longMI: Internal Tests

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Tests

```
#> test
#> Call:
#> Comparison(configural = configural_fit, weak = weak_fit, strong = strong_fit,
#>     strict = strict_fit)
#>
#>               chisq df pvalue    cfi    tli  rmsea   srmr      aic      bic
#> configural  25.9682 19 0.1311 0.9915 0.9875 0.0424 0.0306 11252.23 11335.18
#> weak        41.8973 22 0.0064 0.9757 0.9691 0.0666 0.0763 11262.16 11335.16
#> strong      53.7228 25 0.0007 0.9650 0.9608 0.0750 0.0872 11267.98 11331.03
#> strict     134.5591 29 0.0000 0.8712 0.8757 0.1336 0.1690 11340.82 11390.59
#> Call:
#> Comparison(configural = configural_fit, weak = weak_fit, strong = strong_fit,
#>     strict = strict_fit)
#>
#> Fit Measures
#>               chisq df pvalue    cfi    tli  rmsea   srmr      aic      bic
#> configural  25.9682 19 0.1311 0.9915 0.9875 0.0424 0.0306 11252.23 11335.18
#> weak        41.8973 22 0.0064 0.9757 0.9691 0.0666 0.0763 11262.16 11335.16
#> strong      53.7228 25 0.0007 0.9650 0.9608 0.0750 0.0872 11267.98 11331.03
#> strict     134.5591 29 0.0000 0.8712 0.8757 0.1336 0.1690 11340.82 11390.59
#>
#>
#>
#> CONFIGURAL INVARIANCE MODEL
#>
#> lavaan 0.6.16 ended normally after 75 iterations
#>
#>   Estimator                                         ML
#>   Optimization method                           NLMINB
#>   Number of model parameters                        27
#>   Number of equality constraints                     2
#>
#>   Number of observations                           204
#>   Number of missing patterns                         1
```

```
#>
#> Model Test User Model:
#>
#>   Test statistic                                25.968
#>   Degrees of freedom                               19
#>   P-value (Chi-square)                          0.131
#>
#> Parameter Estimates:
#>
#>   Standard errors                             Standard
#>   Information                                 Observed
#>   Observed information based on                Hessian
#>
#> Latent Variables:
#>                    Estimate  Std.Err  z-value  P(>|z|)
#>   f1t1 =~
#>     y1_1     (l11)    4.451    0.400   11.137    0.000
#>     y1_2              6.850    0.637   10.745    0.000
#>     y1_3              4.590    0.520    8.821    0.000
#>     y1_4              5.039    0.396   12.728    0.000
#>   f1t6 =~
#>     y6_1     (l11)    4.451    0.400   11.137    0.000
#>     y6_2              4.006    0.489    8.194    0.000
#>     y6_3              4.551    0.545    8.346    0.000
#>     y6_4              4.102    0.453    9.057    0.000
#>
#> Covariances:
#>                    Estimate  Std.Err  z-value  P(>|z|)
#>   f1t1 ~~
#>     f1t6              1.837    0.215    8.558    0.000
#>
#> Intercepts:
#>                    Estimate  Std.Err  z-value  P(>|z|)
#>    .y1_1      (i1)   19.776    0.427   46.273    0.000
#>    .y1_2             21.797    0.680   32.036    0.000
#>    .y1_3             14.903    0.528   28.223    0.000
#>    .y1_4             20.396    0.439   46.416    0.000
#>    .y6_1      (i1)   19.776    0.427   46.273    0.000
#>    .y6_2             19.317    2.299    8.404    0.000
#>    .y6_3             11.922    2.516    4.738    0.000
#>    .y6_4             17.970    1.844    9.747    0.000
#>     f1t1              0.000
#>     f1t6              6.455    0.606   10.649    0.000
#>
#> Variances:
#>                    Estimate  Std.Err  z-value  P(>|z|)
```

```
#>    .y1_1             17.448    2.240    7.789    0.000
#>    .y1_2             47.511    5.754    8.257    0.000
#>    .y1_3             35.810    4.031    8.884    0.000
#>    .y1_4             13.999    2.133    6.563    0.000
#>    .y6_1             47.096    6.432    7.322    0.000
#>    .y6_2             73.850    8.388    8.805    0.000
#>    .y6_3             88.920   10.354    8.588    0.000
#>    .y6_4             23.267    4.182    5.564    0.000
#>     f1t1              1.000
#>     f1t6              5.834    1.167    4.997    0.000
#>
#>
#>
#> WEAK INVARIANCE MODEL
#>
#> lavaan 0.6.16 ended normally after 54 iterations
#>
#>   Estimator                                         ML
#>   Optimization method                           NLMINB
#>   Number of model parameters                        27
#>   Number of equality constraints                     5
#>
#>   Number of observations                           204
#>   Number of missing patterns                         1
#>
#> Model Test User Model:
#>
#>   Test statistic                                41.897
#>   Degrees of freedom                                22
#>   P-value (Chi-square)                           0.006
#>
#> Parameter Estimates:
#>
#>   Standard errors                             Standard
#>   Information                                 Observed
#>   Observed information based on                Hessian
#>
#> Latent Variables:
#>                    Estimate  Std.Err  z-value  P(>|z|)
#>   f1t1 =~
#>     y1_1     (l11)    4.933    0.339   14.562    0.000
#>     y1_2     (l12)    5.172    0.429   12.052    0.000
#>     y1_3     (l13)    5.072    0.397   12.762    0.000
#>     y1_4     (l14)    4.865    0.336   14.492    0.000
#>   f1t6 =~
#>     y6_1     (l11)    4.933    0.339   14.562    0.000
```

```
#>     y6_2     (l12)    5.172    0.429   12.052    0.000
#>     y6_3     (l13)    5.072    0.397   12.762    0.000
#>     y6_4     (l14)    4.865    0.336   14.492    0.000
#>
#> Covariances:
#>                    Estimate  Std.Err  z-value  P(>|z|)
#>   f1t1 ~~
#>     f1t6              1.558    0.136   11.439    0.000
#>
#> Intercepts:
#>                    Estimate  Std.Err  z-value  P(>|z|)
#>    .y1_1      (i1)   19.776    0.445   44.430    0.000
#>    .y1_2             21.797    0.629   34.633    0.000
#>    .y1_3             14.903    0.544   27.411    0.000
#>    .y1_4             20.396    0.436   46.803    0.000
#>    .y6_1      (i1)   19.776    0.445   44.430    0.000
#>    .y6_2             15.049    2.299    6.547    0.000
#>    .y6_3             11.756    2.212    5.315    0.000
#>    .y6_4             16.111    1.765    9.130    0.000
#>     f1t1              0.000
#>     f1t6              5.824    0.429   13.591    0.000
#>
#> Variances:
#>                    Estimate  Std.Err  z-value  P(>|z|)
#>    .y1_1             16.079    2.188    7.349    0.000
#>    .y1_2             54.055    6.012    8.992    0.000
#>    .y1_3             34.578    3.941    8.775    0.000
#>    .y1_4             15.075    2.109    7.149    0.000
#>    .y6_1             49.748    6.494    7.661    0.000
#>    .y6_2             72.254    8.353    8.650    0.000
#>    .y6_3             91.610   10.487    8.736    0.000
#>    .y6_4             22.022    4.032    5.462    0.000
#>     f1t1              1.000
#>     f1t6              4.240    0.546    7.759    0.000
#>
#>
#>
#> STRONG INVARIANCE MODEL
#>
#> lavaan 0.6.16 ended normally after 52 iterations
#>
#>   Estimator                                         ML
#>   Optimization method                           NLMINB
#>   Number of model parameters                        27
#>   Number of equality constraints                     8
```

```
#>
#>   Number of observations                           204
#>   Number of missing patterns                         1
#>
#> Model Test User Model:
#>
#>   Test statistic                                53.723
#>   Degrees of freedom                               25
#>   P-value (Chi-square)                          0.001
#>
#> Parameter Estimates:
#>
#>   Standard errors                             Standard
#>   Information                                 Observed
#>   Observed information based on                Hessian
#>
#> Latent Variables:
#>                    Estimate  Std.Err  z-value  P(>|z|)
#>   f1t1 =~
#>     y1_1     (l11)    5.270    0.331   15.917    0.000
#>     y1_2     (l12)    4.525    0.312   14.487    0.000
#>     y1_3     (l13)    4.960    0.328   15.112    0.000
#>     y1_4     (l14)    4.547    0.291   15.634    0.000
#>   f1t6 =~
#>     y6_1     (l11)    5.270    0.331   15.917    0.000
#>     y6_2     (l12)    4.525    0.312   14.487    0.000
#>     y6_3     (l13)    4.960    0.328   15.112    0.000
#>     y6_4     (l14)    4.547    0.291   15.634    0.000
#>
#> Covariances:
#>                    Estimate  Std.Err  z-value  P(>|z|)
#>   f1t1 ~~
#>     f1t6               1.608    0.142   11.316    0.000
#>
#> Intercepts:
#>                    Estimate  Std.Err  z-value  P(>|z|)
#>    .y1_1      (i1)   19.929    0.457   43.623    0.000
#>    .y1_2      (i2)   21.459    0.598   35.901    0.000
#>    .y1_3      (i3)   14.882    0.529   28.146    0.000
#>    .y1_4      (i4)   20.311    0.421   48.252    0.000
#>    .y6_1      (i1)   19.929    0.457   43.623    0.000
#>    .y6_2      (i2)   21.459    0.598   35.901    0.000
#>    .y6_3      (i3)   14.882    0.529   28.146    0.000
#>    .y6_4      (i4)   20.311    0.421   48.252    0.000
#>     f1t1              0.000
#>     f1t6              5.337    0.354   15.077    0.000
```

```
#>
#> Variances:
#>                    Estimate  Std.Err  z-value  P(>|z|)
#>    .y1_1             15.124    2.238    6.757    0.000
#>    .y1_2             57.819    6.150    9.402    0.000
#>    .y1_3             34.209    3.869    8.841    0.000
#>    .y1_4             16.339    2.114    7.729    0.000
#>    .y6_1             45.360    6.338    7.157    0.000
#>    .y6_2             74.229    8.352    8.887    0.000
#>    .y6_3             89.572   10.110    8.860    0.000
#>    .y6_4             24.586    3.951    6.223    0.000
#>     f1t1              1.000
#>     f1t6              4.557    0.585    7.791    0.000
#>
#>
#>
#> STRICT INVARIANCE MODEL
#>
#> lavaan 0.6.16 ended normally after 57 iterations
#>
#>   Estimator                                         ML
#>   Optimization method                           NLMINB
#>   Number of model parameters                        27
#>   Number of equality constraints                    12
#>
#>   Number of observations                           204
#>   Number of missing patterns                         1
#>
#> Model Test User Model:
#>
#>   Test statistic                               134.559
#>   Degrees of freedom                                29
#>   P-value (Chi-square)                           0.000
#>
#> Parameter Estimates:
#>
#>   Standard errors                             Standard
#>   Information                                 Observed
#>   Observed information based on                Hessian
#>
#> Latent Variables:
#>                    Estimate  Std.Err  z-value  P(>|z|)
#>   f1t1 =~
#>     y1_1     (l11)    5.083    0.364   13.978    0.000
#>     y1_2     (l12)    4.309    0.333   12.944    0.000
#>     y1_3     (l13)    4.785    0.356   13.447    0.000
```

```
#>     y1_4     (l14)    4.358    0.317   13.765    0.000
#>   f1t6 =~
#>     y6_1     (l11)    5.083    0.364   13.978    0.000
#>     y6_2     (l12)    4.309    0.333   12.944    0.000
#>     y6_3     (l13)    4.785    0.356   13.447    0.000
#>     y6_4     (l14)    4.358    0.317   13.765    0.000
#>
#> Covariances:
#>                    Estimate  Std.Err  z-value  P(>|z|)
#>   f1t1 ~~
#>     f1t6              1.812    0.168   10.812    0.000
#>
#> Intercepts:
#>                    Estimate  Std.Err  z-value  P(>|z|)
#>    .y1_1      (i1)   20.019    0.509   39.339    0.000
#>    .y1_2      (i2)   21.513    0.621   34.648    0.000
#>    .y1_3      (i3)   14.805    0.617   23.988    0.000
#>    .y1_4      (i4)   20.313    0.433   46.915    0.000
#>    .y6_1      (i1)   20.019    0.509   39.339    0.000
#>    .y6_2      (i2)   21.513    0.621   34.648    0.000
#>    .y6_3      (i3)   14.805    0.617   23.988    0.000
#>    .y6_4      (i4)   20.313    0.433   46.915    0.000
#>     f1t1              0.000
#>     f1t6              5.557    0.415   13.396    0.000
#>
#> Variances:
#>                    Estimate  Std.Err  z-value  P(>|z|)
#>    .y1_1      (u1)   28.657    2.958    9.689    0.000
#>    .y1_2      (u2)   68.013    5.253   12.946    0.000
#>    .y1_3      (u3)   61.387    4.897   12.535    0.000
#>    .y1_4      (u4)   20.878    2.142    9.746    0.000
#>    .y6_1      (u1)   28.657    2.958    9.689    0.000
#>    .y6_2      (u2)   68.013    5.253   12.946    0.000
#>    .y6_3      (u3)   61.387    4.897   12.535    0.000
#>    .y6_4      (u4)   20.878    2.142    9.746    0.000
#>     f1t1              1.000
#>     f1t6              5.056    0.692    7.304    0.000
#>
#> Call:
#> Comparison(configural = configural_fit, weak = weak_fit, strong = strong_fit,
#>     strict = strict_fit)
#>
#> Chi-Squared Difference Test
#>
#>              Df   AIC   BIC   Chisq Chisq diff   RMSEA Df diff Pr(>Chisq)
```

```
#> 1.configural 19 11252 11335  25.968
#> 1.weak       22 11262 11335  41.897     15.929 0.14535       3  0.0011726 **
#> 2.configural 19 11252 11335  25.968
#> 2.strong     25 11268 11331  53.723     27.755 0.13332       6  0.0001045 ***
#> 3.configural 19 11252 11335  25.968
#> 3.strict     29 11341 11391 134.559    108.591 0.21984      10  < 2.2e-16 ***
#> 4.weak       22 11262 11335  41.897
#> 4.strong     25 11268 11331  53.723     11.826 0.12009       3  0.0080053 **
#> 5.weak       22 11262 11335  41.897
#> 5.strict     29 11341 11391 134.559     92.662 0.24492       7  < 2.2e-16 ***
#> 6.strong     25 11268 11331  53.723
#> 6.strict     29 11341 11391 134.559     80.836 0.30686       4  < 2.2e-16 ***
#> ---
#> Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
#> Call:
#> Invariance(data = osbornesudick1972, time_points = time_points,
#>     factor_loadings = factor_loadings)
#>
#>               chisq df pvalue    cfi    tli  rmsea   srmr      aic      bic
#> configural  25.9682 19 0.1311 0.9915 0.9875 0.0424 0.0306 11252.23 11335.18
#> weak        41.8973 22 0.0064 0.9757 0.9691 0.0666 0.0720 11262.16 11335.16
#> strong      53.7228 25 0.0007 0.9650 0.9608 0.0750 0.0859 11267.98 11331.03
#> strict     134.5591 29 0.0000 0.8712 0.8757 0.1336 0.1328 11340.82 11390.59
#> Call:
#> Invariance(data = osbornesudick1972, time_points = time_points,
#>     factor_loadings = factor_loadings)
#>
#> Fit Measures
#>               chisq df pvalue    cfi    tli  rmsea   srmr      aic      bic
#> configural  25.9682 19 0.1311 0.9915 0.9875 0.0424 0.0306 11252.23 11335.18
#> weak        41.8973 22 0.0064 0.9757 0.9691 0.0666 0.0720 11262.16 11335.16
#> strong      53.7228 25 0.0007 0.9650 0.9608 0.0750 0.0859 11267.98 11331.03
#> strict     134.5591 29 0.0000 0.8712 0.8757 0.1336 0.1328 11340.82 11390.59
#>
#>
#>
#> CONFIGURAL INVARIANCE MODEL
#>
#> lavaan 0.6.16 ended normally after 75 iterations
#>
#>   Estimator                                         ML
#>   Optimization method                           NLMINB
#>   Number of model parameters                        27
#>   Number of equality constraints                     2
#>
#>   Number of observations                           204
```

```
#>
#> Model Test User Model:
#>
#>   Test statistic                                25.968
#>   Degrees of freedom                               19
#>   P-value (Chi-square)                          0.131
#>
#> Parameter Estimates:
#>
#>   Standard errors                             Standard
#>   Information                                 Expected
#>   Information saturated (h1) model          Structured
#>
#> Latent Variables:
#>                    Estimate  Std.Err  z-value  P(>|z|)
#>   f1t1 =~
#>     y1_1     (l11)    4.451    0.396   11.244    0.000
#>     y1_2              6.850    0.637   10.750    0.000
#>     y1_3              4.590    0.515    8.918    0.000
#>     y1_4              5.039    0.393   12.809    0.000
#>   f1t6 =~
#>     y6_1     (l11)    4.451    0.396   11.244    0.000
#>     y6_2              4.006    0.485    8.261    0.000
#>     y6_3              4.551    0.546    8.342    0.000
#>     y6_4              4.102    0.448    9.150    0.000
#>
#> Covariances:
#>                    Estimate  Std.Err  z-value  P(>|z|)
#>   f1t1 ~~
#>     f1t6              1.837    0.211    8.703    0.000
#>
#> Intercepts:
#>                    Estimate  Std.Err  z-value  P(>|z|)
#>    .y1_1      (i1)   19.776    0.427   46.273    0.000
#>    .y1_2             21.797    0.680   32.036    0.000
#>    .y1_3             14.903    0.528   28.223    0.000
#>    .y1_4             20.396    0.439   46.416    0.000
#>    .y6_1      (i1)   19.776    0.427   46.273    0.000
#>    .y6_2             19.317    2.281    8.467    0.000
#>    .y6_3             11.922    2.538    4.697    0.000
#>    .y6_4             17.970    1.815    9.903    0.000
#>     f1t1              0.000
#>     f1t6              6.455    0.601   10.743    0.000
#>
#> Variances:
#>                    Estimate  Std.Err  z-value  P(>|z|)
```

```
#>    .y1_1             17.448    2.186    7.981    0.000
#>    .y1_2             47.511    5.748    8.266    0.000
#>    .y1_3             35.810    3.969    9.022    0.000
#>    .y1_4             13.999    2.085    6.712    0.000
#>    .y6_1             47.096    6.305    7.470    0.000
#>    .y6_2             73.850    8.395    8.797    0.000
#>    .y6_3             88.920   10.222    8.699    0.000
#>    .y6_4             23.267    4.076    5.709    0.000
#>     f1t1              1.000
#>     f1t6              5.834    1.159    5.035    0.000
#>
#>
#>
#> WEAK INVARIANCE MODEL
#>
#> lavaan 0.6.16 ended normally after 54 iterations
#>
#>   Estimator                                         ML
#>   Optimization method                           NLMINB
#>   Number of model parameters                        27
#>   Number of equality constraints                     5
#>
#>   Number of observations                           204
#>
#> Model Test User Model:
#>
#>   Test statistic                                41.897
#>   Degrees of freedom                                22
#>   P-value (Chi-square)                           0.006
#>
#> Parameter Estimates:
#>
#>   Standard errors                             Standard
#>   Information                                 Expected
#>   Information saturated (h1) model          Structured
#>
#> Latent Variables:
#>                    Estimate  Std.Err  z-value  P(>|z|)
#>   f1t1 =~
#>     y1_1     (l11)    4.933    0.342   14.420    0.000
#>     y1_2     (l12)    5.172    0.413   12.534    0.000
#>     y1_3     (l13)    5.072    0.398   12.733    0.000
#>     y1_4     (l14)    4.865    0.330   14.733    0.000
#>   f1t6 =~
#>     y6_1     (l11)    4.933    0.342   14.420    0.000
#>     y6_2     (l12)    5.172    0.413   12.534    0.000
```

```
#>     y6_3     (l13)    5.072    0.398   12.733    0.000
#>     y6_4     (l14)    4.865    0.330   14.733    0.000
#>
#> Covariances:
#>                    Estimate  Std.Err  z-value  P(>|z|)
#>   f1t1 ~~
#>     f1t6              1.558    0.136   11.482    0.000
#>
#> Intercepts:
#>                    Estimate  Std.Err  z-value  P(>|z|)
#>    .y1_1      (i1)   19.776    0.445   44.430    0.000
#>    .y1_2             21.797    0.629   34.633    0.000
#>    .y1_3             14.903    0.544   27.411    0.000
#>    .y1_4             20.396    0.436   46.803    0.000
#>    .y6_1      (i1)   19.776    0.445   44.430    0.000
#>    .y6_2             15.049    2.223    6.770    0.000
#>    .y6_3             11.756    2.238    5.253    0.000
#>    .y6_4             16.111    1.699    9.484    0.000
#>     f1t1              0.000
#>     f1t6              5.824    0.432   13.476    0.000
#>
#> Variances:
#>                    Estimate  Std.Err  z-value  P(>|z|)
#>    .y1_1             16.079    2.165    7.427    0.000
#>    .y1_2             54.055    5.831    9.270    0.000
#>    .y1_3             34.578    3.922    8.817    0.000
#>    .y1_4             15.075    2.051    7.350    0.000
#>    .y6_1             49.748    6.242    7.970    0.000
#>    .y6_2             72.254    8.498    8.503    0.000
#>    .y6_3             91.610   10.272    8.919    0.000
#>    .y6_4             22.022    3.989    5.521    0.000
#>     f1t1              1.000
#>     f1t6              4.240    0.539    7.867    0.000
#>
#>
#>
#> STRONG INVARIANCE MODEL
#>
#> lavaan 0.6.16 ended normally after 52 iterations
#>
#>   Estimator                                         ML
#>   Optimization method                           NLMINB
#>   Number of model parameters                        27
#>   Number of equality constraints                     8
#>
```

```
#>   Number of observations                           204
#>
#> Model Test User Model:
#>
#>   Test statistic                                53.723
#>   Degrees of freedom                               25
#>   P-value (Chi-square)                          0.001
#>
#> Parameter Estimates:
#>
#>   Standard errors                             Standard
#>   Information                                 Expected
#>   Information saturated (h1) model          Structured
#>
#> Latent Variables:
#>                    Estimate  Std.Err  z-value  P(>|z|)
#>   f1t1 =~
#>     y1_1     (l11)    5.270    0.333   15.813    0.000
#>     y1_2     (l12)    4.525    0.308   14.681    0.000
#>     y1_3     (l13)    4.960    0.328   15.120    0.000
#>     y1_4     (l14)    4.547    0.289   15.707    0.000
#>   f1t6 =~
#>     y6_1     (l11)    5.270    0.333   15.813    0.000
#>     y6_2     (l12)    4.525    0.308   14.681    0.000
#>     y6_3     (l13)    4.960    0.328   15.120    0.000
#>     y6_4     (l14)    4.547    0.289   15.707    0.000
#>
#> Covariances:
#>                    Estimate  Std.Err  z-value  P(>|z|)
#>   f1t1 ~~
#>     f1t6              1.608    0.143   11.281    0.000
#>
#> Intercepts:
#>                    Estimate  Std.Err  z-value  P(>|z|)
#>    .y1_1      (i1)   19.929    0.456   43.727    0.000
#>    .y1_2      (i2)   21.459    0.598   35.868    0.000
#>    .y1_3      (i3)   14.882    0.529   28.153    0.000
#>    .y1_4      (i4)   20.311    0.421   48.237    0.000
#>    .y6_1      (i1)   19.929    0.456   43.727    0.000
#>    .y6_2      (i2)   21.459    0.598   35.868    0.000
#>    .y6_3      (i3)   14.882    0.529   28.153    0.000
#>    .y6_4      (i4)   20.311    0.421   48.237    0.000
#>     f1t1              0.000
#>     f1t6              5.337    0.353   15.109    0.000
#>
#> Variances:
```

```
#>                    Estimate  Std.Err  z-value  P(>|z|)
#>    .y1_1             15.124    2.193    6.895    0.000
#>    .y1_2             57.819    6.078    9.512    0.000
#>    .y1_3             34.209    3.850    8.885    0.000
#>    .y1_4             16.339    2.062    7.925    0.000
#>    .y6_1             45.360    6.182    7.337    0.000
#>    .y6_2             74.229    8.350    8.890    0.000
#>    .y6_3             89.572   10.064    8.900    0.000
#>    .y6_4             24.586    3.878    6.339    0.000
#>     f1t1              1.000
#>     f1t6              4.557    0.584    7.806    0.000
#>
#>
#>
#> STRICT INVARIANCE MODEL
#>
#> lavaan 0.6.16 ended normally after 57 iterations
#>
#>   Estimator                                         ML
#>   Optimization method                           NLMINB
#>   Number of model parameters                        27
#>   Number of equality constraints                    12
#>
#>   Number of observations                           204
#>
#> Model Test User Model:
#>
#>   Test statistic                               134.559
#>   Degrees of freedom                               29
#>   P-value (Chi-square)                          0.000
#>
#> Parameter Estimates:
#>
#>   Standard errors                             Standard
#>   Information                                 Expected
#>   Information saturated (h1) model          Structured
#>
#> Latent Variables:
#>                    Estimate  Std.Err  z-value  P(>|z|)
#>   f1t1 =~
#>     y1_1     (l11)    5.083    0.364   13.968    0.000
#>     y1_2     (l12)    4.309    0.325   13.248    0.000
#>     y1_3     (l13)    4.785    0.354   13.521    0.000
#>     y1_4     (l14)    4.358    0.312   13.971    0.000
#>   f1t6 =~
```

```
#>     y6_1     (l11)    5.083    0.364   13.968    0.000
#>     y6_2     (l12)    4.309    0.325   13.248    0.000
#>     y6_3     (l13)    4.785    0.354   13.521    0.000
#>     y6_4     (l14)    4.358    0.312   13.971    0.000
#>
#> Covariances:
#>                    Estimate  Std.Err  z-value  P(>|z|)
#>   f1t1 ~~
#>     f1t6              1.812    0.168   10.790    0.000
#>
#> Intercepts:
#>                    Estimate  Std.Err  z-value  P(>|z|)
#>    .y1_1      (i1)   20.019    0.506   39.547    0.000
#>    .y1_2      (i2)   21.513    0.621   34.617    0.000
#>    .y1_3      (i3)   14.805    0.617   24.001    0.000
#>    .y1_4      (i4)   20.313    0.433   46.903    0.000
#>    .y6_1      (i1)   20.019    0.506   39.547    0.000
#>    .y6_2      (i2)   21.513    0.621   34.617    0.000
#>    .y6_3      (i3)   14.805    0.617   24.001    0.000
#>    .y6_4      (i4)   20.313    0.433   46.903    0.000
#>     f1t1              0.000
#>     f1t6              5.557    0.411   13.526    0.000
#>
#> Variances:
#>                    Estimate  Std.Err  z-value  P(>|z|)
#>    .y1_1      (u1)   28.657    2.747   10.433    0.000
#>    .y1_2      (u2)   68.013    5.170   13.155    0.000
#>    .y1_3      (u3)   61.387    4.821   12.734    0.000
#>    .y1_4      (u4)   20.878    2.008   10.398    0.000
#>    .y6_1      (u1)   28.657    2.747   10.433    0.000
#>    .y6_2      (u2)   68.013    5.170   13.155    0.000
#>    .y6_3      (u3)   61.387    4.821   12.734    0.000
#>    .y6_4      (u4)   20.878    2.008   10.398    0.000
#>     f1t1              1.000
#>     f1t6              5.056    0.685    7.378    0.000
#>
#> Call:
#> Invariance(data = osbornesudick1972, time_points = time_points,
#>     factor_loadings = factor_loadings)
#>
#> Chi-Squared Difference Test
#>
#>              Df   AIC   BIC   Chisq Chisq diff   RMSEA Df diff Pr(>Chisq)
#> 1.configural 19 11252 11335  25.968
#> 1.weak       22 11262 11335  41.897     15.929 0.14535       3  0.0011726 **
```

```
#> 2.configural 19 11252 11335  25.968
#> 2.strong     25 11268 11331  53.723     27.755 0.13332       6  0.0001045 ***
#> 3.configural 19 11252 11335  25.968
#> 3.strict     29 11341 11391 134.559    108.591 0.21984      10  < 2.2e-16 ***
#> 4.weak       22 11262 11335  41.897
#> 4.strong     25 11268 11331  53.723     11.826 0.12009       3  0.0080053 **
#> 5.weak       22 11262 11335  41.897
#> 5.strict     29 11341 11391 134.559     92.662 0.24492       7  < 2.2e-16 ***
#> 6.strong     25 11268 11331  53.723
#> 6.strict     29 11341 11391 134.559     80.836 0.30686       4  < 2.2e-16 ***
#> ---
#> Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
#> Test passed
#> Test passed
#> Test passed
#> Test passed
#> Test passed
#> Test passed
#> [[1]]
#> [[1]][[1]]
#> [[1]][[1]]$value
#> [[1]][[1]]$value[[1]]
#> lavaan 0.6.16 ended normally after 90 iterations
#>
#>   Estimator                                         ML
#>   Optimization method                           NLMINB
#>   Number of model parameters                        31
#>   Number of equality constraints                    12
#>
#>   Number of observations                           204
#>   Number of missing patterns                         1
#>
#> Model Test User Model:
#>
#>   Test statistic                               133.220
#>   Degrees of freedom                                25
#>   P-value (Chi-square)                           0.000
#>
#>
#> [[1]][[1]]$visible
#> [1] TRUE
```

Environment

```
ls()

#> [1] "osbornesudick1972" "root"              "tex_file"
```

Class

```
#> [[1]]
#> [1] "data.frame"
#>
#> [[2]]
#> [1] "root_criterion"
#>
#> [[3]]
#> [1] "character"
```

References

Pesigan, I. J. A., Sun, R. W., & Cheung, S. F. (2023). betaDelta and betaSandwich: Confidence intervals for standardized regression coefficients in R. *Multivariate Behavioral Research*, 1–4. https://doi.org/10.1080/00273171.2023.2201277

R Core Team. (2023). *R: A language and environment for statistical computing*. R Foundation for Statistical Computing. Vienna, Austria. https://www.R-project.org/