

Appendix A.

R syntax used to estimate the internal consistency in four practical scenarios.

See <http://ddd.uab.cat/record/173917> for data bases and Table 1 and Table 2 for selected output. See the main text for additional details. Appendix A is recommended for experienced users of R. Beginners may also find useful the comments in Appendix B.

```
#Defining the working directory
setwd("c:/workingdirectory")

#Installing packages needed to perform the analyses
#Don't run if already installed!
install.packages("reshape2", dependencies = TRUE)
install.packages("psych", dependencies = TRUE)
install.packages("lavaan", dependencies = TRUE)
install.packages("semTools", dependencies = TRUE)
install.packages("MBESS", dependencies = TRUE)

#Loading packages needed to perform the analyses
#Run at the beginning of a new working session
library(reshape2)
library(psych)
library(lavaan)
library(semTools)
library(MBESS)

#Case 1: essentially tau-equivalent measures
#Reading data, see Table B1 for the data structure
C1<-read.table('Case1.txt',header=TRUE)

#Phase 1
#Response percentages
prop.table(table(melt(C1)),1)*100
#Other univariate statistics
describeBy(C1)
#Pearson correlations
lowerCor(C1, digits = 3)

#Phase 2
#Specification of the essentially tau-equivalent model
C1tau <- 'Factor1 =~ L*Y1 + L*Y2 + L*Y3 + L*Y4 + L*Y5 + L*Y6'
#model estimation and fit
CFA_C1tau <- cfa(C1tau, C1,std.lv = TRUE)
#output
summary(CFA_C1tau, fit.measures = TRUE)
#Specification, estimation and fit of the congeneric measurement model
C1cong <- 'Factor1 =~ Y1 + Y2 + Y3 + Y4 + Y5 + Y6'
CFA_C1cong <- cfa(C1cong, C1,std.lv = TRUE)
summary(CFA_C1cong, fit.measures = TRUE)

#Phase 3
#point estimation of coefficients alpha and omega
reliability(CFA_C1tau)
#Interval estimation of coefficient alpha
ci.reliability(data=C1, type='alpha', interval.type='bsil', B=500)
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#Interval estimation of coefficient omega for essentially tau-equivalent measures
ci.reliability(data=C1, type='alpha-CFA', interval.type='bsil', B=500)

#Case 2: congeneric measures with homogeneously high factor loadings
#Reading data
C2<-read.table('Case2.txt',header=TRUE)

#Phase 1
# Response percentages
prop.table(table(melt(C2)),1)*100
#Other univariate statistics
describeBy(C2)
#Pearson correlations
lowerCor(C2, digits = 3)

#Phase 2
C2tau <- 'Factor1 =~ L*Y1 + L*Y2 + L*Y3 + L*Y4 + L*Y5 + L*Y6'
#model estimation and fit
CFA_C2tau <- cfa(C2tau, C2,std.lv = TRUE)
#output
summary(CFA_C2tau, fit.measures=TRUE)
#Specification, estimation and fit of the congeneric measurement model
C2cong <- 'Factor1 =~ Y1 + Y2 + Y3 + Y4 + Y5 + Y6'
CFA_C2cong <- cfa(C2cong, C2,std.lv = TRUE)
summary(CFA_C2cong, fit.measures=TRUE)

#Phase 3
#point estimation of coefficients alpha and omega
reliability(CFA_C2cong)
#Interval estimation of coefficient alpha
ci.reliability(data=C2, type='alpha', interval.type='bsil', B=500)
#Interval estimation of coefficient omega for congeneric measures
ci.reliability(data=C2, type='omega', interval.type='bsil', B=500)

# Case 3: measures with correlated errors
#Reading data
C3<-read.table('Case3.txt',header=TRUE)

#Phase 1
# Response percentages
prop.table(table(melt(C3)),1)*100
#Other univariate statistics
describeBy(C3)
#Pearson correlations
lowerCor(C3, digits = 3)

#Phase 2
#Specification, estimation and fit of the tau-equivalent and congeneric measurement models
C3tau <- 'Factor1 =~ L*Y1 + L*Y2 + L*Y3 + L*Y4 + L*Y5 + L*Y6'
CFA_C3tau <- cfa(C3tau, C3, std.lv = TRUE)
summary(CFA_C3tau, fit.measures=TRUE)
C3cong <- 'Factor1 =~ Y1 + Y2 + Y3 + Y4 + Y5 + Y6'
CFA_C3cong <- cfa(C3cong, C3, std.lv = TRUE)
summary(CFA_C3cong, fit.measures=TRUE)
#Specification, estimation and fit of the measurement model with correlated errors
C3err_corr <- 'Factor1 =~ Y1 + Y2 + Y3 + Y4 + Y5 + Y6

```

```

Y4 ~~ Y5
Y4 ~~ Y6
Y5 ~~ Y6'
CFA_C3err_corr <- cfa(C3err_corr, C3, std.lv = TRUE)
summary(CFA_C3err_corr, fit.measures=TRUE)

#Phase 3
#point estimation of coefficients alpha and omega
reliability(CFA_C3err_corr)
#interval estimation not available

#Case 4: ordered categorical data
#Reading data
C4<-read.table('Case4.txt',header=TRUE)

#Phase 1
# Response percentages
prop.table(table(melt(C4)),1)*100
#Other univariate statistics
describeBy(C4)
#Polychoric correlations
polychoric(C4)

#Phase 2
#Specification, estimation and fit of the tau-equivalent and congeneric measurement models for categorical ordered items
C4tau <- 'Factor1 =~ L*Y1 + L*Y2 + L*Y3 + L*Y4 + L*Y5 + L*Y6'
CFA_C4tau <- cfa(C4tau, C4, std.lv = TRUE, ordered = names(C4))
summary(CFA_C4tau, fit.measures=TRUE)
C4cong <- 'Factor1 =~ Y1 + Y2 + Y3 + Y4 + Y5 + Y6'
CFA_C4cong <- cfa(C4cong, C4, std.lv = TRUE, ordered=names(C4))
summary(CFA_C4cong, fit.measures=TRUE)

#Phase 3
#point estimation of coefficients alpha and omega
reliability(CFA_C4cong)
#Interval estimation of coefficient omega for congeneric categorical items
ci.reliability(data=C4, type='categorical', interval.type='bca')
```