

# CIs on mxAlgebra

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20 May 2019

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## Optimizer: SLSQP

```
require(OpenMx)

mxOption(NULL, "Default optimizer", "SLSQP")

yi <- c(-0.264,-0.230,0.166,0.173,0.225,0.291,0.309,0.435,0.476,0.617,
        0.651,0.718,0.740,0.745,0.758,0.922,0.938,0.962,1.522,1.844)
vi <- c(0.086,0.106,0.055,0.084,0.071,0.078,0.051,0.093,0.149,0.095,
        0.110,0.054,0.081,0.084,0.087,0.103,0.113,0.083,0.100,0.141)
my.df <- cbind(yi,vi)

wi <- 1/vi
s2 <- (length(yi)-1) * sum(wi) / (sum(wi)^2 - sum(wi^2))
## Fixed value
s2

## [1] 0.08486598

test <- mxModel("test", type="default",
  mxMatrix("Full", ncol=1, nrow=1, free=F, values=0, labels="data.vi", name="V"),
  mxMatrix("Full", ncol=1, nrow=1, free=T, values=0.1, lbound=0.0000001, name="Tau"),
  mxMatrix("Full", ncol=1, nrow=1, free=T, values=0.5, name="M"),
  ## S2 is fixed.
  mxMatrix("Full", ncol=1, nrow=1, free=F, values=s2, name="S2"),
  mxAlgebra(V+Tau, name="S"),
  mxAlgebra(Tau/(Tau+S2), name="Tau_2"),
  mxFitFunctionML(),
  mxExpectationNormal(covariance="S", means="M", dimnames=c("yi")),
  mxData(observed=my.df, type="raw"),
  ## CIs on Tau and Tau_2
  mxCI(c("Tau", "Tau_2"))
)
out <- mxRun(test, intervals = TRUE)
summary(out)

## Summary of test
##
```

```

## free parameters:
##           name matrix row col Estimate Std.Error A lbound ubound
## 1 test.Tau[1,1]   Tau   1   1 0.1315197 0.07353605 1e-07
## 2 test.M[1,1]     M     1  yi 0.5790348 0.10510037
##
## confidence intervals:
##           lbound estimate ubound note
## test.Tau[1,1]  0.03486319 0.1315197 0.3642825
## test.Tau_2[1,1] 0.27625149 0.6078022 0.6748704
##
## Model Statistics:
##           | Parameters | Degrees of Freedom | Fit (-2lnL units)
## Model:           2                18                27.79916
## Saturated:       2                18                NA
## Independence:    2                18                NA
## Number of observations/statistics: 20/20
##
## Information Criteria:
##           | df Penalty | Parameters Penalty | Sample-Size Adjusted
## AIC:      -8.200837                31.79916                32.50505
## BIC:      -26.124018                33.79063                27.62514
## CFI: NA
## TLI: 1 (also known as NNFI)
## RMSEA: 0 [95% CI (NA, NA)]
## Prob(RMSEA <= 0.05): NA
## To get additional fit indices, see help(mxRefModels)
## timestamp: 2019-05-20 14:53:04
## Wall clock time: 0.1713524 secs
## optimizer: SLSQP
## OpenMx version number: 2.12.2
## Need help? See help(mxSummary)

```

```

Tau <- out$output$confidenceIntervals["test.Tau[1,1]", ]
rbind(Tau2_correct=Tau/(Tau+s2),
      Tau2_mxCI=out$output$confidenceIntervals["test.Tau_2[1,1]", ])

```

```

##           lbound estimate ubound
## Tau2_correct 0.2911838 0.6078022 0.8110514
## Tau2_mxCI    0.2762515 0.6078022 0.6748704

```

## Optimizer: CSOLNP

```

mxOption(NULL, "Default optimizer", "CSOLNP")

```

```

out <- mxRun(test, intervals = TRUE)

```

```

summary(out)

```

```

## Summary of test
##
## free parameters:
##           name matrix row col Estimate Std.Error A lbound ubound

```

```

## 1 test.Tau[1,1]    Tau    1    1 0.1315197 0.07353602    1e-07
## 2  test.M[1,1]     M      1    yi 0.5790347 0.10510037
##
## confidence intervals:
##           lbound estimate ubound note
## test.Tau[1,1]  0.03481267 0.1315197 0.3654117
## test.Tau_2[1,1] 0.27484529 0.6078022 0.8112579
##
## Model Statistics:
##           | Parameters | Degrees of Freedom | Fit (-2lnL units)
##           |-----|-----|-----|
## Model:           2                18                27.79916
## Saturated:       2                18                NA
## Independence:    2                18                NA
## Number of observations/statistics: 20/20
##
## Information Criteria:
##           | df Penalty | Parameters Penalty | Sample-Size Adjusted
## AIC:       -8.200837                31.79916                32.50505
## BIC:       -26.124018                33.79063                27.62514
## CFI: NA
## TLI: 1 (also known as NNFI)
## RMSEA: 0 [95% CI (NA, NA)]
## Prob(RMSEA <= 0.05): NA
## To get additional fit indices, see help(mxRefModels)
## timestamp: 2019-05-20 14:53:04
## Wall clock time: 0.05050445 secs
## optimizer: CSOLNP
## OpenMx version number: 2.12.2
## Need help? See help(mxSummary)

Tau <- out$output$confidenceIntervals["test.Tau[1,1]", ]
rbind(Tau2_correct=Tau/(Tau+s2),
      Tau2_mxCI=out$output$confidenceIntervals["test.Tau_2[1,1]", ])

##           lbound estimate ubound
## Tau2_correct 0.2908846 0.6078022 0.8115252
## Tau2_mxCI    0.2748453 0.6078022 0.8112579

```

## Optimizer: NPSOL

```

mxOption(NULL, "Default optimizer", "NPSOL")

out <- mxRun(test, intervals = TRUE)

## Running test with 2 parameters

summary(out)

## Summary of test
##
## free parameters:
##           name matrix row col Estimate Std.Error A lbound ubound
## 1 test.Tau[1,1]    Tau    1    1 0.1315197 0.07353607    1e-07
## 2  test.M[1,1]     M      1    yi 0.5790348 0.10510038

```

```

##
## confidence intervals:
##           lbound estimate ubound note
## test.Tau[1,1] 0.0348127 0.1315197 0.3654117
## test.Tau_2[1,1] 0.2748456 0.6078023 0.8112579
##
## Model Statistics:
##           | Parameters | Degrees of Freedom | Fit (-2lnL units)
## Model:           2           18           27.79916
## Saturated:       2           18           NA
## Independence:    2           18           NA
## Number of observations/statistics: 20/20
##
## Information Criteria:
##           | df Penalty | Parameters Penalty | Sample-Size Adjusted
## AIC:       -8.200837           31.79916           32.50505
## BIC:       -26.124018           33.79063           27.62514
## CFI: NA
## TLI: 1 (also known as NNFI)
## RMSEA: 0 [95% CI (NA, NA)]
## Prob(RMSEA <= 0.05): NA
## To get additional fit indices, see help(mxRefModels)
## timestamp: 2019-05-20 14:53:04
## Wall clock time: 0.02254748 secs
## optimizer: NPSOL
## OpenMx version number: 2.12.2
## Need help? See help(mxSummary)

Tau <- out$output$confidenceIntervals["test.Tau[1,1]", ]
rbind(Tau2_correct=Tau/(Tau+s2),
      Tau2_mxCI=out$output$confidenceIntervals["test.Tau_2[1,1]", ])

##           lbound estimate ubound
## Tau2_correct 0.2908848 0.6078023 0.8115252
## Tau2_mxCI    0.2748456 0.6078023 0.8112579

sessionInfo()

## R version 3.6.0 (2019-04-26)
## Platform: x86_64-pc-linux-gnu (64-bit)
## Running under: Ubuntu 18.04.2 LTS
##
## Matrix products: default
## BLAS: /usr/lib/x86_64-linux-gnu/blas/libblas.so.3.7.1
## LAPACK: /usr/lib/x86_64-linux-gnu/lapack/liblapack.so.3.7.1
##
## locale:
## [1] LC_CTYPE=en_SG.UTF-8 LC_NUMERIC=C
## [3] LC_TIME=en_SG.UTF-8 LC_COLLATE=en_SG.UTF-8
## [5] LC_MONETARY=en_SG.UTF-8 LC_MESSAGES=en_SG.UTF-8
## [7] LC_PAPER=en_SG.UTF-8 LC_NAME=C
## [9] LC_ADDRESS=C LC_TELEPHONE=C
## [11] LC_MEASUREMENT=en_SG.UTF-8 LC_IDENTIFICATION=C
##
## attached base packages:

```

```
## [1] stats      graphics  grDevices  utils      datasets  methods   base
##
## other attached packages:
## [1] OpenMx_2.12.2
##
## loaded via a namespace (and not attached):
## [1] Rcpp_1.0.1      lattice_0.20-38 digest_0.6.18  MASS_7.3-51.1
## [5] grid_3.6.0      magrittr_1.5    evaluate_0.13  stringi_1.4.3
## [9] Matrix_1.2-17  rmarkdown_1.12 tools_3.6.0    stringr_1.4.0
## [13] xfun_0.7        yaml_2.2.0      parallel_3.6.0 compiler_3.6.0
## [17] htmltools_0.3.6 knitr_1.22
```