219   1.2591  0.0709 0.0050 1.0015   0.0248 1258.2428 0.0032 0.3216  0.0709
## 220  -0.1896 -0.0102 0.0001 1.0073   0.0250 1261.5022 0.0036 0.3628 -0.0102
## 221  -0.7522 -0.0463 0.0021 1.0055   0.0249 1259.0119 0.0039 0.3869 -0.0463
## 222   0.0245  0.0034 0.0000 1.0098   0.0250 1261.6901 0.0047 0.4747  0.0034
## 223   1.1231  0.0762 0.0058 1.0036   0.0248 1253.0259 0.0046 0.4628  0.0762
## 224   0.1146  0.0096 0.0001 1.0097   0.0250 1261.7646 0.0047 0.4723  0.0096
## 225   1.2987  0.0880 0.0077 1.0016   0.0248 1248.7414 0.0047 0.4677  0.0880
## 226   0.2431  0.0176 0.0003 1.0088   0.0250 1261.6503 0.0044 0.4360  0.0176
## 227   0.4926  0.0339 0.0012 1.0080   0.0250 1260.8559 0.0044 0.4374  0.0339
## 228  -1.4347 -0.0956 0.0091 0.9992   0.0247 1249.3058 0.0043 0.4257 -0.0956
## 229  -0.4173 -0.0205 0.0004 1.0048   0.0249 1261.2804 0.0026 0.2571 -0.0204
## 230  -1.8162 -0.1215 0.0146 0.9937   0.0245 1243.6476 0.0042 0.4193 -0.1215
## 231   1.7350  0.1129 0.0126 0.9954   0.0246 1244.4762 0.0044 0.4449  0.1129
## 232  -0.6988 -0.0436 0.0019 1.0061   0.0249 1259.0632 0.0040 0.4008 -0.0436
## 233  -0.8479 -0.0552 0.0030 1.0054   0.0249 1256.8979 0.0043 0.4272 -0.0552
## 234  -0.0793 -0.0031 0.0000 1.0052   0.0249 1261.7159 0.0025 0.2547 -0.0031
## 235   0.1286  0.0092 0.0001 1.0077   0.0250 1261.7613 0.0037 0.3731  0.0092
## 236   1.2277  0.0812 0.0066 1.0023   0.0248 1253.7130 0.0044 0.4428  0.0811
## 237  -1.5293 -0.1023 0.0104 0.9979   0.0247 1247.6046 0.0043 0.4267 -0.1023
## 238   0.2630  0.0154 0.0002 1.0060   0.0250 1261.6926 0.0030 0.2975  0.0154
## 239  -2.9478 -0.2010 0.0391 0.9710   0.0238 1220.5969 0.0041 0.4102 -0.2010   *
## 240   0.4997  0.0321 0.0010 1.0070   0.0250 1261.1608 0.0038 0.3842  0.0321
## 241   0.8009  0.0519 0.0027 1.0058   0.0249 1259.5594 0.0041 0.4081  0.0519
```

```
## 242   0.1773  0.0141 0.0002 1.0100   0.0250 1261.7023 0.0049 0.4863  0.0141
## 243   0.6476  0.0419 0.0018 1.0066   0.0249 1260.5128 0.0040 0.3988  0.0419
## 244   0.9334  0.0502 0.0025 1.0034   0.0249 1260.1816 0.0029 0.2862  0.0502
## 245   1.3335  0.0415 0.0017 1.0003   0.0248 1259.7402 0.0010 0.0977  0.0415
## 246   0.0575  0.0053 0.0000 1.0088   0.0250 1261.7538 0.0043 0.4266  0.0053
## 247   0.1741  0.0107 0.0001 1.0062   0.0250 1261.7469 0.0030 0.3042  0.0107
## 248   0.1610  0.0121 0.0001 1.0088   0.0250 1261.7466 0.0043 0.4297  0.0121
```

```
# Statistics
cooks.distance.rma.uni(rma(effect_size,
                          var,
                          data = bflpedat,
                          method = "REML"), 4)
```

```
##            1            2            3            4            5            6
## 3.424865e-03 7.437663e-05 6.965572e-04 4.607171e-03 2.646992e-03 9.815705e-05
##            7            8            9           10           11           12
## 3.883290e-05 2.526729e-03 1.245043e-03 9.372300e-04 4.174962e-02 2.517461e-03
##           13           14           15           16           17           18
## 7.747812e-04 3.505497e-03 2.431130e-03 2.141033e-03 6.548330e-03 1.482215e-04
##           19           20           21           22           23           24
## 2.578376e-04 3.629684e-03 3.493561e-04 2.222701e-03 1.208759e-04 4.554880e-03
##           25           26           27           28           29           30
## 3.070258e-05 2.012969e-03 1.244084e-05 3.109297e-03 1.169823e-03 2.258075e-03
##           31           32           33           34           35           36
## 1.061485e-03 2.371151e-04 6.402034e-03 5.451367e-04 1.202784e-02 7.784439e-03
##           37           38           39           40           41           42
## 5.305308e-03 1.434878e-05 6.371951e-05 2.364683e-03 6.932601e-04 1.108433e-03
##           43           44           45           46           47           48
## 3.109633e-03 2.672519e-03 3.328154e-03 2.310798e-03 4.017341e-05 3.530741e-03
##           49           50           51           52           53           54
## 1.800336e-04 3.274736e-04 1.934683e-05 5.480045e-03 3.191007e-06 2.100540e-04
##           55           56           57           58           59           60
## 3.910823e-03 2.645723e-04 3.699370e-04 9.967371e-03 2.344663e-03 1.224275e-02
##           61           62           63           64           65           66
## 1.098676e-03 4.163422e-05 5.810244e-05 1.847039e-02 6.480808e-03 5.550275e-04
##           67           68           69           70           71           72
## 1.201819e-02 1.631333e-03 1.238564e-03 5.729988e-03 1.014807e-04 2.841327e-03
##           73           74           75           76           77           78
## 1.917187e-04 1.680663e-03 1.412356e-03 1.413786e-03 5.492482e-03 3.297446e-04
##           79           80           81           82           83           84
## 3.407982e-04 3.597351e-03 4.434005e-05 1.984652e-04 1.149551e-03 5.384234e-04
##           85           86           87           88           89           90
## 2.545660e-03 4.376347e-03 5.935219e-04 1.078367e-02 1.763398e-03 1.329112e-02
##           91           92           93           94           95           96
## 7.249373e-04 6.482850e-03 4.430981e-03 1.351413e-02 5.599028e-03 7.840128e-03
##           97           98           99          100          101          102
## 4.372208e-04 1.844966e-03 2.707044e-05 2.741402e-03 7.609470e-03 1.181020e-02
```

```
##          103          104          105          106          107          108 
## 1.490585e-03 5.497935e-04 7.936874e-03 9.849474e-03 8.155018e-04 4.399594e-03 
##          109          110          111          112          113          114 
## 7.022256e-04 1.869894e-02 1.355315e-03 1.127282e-02 5.080675e-03 1.889249e-05 
##          115          116          117          118          119          120 
## 4.275551e-02 1.405593e-04 6.087036e-03 2.800944e-03 1.609608e-02 9.073416e-04 
##          121          122          123          124          125          126 
## 1.642267e-03 1.264070e-02 5.879516e-03 1.652630e-03 2.111095e-04 4.167301e-05 
##          127          128          129          130          131          132 
## 3.317084e-04 2.309360e-07 1.349284e-04 1.585109e-02 2.420456e-03 1.924888e-03 
##          133          134          135          136          137          138 
## 1.594048e-04 5.315541e-03 3.184120e-04 1.176377e-03 3.968582e-03 5.089477e-04 
##          139          140          141          142          143          144 
## 1.965748e-03 9.001916e-04 5.558291e-05 7.421455e-03 3.283065e-04 1.068640e-03 
##          145          146          147          148          149          150 
## 1.612775e-05 8.856360e-03 8.955669e-03 2.165234e-02 1.121005e-03 3.986169e-03 
##          151          152          153          154          155          156 
## 5.505581e-05 1.870682e-02 6.772849e-04 1.119656e-04 5.517455e-03 3.042581e-03 
##          157          158          159          160          161          162 
## 8.063370e-03 6.164440e-04 2.607221e-04 5.444614e-03 2.048417e-02 7.975444e-03 
##          163          164          165          166          167          168 
## 1.996028e-03 2.564049e-05 6.070683e-03 1.460885e-03 2.743188e-03 7.506265e-03 
##          169          170          171          172          173          174 
## 1.402585e-04 9.211682e-04 1.824394e-03 7.753266e-04 1.713565e-04 7.715572e-03 
##          175          176          177          178          179          180 
## 5.263698e-03 4.156003e-03 3.231517e-04 1.558018e-04 9.172982e-06 3.954844e-03 
##          181          182          183          184          185          186 
## 1.033701e-04 1.161972e-05 3.361142e-03 2.344246e-03 1.704633e-03 3.217134e-02 
##          187          188          189          190          191          192 
## 2.659026e-04 1.730803e-02 5.350646e-03 1.141226e-02 1.213546e-02 2.476961e-04 
##          193          194          195          196          197          198 
## 9.835130e-04 1.593734e-03 1.198827e-03 1.011350e-03 5.100440e-04 9.684953e-03 
##          199          200          201          202          203          204 
## 3.378581e-03 5.049359e-03 4.068030e-02 5.419414e-03 3.322582e-03 6.795763e-04 
##          205          206          207          208          209          210 
## 3.004450e-03 6.113311e-06 2.224638e-03 1.646550e-03 1.025276e-04 2.115665e-04 
##          211          212          213          214          215          216 
## 7.160204e-05 7.435247e-03 2.378536e-03 1.336927e-04 2.623745e-03 5.805181e-04 
##          217          218          219          220          221          222 
## 4.170255e-03 4.026656e-06 5.017624e-03 1.041519e-04 2.149033e-03 1.164531e-05 
##          223          224          225          226          227          228 
## 5.803704e-03 9.229630e-05 7.713607e-03 3.105099e-04 1.151926e-03 9.084439e-03 
##          229          230          231          232          233          234 
## 4.188645e-04 1.460940e-02 1.262546e-02 1.907538e-03 3.045942e-03 9.608799e-06 
##          235          236          237          238          239          240 
## 8.519000e-05 6.570893e-03 1.039955e-02 2.376143e-04 3.907651e-02 1.034672e-03 
##          241          242          243          244          245          246 
## 2.693184e-03 1.998917e-04 1.756664e-03 2.521346e-03 1.717866e-03 2.826617e-05 
```

```
##          247          248
## 1.149175e-04 1.470180e-04
```

```
dfbetas.rma.uni(rma(effect_size,
                              var,
                              data = bflpedat,
                              method = "REML"), 4)
```

```
##
##     intrcpt
## 1   -0.0585
## 2    0.0086
## 3   -0.0264
## 4   -0.0679
## 5    0.0514
## 6   -0.0099
## 7    0.0062
## 8    0.0502
## 9   -0.0352
## 10   0.0306
## 11   0.2093
## 12  -0.0501
## 13   0.0278
## 14  -0.0592
## 15   0.0492
## 16   0.0462
## 17   0.0810
## 18   0.0121
## 19  -0.0160
## 20   0.0602
## 21   0.0187
## 22   0.0471
## 23  -0.0110
## 24   0.0675
## 25   0.0055
## 26  -0.0448
## 27  -0.0035
## 28   0.0557
## 29  -0.0341
## 30   0.0475
## 31  -0.0325
## 32  -0.0154
## 33   0.0801
## 34   0.0233
## 35   0.1101
## 36   0.0884
## 37  -0.0729
## 38  -0.0038
```

```
## 39  -0.0080
## 40  -0.0486
## 41   0.0263
## 42   0.0332
## 43   0.0557
## 44   0.0516
## 45   0.0576
## 46  -0.0480
## 47   0.0063
## 48   0.0595
## 49   0.0134
## 50   0.0181
## 51   0.0044
## 52  -0.0741
## 53   0.0018
## 54  -0.0145
## 55   0.0625
## 56  -0.0162
## 57   0.0192
## 58  -0.1002
## 59   0.0484
## 60  -0.1111
## 61   0.0331
## 62   0.0064
## 63   0.0076
## 64  -0.1369
## 65  -0.0806
## 66  -0.0235
## 67  -0.1100
## 68  -0.0403
## 69  -0.0351
## 70  -0.0757
## 71  -0.0101
## 72   0.0533
## 73   0.0138
## 74  -0.0409
## 75   0.0375
## 76   0.0375
## 77   0.0741
## 78  -0.0181
## 79   0.0184
## 80   0.0599
## 81   0.0066
## 82  -0.0141
## 83   0.0338
## 84  -0.0232
## 85   0.0504
## 86  -0.0662
```

```
## 87   0.0243
## 88  -0.1042
## 89   0.0419
## 90  -0.1159
## 91  -0.0269
## 92   0.0806
## 93  -0.0666
## 94   0.1168
## 95   0.0749
## 96  -0.0887
## 97  -0.0209
## 98   0.0429
## 99  -0.0052
## 100  0.0523
## 101 -0.0874
## 102  0.1092
## 103  0.0385
## 104  0.0234
## 105 -0.0893
## 106 -0.0995
## 107  0.0285
## 108  0.0663
## 109 -0.0265
## 110 -0.1377
## 111  0.0368
## 112 -0.1066
## 113  0.0713
## 114  0.0043
## 115 -0.2107
## 116 -0.0118
## 117  0.0781
## 118  0.0529
## 119  0.1277
## 120  0.0301
## 121 -0.0405
## 122 -0.1129
## 123 -0.0767
## 124  0.0406
## 125 -0.0145
## 126  0.0064
## 127 -0.0182
## 128  0.0005
## 129 -0.0116
## 130 -0.1266
## 131  0.0491
## 132  0.0438
## 133 -0.0126
## 134 -0.0730
```

```
## 135  0.0178
## 136 -0.0342
## 137  0.0630
## 138 -0.0225
## 139 -0.0443
## 140 -0.0300
## 141 -0.0074
## 142 -0.0863
## 143  0.0181
## 144 -0.0326
## 145  0.0040
## 146  0.0943
## 147 -0.0949
## 148  0.1486
## 149  0.0334
## 150 -0.0631
## 151  0.0074
## 152  0.1379
## 153  0.0260
## 154 -0.0106
## 155  0.0743
## 156 -0.0551
## 157  0.0900
## 158  0.0248
## 159 -0.0161
## 160 -0.0739
## 161 -0.1443
## 162  0.0895
## 163  0.0446
## 164  0.0051
## 165 -0.0780
## 166  0.0382
## 167 -0.0523
## 168  0.0868
## 169 -0.0118
## 170  0.0303
## 171  0.0426
## 172 -0.0278
## 173 -0.0131
## 174  0.0881
## 175  0.0727
## 176 -0.0645
## 177  0.0179
## 178 -0.0125
## 179  0.0030
## 180  0.0629
## 181  0.0101
## 182  0.0034
```

```
## 183 -0.0580
## 184  0.0484
## 185  0.0412
## 186 -0.1819
## 187 -0.0163
## 188 -0.1324
## 189  0.0732
## 190 -0.1072
## 191  0.1106
## 192 -0.0157
## 193  0.0313
## 194 -0.0399
## 195 -0.0346
## 196 -0.0318
## 197 -0.0225
## 198  0.0987
## 199 -0.0581
## 200  0.0711
## 201 -0.2053
## 202  0.0736
## 203 -0.0577
## 204  0.0260
## 205  0.0548
## 206 -0.0025
## 207  0.0471
## 208  0.0405
## 209 -0.0101
## 210  0.0145
## 211 -0.0084
## 212 -0.0864
## 213 -0.0488
## 214 -0.0115
## 215  0.0512
## 216 -0.0241
## 217 -0.0646
## 218 -0.0020
## 219  0.0709
## 220 -0.0102
## 221 -0.0463
## 222  0.0034
## 223  0.0762
## 224  0.0096
## 225  0.0880
## 226  0.0176
## 227  0.0339
## 228 -0.0956
## 229 -0.0204
## 230 -0.1215
```

```
## 231  0.1129
## 232 -0.0436
## 233 -0.0552
## 234 -0.0031
## 235  0.0092
## 236  0.0811
## 237 -0.1023
## 238  0.0154
## 239 -0.2010
## 240  0.0321
## 241  0.0519
## 242  0.0141
## 243  0.0419
## 244  0.0502
## 245  0.0415
## 246  0.0053
## 247  0.0107
## 248  0.0121
```

```
hatvalues.rma.uni(rma(effect_size,
                              var,
                              data = bflpedat,
                              method = "REML"), type="diagonal")
```

```
##            1            2            3            4            5            6
## 0.0039976817 0.0046381325 0.0037188458 0.0047636536 0.0043704690 0.0047023241
##            7            8            9           10           11           12
## 0.0046728803 0.0042068236 0.0044029440 0.0033427716 0.0041935256 0.0041812410
##           13           14           15           16           17           18
## 0.0049733863 0.0044817284 0.0047810800 0.0043725122 0.0046805798 0.0044526043
##           19           20           21           22           23           24
## 0.0037124862 0.0045347945 0.0039431337 0.0044563850 0.0041676686 0.0043839321
##           25           26           27           28           29           30
## 0.0044466799 0.0035366034 0.0045289860 0.0041115428 0.0046298785 0.0047237703
##           31           32           33           34           35           36
## 0.0031587938 0.0043643654 0.0046959757 0.0041650091 0.0046457608 0.0040285689
##           37           38           39           40           41           42
## 0.0039367293 0.0043690815 0.0030316757 0.0038271338 0.0042999148 0.0046547290
##           43           44           45           46           47           48
## 0.0047435427 0.0047017836 0.0045754563 0.0045519271 0.0032524347 0.0015457364
##           49           50           51           52           53           54
## 0.0029920816 0.0046806655 0.0044759014 0.0039606155 0.0048661296 0.0044437237
##           55           56           57           58           59           60
## 0.0033342547 0.0042859959 0.0039139711 0.0035973026 0.0044340856 0.0043181491
##           61           62           63           64           65           66
## 0.0041769990 0.0048392786 0.0043007241 0.0034456613 0.0033112046 0.0045073648
##           67           68           69           70           71           72
## 0.0046052495 0.0038696413 0.0047053444 0.0046246434 0.0038206505 0.0038540374
```

```
##           73           74           75           76           77           78 
## 0.0047618020 0.0042144523 0.0045437996 0.0040758682 0.0045462093 0.0047810274 
##           79           80           81           82           83           84 
## 0.0046698431 0.0046034135 0.0044119232 0.0043201994 0.0040943414 0.0045961420 
##           85           86           87           88           89           90 
## 0.0033337776 0.0039710281 0.0046363294 0.0038477736 0.0044334995 0.0035923404 
##           91           92           93           94           95           96 
## 0.0045978767 0.0046338216 0.0039525263 0.0046384375 0.0032392082 0.0045756248 
##           97           98           99          100          101          102 
## 0.0034747971 0.0045781776 0.0042632021 0.0047630067 0.0043485190 0.0038773080 
##          103          104          105          106          107          108 
## 0.0041474862 0.0045361678 0.0040224880 0.0041417958 0.0027743622 0.0045336442 
##          109          110          111          112          113          114 
## 0.0037810161 0.0040508174 0.0042281727 0.0043356510 0.0045844852 0.0048589931 
##          115          116          117          118          119          120 
## 0.0033152600 0.0044922924 0.0033081738 0.0026437862 0.0045635448 0.0045379064 
##          121          122          123          124          125          126 
## 0.0031778666 0.0040956061 0.0044620591 0.0043700210 0.0045789922 0.0045415189 
##          127          128          129          130          131          132 
## 0.0038886468 0.0046598926 0.0034726514 0.0044984693 0.0043681936 0.0045929353 
##          133          134          135          136          137          138 
## 0.0034958195 0.0033275368 0.0042317712 0.0042815612 0.0042030941 0.0043180105 
##          139          140          141          142          143          144 
## 0.0035454545 0.0031567227 0.0042567664 0.0037278775 0.0045828475 0.0038285129 
##          145          146          147          148          149          150 
## 0.0044877697 0.0046250959 0.0034282150 0.0048724645 0.0031256789 0.0045257043 
##          151          152          153          154          155          156 
## 0.0017929731 0.0042762316 0.0043110308 0.0042998071 0.0041257624 0.0044224812 
##          157          158          159          160          161          162 
## 0.0042836164 0.0047258286 0.0026128507 0.0033527961 0.0041934474 0.0037208502 
##          163          164          165          166          167          168 
## 0.0044755436 0.0037946453 0.0042020180 0.0044811250 0.0040586161 0.0045710289 
##          169          170          171          172          173          174 
## 0.0048096814 0.0036230448 0.0045946271 0.0036056632 0.0034547668 0.0030304153 
##          175          176          177          178          179          180 
## 0.0017977758 0.0031730209 0.0032016902 0.0040503748 0.0047999390 0.0040791380 
##          181          182          183          184          185          186 
## 0.0046015139 0.0042230284 0.0035107949 0.0042977987 0.0045234433 0.0035207043 
##          187          188          189          190          191          192 
## 0.0043992518 0.0041636573 0.0039677109 0.0042977081 0.0043883660 0.0026613124 
##          193          194          195          196          197          198 
## 0.0028341144 0.0045201523 0.0039690736 0.0014625899 0.0044745137 0.0043401811 
##          199          200          201          202          203          204 
## 0.0047221666 0.0037819696 0.0038444823 0.0045389246 0.0017646443 0.0042568928 
##          205          206          207          208          209          210 
## 0.0047305045 0.0048093836 0.0044583555 0.0047131888 0.0024490141 0.0002960950 
##          211          212          213          214          215          216 
## 0.0043868639 0.0027963330 0.0023131570 0.0039820388 0.0042271398 0.0019296753 
```

```
##          217          218          219          220          221          222 
## 0.0037972472 0.0039079676 0.0032159900 0.0036276484 0.0038693578 0.0047467095 
##          223          224          225          226          227          228 
## 0.0046277387 0.0047225785 0.0046770262 0.0043595545 0.0043739634 0.0042571623 
##          229          230          231          232          233          234 
## 0.0025707032 0.0041932830 0.0044492851 0.0040077178 0.0042716675 0.0025465094 
##          235          236          237          238          239          240 
## 0.0037311610 0.0044280090 0.0042667307 0.0029750117 0.0041015711 0.0038419352 
##          241          242          243          244          245          246 
## 0.0040805503 0.0048628922 0.0039876359 0.0028621223 0.0009770115 0.0042659969 
##          247          248 
## 0.0030417899 0.0042965249
```

```
# Leave-one-out analyses
leave1out(rma(effect_size,
                              var,
                              data = bflpedat,
                              method = "REML"))
```

```
## 
##     estimate     se     zval   pval   ci.lb   ci.ub         Q     Qp   tau2 
## 1    -0.4574 0.0114 -39.9524 0.0000 -0.4798 -0.4349 1257.3521 0.0000 0.0249 
## 2    -0.4581 0.0115 -39.9174 0.0000 -0.4806 -0.4356 1261.7647 0.0000 0.0250 
## 3    -0.4577 0.0115 -39.9372 0.0000 -0.4802 -0.4353 1260.7458 0.0000 0.0250 
## 4    -0.4573 0.0114 -39.9367 0.0000 -0.4797 -0.4348 1248.8334 0.0000 0.0249 
## 5    -0.4586 0.0115 -40.0218 0.0000 -0.4811 -0.4362 1259.1472 0.0000 0.0249 
## 6    -0.4579 0.0115 -39.8993 0.0000 -0.4804 -0.4354 1261.0269 0.0000 0.0250 
## 7    -0.4581 0.0115 -39.9132 0.0000 -0.4806 -0.4356 1261.7490 0.0000 0.0250 
## 8    -0.4586 0.0115 -40.0249 0.0000 -0.4811 -0.4362 1259.5680 0.0000 0.0249 
## 9    -0.4576 0.0115 -39.9128 0.0000 -0.4801 -0.4352 1259.1251 0.0000 0.0250 
## 10   -0.4584 0.0115 -40.0088 0.0000 -0.4808 -0.4359 1261.2775 0.0000 0.0249 
## 11   -0.4604 0.0112 -41.1951 0.0000 -0.4823 -0.4385 1207.3691 0.0000 0.0234 
## 12   -0.4575 0.0115 -39.9343 0.0000 -0.4799 -0.4350 1257.9161 0.0000 0.0249 
## 13   -0.4584 0.0115 -39.9352 0.0000 -0.4809 -0.4359 1260.4548 0.0000 0.0250 
## 14   -0.4574 0.0115 -39.9339 0.0000 -0.4798 -0.4349 1255.0120 0.0000 0.0249 
## 15   -0.4586 0.0115 -39.9979 0.0000 -0.4811 -0.4361 1257.8482 0.0000 0.0249 
## 16   -0.4586 0.0115 -40.0059 0.0000 -0.4810 -0.4361 1259.7448 0.0000 0.0249 
## 17   -0.4590 0.0114 -40.1230 0.0000 -0.4814 -0.4365 1250.9250 0.0000 0.0248 
## 18   -0.4582 0.0115 -39.9297 0.0000 -0.4807 -0.4357 1261.7464 0.0000 0.0250 
## 19   -0.4579 0.0115 -39.9375 0.0000 -0.4803 -0.4354 1261.2742 0.0000 0.0250 
## 20   -0.4587 0.0115 -40.0445 0.0000 -0.4812 -0.4363 1257.2788 0.0000 0.0249 
## 21   -0.4583 0.0115 -39.9607 0.0000 -0.4807 -0.4358 1261.6398 0.0000 0.0250 
## 22   -0.4586 0.0115 -40.0050 0.0000 -0.4810 -0.4361 1259.4865 0.0000 0.0249 
## 23   -0.4579 0.0115 -39.9206 0.0000 -0.4804 -0.4354 1261.3445 0.0000 0.0250 
## 24   -0.4588 0.0114 -40.0781 0.0000 -0.4812 -0.4364 1256.7076 0.0000 0.0249 
## 25   -0.4581 0.0115 -39.9217 0.0000 -0.4806 -0.4356 1261.7507 0.0000 0.0250 
## 26   -0.4575 0.0115 -39.9549 0.0000 -0.4800 -0.4351 1259.5262 0.0000 0.0249 
## 27   -0.4580 0.0115 -39.9101 0.0000 -0.4805 -0.4355 1261.5207 0.0000 0.0250 
```

```
## 28   -0.4587 0.0115 -40.0467 0.0000 -0.4811 -0.4362 1259.1020 0.0000 0.0249
## 29   -0.4576 0.0115 -39.9030 0.0000 -0.4801 -0.4352 1258.4224 0.0000 0.0250
## 30   -0.4586 0.0115 -39.9949 0.0000 -0.4811 -0.4361 1258.5318 0.0000 0.0250
## 31   -0.4577 0.0115 -39.9620 0.0000 -0.4801 -0.4352 1260.6059 0.0000 0.0249
## 32   -0.4579 0.0115 -39.9111 0.0000 -0.4803 -0.4354 1260.9988 0.0000 0.0250
## 33   -0.4590 0.0114 -40.1182 0.0000 -0.4814 -0.4365 1250.9528 0.0000 0.0248
## 34   -0.4583 0.0115 -39.9597 0.0000 -0.4808 -0.4358 1261.4905 0.0000 0.0250
## 35   -0.4593 0.0114 -40.2798 0.0000 -0.4816 -0.4369 1241.1132 0.0000 0.0246
## 36   -0.4590 0.0114 -40.1863 0.0000 -0.4814 -0.4367 1254.4008 0.0000 0.0247
## 37   -0.4572 0.0114 -39.9794 0.0000 -0.4796 -0.4348 1255.5271 0.0000 0.0248
## 38   -0.4580 0.0115 -39.9164 0.0000 -0.4805 -0.4355 1261.5598 0.0000 0.0250
## 39   -0.4579 0.0115 -39.9685 0.0000 -0.4804 -0.4355 1261.6162 0.0000 0.0250
## 40   -0.4575 0.0115 -39.9469 0.0000 -0.4799 -0.4350 1258.8451 0.0000 0.0249
## 41   -0.4583 0.0115 -39.9600 0.0000 -0.4808 -0.4359 1261.3421 0.0000 0.0250
## 42   -0.4584 0.0115 -39.9603 0.0000 -0.4809 -0.4359 1260.6187 0.0000 0.0250
## 43   -0.4587 0.0115 -40.0202 0.0000 -0.4811 -0.4362 1256.8016 0.0000 0.0249
## 44   -0.4586 0.0115 -40.0086 0.0000 -0.4811 -0.4362 1257.9132 0.0000 0.0249
## 45   -0.4587 0.0115 -40.0338 0.0000 -0.4812 -0.4362 1257.5271 0.0000 0.0249
## 46   -0.4575 0.0115 -39.9170 0.0000 -0.4800 -0.4350 1256.5806 0.0000 0.0249
## 47   -0.4581 0.0115 -39.9717 0.0000 -0.4806 -0.4356 1261.7650 0.0000 0.0250
## 48   -0.4587 0.0114 -40.1682 0.0000 -0.4811 -0.4363 1258.7155 0.0000 0.0248
## 49   -0.4582 0.0115 -39.9917 0.0000 -0.4806 -0.4357 1261.7199 0.0000 0.0250
## 50   -0.4582 0.0115 -39.9292 0.0000 -0.4807 -0.4358 1261.6024 0.0000 0.0250
## 51   -0.4581 0.0115 -39.9193 0.0000 -0.4806 -0.4356 1261.7368 0.0000 0.0250
## 52   -0.4572 0.0114 -39.9808 0.0000 -0.4796 -0.4348 1255.2592 0.0000 0.0248
## 53   -0.4581 0.0115 -39.9007 0.0000 -0.4806 -0.4356 1261.5977 0.0000 0.0250
## 54   -0.4579 0.0115 -39.9081 0.0000 -0.4804 -0.4354 1260.9884 0.0000 0.0250
## 55   -0.4588 0.0114 -40.1037 0.0000 -0.4812 -0.4363 1259.0671 0.0000 0.0249
## 56   -0.4579 0.0115 -39.9141 0.0000 -0.4803 -0.4354 1261.0056 0.0000 0.0250
## 57   -0.4583 0.0115 -39.9628 0.0000 -0.4807 -0.4358 1261.6278 0.0000 0.0250
## 58   -0.4569 0.0114 -40.0596 0.0000 -0.4793 -0.4345 1252.3751 0.0000 0.0247
## 59   -0.4586 0.0115 -40.0097 0.0000 -0.4811 -0.4361 1259.3806 0.0000 0.0249
## 60   -0.4568 0.0114 -40.0646 0.0000 -0.4791 -0.4344 1244.6586 0.0000 0.0246
## 61   -0.4584 0.0115 -39.9798 0.0000 -0.4809 -0.4359 1261.0144 0.0000 0.0250
## 62   -0.4581 0.0115 -39.9066 0.0000 -0.4806 -0.4356 1261.7416 0.0000 0.0250
## 63   -0.4581 0.0115 -39.9301 0.0000 -0.4806 -0.4356 1261.7643 0.0000 0.0250
## 64   -0.4565 0.0114 -40.1950 0.0000 -0.4787 -0.4342 1246.0987 0.0000 0.0244
## 65   -0.4571 0.0114 -40.0208 0.0000 -0.4795 -0.4347 1255.9341 0.0000 0.0248
## 66   -0.4578 0.0115 -39.9047 0.0000 -0.4803 -0.4353 1260.1513 0.0000 0.0250
## 67   -0.4568 0.0114 -40.0497 0.0000 -0.4791 -0.4344 1238.6974 0.0000 0.0246
## 68   -0.4576 0.0115 -39.9377 0.0000 -0.4800 -0.4351 1259.5787 0.0000 0.0249
## 69   -0.4576 0.0115 -39.9005 0.0000 -0.4801 -0.4352 1257.8170 0.0000 0.0250
## 70   -0.4572 0.0114 -39.9575 0.0000 -0.4796 -0.4347 1249.3861 0.0000 0.0248
## 71   -0.4579 0.0115 -39.9351 0.0000 -0.4804 -0.4354 1261.4736 0.0000 0.0250
## 72   -0.4586 0.0115 -40.0494 0.0000 -0.4811 -0.4362 1259.6402 0.0000 0.0249
## 73   -0.4582 0.0115 -39.9193 0.0000 -0.4807 -0.4357 1261.7165 0.0000 0.0250
## 74   -0.4576 0.0115 -39.9242 0.0000 -0.4800 -0.4351 1258.9413 0.0000 0.0249
## 75   -0.4585 0.0115 -39.9752 0.0000 -0.4809 -0.4360 1260.3717 0.0000 0.0250
```

```
## 76   -0.4585 0.0115 -39.9948 0.0000 -0.4809 -0.4360 1260.7738 0.0000 0.0250
## 77   -0.4589 0.0114 -40.0984 0.0000 -0.4813 -0.4365 1254.3616 0.0000 0.0248
## 78   -0.4578 0.0115 -39.8937 0.0000 -0.4803 -0.4353 1260.0104 0.0000 0.0250
## 79   -0.4582 0.0115 -39.9303 0.0000 -0.4807 -0.4358 1261.5911 0.0000 0.0250
## 80   -0.4587 0.0115 -40.0406 0.0000 -0.4812 -0.4363 1256.9489 0.0000 0.0249
## 81   -0.4581 0.0115 -39.9244 0.0000 -0.4806 -0.4356 1261.7597 0.0000 0.0250
## 82   -0.4579 0.0115 -39.9133 0.0000 -0.4804 -0.4354 1261.1111 0.0000 0.0250
## 83   -0.4584 0.0115 -39.9850 0.0000 -0.4809 -0.4360 1261.0007 0.0000 0.0250
## 84   -0.4578 0.0115 -39.9011 0.0000 -0.4803 -0.4353 1259.9851 0.0000 0.0250
## 85   -0.4586 0.0114 -40.0622 0.0000 -0.4810 -0.4362 1260.1215 0.0000 0.0249
## 86   -0.4573 0.0114 -39.9656 0.0000 -0.4797 -0.4349 1256.3918 0.0000 0.0248
## 87   -0.4583 0.0115 -39.9422 0.0000 -0.4808 -0.4358 1261.3205 0.0000 0.0250
## 88   -0.4569 0.0114 -40.0616 0.0000 -0.4792 -0.4345 1250.5615 0.0000 0.0246
## 89   -0.4585 0.0115 -39.9913 0.0000 -0.4810 -0.4360 1260.0975 0.0000 0.0250
## 90   -0.4567 0.0114 -40.1096 0.0000 -0.4790 -0.4344 1249.6006 0.0000 0.0246
## 91   -0.4577 0.0115 -39.9016 0.0000 -0.4802 -0.4352 1259.5494 0.0000 0.0250
## 92   -0.4590 0.0114 -40.1231 0.0000 -0.4814 -0.4365 1251.7466 0.0000 0.0248
## 93   -0.4573 0.0114 -39.9671 0.0000 -0.4797 -0.4349 1256.3911 0.0000 0.0248
## 94   -0.4594 0.0114 -40.3222 0.0000 -0.4817 -0.4370 1238.4428 0.0000 0.0246
## 95   -0.4589 0.0114 -40.1573 0.0000 -0.4813 -0.4365 1257.7683 0.0000 0.0248
## 96   -0.4570 0.0114 -39.9892 0.0000 -0.4794 -0.4346 1246.5563 0.0000 0.0248
## 97   -0.4578 0.0115 -39.9467 0.0000 -0.4803 -0.4353 1261.1259 0.0000 0.0250
## 98   -0.4585 0.0115 -39.9879 0.0000 -0.4810 -0.4361 1259.7163 0.0000 0.0250
## 99   -0.4580 0.0115 -39.9198 0.0000 -0.4805 -0.4355 1261.5389 0.0000 0.0250
## 100  -0.4586 0.0115 -40.0082 0.0000 -0.4811 -0.4362 1257.3653 0.0000 0.0249
## 101  -0.4570 0.0114 -39.9950 0.0000 -0.4794 -0.4346 1250.2339 0.0000 0.0248
## 102  -0.4593 0.0114 -40.3074 0.0000 -0.4816 -0.4369 1250.7983 0.0000 0.0246
## 103  -0.4585 0.0115 -39.9943 0.0000 -0.4809 -0.4360 1260.6647 0.0000 0.0250
## 104  -0.4583 0.0115 -39.9446 0.0000 -0.4808 -0.4358 1261.4111 0.0000 0.0250
## 105  -0.4570 0.0114 -40.0128 0.0000 -0.4794 -0.4346 1252.3975 0.0000 0.0247
## 106  -0.4569 0.0114 -40.0360 0.0000 -0.4793 -0.4345 1249.4927 0.0000 0.0247
## 107  -0.4584 0.0115 -40.0280 0.0000 -0.4808 -0.4359 1261.3484 0.0000 0.0249
## 108  -0.4588 0.0115 -40.0672 0.0000 -0.4812 -0.4364 1256.1363 0.0000 0.0249
## 109  -0.4577 0.0115 -39.9347 0.0000 -0.4802 -0.4353 1260.7057 0.0000 0.0250
## 110  -0.4565 0.0114 -40.1742 0.0000 -0.4787 -0.4342 1241.2148 0.0000 0.0244
## 111  -0.4585 0.0115 -39.9864 0.0000 -0.4809 -0.4360 1260.7452 0.0000 0.0250
## 112  -0.4568 0.0114 -40.0494 0.0000 -0.4792 -0.4345 1245.6218 0.0000 0.0246
## 113  -0.4589 0.0114 -40.0849 0.0000 -0.4813 -0.4364 1254.6888 0.0000 0.0249
## 114  -0.4581 0.0115 -39.9035 0.0000 -0.4806 -0.4356 1261.6923 0.0000 0.0250
## 115  -0.4557 0.0112 -40.5829 0.0000 -0.4777 -0.4337 1229.0576 0.0000 0.0237
## 116  -0.4579 0.0115 -39.9070 0.0000 -0.4804 -0.4354 1261.1159 0.0000 0.0250
## 117  -0.4589 0.0114 -40.1685 0.0000 -0.4813 -0.4365 1257.3307 0.0000 0.0248
## 118  -0.4586 0.0114 -40.0993 0.0000 -0.4811 -0.4362 1259.9617 0.0000 0.0249
## 119  -0.4595 0.0114 -40.3991 0.0000 -0.4818 -0.4372 1235.9887 0.0000 0.0245
## 120  -0.4584 0.0115 -39.9580 0.0000 -0.4809 -0.4359 1261.0096 0.0000 0.0250
## 121  -0.4576 0.0114 -39.9659 0.0000 -0.4800 -0.4351 1260.0824 0.0000 0.0249
## 122  -0.4568 0.0114 -40.0796 0.0000 -0.4791 -0.4344 1246.8971 0.0000 0.0246
## 123  -0.4572 0.0114 -39.9661 0.0000 -0.4796 -0.4347 1251.4504 0.0000 0.0248
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## 124  -0.4585 0.0115 -39.9904 0.0000 -0.4810 -0.4360 1260.3101 0.0000 0.0250
## 125  -0.4579 0.0115 -39.9026 0.0000 -0.4804 -0.4354 1260.8342 0.0000 0.0250
## 126  -0.4581 0.0115 -39.9188 0.0000 -0.4806 -0.4356 1261.7557 0.0000 0.0250
## 127  -0.4578 0.0115 -39.9300 0.0000 -0.4803 -0.4354 1261.1167 0.0000 0.0250
## 128  -0.4580 0.0115 -39.9079 0.0000 -0.4805 -0.4355 1261.6239 0.0000 0.0250
## 129  -0.4579 0.0115 -39.9487 0.0000 -0.4804 -0.4354 1261.4816 0.0000 0.0250
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## 135  -0.4582 0.0115 -39.9473 0.0000 -0.4807 -0.4358 1261.6509 0.0000 0.0250
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## 140  -0.4577 0.0115 -39.9610 0.0000 -0.4801 -0.4352 1260.7538 0.0000 0.0249
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## 142  -0.4571 0.0114 -40.0173 0.0000 -0.4794 -0.4347 1254.1811 0.0000 0.0247
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## 144  -0.4577 0.0115 -39.9348 0.0000 -0.4801 -0.4352 1260.2517 0.0000 0.0250
## 145  -0.4581 0.0115 -39.9184 0.0000 -0.4806 -0.4356 1261.7308 0.0000 0.0250
## 146  -0.4591 0.0114 -40.1910 0.0000 -0.4815 -0.4367 1247.5963 0.0000 0.0247
## 147  -0.4570 0.0114 -40.0515 0.0000 -0.4793 -0.4346 1253.6997 0.0000 0.0247
## 148  -0.4597 0.0113 -40.5453 0.0000 -0.4819 -0.4375 1200.6701 0.0000 0.0243
## 149  -0.4584 0.0115 -40.0244 0.0000 -0.4809 -0.4360 1261.1593 0.0000 0.0249
## 150  -0.4573 0.0115 -39.9382 0.0000 -0.4798 -0.4349 1253.8261 0.0000 0.0249
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## 152  -0.4596 0.0114 -40.4871 0.0000 -0.4818 -0.4374 1238.5961 0.0000 0.0243
## 153  -0.4583 0.0115 -39.9589 0.0000 -0.4808 -0.4359 1261.3536 0.0000 0.0250
## 154  -0.4579 0.0115 -39.9154 0.0000 -0.4804 -0.4354 1261.3078 0.0000 0.0250
## 155  -0.4589 0.0114 -40.1171 0.0000 -0.4813 -0.4365 1256.5178 0.0000 0.0248
## 156  -0.4574 0.0115 -39.9307 0.0000 -0.4799 -0.4350 1256.1540 0.0000 0.0249
## 157  -0.4591 0.0114 -40.1832 0.0000 -0.4815 -0.4367 1252.7590 0.0000 0.0247
## 158  -0.4583 0.0115 -39.9394 0.0000 -0.4808 -0.4358 1261.2335 0.0000 0.0250
## 159  -0.4579 0.0115 -39.9825 0.0000 -0.4803 -0.4354 1261.4274 0.0000 0.0249
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## 161  -0.4564 0.0114 -40.1962 0.0000 -0.4787 -0.4341 1237.2252 0.0000 0.0244
## 162  -0.4591 0.0114 -40.2050 0.0000 -0.4814 -0.4367 1255.1225 0.0000 0.0247
## 163  -0.4585 0.0115 -39.9970 0.0000 -0.4810 -0.4361 1259.7363 0.0000 0.0250
## 164  -0.4581 0.0115 -39.9479 0.0000 -0.4806 -0.4356 1261.7599 0.0000 0.0250
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## 166  -0.4585 0.0115 -39.9794 0.0000 -0.4809 -0.4360 1260.3983 0.0000 0.0250
## 167  -0.4574 0.0115 -39.9418 0.0000 -0.4799 -0.4350 1257.9725 0.0000 0.0249
## 168  -0.4590 0.0114 -40.1550 0.0000 -0.4814 -0.4366 1250.8266 0.0000 0.0248
## 169  -0.4579 0.0115 -39.8941 0.0000 -0.4804 -0.4354 1260.6519 0.0000 0.0250
## 170  -0.4584 0.0115 -39.9965 0.0000 -0.4808 -0.4359 1261.2722 0.0000 0.0250
## 171  -0.4585 0.0115 -39.9866 0.0000 -0.4810 -0.4360 1259.7055 0.0000 0.0250
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## 172  -0.4577 0.0115 -39.9421 0.0000 -0.4802 -0.4353 1260.7144 0.0000 0.0250
## 173  -0.4579 0.0115 -39.9489 0.0000 -0.4804 -0.4354 1261.4374 0.0000 0.0250
## 174  -0.4590 0.0114 -40.2274 0.0000 -0.4814 -0.4367 1256.1627 0.0000 0.0247
## 175  -0.4589 0.0114 -40.2092 0.0000 -0.4812 -0.4365 1257.4990 0.0000 0.0247
## 176  -0.4573 0.0114 -39.9950 0.0000 -0.4797 -0.4349 1257.9778 0.0000 0.0248
## 177  -0.4582 0.0115 -39.9902 0.0000 -0.4807 -0.4358 1261.6535 0.0000 0.0250
## 178  -0.4579 0.0115 -39.9248 0.0000 -0.4804 -0.4354 1261.3222 0.0000 0.0250
## 179  -0.4581 0.0115 -39.9046 0.0000 -0.4806 -0.4356 1261.6676 0.0000 0.0250
## 180  -0.4588 0.0114 -40.0734 0.0000 -0.4812 -0.4363 1258.2915 0.0000 0.0249
## 181  -0.4582 0.0115 -39.9209 0.0000 -0.4806 -0.4357 1261.7623 0.0000 0.0250
## 182  -0.4581 0.0115 -39.9286 0.0000 -0.4806 -0.4356 1261.7370 0.0000 0.0250
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## 184  -0.4586 0.0115 -40.0154 0.0000 -0.4811 -0.4361 1259.6321 0.0000 0.0249
## 185  -0.4585 0.0115 -39.9857 0.0000 -0.4810 -0.4360 1260.0229 0.0000 0.0250
## 186  -0.4560 0.0113 -40.4069 0.0000 -0.4781 -0.4339 1235.1741 0.0000 0.0240
## 187  -0.4579 0.0115 -39.9095 0.0000 -0.4803 -0.4354 1260.9080 0.0000 0.0250
## 188  -0.4565 0.0114 -40.1482 0.0000 -0.4788 -0.4342 1241.1185 0.0000 0.0245
## 189  -0.4589 0.0114 -40.1190 0.0000 -0.4813 -0.4365 1257.1059 0.0000 0.0248
## 190  -0.4568 0.0114 -40.0530 0.0000 -0.4792 -0.4345 1245.9786 0.0000 0.0246
## 191  -0.4593 0.0114 -40.2942 0.0000 -0.4816 -0.4370 1246.1562 0.0000 0.0246
## 192  -0.4579 0.0115 -39.9806 0.0000 -0.4803 -0.4354 1261.4372 0.0000 0.0249
## 193  -0.4584 0.0115 -40.0317 0.0000 -0.4808 -0.4360 1261.2433 0.0000 0.0249
## 194  -0.4576 0.0115 -39.9110 0.0000 -0.4801 -0.4351 1258.0887 0.0000 0.0250
## 195  -0.4576 0.0115 -39.9300 0.0000 -0.4801 -0.4352 1259.9634 0.0000 0.0250
## 196  -0.4577 0.0114 -40.0309 0.0000 -0.4801 -0.4353 1260.6570 0.0000 0.0249
## 197  -0.4578 0.0115 -39.9060 0.0000 -0.4803 -0.4353 1260.3064 0.0000 0.0250
## 198  -0.4592 0.0114 -40.2268 0.0000 -0.4815 -0.4368 1250.1655 0.0000 0.0247
## 199  -0.4574 0.0115 -39.9227 0.0000 -0.4798 -0.4349 1252.5599 0.0000 0.0249
## 200  -0.4588 0.0114 -40.1182 0.0000 -0.4813 -0.4364 1257.7263 0.0000 0.0248
## 201  -0.4557 0.0112 -40.5286 0.0000 -0.4778 -0.4337 1224.6105 0.0000 0.0238
## 202  -0.4589 0.0114 -40.0966 0.0000 -0.4813 -0.4364 1254.5367 0.0000 0.0248
## 203  -0.4574 0.0114 -40.0416 0.0000 -0.4798 -0.4350 1258.7124 0.0000 0.0248
## 204  -0.4583 0.0115 -39.9612 0.0000 -0.4808 -0.4359 1261.3646 0.0000 0.0250
## 205  -0.4587 0.0115 -40.0175 0.0000 -0.4811 -0.4362 1257.1088 0.0000 0.0249
## 206  -0.4580 0.0115 -39.8994 0.0000 -0.4805 -0.4355 1261.4166 0.0000 0.0250
## 207  -0.4586 0.0115 -40.0050 0.0000 -0.4810 -0.4361 1259.4798 0.0000 0.0249
## 208  -0.4585 0.0115 -39.9759 0.0000 -0.4810 -0.4360 1259.6432 0.0000 0.0250
## 209  -0.4579 0.0115 -39.9914 0.0000 -0.4804 -0.4355 1261.5975 0.0000 0.0249
## 210  -0.4582 0.0114 -40.1055 0.0000 -0.4806 -0.4358 1261.0609 0.0000 0.0249
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## 212  -0.4571 0.0114 -40.0550 0.0000 -0.4794 -0.4347 1255.7146 0.0000 0.0247
## 213  -0.4575 0.0114 -40.0085 0.0000 -0.4799 -0.4351 1259.6538 0.0000 0.0249
## 214  -0.4579 0.0115 -39.9279 0.0000 -0.4804 -0.4354 1261.3817 0.0000 0.0250
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## 217  -0.4573 0.0114 -39.9699 0.0000 -0.4797 -0.4349 1257.0681 0.0000 0.0248
## 218  -0.4580 0.0115 -39.9366 0.0000 -0.4805 -0.4355 1261.6730 0.0000 0.0250
## 219  -0.4588 0.0114 -40.1414 0.0000 -0.4812 -0.4364 1258.2428 0.0000 0.0248
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## 220  -0.4579 0.0115 -39.9430 0.0000 -0.4804 -0.4355 1261.5022 0.0000 0.0250
## 221  -0.4575 0.0115 -39.9429 0.0000 -0.4800 -0.4351 1259.0119 0.0000 0.0249
## 222  -0.4581 0.0115 -39.9072 0.0000 -0.4806 -0.4356 1261.6901 0.0000 0.0250
## 223  -0.4589 0.0114 -40.1039 0.0000 -0.4813 -0.4365 1253.0259 0.0000 0.0248
## 224  -0.4581 0.0115 -39.9152 0.0000 -0.4806 -0.4357 1261.7646 0.0000 0.0250
## 225  -0.4590 0.0114 -40.1563 0.0000 -0.4814 -0.4366 1248.7414 0.0000 0.0248
## 226  -0.4582 0.0115 -39.9417 0.0000 -0.4807 -0.4358 1261.6503 0.0000 0.0250
## 227  -0.4584 0.0115 -39.9734 0.0000 -0.4809 -0.4359 1260.8559 0.0000 0.0250
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## 229  -0.4578 0.0114 -39.9836 0.0000 -0.4802 -0.4354 1261.2804 0.0000 0.0249
## 230  -0.4567 0.0114 -40.1055 0.0000 -0.4790 -0.4343 1243.6476 0.0000 0.0245
## 231  -0.4593 0.0114 -40.3054 0.0000 -0.4817 -0.4370 1244.4762 0.0000 0.0246
## 232  -0.4575 0.0115 -39.9348 0.0000 -0.4800 -0.4351 1259.0632 0.0000 0.0249
## 233  -0.4574 0.0115 -39.9368 0.0000 -0.4799 -0.4350 1256.8979 0.0000 0.0249
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## 244  -0.4586 0.0114 -40.0814 0.0000 -0.4810 -0.4362 1260.1816 0.0000 0.0249
## 245  -0.4585 0.0114 -40.1350 0.0000 -0.4809 -0.4361 1259.7402 0.0000 0.0248
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## 247  -0.4582 0.0115 -39.9859 0.0000 -0.4806 -0.4357 1261.7469 0.0000 0.0250
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##           I2     H2
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## 2   82.4796 5.7076
## 3   82.5112 5.7180
## 4   82.3621 5.6696
## 5   82.4611 5.7016
## 6   82.4656 5.7031
## 7   82.4742 5.7059
## 8   82.4719 5.7051
## 9   82.4782 5.7072
## 10  82.5131 5.7186
## 11  81.5395 5.4170
## 12  82.4652 5.7030
## 13  82.3438 5.6637
## 14  82.4277 5.6908
## 15  82.4077 5.6843
## 16  82.4706 5.7047
## 17  82.3490 5.6654
## 18  82.5001 5.7143
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## 19  82.5206 5.7210
## 20  82.4282 5.6909
## 21  82.5193 5.7206
## 22  82.4628 5.7022
## 23  82.5143 5.7190
## 24  82.4230 5.6892
## 25  82.5021 5.7150
## 26  82.4862 5.7098
## 27  82.4936 5.7122
## 28  82.4641 5.7026
## 29  82.4555 5.6998
## 30  82.4252 5.6900
## 31  82.5048 5.7159
## 32  82.5019 5.7149
## 33  82.3491 5.6654
## 34  82.5100 5.7176
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## 36  82.3721 5.6728
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## 45  82.4293 5.6913
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## 47  82.5280 5.7234
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## 110 82.1751 5.6101
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## 115 81.7660 5.4843
## 116 82.4939 5.7123
## 117 82.4123 5.6858
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## 144 82.5024 5.7151
## 145 82.4986 5.7138
## 146 82.3103 5.6530
## 147 82.3570 5.6680
## 148 81.9588 5.5429
## 149 82.5090 5.7172
## 150 82.4142 5.6864
## 151 82.5135 5.7187
## 152 82.1232 5.5938
## 153 82.5011 5.7147
## 154 82.5086 5.7171
## 155 82.4159 5.6870
## 156 82.4416 5.6953
## 157 82.3573 5.6681
## 158 82.4547 5.6995
## 159 82.5175 5.7200
## 160 82.4216 5.6888
## 161 82.1386 5.5987
## 162 82.3726 5.6730
```
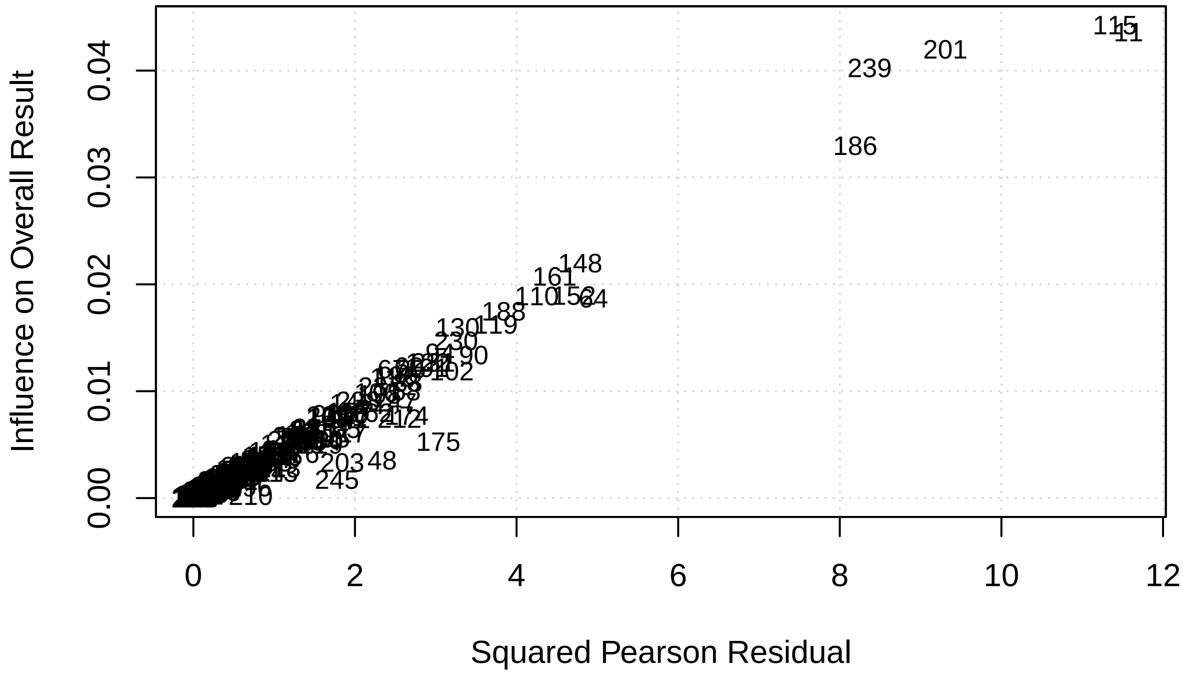

```
## 163 82.4654 5.7030
## 164 82.5263 5.7229
## 165 82.3974 5.6810
## 166 82.4748 5.7061
## 167 82.4650 5.7029
## 168 82.3458 5.6644
## 169 82.4372 5.6939
## 170 82.5130 5.7185
## 171 82.4555 5.6998
## 172 82.5104 5.7177
## 173 82.5237 5.7221
## 174 82.3770 5.6744
## 175 82.4129 5.6860
## 176 82.4453 5.6965
## 177 82.5235 5.7220
## 178 82.5172 5.7199
## 179 82.4446 5.6962
## 180 82.4485 5.6975
## 181 82.4846 5.7093
## 182 82.5158 5.7194
## 183 82.4604 5.7014
## 184 82.4712 5.7049
## 185 82.4662 5.7033
## 186 81.9475 5.5394
## 187 82.4988 5.7139
## 188 82.1959 5.6167
## 189 82.4233 5.6893
## 190 82.2951 5.6482
## 191 82.2643 5.6383
## 192 82.5182 5.7202
## 193 82.5095 5.7174
## 194 82.4609 5.7016
## 195 82.4974 5.7134
## 196 82.4879 5.7103
## 197 82.4874 5.7102
## 198 82.3200 5.6561
## 199 82.3954 5.6803
## 200 82.4321 5.6922
## 201 81.7979 5.4939
## 202 82.3922 5.6793
## 203 82.4477 5.6972
## 204 82.5038 5.7155
## 205 82.4094 5.6849
## 206 82.4410 5.6951
## 207 82.4626 5.7021
## 208 82.4389 5.6944
## 209 82.5193 5.7206
## 210 82.4875 5.7102
```

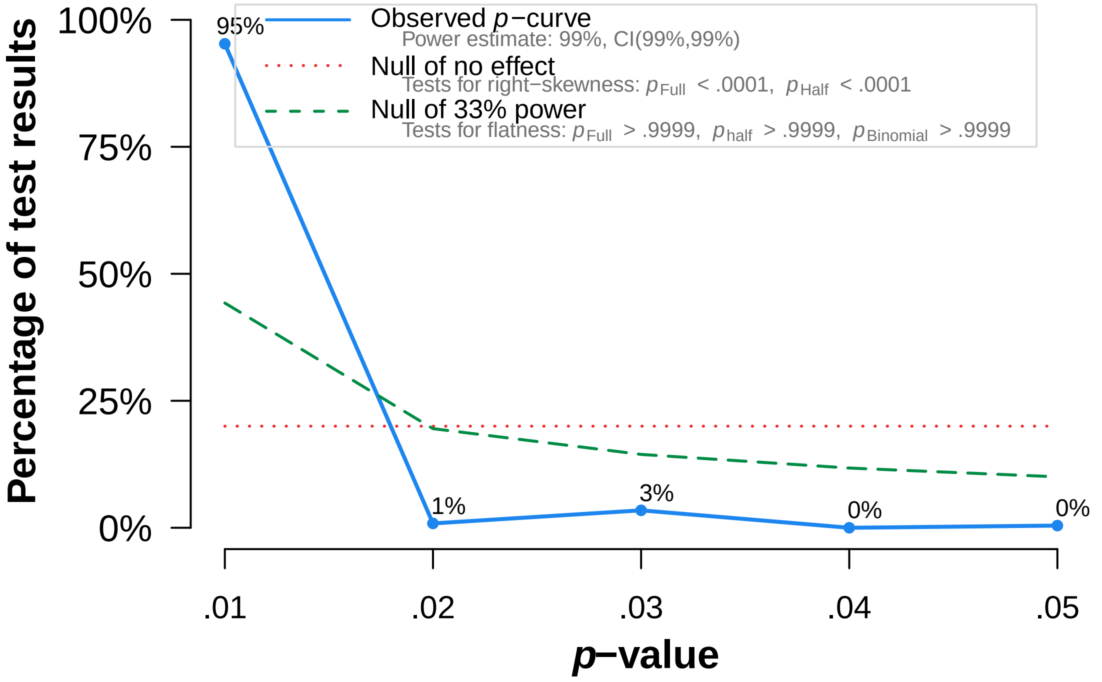
```
## 211 82.5043 5.7157
## 212 82.3825 5.6762
## 213 82.4723 5.7053
## 214 82.5194 5.7206
## 215 82.4692 5.7043
## 216 82.5029 5.7152
## 217 82.4430 5.6957
## 218 82.5243 5.7222
## 219 82.4337 5.6927
## 220 82.5247 5.7224
## 221 82.4805 5.7079
## 222 82.4591 5.7009
## 223 82.3729 5.6731
## 224 82.4638 5.7025
## 225 82.3256 5.6579
## 226 82.5044 5.7157
## 227 82.4889 5.7107
## 228 82.3395 5.6623
## 229 82.5137 5.7188
## 230 82.2428 5.6315
## 231 82.2490 5.6335
## 232 82.4825 5.7086
## 233 82.4511 5.6983
## 234 82.5227 5.7217
## 235 82.5263 5.7229
## 236 82.3791 5.6751
## 237 82.3151 5.6545
## 238 82.5237 5.7220
## 239 81.8193 5.5003
## 240 82.5089 5.7172
## 241 82.4730 5.7055
## 242 82.4196 5.6881
## 243 82.4931 5.7120
## 244 82.4807 5.7080
## 245 82.4706 5.7047
## 246 82.5137 5.7188
## 247 82.5261 5.7228
## 248 82.5106 5.7178
```

```r
# Baujat plot
baujat(rma(effect_size,
                              var,
                              data = bflpedat,
                              method = "REML"))
```



4.7 P-Curve and Z-Curve

```r
# P-curve estimation
pcurve(metagen(TE = effect_size,
               seTE = se,
               data = bflpedat,
               studlab = paste(country),
               comb.fixed = FALSE,
               comb.random = TRUE,
               method.tau = "REML"))
```



Note: The observed *p*−curve includes 233 statistically significant ($p < .05$) results, of which 229 are $p < .025$. There were 15 additional results entered but excluded from *p*−curve because they were $p > .05$.

```
## P-curve analysis
##  -----------------------
## - Total number of provided studies: k = 248
## - Total number of p<0.05 studies included into the analysis: k = 233 (93.95%)
## - Total number of studies with p<0.025: k = 229 (92.34%)
##
## Results
##  -----------------------
##                      pBinomial   zFull pFull   zHalf pHalf
## Right-skewness test          0 -75.090     0 -72.873     0
## Flatness test                1  61.522     1  65.682     1
## Note: p-values of 0 or 1 correspond to p<0.001 and p>0.999, respectively.
## Power Estimate: 99% (99%-99%)
##
## Evidential value
##  -----------------------
## - Evidential value present: yes
## - Evidential value absent/inadequate: no
```

```
# Create z- scores
bflpedat$zval <- bflpedat$effect_size/bflpedat$se

# Z-curve estimation
zedcurve <- zcurve(bflpedat$zval, method = "EM", bootstrap = 1000)
zedcurve
```

```
## Call:
```

```
## zcurve(z = bflpedat$zval, method = "EM", bootstrap = 1000)
##
## Estimates:
##       ERR       EDR
## 0.9601997 0.9330032
```

```
# Summarize the z-curve elements
summary.zcurve(zedcurve)
```

```
## Call:
## zcurve(z = bflpedat$zval, method = "EM", bootstrap = 1000)
##
## model: EM via EM
##
##     Estimate  l.CI  u.CI
## ERR    0.960 0.892 1.000
## EDR    0.933 0.618 1.000
##
## Model converged in 23 + 920 iterations
## Fitted using 127 z-values. 248 supplied, 233 significant (ODR = 0.94, 95% CI [0.90, 0.96]).
## Q = -172.67, 95% CI[-192.78, -150.18]
```

```
# z-curve estimates
ERR(zedcurve)  ## Expected replication rate
```

```
## Estimate     l.CI     u.CI
##    0.960    0.892    1.000
```

```
EDR(zedcurve)  ## Expected discovery rate
```

```
## Estimate     l.CI     u.CI
##    0.933    0.618    1.000
```

```
ODR(zedcurve)  ## Observed discovery rate
```

```
## Estimate     l.CI     u.CI
##    0.940    0.900    0.965
```

```
Soric(zedcurve)  ## Soric false discovery rate
```

```
## Estimate     l.CI     u.CI
##    0.004    0.000    0.033
```

```
file_drawer_ration(zedcurve)
```

```
## Estimate     l.CI     u.CI
##    0.072    0.000    0.619
```

```
expected_n(zedcurve)
```

```
## Estimate     l.CI     u.CI
##      250      233      377
```

```
missing_n(zedcurve)
```

```
## Estimate     l.CI     u.CI
##        2      -15      129
```

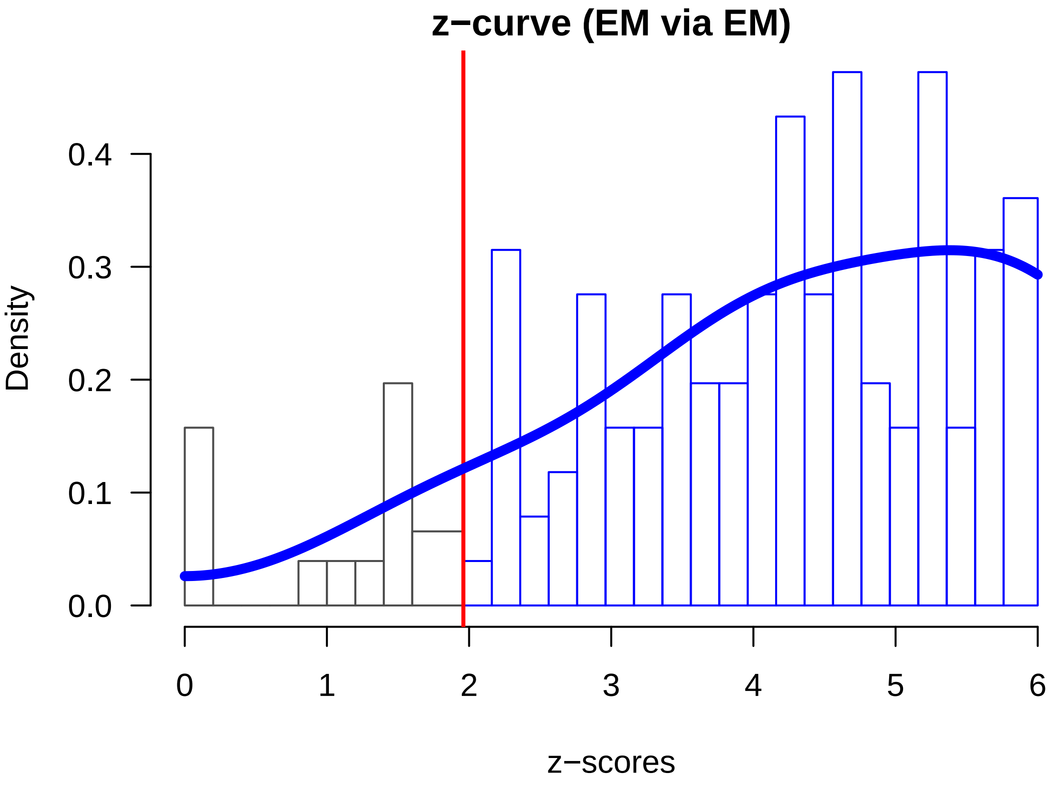
```
significant_n(zedcurve)
```

```
##   N
## 233
```

```
included_n(zedcurve)
```

```
##   N
## 127
```

```
# Plot the z-curve
plot.zcurve(zedcurve)
```



4.8 Publication bias via sensitivity analyses

```
## Worst-case sensitivity analyses
svalue(yi = bflpedat$effect_size,
       vi = bflpedat$var,
       clustervar = bflpedat$country,
       q = 0, ## Threshold to shift to
       model = "robust",
```

```
        favor.positive = FALSE,  ## Not favoring positve effects
        return.worst.meta = TRUE)
```

```
## $stats
##       sval.est      sval.ci k.affirmative k.nonaffirmative signs.recoded
## 1 Not possible Not possible           233               15          TRUE
##
## $meta.worst
## RVE: User Specified Weights with Small-Sample Corrections
##
## Model: yi ~ 1
##
## Number of studies = 12
## Number of outcomes = 15 (min = 1 , mean = 1.25 , median = 1 , max = 3 )
##                Estimate StdErr t-value  dfs P(|t|>) 95% CI.L 95% CI.U Sig
## 1 X.Intercept.    0.128 0.0368    3.47 8.96 0.00707   0.0445    0.211 ***
## ---
## Signif. codes: < .01 *** < .05 ** < .10 *
## ---
## Note: If df < 4, do not trust the results
```

5 R session info

```r
sessionInfo()
```

```
## R version 4.1.1 (2021-08-10)
## Platform: x86_64-apple-darwin17.0 (64-bit)
## Running under: macOS Catalina 10.15.7
##
## Matrix products: default
## BLAS:   /Library/Frameworks/R.framework/Versions/4.1/Resources/lib/libRblas.0.dylib
## LAPACK: /Library/Frameworks/R.framework/Versions/4.1/Resources/lib/libRlapack.dylib
##
## locale:
## [1] en_US.UTF-8/en_US.UTF-8/en_US.UTF-8/C/en_US.UTF-8/en_US.UTF-8
##
## attached base packages:
## [1] grid      stats     graphics  grDevices utils     datasets  methods
## [8] base
##
## other attached packages:
##  [1] PublicationBias_2.2.0 zcurve_1.0.9          caret_6.0-88
##  [4] lattice_0.20-44       metaforest_0.1.3      data.table_1.14.0
##  [7] ranger_0.13.1         meta_4.19-0           ggpubr_0.4.0
## [10] psych_2.1.6           forestplot_2.0.0      checkmate_2.0.0
## [13] magrittr_2.0.1        dmetar_0.0.9000       forcats_0.5.1
## [16] stringr_1.4.0         dplyr_1.0.7           purrr_0.3.4
## [19] readr_2.0.0           tidyr_1.1.3           tibble_3.1.3
## [22] ggplot2_3.3.5         tidyverse_1.3.1       clubSandwich_0.5.3
## [25] robumeta_2.0          metaSEM_1.2.5.1       OpenMx_2.19.6
## [28] metafor_3.0-2         Matrix_1.3-4
##
## loaded via a namespace (and not attached):
##   [1] readxl_1.3.1         backports_1.2.1      plyr_1.8.6
##   [4] splines_4.1.1        digest_0.6.27        foreach_1.5.1
##   [7] htmltools_0.5.1.1    fansi_0.5.0          cluster_2.1.2
##  [10] tzdb_0.1.2           openxlsx_4.2.4       recipes_0.1.16
##  [13] modelr_0.1.8         gower_0.2.2          RcppParallel_5.1.4
##  [16] sandwich_3.0-1       colorspace_2.0-2     rvest_1.0.1
##  [19] ggrepel_0.9.1        rbibutils_2.2.3      haven_2.4.2
##  [22] xfun_0.24            crayon_1.4.1         jsonlite_1.7.2
##  [25] lme4_1.1-27.1        survival_3.2-11      zoo_1.8-9
##  [28] iterators_1.0.13     glue_1.4.2           gtable_0.3.0
##  [31] ipred_0.9-11         car_3.0-11           kernlab_0.9-29
##  [34] prabclus_2.3-2       DEoptimR_1.0-9       abind_1.4-5
##  [37] scales_1.1.1         mvtnorm_1.1-2        DBI_1.1.1
##  [40] rstatix_0.7.0        Rcpp_1.0.7           magic_1.5-9
##  [43] tmvnsim_1.0-2        foreign_0.8-81       mclust_5.4.7
```

```
##  [46] stats4_4.1.1         lava_1.6.9           prodlim_2019.11.13
##  [49] netmeta_1.5-0        httr_1.4.2           fpc_2.2-9
##  [52] lavaan_0.6-9         modeltools_0.2-23    ellipsis_0.3.2
##  [55] pkgconfig_2.0.3      flexmix_2.3-17       nnet_7.3-16
##  [58] dbplyr_2.1.1         utf8_1.2.2           tidyselect_1.1.1
##  [61] rlang_0.4.11         reshape2_1.4.4       munsell_0.5.0
##  [64] cellranger_1.1.0     tools_4.1.1          cli_3.0.1
##  [67] generics_0.1.0       broom_0.7.9          mathjaxr_1.4-0
##  [70] evaluate_0.14        yaml_2.2.1           ModelMetrics_1.2.2.2
##  [73] knitr_1.33           fs_1.5.0             zip_2.2.0
##  [76] robustbase_0.93-8    pbapply_1.4-3        nlme_3.1-152
##  [79] xml2_1.3.2           compiler_4.1.1       rstudioapi_0.13
##  [82] curl_4.3.2           ggsignif_0.6.2       MetaUtility_2.1.1
##  [85] reprex_2.0.0         pbivnorm_0.6.0       stringi_1.7.3
##  [88] highr_0.9            poibin_1.5           nloptr_1.2.2.2
##  [91] vctrs_0.3.8          CompQuadForm_1.4.3   pillar_1.6.2
##  [94] lifecycle_1.0.0      Rdpack_2.1.2         R6_2.5.0
##  [97] MuMIn_1.43.17        gridExtra_2.3        rio_0.5.27
## [100] codetools_0.2-18     boot_1.3-28          MASS_7.3-54
## [103] assertthat_0.2.1     withr_2.4.2          mnormt_2.0.2
## [106] diptest_0.76-0       parallel_4.1.1       hms_1.1.0
## [109] rpart_4.1-15         timeDate_3043.102    class_7.3-19
## [112] minqa_1.2.4          rmarkdown_2.9        carData_3.0-4
## [115] pROC_1.17.0.1        lubridate_1.7.10     ellipse_0.4.2
```