Exercise 3

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Dataset description

Look at the data collected by Sánchez-Meca, Rosa-Alcázar, Marín-Martínez, and Gómez-Conesa (2010), investigating the psychological treatment of panic disorders. Variables DG1-DG7 refer to the standardized mean differences found for different kinds of outcome variables: panic attacks, agoraphobic avoidance, general anxiety, depression, bodily sensation, global adjustment, and other. The variables vdg1-vdg7 refer to the corresponding sampling variances.

```
# Load packages
library(readxl)
library(metafor)
```

```
## Loading required package: Matrix
```

```
##
## Loading the 'metafor' package (version 3.0-2). For an
## introduction to the package please type: help(metafor)
```

```
# Import data
df1 <- read_excel('data/Exercise3.xlsx')
head(df1)
```

```
## # A tibble: 6 x 15
##   Study    DG1    DG2    DG3    DG4   DG5    DG6    DG7    vdg1    vdg2    vdg3
##   <chr>  <dbl>  <dbl>  <dbl>  <dbl> <dbl>  <dbl>  <dbl>   <dbl>   <dbl>   <dbl>
## 1 Arnt~  1.34  NA     NA     NA        NA NA     NA      0.136  NA      NA
## 2 Arnt~  0.581 NA     NA     NA        NA NA     NA      0.116  NA      NA
## 3 Bakk~ -0.086  0.15   0.081 -0.392    NA  0.039 NA      0.0599  0.0600  0.0599
## 4 Bakk~  0.602  0.513 NA     NA        NA NA     -0.352  0.0665  0.0658 NA
## 5 Barl~ NA     NA     NA     NA        NA NA     NA     NA      NA      NA
## 6 Barl~  1.28  NA      0.901  0.479    NA NA      0.556  0.200  NA       0.183
## # ... with 4 more variables: vdg4 <dbl>, vdg5 <dbl>, vdg6 <dbl>, vdg7 <dbl>
```

Question a

Perform a fixed effects and a random effects analysis for the first outcome variable (panic attacks) as well as for the fourth outcome variable (depression). For which outcome variable the effect of the model on the standard error of the mean effect is largest? Can you explain why?

```
## Panic attacks FEM
FEM1 <- rma(yi=DG1, vi=vdg1, data=df1, method='FE')
```

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

```
summary(FEM1)
```

```
##
## Fixed-Effects Model (k = 61)
##
##   logLik  deviance       AIC       BIC      AICc
## -95.2310  202.7692  192.4620  194.5728  192.5298
##
## I^2 (total heterogeneity / total variability):   70.41%
## H^2 (total variability / sampling variability):  3.38
##
## Test for Heterogeneity:
## Q(df = 60) = 202.7692, p-val < .0001
##
## Model Results:
##
## estimate      se     zval    pval   ci.lb   ci.ub
##   0.9256  0.0429  21.5749  <.0001  0.8415  1.0097  ***
##
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

```
## Panic attacks FEM
REM1 <- rma(yi=DG1, vi=vdg1, data=df1, method='REML')
```

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

```
summary(REM1)
```

```
##
## Random-Effects Model (k = 61; tau^2 estimator: REML)
##
##   logLik  deviance       AIC       BIC      AICc
## -64.4823  128.9647  132.9647  137.1534  133.1752
##
## tau^2 (estimated amount of total heterogeneity): 0.3156 (SE = 0.0819)
## tau (square root of estimated tau^2 value):      0.5618
## I^2 (total heterogeneity / total variability):   73.65%
## H^2 (total variability / sampling variability):  3.80
##
## Test for Heterogeneity:
## Q(df = 60) = 202.7692, p-val < .0001
##
## Model Results:
##
## estimate      se     zval    pval   ci.lb   ci.ub
```

```
##   1.0195  0.0862  11.8283  <.0001  0.8506  1.1885  ***
##
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

```
## Depression FEM
FEM4 <- rma(yi=DG4, vi=vdg4, data=df1, method='FE')
```

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

```
summary(FEM4)
```

```
##
## Fixed-Effects Model (k = 42)
##
##   logLik  deviance       AIC       BIC      AICc
## -32.7821   72.0824   67.5641   69.3018   67.6641
##
## I^2 (total heterogeneity / total variability):   43.12%
## H^2 (total variability / sampling variability):  1.76
##
## Test for Heterogeneity:
## Q(df = 41) = 72.0824, p-val = 0.0019
##
## Model Results:
##
## estimate      se     zval    pval   ci.lb   ci.ub
##   0.6194  0.0548  11.3124  <.0001  0.5121  0.7267  ***
##
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

```
## Depression REM
REM4 <- rma(yi=DG4, vi=vdg4, data=df1, method='REML')
```

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

```
summary(REM4)
```

```
##
## Random-Effects Model (k = 42; tau^2 estimator: REML)
##
##   logLik  deviance       AIC       BIC      AICc
## -28.4646   56.9292   60.9292   64.3564   61.2450
##
## tau^2 (estimated amount of total heterogeneity): 0.0939 (SE = 0.0494)
## tau (square root of estimated tau^2 value):      0.3064
## I^2 (total heterogeneity / total variability):   42.59%
## H^2 (total variability / sampling variability):  1.74
##
## Test for Heterogeneity:
## Q(df = 41) = 72.0824, p-val = 0.0019
##
## Model Results:
##
## estimate      se    zval    pval   ci.lb   ci.ub
##   0.6449  0.0738  8.7390  <.0001  0.5003  0.7896  ***
```

```
##
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

```
# Comparison of standard errors
model <- c('FEM1', 'REM1', 'FEM4', 'REM4')
se <- c(FEM1$se, REM1$se, FEM4$se, REM4$se)

df2 <- data.frame(model, se)
df2
```

```
##   model         se
## 1  FEM1 0.04290049
## 2  REM1 0.08619424
## 3  FEM4 0.05475208
## 4  REM4 0.07380122
```

```
# Comparison of tau^2
model <- c( 'REM1', 'REM4')
tau2 <- c(REM1$tau2, REM4$tau2)
(df3 <- data.frame(model, tau2))
```

```
##   model      tau2
## 1  REM1 0.3156062
## 2  REM4 0.0938528
```

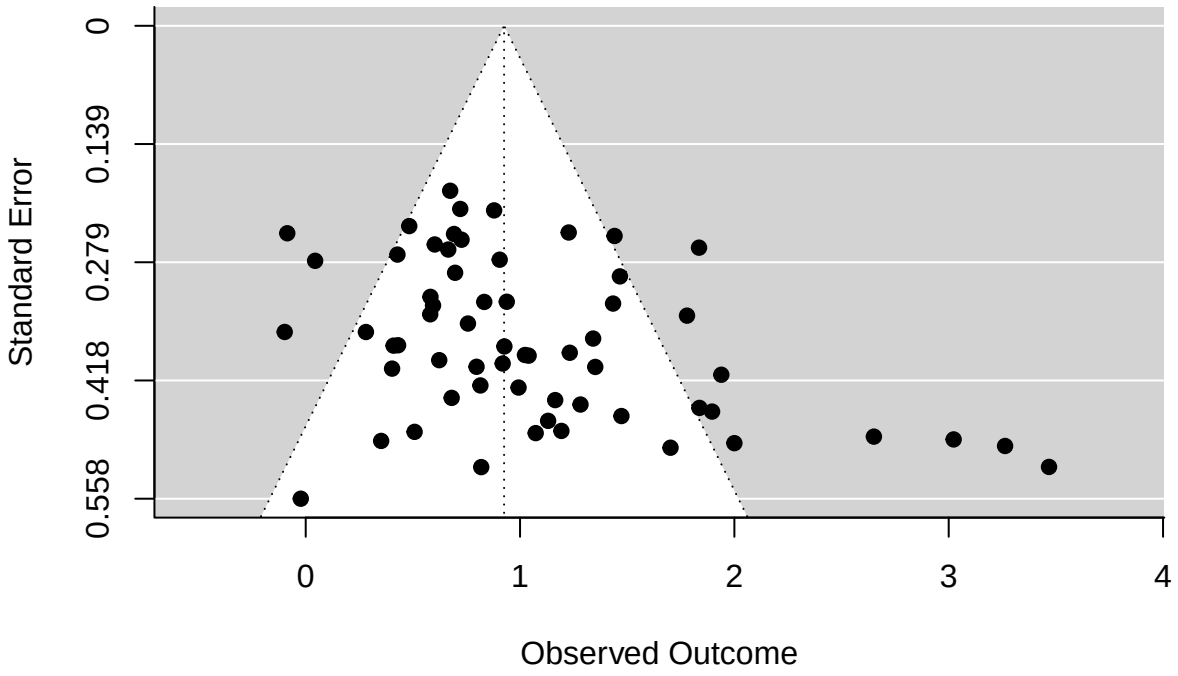
The standard error always increases when moving from a FEM to a REM. This is because in FEM the variance of the mean effect size is just the sampling varinace. Instead in a REM, the variance takes into account the additional uncertainty given by the between-studies heterogeneity.

The standard errors increase more for panic attacks than for depression because the between studies variance (τ^2) is larger for panic attacks than depression.

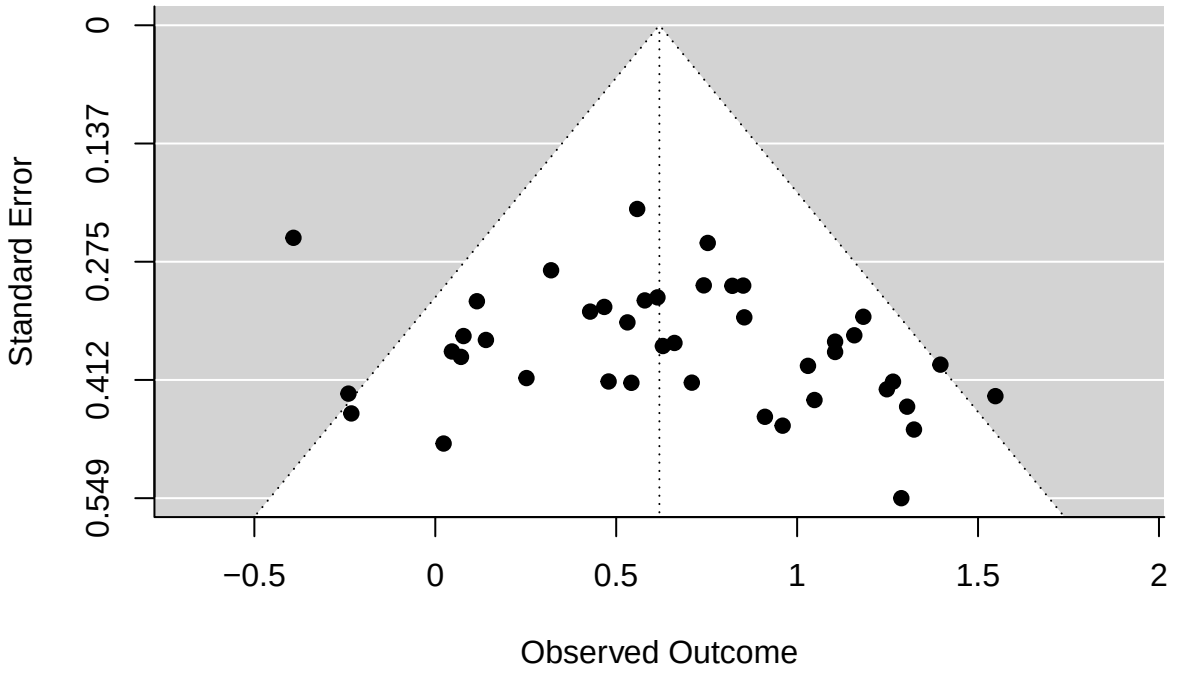
Question b

Make a funnel plot for both outcome variables, and use the trim and fill method. Is there evidence for publication bias? Does the correction for publication bias alter the conclusions?

```
# Funnel plots
funnel(FEM1)
```




```
funnel(FEM4)
```



The funnel plot for panic attacks is asymmetric with 4 studies on the bottom-right reporting particularly large effect-sizes and large standard errors. However, a number of other studies with smaller standard errors also fall outside the funnel.

The funnel plot for depression is more symmetric. One study stands out to be outside the funnel, reporting a negative effect size and a standard error around 0.25. In this case it is harder to conclude asymmetry by eye.

```
# Trim and fill
trimfill(FEM1)
```

```
##
## Estimated number of missing studies on the left side: 12 (SE = 5.1527)
##
## Fixed-Effects Model (k = 73)
##
## I^2 (total heterogeneity / total variability):   80.38%
## H^2 (total variability / sampling variability):  5.10
##
## Test for Heterogeneity:
## Q(df = 72) = 366.9643, p-val < .0001
##
## Model Results:
##
## estimate      se     zval    pval   ci.lb   ci.ub
##   0.7553  0.0404  18.6737  <.0001  0.6760  0.8346  ***
##
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

```
trimfill(FEM4)
```

```
##
## Estimated number of missing studies on the left side: 7 (SE = 4.2913)
##
## Fixed-Effects Model (k = 49)
##
## I^2 (total heterogeneity / total variability):   51.43%
## H^2 (total variability / sampling variability):  2.06
##
## Test for Heterogeneity:
## Q(df = 48) = 98.8303, p-val < .0001
##
## Model Results:
##
## estimate      se     zval    pval   ci.lb   ci.ub
##   0.5314  0.0520  10.2180  <.0001  0.4295  0.6333  ***
##
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

The trim and fill method for the panic attack studies estimate that there are 12 studies missing on the left side. The corrected effect size estimate is 0.7553 and statistically significant. The uncorrected estimate was about 1. So it has considerably decreased in size.

The trim and fill method for the depression studies estimate that there are 7 studies missing on the left side. The corrected effect size estimate is 0.5314 and statistically significant. The uncorrected estimate was about 0.6. So it has decreased in size, although not as much as for the panic attacks estimate.