Mplus syntax used to estimate the internal consistency in the four practical scenarios described in
Viladrich, C., Angulo-Brunet, A., & Doval, E. (2017). A journey around alpha and omega to estimate internal consistency reliability. Annals of Psychology, 33(3), 755-782. doi: 10.6018/analesps.33.3.268401

See http://ddd.uab.cat/record/173917 for datasets headed with the variable names and Table 1 and Table 2 in the paper for selected output obtained using R.

See http://ddd.uab.cat/record/205870 for datasets without variable names, as required by Mplus. Output using Mplus could differ from Table 1 and Table 2 due to differences in computational algorithms.

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!Starting Mplus
!Defining the working directory
!Save the input file in the same folder as data file

!Installing and checking packages needed to perform the analyses
!All analyses use the Mplus Base Program
!Copy-paste each syntax from TITLE to OUTPUT to separate Mplus input files (extension .inp)

!Case 1: essentially tau-equivalent measures

```
!Phase 1
TITLE:
  Response percentiles, other univariate statistics, Pearson correlations
DATA:
  FILE IS Case1_noNames.txt;
VARIABLE:
  NAMES = y1-y6;
  USEVARIABLES = y1-y6;
ANALYSIS: TYPE = BASIC;
OUTPUT: sampstat

!Phase 2
TITLE:
  Specification, estimation and fit of the essentially tau-equivalent measurement model
DATA:
  FILE IS Case1_noNames.txt;
VARIABLE:
  NAMES =  y1-y6 ;
  USEVARIABLES =  y1-y6 ;
MODEL:
  F1 by y1*(la)
          y2(la)
          y3(la)
          y4(la)
          y5(la)
         y6(la);
```

```
  F1@1;
OUTPUT: stdyx tech1

TITLE:
   Specification, estimation and fit of the congeneric measurement model
DATA:
  FILE IS Case1_noNames.txt;
VARIABLE:
  NAMES =  y1-y6 ;
  USEVARIABLES =  y1-y6 ;
MODEL:
  F1 by y1-y6*;
  F1@1;
 OUTPUT: stdyx tech1

!Phase 3
TITLE:
  Point and interval estimation of coefficient alpha
DATA:
  FILE IS Case1_noNames.txt;
VARIABLE:
  NAMES = y1-y6;
  USEVARIABLES = y1-y6;
ANALYSIS: BOOTSTRAP = 500;
MODEL:
  !defining latents equal to observed
  k1 by y1@1;
  k2 by y2@1;
  k3 by y3@1;
  k4 by y4@1;
  k5 by y5@1;
  k6 by y6@1;
  y1-y6@0;
  !labeling variances and covariances
  k1-k6 (s1-s6);
  k1 with k2-k6 (s12-s16);
  k2 with k3-K6 (s23 - s26);
  k3 with k4-k6 (s34 - s36);
  k4 with k5-k6 (s45 - s46);
  k5 with k6 (s56);
  MODEL CONSTRAINT:
  NEW (alpha, p, cs, vs);
  p = 6; !number of items
  cs = 2*(s12 + s13 + s14 + s15 + s16+ s23 + s24 + s25+ s26 +
      s34 + s35 + s36 + s45 + s46 + s56); !covariance sum
  vs = s1 + s2+ s3 +s4 + s5+ s6; !variance sum
  alpha = p/(p-1)*cs/(cs+vs);
OUTPUT: CINTERVAL(BCBOOTSTRAP)


TITLE:
  Point and interval estimation of coefficient omega
DATA:
  FILE IS Case1_noNames.txt;
VARIABLE:
  NAMES = y1-y6;
  USEVARIABLES = y1-y6;
ANALYSIS: BOOTSTRAP = 500;
```

```
MODEL:
 F1 by y1*(la)
      y2(la)
      y3(la)
      y4(la)
      y5(la)
      y6(la);
 F1@1;
 y1-y6 (e1-e6);
 MODEL CONSTRAINT:
 NEW(omega); !equation 2 in Viladrich, Angulo-Brunet & Doval (2017)
 omega = (6*la)^2/((6*la)^2+e1+e2+e3+e4+e5+e6);
OUTPUT: stdyx CINTERVAL(BCBOOTSTRAP)


!Case 2: congeneric measures

!Phase 1
TITLE:
 Response percentiles, other univariate statistics, Pearson correlations
DATA:
 FILE IS Case2_noNames.txt;
VARIABLE:
 NAMES = y1-y6;
 USEVARIABLES = y1-y6;
ANALYSIS: TYPE = BASIC;
OUTPUT: sampstat

!Phase 2
TITLE:
 Specification, estimation and fit of the essentially tau-equivalent measurement model
DATA:
 FILE IS Case2_noNames.txt;
VARIABLE:
 NAMES =  y1-y6 ;
 USEVARIABLES =  y1-y6 ;
MODEL:
 F1 by y1*(la)
        y2(la)
        y3(la)
        y4(la)
        y5(la)
       y6(la);
 F1@1;
OUTPUT: stdyx tech1

TITLE:
 Specification, estimation and fit of the congeneric measurement model
DATA:
 FILE IS Case2_noNames.txt;
VARIABLE:
 NAMES =  y1-y6 ;
 USEVARIABLES =  y1-y6 ;
MODEL:
 F1 by y1-y6*;
 F1@1;
OUTPUT: stdyx tech1
```

```
!Phase 3
TITLE:Point and interval estimation of coefficient alpha
DATA:
  FILE IS Case2_noNames.txt;
VARIABLE:
  NAMES = y1-y6;
  USEVARIABLES = y1-y6;
ANALYSIS: BOOTSTRAP = 500;
MODEL:
  !defining latent variables  equal to observed variables
  k1 by y1@1;
  k2 by y2@1;
  k3 by y3@1;
  k4 by y4@1;
  k5 by y5@1;
  k6 by y6@1;
  y1-y6@0;
  !labeling  variances and covariances
  k1-k6 (s1-s6);
  k1 with k2-k6 (s12-s16);
  k2 with k3-K6 (s23 - s26);
  k3 with k4-k6 (s34 - s36);
  k4 with k5-k6 (s45 - s46);
  k5 with k6 (s56);
MODEL CONSTRAINT:
  NEW (alpha, p, cs, vs);
  p = 6; !number of items
  cs = 2*(s12 + s13 + s14 + s15 + s16+ s23 + s24 + s25+ s26 +
      s34 + s35 + s36 + s45 + s46 + s56); !covariance sum
  vs = s1 + s2+ s3 +s4 + s5+ s6; !variance sum
  alpha = p/(p-1)*cs/(cs+vs);
OUTPUT: CINTERVAL(BCBOOTSTRAP)

TITLE:
  Point and interval estimation of coefficient omega
DATA:
 FILE IS Case2_noNames.txt;
VARIABLE:
  NAMES = y1-y6;
  USEVARIABLES = y1-y6;
ANALYSIS: BOOTSTRAP = 500;
MODEL:
  F1 by  y1-y6* (la1-la6);
  F1@1;
  y1-y6 (e1-e6);
  MODEL CONSTRAINT:
  NEW(omega); !equation 2 in Viladrich, Angulo-Brunet y Doval (2017)
  omega = (la1+la2+la3+la4+la5+la6)^2/((la1+la2+la3+la4+la5+la6)^2+e1+e2+e3+e4+e5+e6);
OUTPUT: CINTERVAL(BCBOOTSTRAP)


!Case 3: measures with correlated errors

!Phase 1
TITLE:
  Response percentiles, other univariate statistics, Pearson correlations
DATA:
  FILE IS Case3_noNames.txt;
```

```
VARIABLE:
  NAMES = y1-y6;
  USEVARIABLES = y1-y6;
ANALYSIS: TYPE = BASIC;
OUTPUT: sampstat

!Phase 2
TITLE:
  Specification, estimation and fit of the essentially tau-equivalent measurement model
DATA:
  FILE IS Case3_noNames.txt;
VARIABLE:
  NAMES =  y1-y6 ;
  USEVARIABLES =  y1-y6 ;
MODEL:
  F1 by y1*(la)
          y2(la)
          y3(la)
          y4(la)
          y5(la)
         y6(la);
  F1@1;
OUTPUT: stdyx tech1

TITLE:
  Specification, estimation and fit of the congeneric measurement model
DATA:
  FILE IS Case3_noNames.txt;
VARIABLE:
  NAMES =  y1-y6;
  USEVARIABLES =  y1-y6;
MODEL:
  F1 by y1-y6*;
  F1@1;
OUTPUT: stdyx tech1

TITLE:
  Specification, estimation and fit of measures with correlated errors
DATA:
  FILE IS Case3_noNames.txt;
VARIABLE:
  NAMES =  y1-y6;
  USEVARIABLES =  y1-y6;
MODEL:
  F1 by y1-y6*;
  F1@1;
  y4 with y5 y6;
  y5 with y6;
OUTPUT: stdyx tech1

!Phase 3
TITLE:
  Point and interval estimation of coefficient omega
DATA:
  FILE IS Case3_noNames.txt;
VARIABLE:
  NAMES = y1-y6;
  USEVARIABLES = y1-y6;
```

```
  ANALYSIS: BOOTSTRAP = 500;
MODEL:
  F1 by y1-y6* (la1-la6);
  F1@1;
  y4 with y5 (s45);
  y4 with y6 (s46);
  y5 with y6 (s56);
  y1-y6 (e1-e6);
MODEL CONSTRAINT:
!equation 5 in Viladrich, Angulo-Brunet y Doval (2017)
NEW(omega num, den);
num =  (la1+la2+la3+la4+la5+la6)^2;
den = num + e1+e2+e3+e4+e5+e6+ 2*(s45+s46+s56);
omega = num/den;
OUTPUT: CINTERVAL(BCBOOTSTRAP)

!Case 4: ordered categorical data

!Phase 1
TITLE:
  Response proportions, thresholds and polychoric correlations
DATA:
  FILE IS Case4_noNames.txt;
VARIABLE:
  NAMES = y1-y6;
  USEVARIABLES = y1-y6;
  CATEGORICAL = Y1-Y6;
ANALYSIS: TYPE = BASIC;
OUTPUT: tech1;

!Phase 2
TITLE:
  Specification, estimation and fit of the congeneric measurement model
DATA:
  FILE IS Case4_noNames.txt;
VARIABLE:
  NAMES = y1-y6;
  USEVARIABLES = y1-y6;
  CATEGORICAL = y1-y6;
MODEL:
  F1 by y1-y6;
SAVEDATA:
  DIFFTEST = deriv1.dat;
OUTPUT: stdyx tech1;

TITLE:
  Specification, estimation and fit of the essentially tau-equivalent measurement model
DATA:
  FILE IS Case4_noNames.txt;
VARIABLE:
  NAMES = y1-y6;
  USEVARIABLES = y1-y6;
  CATEGORICAL = y1-y6;
ANALYSIS:
  DIFFTEST = deriv1.dat;
MODEL:
  F1 by y1*(la)
       y2(la)
```

```
      y3(la)
      y4(la)
      y5(la)
      y6(la);
 F1@1;
OUTPUT: stdyx tech1;

!Phase 3 Point and interval estimation of coefficient omega
!To obtain ordinal omega run the Mplus syntax in Phase 2 and copy-paste the standardized
!factor loadings from the best fitting measurement model into a calculator such as Dueber's
!(2017, doi: 10.13023/edp.tool.01) excel calculator. Use the column labelled general factor.

!To obtain categorical omega run Mplus from R
!both Mplus and R (with lavaan package) must be installed
!R code below, Mplus code under Phase 2 congeneric measurement model


#Set working directory
setwd("c:/workingdirectory")

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

#Obtain parameter estimates from Mplus syntax
#Set library and run Mplus syntax for the congeneric model fitted in Phase 2
library(lavaan)
congeneric<-mplus2lavaan("myfile.inp", run = TRUE)

#Obtain categorical omega from R
#Set library and calculate reliability coefficients
library(semTools)
reliability(congeneric)
```