Exercise 4

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4/4/2022

Dataset description

Aguayo, Vargas, de la Fuente, and Lozano (2011) conducted a meta-analysis integrating several reliability estimates from different applications of the Maslach Burnout Inventory (MBI). Data can be found in the file 'Exercise4.csv', which includes the sample sizes (ni), reliability coefficients (yi), and means and standard deviations of the total scores at each administration of the test (Mean and SD).

Note: The reliability coefficient is a measure of the accuracy of an instrument obtained by measuring the same individuals twice and computing the correlation of the two sets of measures.

```
# 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/Exercise4.xlsx')
str(df1)
```

```
## tibble [30 x 4] (S3: tbl_df/tbl/data.frame)
##  $ ni  : num [1:30] 454 170 318 115 667 333 219 714 631 220 ...
##  $ yi  : num [1:30] 0.86 0.76 0.77 0.88 0.88 0.95 0.89 0.89 0.83 0.81 ...
##  $ Mean: num [1:30] 13.5 15.2 15.8 15.9 16.7 ...
##  $ SD  : num [1:30] 9.39 8.35 6.72 8.8 8.45 ...
```

```
# Rename yi column as yi_original
names(df1)[names(df1)=="yi"] <- "yi_original"
str(df1)
```

```
## tibble [30 x 4] (S3: tbl_df/tbl/data.frame)
##  $ ni         : num [1:30] 454 170 318 115 667 333 219 714 631 220 ...
##  $ yi_original: num [1:30] 0.86 0.76 0.77 0.88 0.88 0.95 0.89 0.89 0.83 0.81 ...
##  $ Mean       : num [1:30] 13.5 15.2 15.8 15.9 16.7 ...
##  $ SD         : num [1:30] 9.39 8.35 6.72 8.8 8.45 ...
```

Question a

The sampling distribution for reliability coefficients is typically skewed. To solve this problem, compute the Z transformation on the reliability coefficients of this data set.

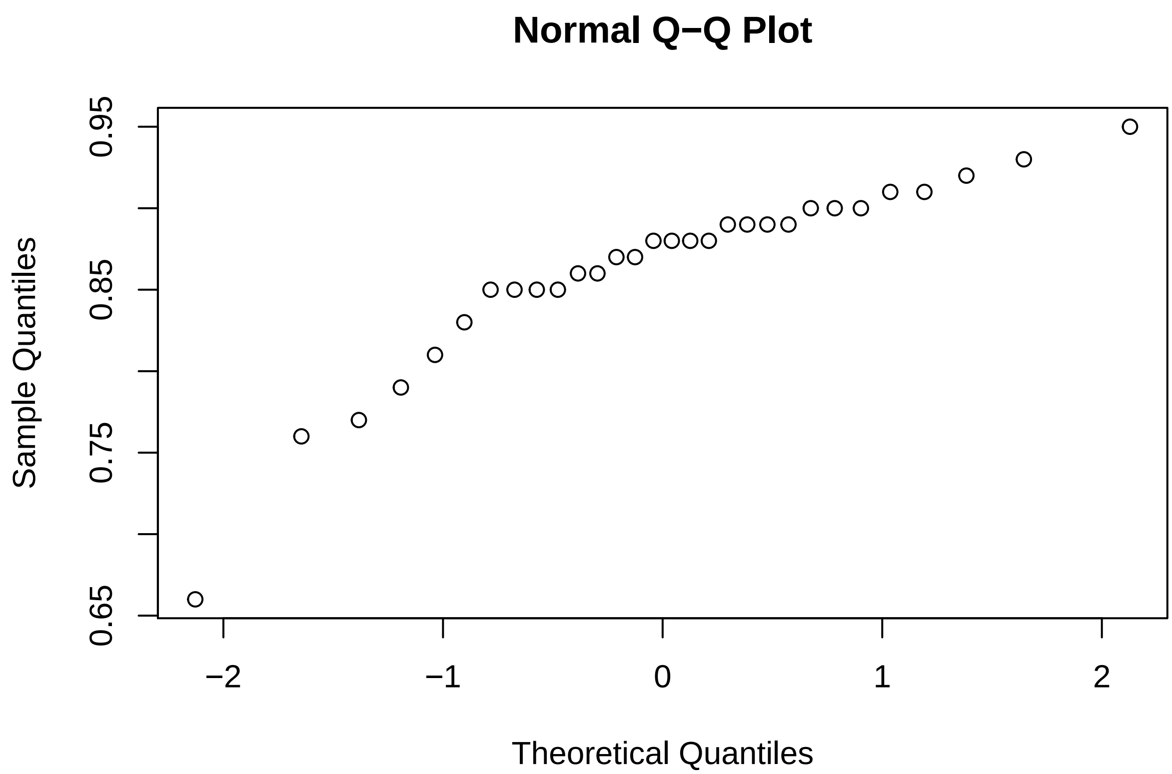
```r
df1 <- escalc(ri = yi_original, ni = ni, measure = 'ZCOR',  data = df1, append = TRUE)
str(df1)
```

```
## Classes 'escalc' and 'data.frame':   30 obs. of  6 variables:
##  $ ni         : num  454 170 318 115 667 333 219 714 631 220 ...
##  $ yi_original: num  0.86 0.76 0.77 0.88 0.88 0.95 0.89 0.89 0.83 0.81 ...
##  $ Mean       : num  13.5 15.2 15.8 15.9 16.7 ...
##  $ SD         : num  9.39 8.35 6.72 8.8 8.45 ...
##  $ yi         : num  1.293 0.996 1.02 1.376 1.376 ...
##   ..- attr(*, "ni")= num  454 170 318 115 667 333 219 714 631 220 ...
##   ..- attr(*, "measure")= chr "ZCOR"
##  $ vi         : num  0.00222 0.00599 0.00317 0.00893 0.00151 ...
##  - attr(*, "digits")= Named num  4 4 4 4 4 4 4 4 4
##   ..- attr(*, "names")= chr  "est" "se" "test" "pval" ...
##  - attr(*, "yi.names")= chr "yi"
##  - attr(*, "vi.names")= chr "vi"
```

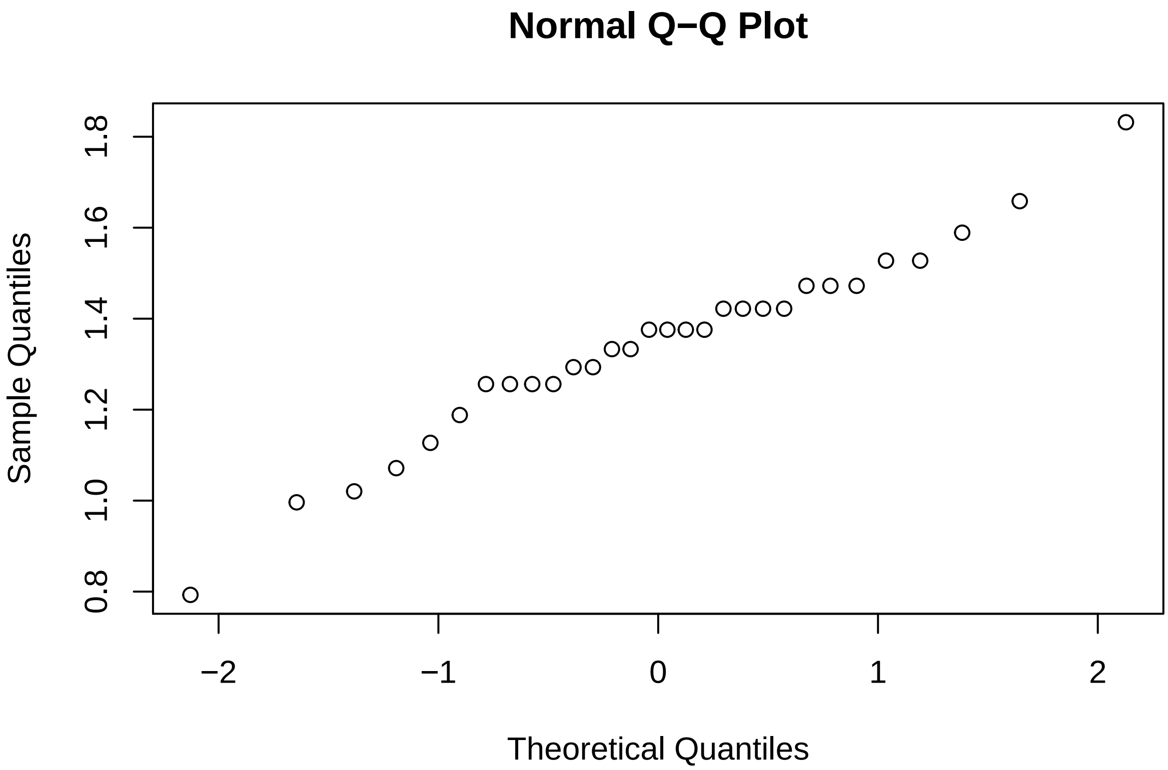
Question b

Explore, by means of Q-Q plots, how the distribution of the reliability coefficients has changed after applying the Z transformation.

```
qqnorm(df1$yi_original)
```




```
qqnorm(df1$yi)
```



The distribution of the transformed coefficients departs less from normality than the distribution of the original correlation coefficients.

Question c

Is there a moderating effect of the mean of the total scores on the transformed coefficients? Use a mixed-effects model (choosing the REML estimation method).

```
MREM1 <- rma(yi=yi, vi=vi, mods = Mean, data = df1)
summary(MREM1)
```

```
##
## Mixed-Effects Model (k = 30; tau^2 estimator: REML)
##
##   logLik  deviance       AIC       BIC      AICc
##   3.7999   -7.5999   -1.5999    2.3967   -0.5999
##
## tau^2 (estimated amount of residual heterogeneity):     0.0396 (SE = 0.0119)
## tau (square root of estimated tau^2 value):             0.1991
## I^2 (residual heterogeneity / unaccounted variability): 93.27%
## H^2 (unaccounted variability / sampling variability):   14.87
## R^2 (amount of heterogeneity accounted for):            0.00%
##
## Test for Residual Heterogeneity:
## QE(df = 28) = 341.5078, p-val < .0001
##
## Test of Moderators (coefficient 2):
## QM(df = 1) = 0.0207, p-val = 0.8856
##
## Model Results:
##
##          estimate      se     zval    pval    ci.lb   ci.ub
## intrcpt    1.3704  0.2154   6.3613  <.0001   0.9481  1.7926  ***
## mods      -0.0014  0.0100  -0.1439  0.8856  -0.0211  0.0182
##
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

The mean total score does not show a statistically significant relationship with the transformed reliability score ($p = 0.8855891$).

Question d

Is there a moderating effect of the standard deviation of the total scores on the transformed coefficients? Again, use a mixed-effects model.

```r
MREM2 <- rma(yi=yi, vi=vi, mods = SD, data = df1)
summary(MREM2)
```

```
##
## Mixed-Effects Model (k = 30; tau^2 estimator: REML)
##
##   logLik  deviance       AIC       BIC      AICc
##  12.2745  -24.5491  -18.5491  -14.5525  -17.5491
##
## tau^2 (estimated amount of residual heterogeneity):     0.0197 (SE = 0.0065)
## tau (square root of estimated tau^2 value):             0.1404
## I^2 (residual heterogeneity / unaccounted variability): 87.39%
## H^2 (unaccounted variability / sampling variability):   7.93
## R^2 (amount of heterogeneity accounted for):            48.23%
##
## Test for Residual Heterogeneity:
## QE(df = 28) = 202.9764, p-val < .0001
##
## Test of Moderators (coefficient 2):
## QM(df = 1) = 23.0806, p-val < .0001
##
## Model Results:
##
##          estimate      se    zval    pval    ci.lb   ci.ub
## intrcpt    0.3514  0.2077  1.6915  0.0907  -0.0558  0.7585    .
## mods       0.0964  0.0201  4.8042  <.0001   0.0571  0.1358  ***
##
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

Yes, the standard deviation shows a statistically significant relationship with the transformed coefficient ($p = 1.5534766 \times 10^{-6}$)