Meta-Analysis using Contingency Table Values

John Robert Torres

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1 Load required and new packages

```
if (!require("pacman")) install.packages("pacman")
```

```
## Loading required package: pacman
```

```
library(pacman)
pacman::p_load("here", "glue", "crayon","readxl", "writexl", "dplyr", "tidyr", "rstatix")
pacman::p_load("meta")

`%ni%` = Negate(`%in%`)
```

2 Set data paths and details

```
main.path = here::here()
data.path = file.path(main.path, "02 Data")
output.path = file.path(main.path, "04 Outputs")

file.name = "Final Data.xlsx"
sheet.name = "Final"
output.name = paste0(format(Sys.Date(), "%m%d%y"), "_OUTPUT", ".xlsx")
```

3 Load dataset

```
df = readxl::read_excel(file.path(data.path, file.name),
                        sheet = sheet.name)
```

4 Process data

```
df.final = df %>%
  dplyr::mutate(n = tp + tn + fp + fn,
                n_splus = tp + fn,
                n_sminus = tn + fp,
                n_ppv = tp + fp,
                n_npv = tn + fn,
                year = stringr::str_sub(authors_year, -5),
                year = stringr::str_sub(year, 1, 4)) %>%
  dplyr::arrange(desc(year), authors_year)
```

5 Implement methodology

5.1 Sensitivity

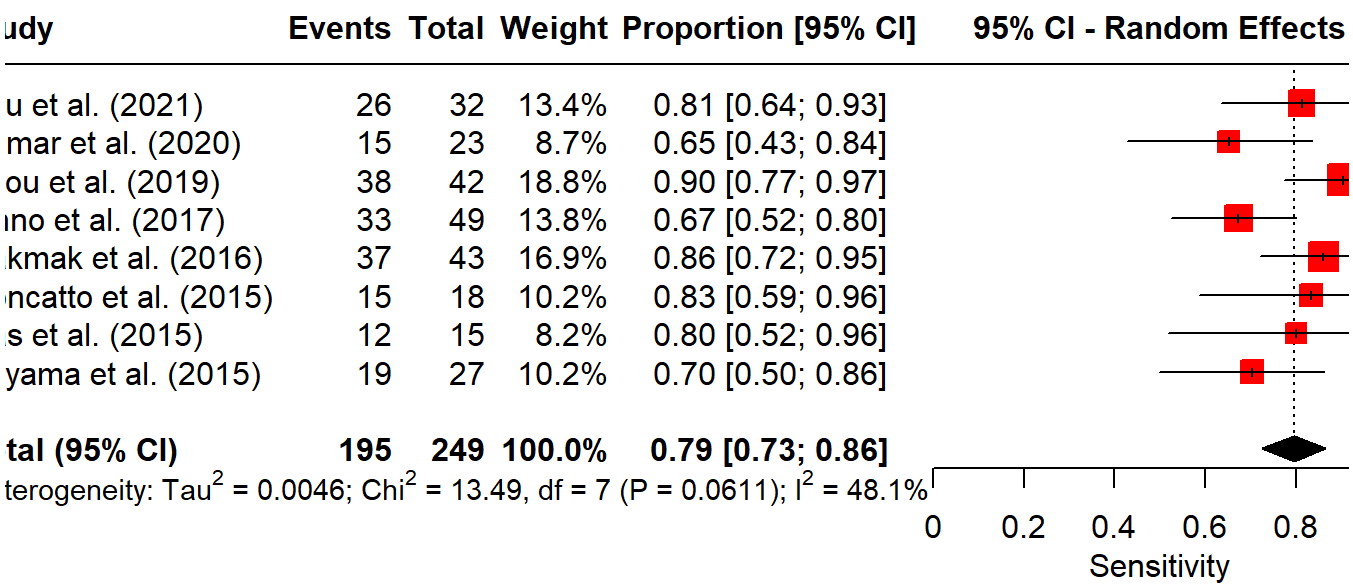
```
splus_meta = meta::metaprop(data = df.final,
                            event = tp,
                            n = n_splus,
                            studlab = authors_year,
                            random = TRUE,
                            fixed = FALSE,
                            method = "I",
                            sm = "PRAW")
```

```
## Warning: Use argument 'common' instead of 'fixed' (deprecated).
```

```
summary(splus_meta)
```

```
##                         proportion           95%-CI %W(random)
## Zhu et al. (2021)           0.8125 [0.6356; 0.9279]       13.4
## Kumar et al. (2020)         0.6522 [0.4273; 0.8362]        8.7
## Zhou et al. (2019)          0.9048 [0.7738; 0.9734]       18.8
## Ohno et al. (2017)          0.6735 [0.5246; 0.8005]       13.8
## Cakmak et al. (2016)        0.8605 [0.7207; 0.9470]       16.9
## Concatto et al. (2015)      0.8333 [0.5858; 0.9642]       10.2
## Das et al. (2015)           0.8000 [0.5191; 0.9567]        8.2
## Koyama et al. (2015)        0.7037 [0.4982; 0.8625]       10.2
##
## Number of studies: k = 8
## Number of observations: o = 249
## Number of events: e = 195
##
##                       proportion           95%-CI
## Random effects model     0.7949 [0.7254; 0.8644]
##
## Quantifying heterogeneity (with 95%-CIs):
##  tau^2 = 0.0046 [0.0000; 0.0300]; tau = 0.0682 [0.0000; 0.1732]
##  I^2 = 48.1% [0.0%; 76.9%]; H = 1.39 [1.00; 2.08]
##
## Test of heterogeneity:
##      Q d.f. p-value
##  13.49    7  0.0611
##
## Details of meta-analysis methods:
## - Inverse variance method
## - Restricted maximum-likelihood estimator for tau^2
## - Q-Profile method for confidence interval of tau^2 and tau
## - Calculation of I^2 based on Q
## - Untransformed proportions
## - Clopper-Pearson confidence interval for individual studies
```

```
meta::forest(splus_meta,
             pooled.events = T,
             layout = "RevMan5",
             xlab = "Sensitivity",
             smlab = "95% CI - Random Effects",
             digits = 2,
             events.show = F,
             xlim = c(0, 1))
```



5.2 Specificity

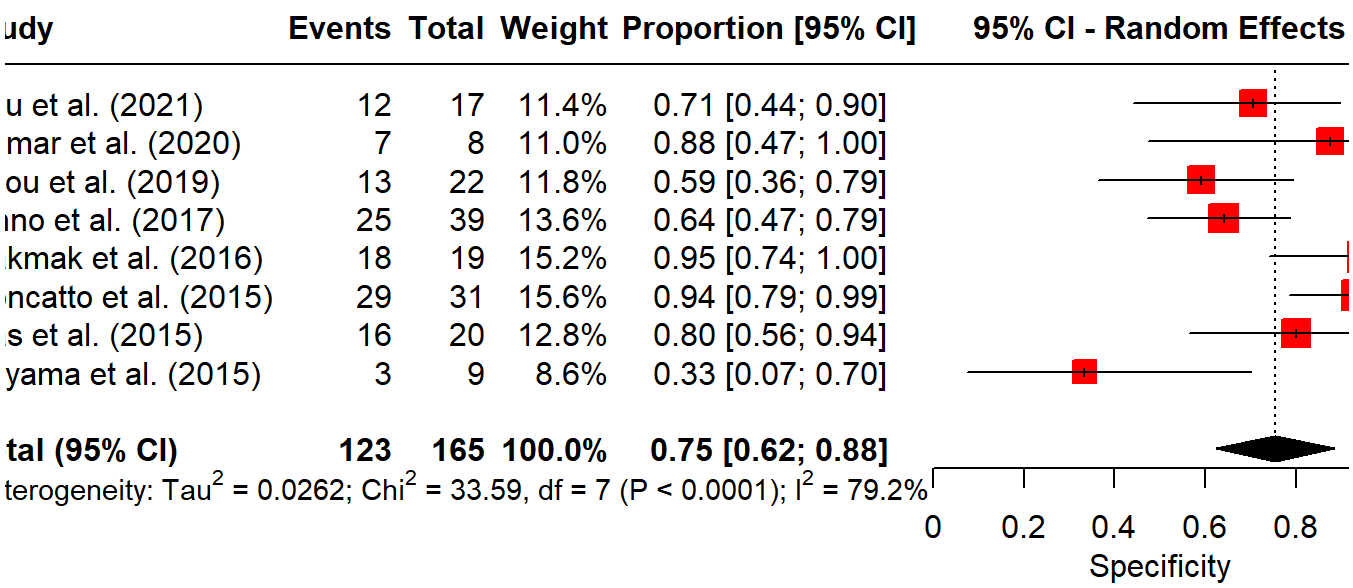
```
sminus_meta = meta::metaprop(data = df.final,
                             event = tn,
                             n = n_sminus,
                             studlab = authors_year,
                             random = TRUE,
                             fixed = FALSE,
                             method = "I",
                             sm = "PRAW")
```

```
## Warning: Use argument 'common' instead of 'fixed' (deprecated).
```

```
summary(sminus_meta)
```

```
##                         proportion           95%-CI %W(random)
## Zhu et al. (2021)           0.7059 [0.4404; 0.8969]       11.4
## Kumar et al. (2020)         0.8750 [0.4735; 0.9968]       11.0
## Zhou et al. (2019)          0.5909 [0.3635; 0.7929]       11.8
## Ohno et al. (2017)          0.6410 [0.4718; 0.7880]       13.6
## Cakmak et al. (2016)        0.9474 [0.7397; 0.9987]       15.2
## Concatto et al. (2015)      0.9355 [0.7858; 0.9921]       15.6
## Das et al. (2015)           0.8000 [0.5634; 0.9427]       12.8
## Koyama et al. (2015)        0.3333 [0.0749; 0.7007]        8.6
##
## Number of studies: k = 8
## Number of observations: o = 165
## Number of events: e = 123
##
##                       proportion           95%-CI
## Random effects model     0.7545 [0.6247; 0.8842]
##
## Quantifying heterogeneity (with 95%-CIs):
##  tau^2 = 0.0262 [0.0071; 0.1628]; tau = 0.1619 [0.0845; 0.4034]
##  I^2 = 79.2% [59.3%; 89.3%]; H = 2.19 [1.57; 3.06]
##
## Test of heterogeneity:
##      Q d.f.  p-value
##  33.59    7 < 0.0001
##
## Details of meta-analysis methods:
## - Inverse variance method
## - Restricted maximum-likelihood estimator for tau^2
## - Q-Profile method for confidence interval of tau^2 and tau
## - Calculation of I^2 based on Q
## - Untransformed proportions
## - Clopper-Pearson confidence interval for individual studies
```

```
meta::forest(sminus_meta,
             pooled.events = T,
             layout = "RevMan5",
             xlab = "Specificity",
             smlab = "95% CI - Random Effects",
             digits = 2,
             events.show = F,
             xlim = c(0, 1))
```



5.3 PPV

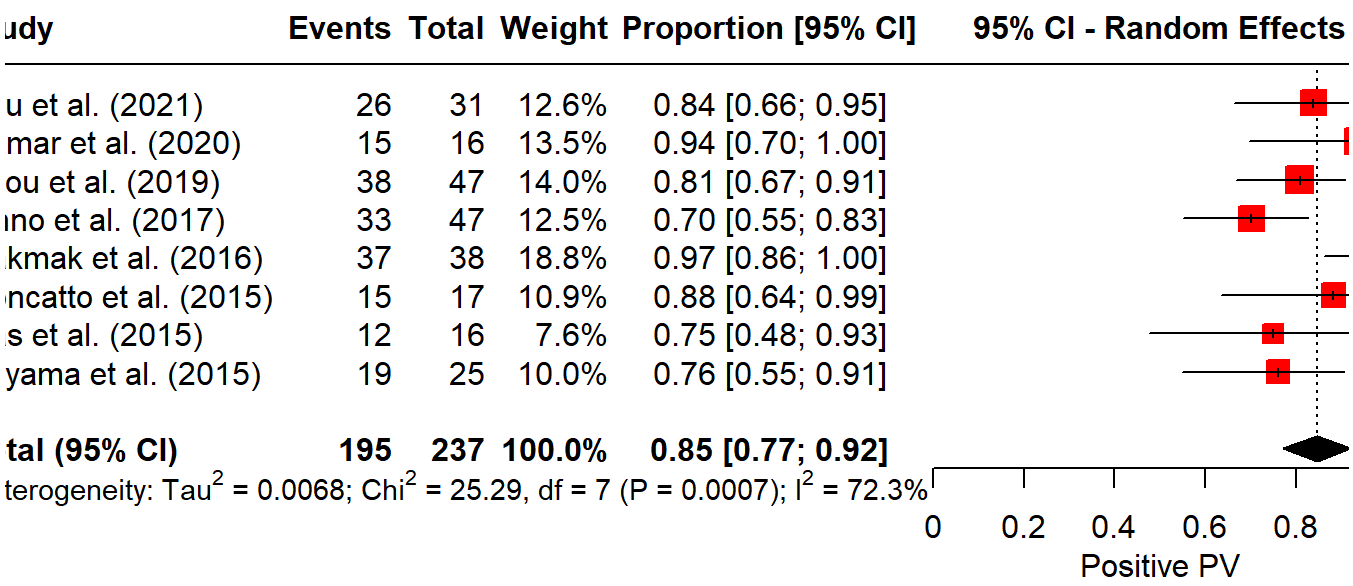
```
ppv_meta = meta::metaprop(data = df.final,
                          event = tp,
                          n = n_ppv,
                          studlab = authors_year,
                          random = TRUE,
                          fixed = FALSE,
                          method = "I",
                          sm = "PRAW")
```

```
## Warning: Use argument 'common' instead of 'fixed' (deprecated).
```

```
summary(ppv_meta)
```

```
##                         proportion           95%-CI %W(random)
## Zhu et al. (2021)           0.8387 [0.6627; 0.9455]       12.6
## Kumar et al. (2020)         0.9375 [0.6977; 0.9984]       13.5
## Zhou et al. (2019)          0.8085 [0.6674; 0.9085]       14.0
## Ohno et al. (2017)          0.7021 [0.5511; 0.8266]       12.5
## Cakmak et al. (2016)        0.9737 [0.8619; 0.9993]       18.8
## Concatto et al. (2015)      0.8824 [0.6356; 0.9854]       10.9
## Das et al. (2015)           0.7500 [0.4762; 0.9273]        7.6
## Koyama et al. (2015)        0.7600 [0.5487; 0.9064]       10.0
##
## Number of studies: k = 8
## Number of observations: o = 237
## Number of events: e = 195
##
##                       proportion           95%-CI
## Random effects model     0.8462 [0.7725; 0.9199]
##
## Quantifying heterogeneity (with 95%-CIs):
##  tau^2 = 0.0068 [0.0011; 0.0333]; tau = 0.0827 [0.0325; 0.1826]
##  I^2 = 72.3% [43.3%; 86.5%]; H = 1.90 [1.33; 2.72]
##
## Test of heterogeneity:
##      Q d.f. p-value
##  25.29    7  0.0007
##
## Details of meta-analysis methods:
## - Inverse variance method
## - Restricted maximum-likelihood estimator for tau^2
## - Q-Profile method for confidence interval of tau^2 and tau
## - Calculation of I^2 based on Q
## - Untransformed proportions
## - Clopper-Pearson confidence interval for individual studies
```

```
meta::forest(ppv_meta,
             pooled.events = T,
             layout = "RevMan5",
             xlab = "Positive PV",
             smlab = "95% CI - Random Effects",
             digits = 2,
             events.show = F,
             xlim = c(0, 1))
```



5.4 NPV

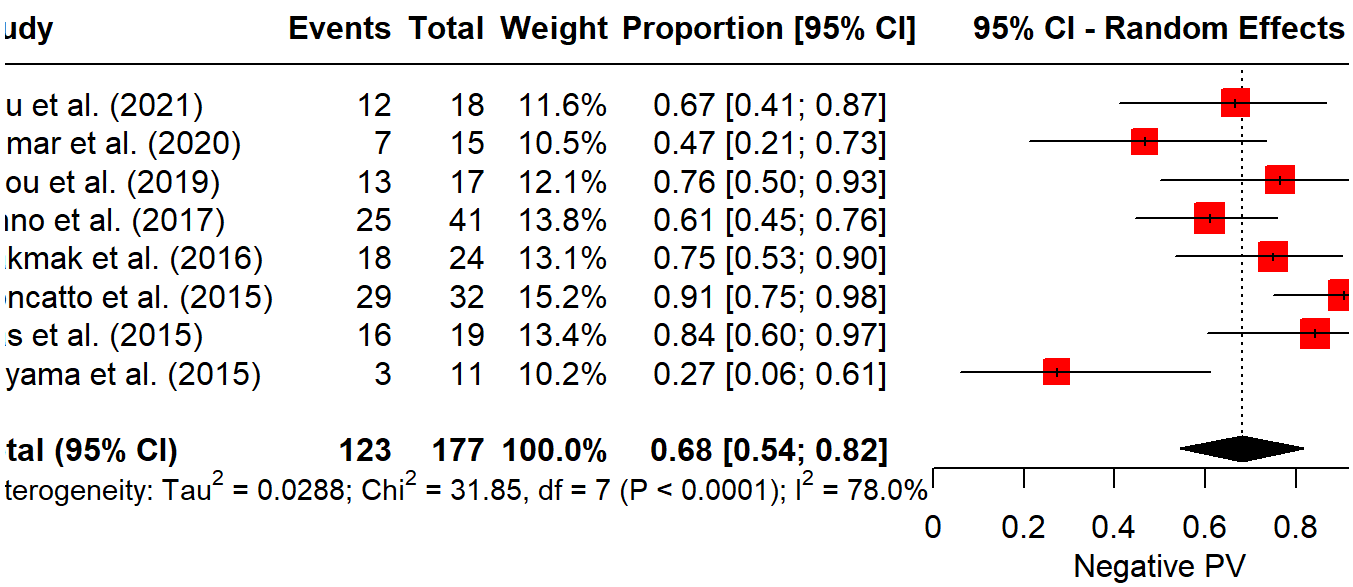
```
npv_meta = meta::metaprop(data = df.final,
                          event = tn,
                          n = n_npv,
                          studlab = authors_year,
                          random = TRUE,
                          fixed = FALSE,
                          method = "I",
                          sm = "PRAW")
```

```
## Warning: Use argument 'common' instead of 'fixed' (deprecated).
```

```
summary(npv_meta)
```

```
##                         proportion           95%-CI %W(random)
## Zhu et al. (2021)           0.6667 [0.4099; 0.8666]       11.6
## Kumar et al. (2020)         0.4667 [0.2127; 0.7341]       10.5
## Zhou et al. (2019)          0.7647 [0.5010; 0.9319]       12.1
## Ohno et al. (2017)          0.6098 [0.4450; 0.7580]       13.8
## Cakmak et al. (2016)        0.7500 [0.5329; 0.9023]       13.1
## Concatto et al. (2015)      0.9062 [0.7498; 0.9802]       15.2
## Das et al. (2015)           0.8421 [0.6042; 0.9662]       13.4
## Koyama et al. (2015)        0.2727 [0.0602; 0.6097]       10.2
##
## Number of studies: k = 8
## Number of observations: o = 177
## Number of events: e = 123
##
##                       proportion           95%-CI
## Random effects model     0.6802 [0.5446; 0.8157]
##
## Quantifying heterogeneity (with 95%-CIs):
##  tau^2 = 0.0288 [0.0075; 0.1664]; tau = 0.1697 [0.0867; 0.4079]
##  I^2 = 78.0% [56.7%; 88.9%]; H = 2.13 [1.52; 2.99]
##
## Test of heterogeneity:
##      Q d.f.  p-value
##  31.85    7 < 0.0001
##
## Details of meta-analysis methods:
## - Inverse variance method
## - Restricted maximum-likelihood estimator for tau^2
## - Q-Profile method for confidence interval of tau^2 and tau
## - Calculation of I^2 based on Q
## - Untransformed proportions
## - Clopper-Pearson confidence interval for individual studies
```

```
meta::forest(npv_meta,
             pooled.events = T,
             layout = "RevMan5",
             xlab = "Negative PV",
             smlab = "95% CI - Random Effects",
             digits = 2,
             events.show = F,
             xlim = c(0, 1))
```



5.5 Accuracy

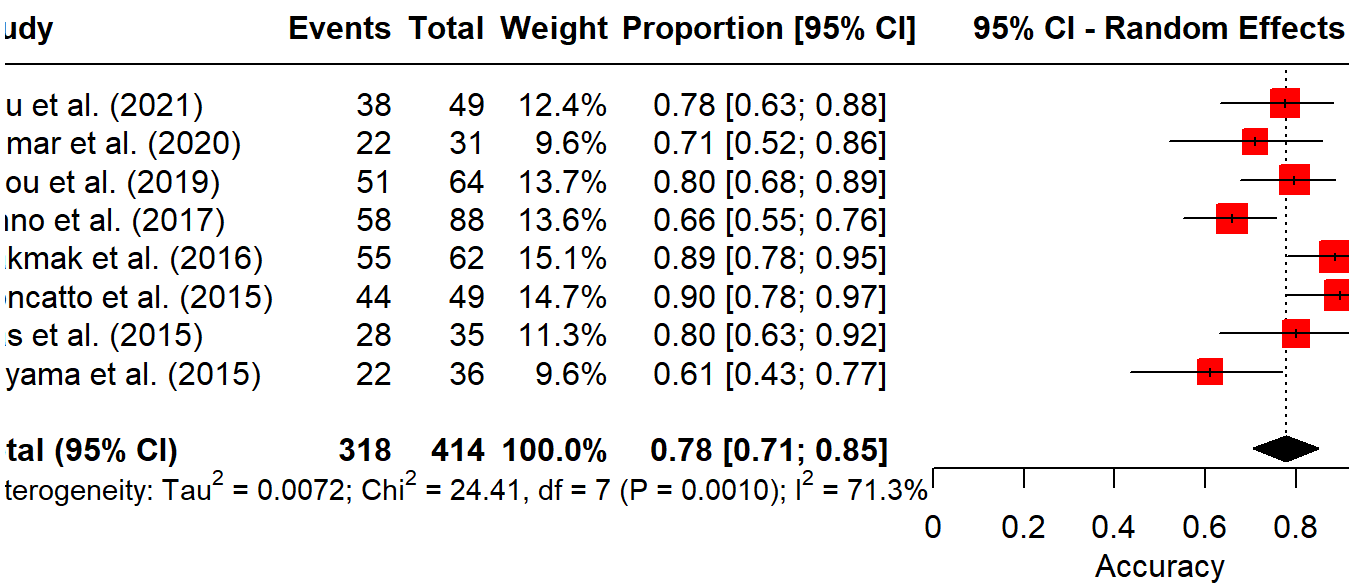
```
acc_meta = meta::metaprop(data = df.final,
                          event = tp + tn,
                          n = n,
                          studlab = authors_year,
                          random = TRUE,
                          fixed = FALSE,
                          method = "I",
                          sm = "PRAW")
```

```
## Warning: Use argument 'common' instead of 'fixed' (deprecated).
```

```
summary(acc_meta)
```

```
##                         proportion           95%-CI %W(random)
## Zhu et al. (2021)           0.7755 [0.6338; 0.8823]       12.4
## Kumar et al. (2020)         0.7097 [0.5196; 0.8578]        9.6
## Zhou et al. (2019)          0.7969 [0.6777; 0.8872]       13.7
## Ohno et al. (2017)          0.6591 [0.5503; 0.7568]       13.6
## Cakmak et al. (2016)        0.8871 [0.7811; 0.9534]       15.1
## Concatto et al. (2015)      0.8980 [0.7777; 0.9660]       14.7
## Das et al. (2015)           0.8000 [0.6306; 0.9156]       11.3
## Koyama et al. (2015)        0.6111 [0.4346; 0.7686]        9.6
##
## Number of studies: k = 8
## Number of observations: o = 414
## Number of events: e = 318
##
##                       proportion           95%-CI
## Random effects model     0.7780 [0.7065; 0.8494]
##
## Quantifying heterogeneity (with 95%-CIs):
##  tau^2 = 0.0072 [0.0014; 0.0394]; tau = 0.0848 [0.0370; 0.1985]
##  I^2 = 71.3% [40.8%; 86.1%]; H = 1.87 [1.30; 2.68]
##
## Test of heterogeneity:
##      Q d.f. p-value
##  24.41    7  0.0010
##
## Details of meta-analysis methods:
## - Inverse variance method
## - Restricted maximum-likelihood estimator for tau^2
## - Q-Profile method for confidence interval of tau^2 and tau
## - Calculation of I^2 based on Q
## - Untransformed proportions
## - Clopper-Pearson confidence interval for individual studies
```

```
meta::forest(acc_meta,
             pooled.events = T,
             layout = "RevMan5",
             xlab = "Accuracy",
             smlab = "95% CI - Random Effects",
             digits = 2,
             events.show = F,
             xlim = c(0, 1))
```



6 Export necessary data

```
export.list = list()

if(length(export.list) != 0){
  if (!file.exists(file.path(output.path, output.name))) {
    writexl::write_xlsx(export.list, file.path(output.path, output.name))
    cat(crayon::green("File successfully written."))
  } else {
    cat(crayon::red(glue::glue("Filename already used: {output.name}")))
    overwrite = readline(prompt = "Overwrite (1 for Yes, 0 for No): ")
    if (overwrite == "1") {
      writexl::write_xlsx(export.list, file.path(output.path, output.name))
      cat(crayon::green("File successfully overwritten"))
    } else {
      cat(crayon::red("File not overwritten"))
    }
  }
}
```