R Notebook for Psy 600K & 601 Project

Contents

Load libraries

```
library(psych)
library(GPArotation)
library(lavaan)
library(semTools)
# install.packages("tidyverse")
library(tidyverse)
```

Clear Environment

```
rm(list=ls())
```

Import data

```r
data <- read.csv("Class Survey Data.csv", header = TRUE, stringsAsFactors = FALSE)
```

Subset the data

```r
data2 <- data %>%
  select(starts_with("change"),
         starts_with("pc_comm"),
         starts_with("lo"),
         starts_with("lc"),
         starts_with("bf"),
         Age, Sex,
         Sex_3_TEXT,
         Race,
         Race_6_TEXT,
         Hispanic)
```

Item text & Desciption

```r
key <- read_csv("key.csv")

key <- key %>%
  filter(Scale %in% c("Belief in Community-Level Social Change", "Perceived Control at the Community Lev
  select(-Source, -Dimension)

key
```

```
## # A tibble: 80 x 3
##    Item      Scale                                  `Item Text`
##    <chr>     <chr>                                  <chr>
##  1 change1_1 Belief in Community-Level Social Change I believe positive c~
##  2 change1_2 Belief in Community-Level Social Change Positive community c~
##  3 change1_3 Belief in Community-Level Social Change It is possible for m~
##  4 change1_4 Belief in Community-Level Social Change My community is unli~
##  5 change1_5 Belief in Community-Level Social Change My community can pro~
##  6 change1_6 Belief in Community-Level Social Change I think positive cha~
##  7 change1_7 Belief in Community-Level Social Change My community has the~
##  8 change1_8 Belief in Community-Level Social Change I am optimistic that~
##  9 change1_9 Belief in Community-Level Social Change I doubt that positiv~
## 10 change2_1 Belief in Community-Level Social Change I have the power to ~
## # ... with 70 more rows
```

Reverse-coding

```r
data2 <- data2 %>%
  mutate(
```

```
      #Change Scale
      change1_2R = 6-change1_2,
      change1_4R = 6-change1_4,
      change1_6R = 6-change1_6,
      change1_9R = 6-change1_9,
      change2_2R = 6-change2_2,
      change2_5R = 6-change2_5,
      change2_7R = 6-change2_7,
      change2_9R = 6-change2_9,

      #Life Orientation
      lo_2R = 6-lo_2,
      lo_4R = 6-lo_4,
      lo_5R = 6-lo_5,

      #Locus of Control
      lc_2R = 6-lc_2,
      lc_4R = 6-lc_4,
      lc_6R = 6-lc_6)
```

Subset the data (just our scale)

```
change <- data2 %>%
  select(change1_1, change1_2R, change1_3, change1_4R, change1_5, change1_6R, change1_7, change1_8, chan
```

Descriptive stats

```
describe(change)
```

```
##              vars   n mean   sd median trimmed  mad min max range  skew
## change1_1      1 122 4.16 0.56      4    4.16 0.00   2   5     3 -0.52
## change1_2R     2 122 4.25 0.77      4    4.38 0.74   2   5     3 -1.11
## change1_3      3 122 4.18 0.62      4    4.19 0.00   1   5     4 -1.38
## change1_4R     4 122 3.93 0.74      4    3.96 0.00   2   5     3 -0.49
## change1_5      5 122 4.27 0.58      4    4.28 0.00   2   5     3 -0.60
## change1_6R     6 122 4.16 0.68      4    4.24 0.00   2   5     3 -0.83
## change1_7      7 122 4.22 0.49      4    4.18 0.00   2   5     3  0.03
## change1_8      8 122 4.04 0.72      4    4.12 0.00   1   5     4 -1.24
## change1_9R     9 122 4.15 0.69      4    4.22 0.00   2   5     3 -0.80
## change2_1     10 121 4.14 0.75      4    4.22 0.00   2   5     3 -0.71
## change2_2R    11 121 3.59 0.95      4    3.62 0.00   1   5     4 -0.53
## change2_3     12 121 4.19 0.58      4    4.22 0.00   2   5     3 -0.29
## change2_4     13 121 4.12 0.67      4    4.19 0.00   2   5     3 -0.64
## change2_5R    14 120 3.89 0.72      4    3.92 0.00   2   5     3 -0.51
## change2_6     15 121 4.12 0.64      4    4.19 0.00   2   5     3 -0.68
## change2_7R    16 121 4.07 0.65      4    4.11 0.00   2   5     3 -0.60
## change2_8     17 121 3.72 0.80      4    3.74 0.00   2   5     3 -0.34
## change2_9R    18 121 3.54 1.02      4    3.56 1.48   1   5     4 -0.36
## change2_10    19 121 3.50 0.92      4    3.52 1.48   1   5     4 -0.39
```

```
##            kurtosis   se
## change1_1      2.51 0.05
## change1_2R     1.39 0.07
## change1_3      6.37 0.06
## change1_4R     0.21 0.07
## change1_5      2.22 0.05
## change1_6R     1.48 0.06
## change1_7      2.39 0.04
## change1_8      3.20 0.07
## change1_9R     1.35 0.06
## change2_1      0.46 0.07
## change2_2R    -0.55 0.09
## change2_3      0.85 0.05
## change2_4      1.11 0.06
## change2_5R     0.38 0.07
## change2_6      1.59 0.06
## change2_7R     1.13 0.06
## change2_8     -0.28 0.07
## change2_9R    -0.89 0.09
## change2_10    -0.58 0.08
```

Inter-item correlations

```
cortable <- cor(change, use = "pairwise.complete.obs")
write.csv(cortable, "Correlations.csv")
```

CFA - two factor no items removed

```
model.2f <- 'f1 =~ change1_1 + change1_2R + change1_3 + change1_4R + change1_5 + change1_6R + change1_7
             f2 =~ change2_1 + change2_2R + change2_3 + change2_4 + change2_5R + change2_6 + change2_7R

fit.model.2f <- cfa(model.2f, change)
summary(fit.model.2f, fit.measures = TRUE, standardized = TRUE)
```

```
## lavaan (0.5-23.1097) converged normally after  51 iterations
##
##                                                  Used       Total
##    Number of observations                         120         173
##
##    Estimator                                        ML
##    Minimum Function Test Statistic              447.100
##    Degrees of freedom                               151
##    P-value (Chi-square)                           0.000
##
## Model test baseline model:
##
##    Minimum Function Test Statistic             1796.107
##    Degrees of freedom                               171
##    P-value                                        0.000
##
```

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```
## User model versus baseline model:
##
##   Comparative Fit Index (CFI)                        0.818
##   Tucker-Lewis Index (TLI)                           0.794
##
## Loglikelihood and Information Criteria:
##
##   Loglikelihood user model (H0)                  -1745.073
##   Loglikelihood unrestricted model (H1)          -1521.523
##
##   Number of free parameters                             39
##   Akaike (AIC)                                    3568.146
##   Bayesian (BIC)                                  3676.858
##   Sample-size adjusted Bayesian (BIC)             3553.559
##
## Root Mean Square Error of Approximation:
##
##   RMSEA                                              0.128
##   90 Percent Confidence Interval           0.114   0.142
##   P-value RMSEA <= 0.05                              0.000
##
## Standardized Root Mean Square Residual:
##
##   SRMR                                               0.071
##
## Parameter Estimates:
##
##   Information                                     Expected
##   Standard Errors                                 Standard
##
## Latent Variables:
##                    Estimate  Std.Err  z-value  P(>|z|)   Std.lv   Std.all
##   f1 =~
##     change1_1         1.000                                0.442    0.785
##     change1_2R        1.063    0.152    6.975    0.000     0.470    0.611
##     change1_3         0.956    0.120    7.949    0.000     0.422    0.682
##     change1_4R        1.390    0.138   10.105    0.000     0.614    0.826
##     change1_5         0.948    0.111    8.581    0.000     0.419    0.727
##     change1_6R        1.352    0.125   10.815    0.000     0.597    0.869
##     change1_7         0.833    0.093    8.921    0.000     0.368    0.750
##     change1_8         1.190    0.139    8.587    0.000     0.526    0.727
##     change1_9R        1.365    0.126   10.877    0.000     0.603    0.873
##   f2 =~
##     change2_1         1.000                                0.566    0.764
##     change2_2R        0.959    0.153    6.274    0.000     0.543    0.569
##     change2_3         0.846    0.089    9.552    0.000     0.479    0.823
##     change2_4         0.950    0.102    9.341    0.000     0.537    0.808
##     change2_5R        0.995    0.110    9.042    0.000     0.563    0.786
##     change2_6         0.739    0.096    7.730    0.000     0.418    0.686
##     change2_7R        0.837    0.102    8.213    0.000     0.474    0.724
##     change2_8         1.014    0.124    8.182    0.000     0.574    0.721
##     change2_9R        1.236    0.159    7.761    0.000     0.700    0.689
##     change2_10        0.988    0.145    6.806    0.000     0.559    0.613
##
```

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```
## Covariances:
##                   Estimate  Std.Err  z-value  P(>|z|)   Std.lv  Std.all
##   f1 ~~
##     f2               0.177    0.035    5.110    0.000    0.708    0.708
##
## Variances:
##                   Estimate  Std.Err  z-value  P(>|z|)   Std.lv  Std.all
##    .change1_1        0.121    0.017    6.956    0.000    0.121    0.383
##    .change1_2R       0.371    0.050    7.456    0.000    0.371    0.627
##    .change1_3        0.205    0.028    7.320    0.000    0.205    0.534
##    .change1_4R       0.175    0.026    6.688    0.000    0.175    0.317
##    .change1_5        0.157    0.022    7.198    0.000    0.157    0.472
##    .change1_6R       0.115    0.019    6.217    0.000    0.115    0.244
##    .change1_7        0.106    0.015    7.117    0.000    0.106    0.438
##    .change1_8        0.247    0.034    7.197    0.000    0.247    0.471
##    .change1_9R       0.113    0.018    6.162    0.000    0.113    0.238
##    .change2_1        0.229    0.033    6.901    0.000    0.229    0.416
##    .change2_2R       0.615    0.082    7.459    0.000    0.615    0.676
##    .change2_3        0.109    0.017    6.477    0.000    0.109    0.323
##    .change2_4        0.154    0.023    6.613    0.000    0.154    0.348
##    .change2_5R       0.196    0.029    6.772    0.000    0.196    0.383
##    .change2_6        0.197    0.027    7.210    0.000    0.197    0.529
##    .change2_7R       0.204    0.029    7.084    0.000    0.204    0.476
##    .change2_8        0.304    0.043    7.093    0.000    0.304    0.480
##    .change2_9R       0.543    0.075    7.203    0.000    0.543    0.526
##    .change2_10       0.520    0.070    7.385    0.000    0.520    0.625
##     f1               0.195    0.039    5.069    0.000    1.000    1.000
##     f2               0.320    0.066    4.841    0.000    1.000    1.000
```

`resid(fit.model.2f, type = "cor")`

```
## $type
## [1] "cor.bollen"
##
## $cor
##           chn1_1 ch1_2R chn1_3 ch1_4R chn1_5 ch1_6R chn1_7 chn1_8 ch1_9R
## change1_1  0.000
## change1_2R  0.042  0.000
## change1_3   0.123 -0.026  0.000
## change1_4R -0.063 -0.048 -0.063  0.000
## change1_5  -0.037  0.016 -0.007  0.031  0.000
## change1_6R  0.003 -0.029  0.040  0.040 -0.096  0.000
## change1_7   0.127  0.028  0.175 -0.094  0.061 -0.047  0.000
## change1_8   0.007 -0.134 -0.104 -0.006  0.063 -0.009  0.039  0.000
## change1_9R -0.061  0.068 -0.115  0.063  0.015  0.048 -0.091  0.036  0.000
## change2_1   0.004 -0.069  0.050 -0.081  0.028 -0.121 -0.007 -0.030 -0.153
## change2_2R -0.069  0.083 -0.033  0.034 -0.024 -0.054 -0.102 -0.026  0.059
## change2_3   0.035  0.018  0.130 -0.043  0.065 -0.024  0.113 -0.066 -0.083
## change2_4  -0.079 -0.103  0.020 -0.133 -0.027 -0.142  0.046 -0.046 -0.196
## change2_5R -0.022  0.135  0.041  0.057  0.051  0.010  0.031 -0.042  0.086
## change2_6   0.039  0.052  0.041  0.027  0.105  0.078  0.114  0.030  0.020
## change2_7R -0.001  0.149  0.052  0.066  0.109  0.011  0.010 -0.044  0.138
## change2_8   0.106  0.049  0.008  0.093  0.103 -0.025  0.074  0.199 -0.007
## change2_9R  0.082  0.048  0.095  0.091 -0.007 -0.026  0.096  0.137  0.018
## change2_10 -0.046  0.115  0.053  0.067  0.048 -0.103  0.029 -0.007 -0.052
```

```
##            chn2_1 ch2_2R chn2_3 chn2_4 ch2_5R chn2_6 ch2_7R chn2_8 ch2_9R
## change1_1
## change1_2R
## change1_3
## change1_4R
## change1_5
## change1_6R
## change1_7
## change1_8
## change1_9R
## change2_1    0.000
## change2_2R -0.038  0.000
## change2_3   0.086 -0.069  0.000
## change2_4   0.093 -0.128  0.113  0.000
## change2_5R -0.055  0.182 -0.037 -0.029  0.000
## change2_6   0.043 -0.017  0.017  0.060 -0.027  0.000
## change2_7R -0.090  0.060  0.005 -0.106  0.104 -0.082  0.000
## change2_8  -0.064 -0.001 -0.083  0.049 -0.034 -0.036  0.009  0.000
## change2_9R  0.022  0.053 -0.049 -0.100 -0.015 -0.097  0.074  0.108  0.000
## change2_10 -0.040  0.052 -0.126  0.003 -0.001  0.032  0.043  0.098  0.081
##            ch2_10
## change1_1
## change1_2R
## change1_3
## change1_4R
## change1_5
## change1_6R
## change1_7
## change1_8
## change1_9R
## change2_1
## change2_2R
## change2_3
## change2_4
## change2_5R
## change2_6
## change2_7R
## change2_8
## change2_9R
## change2_10  0.000
##
## $mean
##  change1_1 change1_2R  change1_3 change1_4R  change1_5 change1_6R
##          0          0          0          0          0          0
##  change1_7  change1_8 change1_9R  change2_1 change2_2R  change2_3
##          0          0          0          0          0          0
##  change2_4 change2_5R  change2_6 change2_7R  change2_8 change2_9R
##          0          0          0          0          0          0
## change2_10
##          0
```

```r
reliability(fit.model.2f)
```

```
##              f1        f2     total
## alpha 0.9206542 0.9050732 0.9387006
```

```
## omega  0.9251654 0.9051057 0.9468503
## omega2 0.9251654 0.9051057 0.9468503
## omega3 0.9295068 0.8975976 0.9286573
## avevar 0.5860741 0.4925037 0.5291214
```

CFA - one factor

```
model.1f <- 'f1 =~ change1_1 + change1_2R + change1_3 + change1_4R + change1_5 + change1_6R + change1_7

fit.model.1f <- cfa(model.1f, change)
summary(fit.model.1f, fit.measures = TRUE, standardized = TRUE)
```

```
## lavaan (0.5-23.1097) converged normally after  47 iterations
##
##                                                  Used       Total
##   Number of observations                          120         173
##
##   Estimator                                        ML
##   Minimum Function Test Statistic              648.728
##   Degrees of freedom                               152
##   P-value (Chi-square)                           0.000
##
## Model test baseline model:
##
##   Minimum Function Test Statistic             1796.107
##   Degrees of freedom                               171
##   P-value                                        0.000
##
## User model versus baseline model:
##
##   Comparative Fit Index (CFI)                    0.694
##   Tucker-Lewis Index (TLI)                       0.656
##
## Loglikelihood and Information Criteria:
##
##   Loglikelihood user model (H0)              -1845.887
##   Loglikelihood unrestricted model (H1)      -1521.523
##
##   Number of free parameters                         38
##   Akaike (AIC)                                3767.773
##   Bayesian (BIC)                              3873.698
##   Sample-size adjusted Bayesian (BIC)         3753.560
##
## Root Mean Square Error of Approximation:
##
##   RMSEA                                          0.165
##   90 Percent Confidence Interval       0.152    0.178
##   P-value RMSEA <= 0.05                          0.000
##
## Standardized Root Mean Square Residual:
##
##   SRMR                                           0.095
```

```
## 
## Parameter Estimates:
## 
##   Information                                 Expected
##   Standard Errors                             Standard
## 
## Latent Variables:
##                   Estimate  Std.Err  z-value  P(>|z|)   Std.lv  Std.all
##   f1 =~
##     change1_1        1.000                                0.420    0.746
##     change1_2R       1.102    0.166    6.650    0.000     0.463    0.601
##     change1_3        0.996    0.132    7.548    0.000     0.418    0.676
##     change1_4R       1.368    0.156    8.754    0.000     0.574    0.772
##     change1_5        0.983    0.122    8.039    0.000     0.413    0.716
##     change1_6R       1.275    0.144    8.842    0.000     0.536    0.779
##     change1_7        0.868    0.104    8.373    0.000     0.364    0.742
##     change1_8        1.179    0.154    7.651    0.000     0.495    0.684
##     change1_9R       1.307    0.145    9.036    0.000     0.549    0.794
##     change2_1        1.120    0.159    7.047    0.000     0.470    0.635
##     change2_2R       1.147    0.208    5.525    0.000     0.482    0.505
##     change2_3        1.007    0.123    8.184    0.000     0.423    0.727
##     change2_4        1.027    0.142    7.213    0.000     0.431    0.648
##     change2_5R       1.244    0.152    8.204    0.000     0.522    0.729
##     change2_6        0.942    0.130    7.216    0.000     0.395    0.649
##     change2_7R       1.078    0.139    7.738    0.000     0.453    0.691
##     change2_8        1.312    0.169    7.750    0.000     0.551    0.692
##     change2_9R       1.603    0.217    7.383    0.000     0.673    0.662
##     change2_10       1.207    0.198    6.109    0.000     0.507    0.555
## 
## Variances:
##                   Estimate  Std.Err  z-value  P(>|z|)   Std.lv  Std.all
##    .change1_1        0.140    0.019    7.214    0.000     0.140    0.443
##    .change1_2R       0.378    0.050    7.507    0.000     0.378    0.638
##    .change1_3        0.208    0.028    7.390    0.000     0.208    0.543
##    .change1_4R       0.223    0.031    7.120    0.000     0.223    0.403
##    .change1_5        0.162    0.022    7.302    0.000     0.162    0.488
##    .change1_6R       0.185    0.026    7.091    0.000     0.185    0.393
##    .change1_7        0.108    0.015    7.227    0.000     0.108    0.449
##    .change1_8        0.278    0.038    7.374    0.000     0.278    0.532
##    .change1_9R       0.176    0.025    7.022    0.000     0.176    0.369
##    .change2_1        0.328    0.044    7.461    0.000     0.328    0.597
##    .change2_2R       0.678    0.089    7.601    0.000     0.678    0.745
##    .change2_3        0.159    0.022    7.271    0.000     0.159    0.471
##    .change2_4        0.257    0.034    7.439    0.000     0.257    0.580
##    .change2_5R       0.241    0.033    7.266    0.000     0.241    0.469
##    .change2_6        0.215    0.029    7.439    0.000     0.215    0.579
##    .change2_7R       0.224    0.030    7.359    0.000     0.224    0.522
##    .change2_8        0.329    0.045    7.357    0.000     0.329    0.521
##    .change2_9R       0.579    0.078    7.416    0.000     0.579    0.561
##    .change2_10       0.576    0.076    7.557    0.000     0.576    0.691
##     f1               0.176    0.037    4.725    0.000     1.000    1.000
```

```r
resid(fit.model.1f, type = "cor")
```

```
## $type
```

```
## [1] "cor.bollen"
##
## $cor
##            chn1_1 ch1_2R chn1_3 ch1_4R chn1_5 ch1_6R chn1_7 chn1_8 ch1_9R
## change1_1   0.000
## change1_2R  0.073  0.000
## change1_3   0.154 -0.016  0.000
## change1_4R  0.010 -0.008 -0.021  0.000
## change1_5  -0.001  0.029  0.005  0.078  0.000
## change1_6R  0.105  0.033  0.107  0.157 -0.022  0.000
## change1_7   0.162  0.040  0.185 -0.048  0.074  0.027  0.000
## change1_8   0.067 -0.101 -0.070  0.066  0.102  0.090  0.076  0.000
## change1_9R  0.032  0.124 -0.056  0.171  0.081  0.188 -0.026  0.127  0.000
## change2_1  -0.044 -0.120 -0.010 -0.124 -0.033 -0.145 -0.072 -0.071 -0.185
## change2_2R -0.130  0.025 -0.099 -0.023 -0.093 -0.097 -0.175 -0.079  0.010
## change2_3  -0.050 -0.064  0.036 -0.124 -0.032 -0.084  0.009 -0.140 -0.152
## change2_4  -0.114 -0.144 -0.028 -0.162 -0.076 -0.150 -0.006 -0.074 -0.211
## change2_5R -0.129  0.036 -0.072 -0.046 -0.066 -0.074 -0.093 -0.136 -0.008
## change2_6  -0.064 -0.042 -0.065 -0.073 -0.006 -0.005 -0.003 -0.060 -0.071
## change2_7R -0.115  0.046 -0.066 -0.044 -0.014 -0.082 -0.119 -0.145  0.036
## change2_8  -0.010 -0.055 -0.112 -0.020 -0.022 -0.120 -0.057  0.097 -0.111
## change2_9R -0.030 -0.052 -0.020 -0.017 -0.127 -0.118 -0.031  0.038 -0.082
## change2_10 -0.119  0.046 -0.027 -0.003 -0.034 -0.158 -0.058 -0.072 -0.115
##            chn2_1 ch2_2R chn2_3 chn2_4 ch2_5R chn2_6 ch2_7R chn2_8 ch2_9R
## change1_1
## change1_2R
## change1_3
## change1_4R
## change1_5
## change1_6R
## change1_7
## change1_8
## change1_9R
## change2_1   0.000
## change2_2R  0.077  0.000
## change2_3   0.253  0.032  0.000
## change2_4   0.299  0.004  0.306  0.000
## change2_5R  0.083  0.261  0.080  0.133  0.000
## change2_6   0.156  0.046  0.110  0.193  0.039  0.000
## change2_7R  0.024  0.122  0.098  0.030  0.169 -0.034  0.000
## change2_8   0.047  0.059  0.007  0.183  0.028  0.009  0.052  0.000
## change2_9R  0.127  0.110  0.036  0.027  0.043 -0.054  0.115  0.146  0.000
## change2_10  0.076  0.120 -0.025  0.137  0.076  0.092  0.102  0.155  0.135
##            ch2_10
## change1_1
## change1_2R
## change1_3
## change1_4R
## change1_5
## change1_6R
## change1_7
## change1_8
## change1_9R
## change2_1
```

```
## change2_2R
## change2_3
## change2_4
## change2_5R
## change2_6
## change2_7R
## change2_8
## change2_9R
## change2_10   0.000
##
## $mean
##   change1_1  change1_2R   change1_3  change1_4R   change1_5  change1_6R
##           0           0           0           0           0           0
##   change1_7   change1_8  change1_9R   change2_1  change2_2R   change2_3
##           0           0           0           0           0           0
##   change2_4  change2_5R   change2_6  change2_7R   change2_8  change2_9R
##           0           0           0           0           0           0
## change2_10
##           0
```

CFA -two factor without items 1__2R and 2__4

```
model.2f2 <- 'f1 =~ change1_1 + change1_3 + change1_4R + change1_5 + change1_6R + change1_7 + change1_8
          f2 =~ change2_1 + change2_2R + change2_3 + change2_5R + change2_6 + change2_7R + change2_8
```

```
fit.model.2f2 <- cfa(model.2f2, change)
summary(fit.model.2f2, fit.measures = TRUE, standardized = TRUE)
```

```
## lavaan (0.5-23.1097) converged normally after  47 iterations
##
##                                                  Used       Total
##   Number of observations                          120         173
##
##   Estimator                                         ML
##   Minimum Function Test Statistic              326.390
##   Degrees of freedom                               118
##   P-value (Chi-square)                           0.000
##
## Model test baseline model:
##
##   Minimum Function Test Statistic             1518.681
##   Degrees of freedom                               136
##   P-value                                        0.000
##
## User model versus baseline model:
##
##   Comparative Fit Index (CFI)                    0.849
##   Tucker-Lewis Index (TLI)                       0.826
##
## Loglikelihood and Information Criteria:
##
##   Loglikelihood user model (H0)              -1563.271
```

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```
##    Loglikelihood unrestricted model (H1)       -1400.077
##
##    Number of free parameters                         35
##    Akaike (AIC)                                3196.543
##    Bayesian (BIC)                              3294.105
##    Sample-size adjusted Bayesian (BIC)         3183.452
##
## Root Mean Square Error of Approximation:
##
##    RMSEA                                           0.121
##    90 Percent Confidence Interval        0.106   0.137
##    P-value RMSEA <= 0.05                           0.000
##
## Standardized Root Mean Square Residual:
##
##    SRMR                                            0.064
##
## Parameter Estimates:
##
##    Information                                  Expected
##    Standard Errors                              Standard
##
## Latent Variables:
##                   Estimate  Std.Err  z-value  P(>|z|)   Std.lv   Std.all
##   f1 =~
##     change1_1       1.000                                0.439    0.780
##     change1_3       0.961    0.122    7.886    0.000     0.422    0.682
##     change1_4R      1.409    0.140   10.097    0.000     0.619    0.833
##     change1_5       0.952    0.112    8.492    0.000     0.418    0.725
##     change1_6R      1.364    0.127   10.717    0.000     0.599    0.871
##     change1_7       0.832    0.095    8.767    0.000     0.365    0.744
##     change1_8       1.212    0.140    8.641    0.000     0.532    0.735
##     change1_9R      1.370    0.128   10.707    0.000     0.602    0.871
##   f2 =~
##     change2_1       1.000                                0.536    0.724
##     change2_2R      1.081    0.168    6.435    0.000     0.579    0.608
##     change2_3       0.843    0.102    8.278    0.000     0.452    0.777
##     change2_5R      1.072    0.125    8.546    0.000     0.575    0.802
##     change2_6       0.753    0.107    7.023    0.000     0.403    0.662
##     change2_7R      0.927    0.115    8.075    0.000     0.497    0.759
##     change2_8       1.062    0.140    7.610    0.000     0.570    0.716
##     change2_9R      1.362    0.178    7.640    0.000     0.730    0.719
##     change2_10      1.054    0.161    6.562    0.000     0.565    0.619
##
## Covariances:
##                   Estimate  Std.Err  z-value  P(>|z|)   Std.lv   Std.all
##   f1 ~~
##     f2              0.173    0.034    5.058    0.000     0.737    0.737
##
## Variances:
##                   Estimate  Std.Err  z-value  P(>|z|)   Std.lv   Std.all
##    .change1_1      0.124    0.018    6.959    0.000     0.124    0.391
##    .change1_3      0.205    0.028    7.309    0.000     0.205    0.535
##    .change1_4R     0.170    0.026    6.601    0.000     0.170    0.307
```

```
##     .change1_5          0.158     0.022     7.188     0.000     0.158     0.474
##     .change1_6R         0.114     0.018     6.141     0.000     0.114     0.241
##     .change1_7          0.108     0.015     7.120     0.000     0.108     0.446
##     .change1_8          0.240     0.034     7.152     0.000     0.240     0.459
##     .change1_9R         0.115     0.019     6.151     0.000     0.115     0.242
##     .change2_1          0.261     0.038     6.962     0.000     0.261     0.476
##     .change2_2R         0.574     0.078     7.330     0.000     0.574     0.631
##     .change2_3          0.134     0.020     6.653     0.000     0.134     0.396
##     .change2_5R         0.183     0.028     6.454     0.000     0.183     0.356
##     .change2_6          0.209     0.029     7.191     0.000     0.209     0.562
##     .change2_7R         0.182     0.027     6.776     0.000     0.182     0.424
##     .change2_8          0.308     0.044     6.996     0.000     0.308     0.487
##     .change2_9R         0.499     0.071     6.984     0.000     0.499     0.483
##     .change2_10         0.513     0.070     7.303     0.000     0.513     0.616
##      f1                 0.193     0.038     5.019     0.000     1.000     1.000
##      f2                 0.287     0.064     4.460     0.000     1.000     1.000
```

```r
resid(fit.model.2f2, type = "cor")
```

```
## $type
## [1] "cor.bollen"
##
## $cor
##            chn1_1 chn1_3 ch1_4R chn1_5 ch1_6R chn1_7 chn1_8 ch1_9R chn2_1
## change1_1   0.000
## change1_3   0.126  0.000
## change1_4R -0.064 -0.067  0.000
## change1_5  -0.032 -0.005  0.027  0.000
## change1_6R  0.006  0.039  0.033 -0.096  0.000
## change1_7   0.135  0.180 -0.094  0.066 -0.043  0.000
## change1_8   0.004 -0.109 -0.018  0.058 -0.018  0.036  0.000
## change1_9R -0.055 -0.112  0.059  0.018  0.048 -0.084  0.031  0.000
## change2_1   0.013  0.056 -0.078  0.035 -0.115  0.002 -0.029 -0.145  0.000
## change2_2R -0.102 -0.063 -0.005 -0.056 -0.093 -0.133 -0.062  0.021 -0.043
## change2_3   0.046  0.137 -0.039  0.073 -0.016  0.123 -0.064 -0.073  0.152
## change2_5R -0.047  0.018  0.025  0.027 -0.021  0.008 -0.072  0.057 -0.035
## change2_6   0.040  0.040  0.022  0.104  0.076  0.115  0.025  0.019  0.088
## change2_7R -0.035  0.020  0.024  0.076 -0.030 -0.022 -0.083  0.099 -0.087
## change2_8   0.095 -0.003  0.076  0.091 -0.040  0.065  0.182 -0.020 -0.032
## change2_9R  0.051  0.067  0.053 -0.037 -0.064  0.067  0.102 -0.017  0.028
## change2_10 -0.061  0.038  0.046  0.032 -0.123  0.015 -0.027 -0.071 -0.020
##            ch2_2R chn2_3 ch2_5R chn2_6 ch2_7R chn2_8 ch2_9R ch2_10
## change1_1
## change1_3
## change1_4R
## change1_5
## change1_6R
## change1_7
## change1_8
## change1_9R
## change2_1
## change2_2R  0.000
## change2_3  -0.073  0.000
## change2_5R  0.142 -0.014  0.000
## change2_6  -0.028  0.067 -0.019  0.000
```

```
## change2_7R   0.010   0.011   0.064 -0.088   0.000
## change2_8   -0.026 -0.046 -0.042 -0.016 -0.012   0.000
## change2_9R   0.008 -0.041 -0.051 -0.100   0.027   0.090   0.000
## change2_10   0.024 -0.103 -0.016   0.043   0.016   0.097   0.057   0.000
##
## $mean
##  change1_1  change1_3 change1_4R  change1_5 change1_6R  change1_7
##         0          0          0          0          0          0
##  change1_8 change1_9R  change2_1 change2_2R  change2_3 change2_5R
##         0          0          0          0          0          0
##  change2_6 change2_7R  change2_8 change2_9R change2_10
##         0          0          0          0          0
```

```r
reliability(fit.model.2f2)
```

```
##             f1         f2      total
## alpha  0.9235551 0.8920532 0.9334100
## omega  0.9283228 0.8937598 0.9439265
## omega2 0.9283228 0.8937598 0.9439265
## omega3 0.9288412 0.8893668 0.9405768
## avevar 0.6262561 0.4894418 0.5401128
```

CFA -two factor without items 1__2R, 1__3, and 2__4

```r
model.2f3 <- 'f1 =~ change1_1 + change1_4R + change1_5 + change1_6R + change1_7 + change1_8 + change1_9R
          f2 =~ change2_1 + change2_2R + change2_3 + change2_5R + change2_6 + change2_7R + change2_8 +
```

```r
fit.model.2f3 <- cfa(model.2f3, change)
summary(fit.model.2f3, fit.measures = TRUE, standardized = TRUE)
```

```
## lavaan (0.5-23.1097) converged normally after  47 iterations
##
##                                                  Used       Total
##    Number of observations                        120         173
##
##    Estimator                                        ML
##    Minimum Function Test Statistic             270.105
##    Degrees of freedom                              103
##    P-value (Chi-square)                          0.000
##
## Model test baseline model:
##
##    Minimum Function Test Statistic            1395.569
##    Degrees of freedom                              120
##    P-value                                       0.000
##
## User model versus baseline model:
##
##    Comparative Fit Index (CFI)                   0.869
##    Tucker-Lewis Index (TLI)                      0.847
##
## Loglikelihood and Information Criteria:
##
```

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```
##    Loglikelihood user model (H0)            -1483.987
##    Loglikelihood unrestricted model (H1)    -1348.935
##
##    Number of free parameters                       33
##    Akaike (AIC)                             3033.974
##    Bayesian (BIC)                           3125.962
##    Sample-size adjusted Bayesian (BIC)      3021.631
##
## Root Mean Square Error of Approximation:
##
##    RMSEA                                        0.116
##    90 Percent Confidence Interval       0.099   0.133
##    P-value RMSEA <= 0.05                        0.000
##
## Standardized Root Mean Square Residual:
##
##    SRMR                                         0.063
##
## Parameter Estimates:
##
##    Information                               Expected
##    Standard Errors                           Standard
##
## Latent Variables:
##                   Estimate  Std.Err  z-value  P(>|z|)   Std.lv   Std.all
##    f1 =~
##      change1_1       1.000                               0.427    0.758
##      change1_4R      1.472    0.150    9.839    0.000    0.628    0.845
##      change1_5       0.981    0.119    8.237    0.000    0.418    0.725
##      change1_6R      1.398    0.138   10.162    0.000    0.596    0.868
##      change1_7       0.824    0.102    8.117    0.000    0.352    0.716
##      change1_8       1.263    0.149    8.496    0.000    0.539    0.745
##      change1_9R      1.443    0.138   10.484    0.000    0.616    0.891
##    f2 =~
##      change2_1       1.000                               0.535    0.721
##      change2_2R      1.089    0.169    6.448    0.000    0.582    0.610
##      change2_3       0.843    0.103    8.214    0.000    0.450    0.774
##      change2_5R      1.078    0.126    8.529    0.000    0.576    0.804
##      change2_6       0.754    0.108    6.994    0.000    0.403    0.661
##      change2_7R      0.932    0.116    8.064    0.000    0.498    0.761
##      change2_8       1.066    0.140    7.591    0.000    0.570    0.717
##      change2_9R      1.366    0.179    7.611    0.000    0.730    0.718
##      change2_10      1.058    0.162    6.549    0.000    0.566    0.620
##
## Covariances:
##                   Estimate  Std.Err  z-value  P(>|z|)   Std.lv   Std.all
##    f1 ~~
##      f2              0.166    0.033    4.970    0.000    0.729    0.729
##
## Variances:
##                   Estimate  Std.Err  z-value  P(>|z|)   Std.lv   Std.all
##     .change1_1      0.135    0.019    7.044    0.000    0.135    0.425
##     .change1_4R     0.158    0.025    6.444    0.000    0.158    0.286
##     .change1_5      0.158    0.022    7.171    0.000    0.158    0.474
```

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```
##     .change1_6R      0.116   0.019   6.145   0.000   0.116   0.247
##     .change1_7       0.117   0.016   7.202   0.000   0.117   0.487
##     .change1_8       0.233   0.033   7.099   0.000   0.233   0.445
##     .change1_9R      0.098   0.017   5.725   0.000   0.098   0.206
##     .change2_1       0.263   0.038   6.968   0.000   0.263   0.479
##     .change2_2R      0.571   0.078   7.322   0.000   0.571   0.628
##     .change2_3       0.135   0.020   6.670   0.000   0.135   0.400
##     .change2_5R      0.182   0.028   6.432   0.000   0.182   0.354
##     .change2_6       0.209   0.029   7.191   0.000   0.209   0.563
##     .change2_7R      0.181   0.027   6.762   0.000   0.181   0.422
##     .change2_8       0.308   0.044   6.990   0.000   0.308   0.487
##     .change2_9R      0.499   0.072   6.982   0.000   0.499   0.484
##     .change2_10      0.513   0.070   7.301   0.000   0.513   0.616
##      f1              0.182   0.038   4.811   0.000   1.000   1.000
##      f2              0.286   0.064   4.441   0.000   1.000   1.000
```

```r
resid(fit.model.2f3, type = "cor")
```

```
## $type
## [1] "cor.bollen"
##
## $cor
##            chn1_1 ch1_4R chn1_5 ch1_6R chn1_7 chn1_8 ch1_9R chn2_1 ch2_2R
## change1_1   0.000
## change1_4R -0.054  0.000
## change1_5  -0.017  0.018  0.000
## change1_6R  0.028  0.025 -0.094  0.000
## change1_7   0.173 -0.079  0.086 -0.016  0.000
## change1_8   0.012 -0.035  0.051 -0.024  0.050  0.000
## change1_9R -0.051  0.032  0.003  0.034 -0.074  0.007  0.000
## change2_1   0.030 -0.078  0.040 -0.107  0.022 -0.029 -0.149  0.000
## change2_2R -0.090 -0.008 -0.054 -0.089 -0.118 -0.065  0.015 -0.043  0.000
## change2_3   0.065 -0.039  0.079 -0.007  0.145 -0.063 -0.077  0.156 -0.073
## change2_5R -0.030  0.022  0.030 -0.015  0.029 -0.074  0.049 -0.035  0.138
## change2_6   0.055  0.021  0.109  0.083  0.133  0.024  0.015  0.090 -0.030
## change2_7R -0.019  0.021  0.079 -0.024 -0.003 -0.085  0.092 -0.086  0.007
## change2_8   0.111  0.074  0.095 -0.034  0.083  0.181 -0.026 -0.031 -0.028
## change2_9R  0.068  0.052 -0.033 -0.057  0.086  0.101 -0.023  0.029  0.006
## change2_10 -0.047  0.044  0.036 -0.117  0.031 -0.028 -0.076 -0.019  0.022
##            chn2_3 ch2_5R chn2_6 ch2_7R chn2_8 ch2_9R ch2_10
## change1_1
## change1_4R
## change1_5
## change1_6R
## change1_7
## change1_8
## change1_9R
## change2_1
## change2_2R
## change2_3   0.000
## change2_5R -0.013  0.000
## change2_6   0.070 -0.019  0.000
## change2_7R  0.012  0.061 -0.088  0.000
## change2_8  -0.045 -0.043 -0.015 -0.014  0.000
## change2_9R -0.038 -0.052 -0.099  0.026  0.089  0.000
```

```
## change2_10 -0.101 -0.017  0.043  0.015  0.096  0.057  0.000
##
## $mean
##  change1_1 change1_4R  change1_5 change1_6R  change1_7  change1_8
##          0          0          0          0          0          0
## change1_9R  change2_1 change2_2R  change2_3 change2_5R  change2_6
##          0          0          0          0          0          0
## change2_7R  change2_8 change2_9R change2_10
##          0          0          0          0
```

```r
reliability(fit.model.2f3)
```

```
##                f1        f2     total
## alpha  0.9205266 0.8920532 0.9302027
## omega  0.9264416 0.8938772 0.9415718
## omega2 0.9264416 0.8938772 0.9415718
## omega3 0.9252147 0.8898480 0.9376158
## avevar 0.6518063 0.4897978 0.5452163
```

CFA -two factor without items 1_2R, 1_3, 1_7, 2_4, 2_6

```r
model.2f4 <- 'f1 =~ change1_1 + change1_4R + change1_5 + change1_6R + change1_8 + change1_9R
          f2 =~ change2_1 + change2_2R + change2_3 + change2_5R + change2_7R + change2_8 + change2_9R

fit.model.2f4 <- cfa(model.2f4, change)
summary(fit.model.2f4, fit.measures = TRUE, standardized = TRUE)
```

```
## lavaan (0.5-23.1097) converged normally after  43 iterations
##
##                                                  Used       Total
##   Number of observations                          120         173
##
##   Estimator                                        ML
##   Minimum Function Test Statistic              190.857
##   Degrees of freedom                                76
##   P-value (Chi-square)                           0.000
##
## Model test baseline model:
##
##   Minimum Function Test Statistic             1180.024
##   Degrees of freedom                                91
##   P-value                                        0.000
##
## User model versus baseline model:
##
##   Comparative Fit Index (CFI)                    0.895
##   Tucker-Lewis Index (TLI)                       0.874
##
## Loglikelihood and Information Criteria:
##
##   Loglikelihood user model (H0)              -1356.354
##   Loglikelihood unrestricted model (H1)      -1260.926
##
```

```
##    Number of free parameters                          29
##    Akaike (AIC)                               2770.708
##    Bayesian (BIC)                             2851.546
##    Sample-size adjusted Bayesian (BIC)        2759.861
##
## Root Mean Square Error of Approximation:
##
##    RMSEA                                          0.112
##    90 Percent Confidence Interval      0.092   0.132
##    P-value RMSEA <= 0.05                          0.000
##
## Standardized Root Mean Square Residual:
##
##    SRMR                                           0.059
##
## Parameter Estimates:
##
##    Information                              Expected
##    Standard Errors                          Standard
##
## Latent Variables:
##                  Estimate  Std.Err  z-value  P(>|z|)   Std.lv  Std.all
##   f1 =~
##     change1_1       1.000                               0.411    0.730
##     change1_4R      1.553    0.164    9.446    0.000    0.638    0.858
##     change1_5       1.000    0.129    7.750    0.000    0.411    0.712
##     change1_6R      1.456    0.152    9.585    0.000    0.598    0.870
##     change1_8       1.296    0.162    8.022    0.000    0.532    0.735
##     change1_9R      1.530    0.153   10.028    0.000    0.628    0.909
##   f2 =~
##     change2_1       1.000                               0.520    0.702
##     change2_2R      1.138    0.178    6.392    0.000    0.592    0.620
##     change2_3       0.846    0.109    7.737    0.000    0.440    0.757
##     change2_5R      1.117    0.135    8.251    0.000    0.581    0.810
##     change2_7R      0.980    0.123    7.947    0.000    0.510    0.778
##     change2_8       1.098    0.149    7.357    0.000    0.571    0.718
##     change2_9R      1.430    0.191    7.496    0.000    0.743    0.732
##     change2_10      1.082    0.170    6.353    0.000    0.563    0.616
##
## Covariances:
##                  Estimate  Std.Err  z-value  P(>|z|)   Std.lv  Std.all
##   f1 ~~
##     f2              0.151    0.032    4.772    0.000    0.709    0.709
##
## Variances:
##                  Estimate  Std.Err  z-value  P(>|z|)   Std.lv  Std.all
##    .change1_1       0.148    0.021    7.144    0.000    0.148    0.468
##    .change1_4R      0.146    0.023    6.243    0.000    0.146    0.264
##    .change1_5       0.164    0.023    7.204    0.000    0.164    0.493
##    .change1_6R      0.115    0.019    6.063    0.000    0.115    0.243
##    .change1_8       0.240    0.034    7.123    0.000    0.240    0.459
##    .change1_9R      0.083    0.016    5.180    0.000    0.083    0.174
##    .change2_1       0.279    0.040    6.996    0.000    0.279    0.508
##    .change2_2R      0.560    0.077    7.264    0.000    0.560    0.615
```

```
##     .change2_3          0.145   0.022   6.709   0.000   0.145   0.428
##     .change2_5R         0.176   0.028   6.261   0.000   0.176   0.343
##     .change2_7R         0.169   0.026   6.554   0.000   0.169   0.394
##     .change2_8          0.307   0.044   6.925   0.000   0.307   0.485
##     .change2_9R         0.480   0.070   6.854   0.000   0.480   0.465
##     .change2_10         0.517   0.071   7.274   0.000   0.517   0.620
##      f1                 0.169   0.037   4.555   0.000   1.000   1.000
##      f2                 0.270   0.063   4.263   0.000   1.000   1.000
```

```r
resid(fit.model.2f4, type = "cor")
```

```
## $type
## [1] "cor.bollen"
##
## $cor
##            chn1_1 ch1_4R chn1_5 ch1_6R chn1_8 ch1_9R chn2_1 ch2_2R chn2_3
## change1_1   0.000
## change1_4R -0.040  0.000
## change1_5   0.014  0.020  0.000
## change1_6R  0.051  0.012 -0.083  0.000
## change1_8   0.041 -0.036  0.068 -0.017  0.000
## change1_9R -0.039  0.004  0.002  0.016  0.002  0.000
## change2_1   0.066 -0.061  0.067 -0.084 -0.003 -0.134  0.000
## change2_2R -0.074 -0.010 -0.044 -0.086 -0.057  0.011 -0.038  0.000
## change2_3   0.101 -0.023  0.107  0.016 -0.037 -0.062  0.183 -0.070  0.000
## change2_5R -0.005  0.024  0.046 -0.006 -0.060  0.049 -0.023  0.127 -0.003
## change2_7R -0.002  0.016  0.088 -0.024 -0.078  0.084 -0.084 -0.011  0.012
## change2_8   0.135  0.078  0.111 -0.024  0.196 -0.024 -0.017 -0.036 -0.033
## change2_9R  0.086  0.049 -0.023 -0.054  0.110 -0.028  0.034 -0.010 -0.036
## change2_10 -0.024  0.050  0.052 -0.106 -0.013 -0.071 -0.005  0.018 -0.088
##            ch2_5R ch2_7R chn2_8 ch2_9R ch2_10
## change1_1
## change1_4R
## change1_5
## change1_6R
## change1_8
## change1_9R
## change2_1
## change2_2R
## change2_3
## change2_5R  0.000
## change2_7R  0.042  0.000
## change2_8  -0.049 -0.027  0.000
## change2_9R -0.067  0.003  0.079  0.000
## change2_10 -0.019  0.006  0.098  0.052  0.000
##
## $mean
##  change1_1 change1_4R  change1_5 change1_6R  change1_8 change1_9R
##          0          0          0          0          0          0
##  change2_1 change2_2R  change2_3 change2_5R change2_7R  change2_8
##          0          0          0          0          0          0
## change2_9R change2_10
##          0          0
```

```r
reliability(fit.model.2f4)
```

```
##              f1        f2     total
## alpha   0.9147441 0.8844670 0.9226475
## omega   0.9203225 0.8858366 0.9357727
## omega2  0.9203225 0.8858366 0.9357727
## omega3  0.9196716 0.8814544 0.9305030
## avevar  0.6650539 0.4975546 0.5541850
```

CFA -two factor without items 1_2R, 1_3, 1_7, 2_3, 2_4, 2_6, 2_8

```r
model.2f5 <- 'f1 =~ change1_1 + change1_4R + change1_5 + change1_6R + change1_8 + change1_9R
              f2 =~ change2_1 + change2_2R + change2_5R + change2_7R + change2_9R + change2_10'

fit.model.2f5 <- cfa(model.2f5, change)
summary(fit.model.2f5, fit.measures = TRUE, standardized = TRUE)
```

```
## lavaan (0.5-23.1097) converged normally after  42 iterations
##
##                                                  Used       Total
##   Number of observations                         120         173
##
##   Estimator                                         ML
##   Minimum Function Test Statistic              111.419
##   Degrees of freedom                                53
##   P-value (Chi-square)                           0.000
##
## Model test baseline model:
##
##   Minimum Function Test Statistic              940.976
##   Degrees of freedom                                66
##   P-value                                        0.000
##
## User model versus baseline model:
##
##   Comparative Fit Index (CFI)                    0.933
##   Tucker-Lewis Index (TLI)                       0.917
##
## Loglikelihood and Information Criteria:
##
##   Loglikelihood user model (H0)              -1188.114
##   Loglikelihood unrestricted model (H1)      -1132.405
##
##   Number of free parameters                         25
##   Akaike (AIC)                                2426.229
##   Bayesian (BIC)                              2495.916
##   Sample-size adjusted Bayesian (BIC)         2416.878
##
## Root Mean Square Error of Approximation:
##
```

```
##    RMSEA                                        0.096
##    90 Percent Confidence Interval       0.071   0.121
##    P-value RMSEA <= 0.05                        0.002
##
## Standardized Root Mean Square Residual:
##
##    SRMR                                         0.050
##
## Parameter Estimates:
##
##    Information                          Expected
##    Standard Errors                      Standard
##
## Latent Variables:
##                 Estimate  Std.Err  z-value  P(>|z|)   Std.lv  Std.all
##   f1 =~
##     change1_1      1.000                               0.407    0.724
##     change1_4R     1.565    0.167    9.342    0.000    0.638    0.858
##     change1_5      1.003    0.131    7.663    0.000    0.409    0.709
##     change1_6R     1.466    0.155    9.475    0.000    0.597    0.869
##     change1_8      1.299    0.164    7.921    0.000    0.529    0.732
##     change1_9R     1.551    0.156    9.967    0.000    0.632    0.915
##   f2 =~
##     change2_1      1.000                               0.480    0.648
##     change2_2R     1.303    0.210    6.192    0.000    0.625    0.656
##     change2_5R     1.251    0.167    7.480    0.000    0.600    0.838
##     change2_7R     1.073    0.150    7.150    0.000    0.515    0.786
##     change2_9R     1.506    0.228    6.618    0.000    0.723    0.711
##     change2_10     1.167    0.199    5.856    0.000    0.560    0.614
##
## Covariances:
##                 Estimate  Std.Err  z-value  P(>|z|)   Std.lv  Std.all
##   f1 ~~
##     f2             0.137    0.030    4.531    0.000    0.699    0.699
##
## Variances:
##                 Estimate  Std.Err  z-value  P(>|z|)   Std.lv  Std.all
##    .change1_1      0.151    0.021    7.169    0.000    0.151    0.476
##    .change1_4R     0.146    0.023    6.260    0.000    0.146    0.265
##    .change1_5      0.166    0.023    7.219    0.000    0.166    0.498
##    .change1_6R     0.115    0.019    6.085    0.000    0.115    0.244
##    .change1_8      0.243    0.034    7.142    0.000    0.243    0.464
##    .change1_9R     0.078    0.016    5.014    0.000    0.078    0.163
##    .change2_1      0.319    0.045    7.030    0.000    0.319    0.580
##    .change2_2R     0.518    0.074    6.998    0.000    0.518    0.570
##    .change2_5R     0.153    0.028    5.382    0.000    0.153    0.298
##    .change2_7R     0.164    0.027    6.121    0.000    0.164    0.382
##    .change2_9R     0.510    0.076    6.725    0.000    0.510    0.494
##    .change2_10     0.519    0.073    7.149    0.000    0.519    0.623
##     f1             0.166    0.037    4.509    0.000    1.000    1.000
##     f2             0.230    0.061    3.790    0.000    1.000    1.000
```

```r
resid(fit.model.2f5, type = "cor")
```

```
## $type
```

```
## [1] "cor.bollen"
##
## $cor
##             chn1_1 ch1_4R chn1_5 ch1_6R chn1_8 ch1_9R chn2_1 ch2_2R ch2_5R
## change1_1    0.000
## change1_4R -0.035  0.000
## change1_5   0.020  0.023  0.000
## change1_6R  0.056  0.013 -0.080  0.000
## change1_8   0.047 -0.033  0.073 -0.013  0.000
## change1_9R -0.038  0.000  0.001  0.012  0.002  0.000
## change2_1   0.101 -0.022  0.100 -0.045  0.031 -0.095  0.000
## change2_2R -0.085 -0.026 -0.056 -0.102 -0.069 -0.008 -0.028  0.000
## change2_5R -0.010  0.014  0.040 -0.016 -0.066  0.036  0.003  0.080  0.000
## change2_7R  0.003  0.018  0.091 -0.021 -0.074  0.083 -0.046 -0.044  0.014
## change2_9R  0.104  0.068 -0.006 -0.035  0.127 -0.011  0.087 -0.022 -0.070
## change2_10 -0.016  0.058  0.059 -0.098 -0.006 -0.066  0.031 -0.002 -0.034
##            ch2_7R ch2_9R ch2_10
## change1_1
## change1_4R
## change1_5
## change1_6R
## change1_8
## change1_9R
## change2_1
## change2_2R
## change2_5R
## change2_7R  0.000
## change2_9R  0.014  0.000
## change2_10  0.004  0.066  0.000
##
## $mean
##  change1_1 change1_4R  change1_5 change1_6R  change1_8 change1_9R
##          0          0          0          0          0          0
##  change2_1 change2_2R change2_5R change2_7R change2_9R change2_10
##          0          0          0          0          0          0
```

```
reliability(fit.model.2f5)
```

```
##              f1        f2     total
## alpha  0.9147441 0.8485490 0.9083619
## omega  0.9199175 0.8489647 0.9255868
## omega2 0.9199175 0.8489647 0.9255868
## omega3 0.9172840 0.8425081 0.9241453
## avevar 0.6640772 0.4882244 0.5559961
```

CFA -two factor without items 1_2R, 1_3, 1_7, 2_3, 2_4, 2_6, 2_8, 2_9R

```
model.2f6 <- 'f1 =~ change1_1 + change1_4R + change1_5 + change1_6R + change1_8 + change1_9R
          f2 =~ change2_1 + change2_2R + change2_5R + change2_7R + change2_10'

fit.model.2f6 <- cfa(model.2f6, change)
```

```r
summary(fit.model.2f6, fit.measures = TRUE, standardized = TRUE)
```

```
## lavaan (0.5-23.1097) converged normally after  40 iterations
##
##                                                   Used       Total
##    Number of observations                         120         173
##
##    Estimator                                        ML
##    Minimum Function Test Statistic              77.376
##    Degrees of freedom                               43
##    P-value (Chi-square)                          0.001
##
## Model test baseline model:
##
##    Minimum Function Test Statistic             838.727
##    Degrees of freedom                               55
##    P-value                                       0.000
##
## User model versus baseline model:
##
##    Comparative Fit Index (CFI)                   0.956
##    Tucker-Lewis Index (TLI)                      0.944
##
## Loglikelihood and Information Criteria:
##
##    Loglikelihood user model (H0)             -1050.042
##    Loglikelihood unrestricted model (H1)     -1011.354
##
##    Number of free parameters                        23
##    Akaike (AIC)                               2146.084
##    Bayesian (BIC)                             2210.196
##    Sample-size adjusted Bayesian (BIC)        2137.481
##
## Root Mean Square Error of Approximation:
##
##    RMSEA                                         0.082
##    90 Percent Confidence Interval        0.051   0.110
##    P-value RMSEA <= 0.05                         0.044
##
## Standardized Root Mean Square Residual:
##
##    SRMR                                          0.048
##
## Parameter Estimates:
##
##    Information                                Expected
##    Standard Errors                            Standard
##
## Latent Variables:
##                   Estimate  Std.Err  z-value  P(>|z|)   Std.lv   Std.all
##    f1 =~
##      change1_1        1.000                                0.406    0.722
##      change1_4R       1.567    0.169    9.287    0.000      0.637    0.856
##      change1_5        1.006    0.132    7.637    0.000      0.409    0.709
```

```
##      change1_6R          1.473    0.156    9.443    0.000    0.598    0.870
##      change1_8           1.298    0.165    7.865    0.000    0.527    0.729
##      change1_9R          1.560    0.157    9.938    0.000    0.634    0.917
##    f2 =~
##      change2_1           1.000                                0.460    0.621
##      change2_2R          1.387    0.230    6.041    0.000    0.638    0.669
##      change2_5R          1.369    0.190    7.210    0.000    0.630    0.879
##      change2_7R          1.099    0.164    6.703    0.000    0.505    0.772
##      change2_10          1.163    0.214    5.442    0.000    0.535    0.586
##
## Covariances:
##                      Estimate  Std.Err  z-value  P(>|z|)   Std.lv   Std.all
##    f1 ~~
##      f2                  0.128    0.029    4.386    0.000    0.685    0.685
##
## Variances:
##                      Estimate  Std.Err  z-value  P(>|z|)   Std.lv   Std.all
##     .change1_1           0.152    0.021    7.179    0.000    0.152    0.479
##     .change1_4R          0.147    0.023    6.280    0.000    0.147    0.267
##     .change1_5           0.166    0.023    7.221    0.000    0.166    0.498
##     .change1_6R          0.114    0.019    6.071    0.000    0.114    0.242
##     .change1_8           0.245    0.034    7.154    0.000    0.245    0.468
##     .change1_9R          0.076    0.015    4.943    0.000    0.076    0.159
##     .change2_1           0.337    0.048    7.089    0.000    0.337    0.615
##     .change2_2R          0.503    0.073    6.890    0.000    0.503    0.553
##     .change2_5R          0.117    0.028    4.153    0.000    0.117    0.227
##     .change2_7R          0.174    0.028    6.130    0.000    0.174    0.405
##     .change2_10          0.547    0.076    7.201    0.000    0.547    0.657
##      f1                  0.165    0.037    4.490    0.000    1.000    1.000
##      f2                  0.212    0.059    3.579    0.000    1.000    1.000
```

```r
resid(fit.model.2f6, type = "cor")
```

```
## $type
## [1] "cor.bollen"
##
## $cor
##            chn1_1 ch1_4R chn1_5 ch1_6R chn1_8 ch1_9R chn2_1 ch2_2R ch2_5R
## change1_1   0.000
## change1_4R -0.032  0.000
## change1_5   0.022  0.024  0.000
## change1_6R  0.058  0.013 -0.081  0.000
## change1_8   0.051 -0.030  0.075 -0.012  0.000
## change1_9R -0.037 -0.001  0.000  0.009  0.003  0.000
## change2_1   0.122  0.002  0.120 -0.021  0.053 -0.071  0.000
## change2_2R -0.083 -0.025 -0.056 -0.102 -0.067 -0.009 -0.018  0.000
## change2_5R -0.020  0.001  0.029 -0.030 -0.076  0.020  0.000  0.041  0.000
## change2_7R  0.020  0.037  0.107 -0.003 -0.057  0.101 -0.016 -0.045 -0.006
## change2_10  0.005  0.082  0.079 -0.075  0.016 -0.041  0.064  0.009 -0.034
##            ch2_7R ch2_10
## change1_1
## change1_4R
## change1_5
## change1_6R
## change1_8
```

```
## change1_9R
## change2_1
## change2_2R
## change2_5R
## change2_7R  0.000
## change2_10  0.034  0.000
##
## $mean
##  change1_1 change1_4R  change1_5 change1_6R  change1_8 change1_9R
##          0          0          0          0          0          0
##  change2_1 change2_2R change2_5R change2_7R change2_10
##          0          0          0          0          0
```

```
reliability(fit.model.2f6)
```

```
##               f1        f2      total
## alpha   0.9147441 0.8194332 0.9013332
## omega   0.9196772 0.8203170 0.9211995
## omega2  0.9196772 0.8203170 0.9211995
## omega3  0.9160522 0.8158089 0.9211537
## avevar  0.6634338 0.4812202 0.5637107
```

CFA -one factor without items 1_2R, 1_3, 1_7, 2_3, 2_4, 2_6, 2_8, 2_9R

```
model.1f6 <- 'f1 =~ change1_1 + change1_4R + change1_5 + change1_6R + change1_8 + change1_9R + change2_
```

```
fit.model.1f6 <- cfa(model.1f6, change)
summary(fit.model.1f6, fit.measures = TRUE, standardized = TRUE)
```

```
## lavaan (0.5-23.1097) converged normally after  40 iterations
##
##                                                   Used       Total
##   Number of observations                          120         173
##
##   Estimator                                        ML
##   Minimum Function Test Statistic              179.040
##   Degrees of freedom                                44
##   P-value (Chi-square)                           0.000
##
## Model test baseline model:
##
##   Minimum Function Test Statistic              838.727
##   Degrees of freedom                                55
##   P-value                                        0.000
##
## User model versus baseline model:
##
##   Comparative Fit Index (CFI)                    0.828
##   Tucker-Lewis Index (TLI)                       0.785
##
## Loglikelihood and Information Criteria:
```

```
##
##    Loglikelihood user model (H0)            -1100.874
##    Loglikelihood unrestricted model (H1)    -1011.354
##
##    Number of free parameters                       22
##    Akaike (AIC)                             2245.748
##    Bayesian (BIC)                           2307.073
##    Sample-size adjusted Bayesian (BIC)      2237.519
##
## Root Mean Square Error of Approximation:
##
##    RMSEA                                       0.160
##    90 Percent Confidence Interval      0.136   0.185
##    P-value RMSEA <= 0.05                        0.000
##
## Standardized Root Mean Square Residual:
##
##    SRMR                                        0.097
##
## Parameter Estimates:
##
##    Information                              Expected
##    Standard Errors                          Standard
##
## Latent Variables:
##                  Estimate  Std.Err  z-value  P(>|z|)   Std.lv  Std.all
##   f1 =~
##     change1_1       1.000                               0.404    0.718
##     change1_4R      1.569    0.171    9.177    0.000    0.634    0.853
##     change1_5       1.026    0.133    7.706    0.000    0.414    0.718
##     change1_6R      1.445    0.158    9.141    0.000    0.584    0.849
##     change1_8       1.285    0.167    7.696    0.000    0.519    0.717
##     change1_9R      1.549    0.159    9.745    0.000    0.626    0.906
##     change2_1       0.884    0.172    5.138    0.000    0.357    0.482
##     change2_2R      1.100    0.221    4.966    0.000    0.444    0.466
##     change2_5R      1.164    0.166    7.030    0.000    0.470    0.656
##     change2_7R      1.031    0.151    6.809    0.000    0.417    0.636
##     change2_10      1.026    0.212    4.841    0.000    0.415    0.454
##
## Variances:
##                  Estimate  Std.Err  z-value  P(>|z|)   Std.lv  Std.all
##    .change1_1       0.153    0.021    7.202    0.000    0.153    0.485
##    .change1_4R      0.151    0.024    6.365    0.000    0.151    0.273
##    .change1_5       0.161    0.022    7.200    0.000    0.161    0.484
##    .change1_6R      0.132    0.021    6.404    0.000    0.132    0.279
##    .change1_8       0.254    0.035    7.203    0.000    0.254    0.485
##    .change1_9R      0.086    0.016    5.382    0.000    0.086    0.180
##    .change2_1       0.421    0.056    7.592    0.000    0.421    0.768
##    .change2_2R      0.712    0.094    7.605    0.000    0.712    0.783
##    .change2_5R      0.292    0.040    7.360    0.000    0.292    0.569
##    .change2_7R      0.255    0.035    7.399    0.000    0.255    0.595
##    .change2_10      0.661    0.087    7.614    0.000    0.661    0.794
##     f1              0.163    0.037    4.458    0.000    1.000    1.000
```

```r
resid(fit.model.1f6, type = "cor")
```

```
## $type
## [1] "cor.bollen"
##
## $cor
##            chn1_1 ch1_4R chn1_5 ch1_6R chn1_8 ch1_9R chn2_1 ch2_2R ch2_5R
## change1_1   0.000
## change1_4R -0.026  0.000
## change1_5   0.018  0.019  0.000
## change1_6R  0.076  0.034 -0.074  0.000
## change1_8   0.062 -0.017  0.076  0.014  0.000
## change1_9R -0.025  0.012 -0.001  0.038  0.021  0.000
## change2_1   0.083 -0.045  0.075 -0.060  0.017 -0.117  0.000
## change2_2R -0.087 -0.030 -0.066 -0.099 -0.067 -0.011  0.173  0.000
## change2_5R -0.057 -0.043 -0.016 -0.064 -0.108 -0.023  0.229  0.323  0.000
## change2_7R -0.056 -0.053  0.024 -0.084 -0.128  0.009  0.156  0.175  0.255
## change2_10 -0.031  0.038  0.037 -0.111 -0.018 -0.085  0.209  0.189  0.183
##            ch2_7R ch2_10
## change1_1
## change1_4R
## change1_5
## change1_6R
## change1_8
## change1_9R
## change2_1
## change2_2R
## change2_5R
## change2_7R  0.000
## change2_10  0.197  0.000
##
## $mean
##  change1_1 change1_4R  change1_5 change1_6R  change1_8 change1_9R
##          0          0          0          0          0          0
##  change2_1 change2_2R change2_5R change2_7R change2_10
##          0          0          0          0          0
```

```r
reliability(fit.model.1f6)
```

```
##               f1     total
## alpha  0.9013332 0.9013332
## omega  0.8948743 0.8948743
## omega2 0.8948743 0.8948743
## omega3 0.8531889 0.8531889
## avevar 0.4450429 0.4450429
```