Factor Analysis of GCA

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Data

I'm going to break this data into two sets, one for EFA, one for CFA

```
library(psych)
d<-read.csv("1516GCA.csv")
x<-seq(from=1, to=nrow(d), by=2)
y<-seq(from=2, to=nrow(d), by=2)
d1<-d[x,]
d2<-d[y,]
df<-as.data.frame(d)
```

Item Descriptives and Reliability

Let's have a look at item descriptives and alpha

```
alpha(df,na.rm=T)
```

```
##
## Reliability analysis
## Call: alpha(x = df, na.rm = T)
##
##   raw_alpha std.alpha G6(smc) average_r S/N    ase mean   sd
##       0.84      0.84    0.84      0.17 5.1 0.0048 0.52 0.22
##
##  lower alpha upper     95% confidence boundaries
## 0.83 0.84 0.85
##
##  Reliability if an item is dropped:
##       raw_alpha std.alpha G6(smc) average_r S/N alpha se
## GCA1       0.83      0.83    0.83      0.17 4.8   0.0050
## GCA2       0.84      0.83    0.84      0.17 5.0   0.0048
## GCA3       0.84      0.84    0.84      0.18 5.1   0.0048
## GCA4       0.83      0.83    0.83      0.17 4.9   0.0050
## GCA5       0.83      0.83    0.83      0.17 4.9   0.0050
## GCA6       0.83      0.83    0.83      0.17 4.8   0.0050
## GCA7       0.83      0.83    0.83      0.17 4.8   0.0050
## GCA8       0.83      0.83    0.83      0.17 4.9   0.0049
## GCA9       0.84      0.83    0.84      0.17 5.1   0.0048
## GCA10      0.83      0.83    0.83      0.17 4.8   0.0051
## GCA11      0.83      0.83    0.83      0.17 4.8   0.0050
## GCA12      0.83      0.83    0.83      0.17 4.9   0.0050
## GCA13      0.83      0.83    0.83      0.17 4.9   0.0050
## GCA14      0.83      0.83    0.83      0.17 4.9   0.0049
## GCA15      0.84      0.83    0.83      0.17 5.0   0.0049
## GCA16      0.83      0.83    0.83      0.17 4.8   0.0050
## GCA17      0.83      0.83    0.83      0.17 4.9   0.0049
```

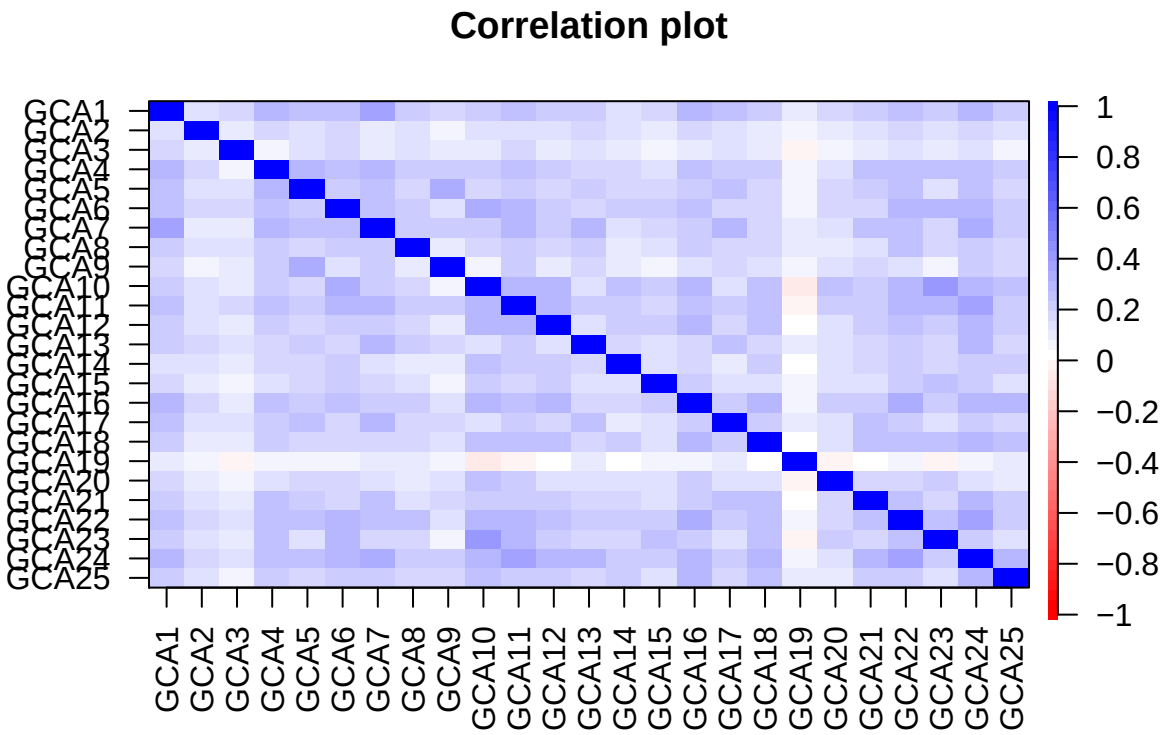
```
## GCA18      0.83      0.83    0.83      0.17 4.8   0.0050
## GCA19      0.84      0.84    0.84      0.18 5.3   0.0047
## GCA20      0.84      0.83    0.84      0.17 5.0   0.0048
## GCA21      0.83      0.83    0.83      0.17 4.8   0.0050
## GCA22      0.83      0.83    0.83      0.17 4.8   0.0050
## GCA23      0.83      0.83    0.83      0.17 4.8   0.0050
## GCA24      0.83      0.82    0.83      0.16 4.7   0.0051
## GCA25      0.83      0.83    0.83      0.17 4.8   0.0050
##
##  Item statistics
##          n raw.r std.r r.cor r.drop mean   sd
## GCA1  2071  0.50  0.50  0.47   0.43 0.66 0.47
## GCA2  2069  0.36  0.36  0.31   0.28 0.73 0.44
## GCA3  2065  0.30  0.30  0.24   0.22 0.40 0.49
## GCA4  2065  0.47  0.47  0.43   0.39 0.65 0.48
## GCA5  2068  0.48  0.48  0.44   0.41 0.56 0.50
## GCA6  2060  0.52  0.52  0.49   0.45 0.53 0.50
## GCA7  2064  0.52  0.52  0.49   0.45 0.65 0.48
## GCA8  2063  0.40  0.41  0.37   0.33 0.79 0.41
## GCA9  2065  0.34  0.34  0.28   0.26 0.50 0.50
## GCA10 2069  0.55  0.54  0.53   0.48 0.35 0.48
## GCA11 2062  0.53  0.53  0.51   0.46 0.44 0.50
## GCA12 2058  0.46  0.45  0.42   0.38 0.46 0.50
## GCA13 2064  0.46  0.46  0.42   0.39 0.71 0.45
## GCA14 2062  0.42  0.42  0.37   0.34 0.55 0.50
## GCA15 2064  0.38  0.38  0.33   0.30 0.40 0.49
## GCA16 2062  0.52  0.52  0.49   0.45 0.51 0.50
## GCA17 2060  0.44  0.43  0.39   0.36 0.48 0.50
## GCA18 2062  0.49  0.49  0.45   0.41 0.47 0.50
## GCA19 2060  0.18  0.19  0.12   0.11 0.82 0.39
## GCA20 2060  0.36  0.36  0.31   0.28 0.31 0.46
## GCA21 2059  0.49  0.48  0.45   0.41 0.49 0.50
## GCA22 2056  0.51  0.51  0.48   0.44 0.39 0.49
## GCA23 2060  0.50  0.50  0.47   0.43 0.39 0.49
## GCA24 2052  0.59  0.58  0.57   0.52 0.38 0.49
## GCA25 2050  0.49  0.48  0.45   0.41 0.50 0.50
##
## Non missing response frequency for each item
##          0    1 miss
## GCA1  0.34 0.66 0.12
## GCA2  0.27 0.73 0.12
## GCA3  0.60 0.40 0.12
## GCA4  0.35 0.65 0.12
## GCA5  0.44 0.56 0.12
## GCA6  0.47 0.53 0.12
## GCA7  0.35 0.65 0.12
## GCA8  0.21 0.79 0.12
## GCA9  0.50 0.50 0.12
## GCA10 0.65 0.35 0.12
## GCA11 0.56 0.44 0.12
## GCA12 0.54 0.46 0.12
## GCA13 0.29 0.71 0.12
## GCA14 0.45 0.55 0.12
## GCA15 0.60 0.40 0.12
```

```
## GCA16 0.49 0.51 0.12
## GCA17 0.52 0.48 0.12
## GCA18 0.53 0.47 0.12
## GCA19 0.18 0.82 0.12
## GCA20 0.69 0.31 0.12
## GCA21 0.51 0.49 0.12
## GCA22 0.61 0.39 0.12
## GCA23 0.61 0.39 0.12
## GCA24 0.62 0.38 0.13
## GCA25 0.50 0.50 0.13
```

One thing to notice here is that item 19 stands out as having by far the lowest correlations with total score based on all other GCA items.

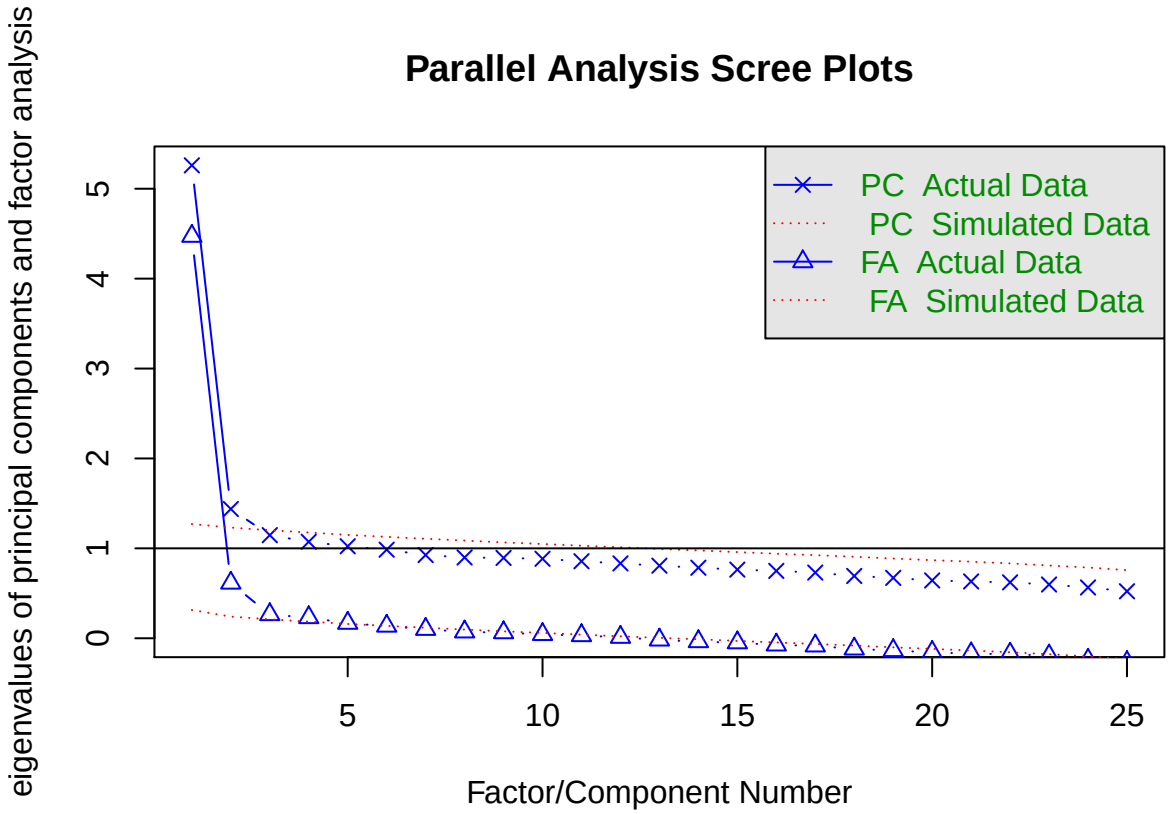
Dimensionality Analyses

```
cm<-cor(d1,use="complete.obs")
ev <- eigen(cm)
library(corrplot)
cor.plot(cm)
```



Let's run a Parallel Analysis Scree Plot

```
fa.parallel(cm, n.obs = nrow(d1), fm="minres", fa="both",
            main = "Parallel Analysis Scree Plots",
            n.iter=100, error.bars=FALSE, SMC=FALSE,
            ylabel=NULL, show.legend=TRUE)
```




```
## Parallel analysis suggests that the number of factors =  5  and the number of components =  2
```

So based on principal components could make a case for about 2; based on factors could make a case for up to 4 or 5. I'm going to run EFA with 2, 3 and 4 factors.

Starting with 2 Factors

```
mod1<-fa(d1,nfactors=2,rotate="Promax",fm="pa",cor="tet")
```

```
## Warning in fac(r = r, nfactors = nfactors, n.obs = n.obs, rotate =
## rotate, : A Heywood case was detected. Examine the loadings carefully.
```

```
print(mod1$loadings,cut=.3)
```

```
##
## Loadings:
##       PA2    PA1
## GCA1   0.542
## GCA2
## GCA3
## GCA4   0.466
## GCA5   0.662
## GCA6          0.550
## GCA7   0.682
## GCA8   0.351
## GCA9   0.661
## GCA10 -0.319  1.018
## GCA11         0.423
## GCA12         0.507
## GCA13  0.642
```

```
## GCA14         0.371
## GCA15         0.427
## GCA16         0.421
## GCA17  0.705
## GCA18         0.360
## GCA19  0.398
## GCA20         0.376
## GCA21  0.421
## GCA22         0.435
## GCA23         0.831
## GCA24  0.442  0.342
## GCA25
##
##                   PA2   PA1
## SS loadings     4.014 3.971
## Proportion Var 0.161 0.159
## Cumulative Var 0.161 0.319
```

```
mod1$rms
```

```
## [1] 0.04332974
```

Not bad. We have a Heywood case due to item 10, and a cross-loading for items 24. But root mean residual is just .04. This solution explains about 32% of item covariance. Notice also that three items don't have loadings $> .3$ on either factor (items 2, 3 and 25). Let's try 3 factors.

```
mod2<-fa(d1,nfactors=3,rotate="Promax",fm="pa",cor="tet")
```

```
## Warning in fac(r = r, nfactors = nfactors, n.obs = n.obs, rotate =
## rotate, : A Heywood case was detected. Examine the loadings carefully.
```

```
print(mod2$loadings,cut=.3)
```

```
##
## Loadings:
##       PA1    PA2    PA3
## GCA1          0.444
## GCA2
## GCA3
## GCA4          0.496
## GCA5          0.799
## GCA6   0.600
## GCA7          0.552
## GCA8
## GCA9  -0.319  0.871
## GCA10  1.100       -0.338
## GCA11  0.476  0.415
## GCA12  0.567
## GCA13         0.428
## GCA14  0.409
## GCA15  0.474
## GCA16  0.476
## GCA17         0.569
## GCA18  0.408
## GCA19 -0.366        0.749
## GCA20  0.415       -0.327
## GCA21         0.386
```

```
## GCA22  0.490
## GCA23  0.892
## GCA24  0.400
## GCA25  0.331
##
##                  PA1   PA2   PA3
## SS loadings    4.877 3.330 1.275
## Proportion Var 0.195 0.133 0.051
## Cumulative Var 0.195 0.328 0.379
```

```
mod2$rms
```

```
## [1] 0.03764688
```

The 3 factor solution explains a little more covariance, reduces root mean residual from .043 to .038. Still getting that Heywood case. Also notice that items 2, 3 and 8 don't have loadings > .3. With three factors we get a lot more cross-loadings that show up–tricky to interpret. Item 19 now shows up as a problem. Lastly, let's try 4 factors.

```
mod3<-fa(d1,nfactors=4,rotate="Promax",fm="pa",cor="tet")
```

```
print(mod3$loadings,cut=.3)
```

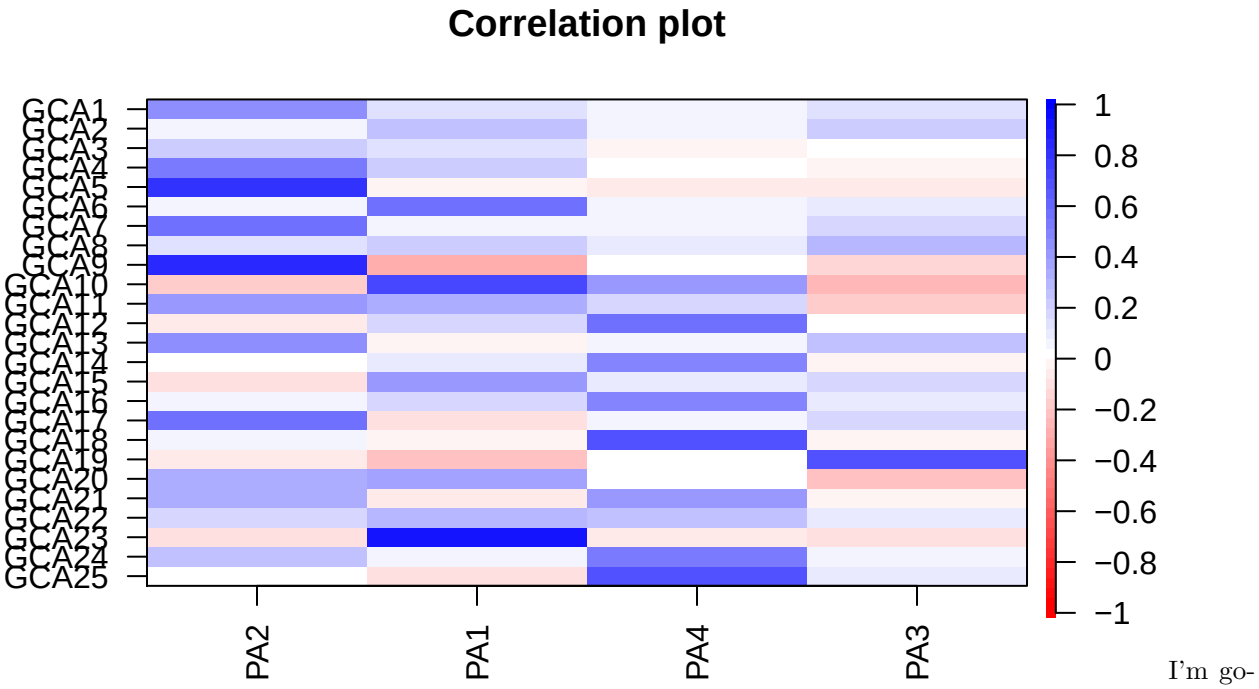
```
##
## Loadings:
##       PA2    PA1    PA4    PA3
## GCA1   0.447
## GCA2
## GCA3
## GCA4   0.498
## GCA5   0.777
## GCA6          0.554
## GCA7   0.550
## GCA8
## GCA9   0.810 -0.310
## GCA10         0.696  0.400
## GCA11  0.397  0.305
## GCA12                0.546
## GCA13  0.429
## GCA14                0.456
## GCA15         0.396
## GCA16                0.464
## GCA17  0.554
## GCA18                0.650
## GCA19                       0.679
## GCA20         0.358
## GCA21  0.328         0.378
## GCA22
## GCA23         0.898
## GCA24                0.506
## GCA25                0.671
##
##                  PA2   PA1   PA4   PA3
## SS loadings    3.063 2.472 2.272 0.975
## Proportion Var 0.123 0.099 0.091 0.039
## Cumulative Var 0.123 0.221 0.312 0.351
```

```
mod3$rms
```

```
## [1] 0.03346377
```

OK, so this is interesting. With the 4 factor solution we no longer have the Heywood case, but now the cumulative proportion of variance explained is lower than it was in the 3 factor solution! Root mean residual is down to .033. But notice that only item 19 loads on the 4th factor. We also now lose item 22 on top of 2, 3 and 8. Here's a visualization

```
cor.plot(mod3)
```



I'm going to try specifying a CFA model based on results from the two factor EFA. I'm gonna drop item 19 and not only keep strongest factor loading for each item.

CFA

```
library("lavaan")
```

```
## This is lavaan 0.5-23.1097
```

```
## lavaan is BETA software! Please report any bugs.
```

```
fac3_mod <-
'factor1 =~ GCA1 + GCA4 + GCA7 + GCA8 + GCA9
+ GCA13 + GCA17 + GCA21 + GCA24
factor2 =~ GCA6 + GCA10 + GCA11 + GCA12 + GCA14
+ GCA15 + GCA16 + GCA18 + GCA20 + GCA22 + GCA23
+ GCA24'
fac3mod <- cfa(model = fac3_mod, data = d2, ordered = names(d2) ,estimator = "DWLS", se = "robust", tes
summary(fac3mod,fit.measures = TRUE)
```

```
## lavaan (0.5-23.1097) converged normally after  23 iterations
##
##                                                   Used       Total
```

```
##   Number of observations                              997        1173
##
##   Estimator                                         DWLS      Robust
##   Minimum Function Test Statistic                139.748     195.046
##   Degrees of freedom                                 168         168
##   P-value (Chi-square)                             0.945       0.075
##   Scaling correction factor                                    0.784
##   Shift parameter                                             16.892
##     for simple second-order correction (Mplus variant)
##
## Model test baseline model:
##
##   Minimum Function Test Statistic             8909.287    5909.108
##   Degrees of freedom                               190         190
##   P-value                                        0.000       0.000
##
## User model versus baseline model:
##
##   Comparative Fit Index (CFI)                    1.000       0.995
##   Tucker-Lewis Index (TLI)                       1.004       0.995
##
##   Robust Comparative Fit Index (CFI)                            NA
##   Robust Tucker-Lewis Index (TLI)                               NA
##
## Root Mean Square Error of Approximation:
##
##   RMSEA                                          0.000       0.013
##   90 Percent Confidence Interval          0.000  0.002       0.000  0.020
##   P-value RMSEA <= 0.05                          1.000       1.000
##
##   Robust RMSEA                                                  NA
##   90 Percent Confidence Interval                             0.000     NA
##
## Standardized Root Mean Square Residual:
##
##   SRMR                                           0.039       0.039
##
## Weighted Root Mean Square Residual:
##
##   WRMR                                           0.816       0.816
##
## Parameter Estimates:
##
##   Information                                 Expected
##   Standard Errors                           Robust.sem
##
## Latent Variables:
##                    Estimate  Std.Err  z-value  P(>|z|)
##   factor1 =~
##     GCA1              0.614    0.034   18.076    0.000
##     GCA4              0.548    0.037   14.856    0.000
##     GCA7              0.659    0.033   20.085    0.000
##     GCA8              0.564    0.036   15.504    0.000
##     GCA9              0.359    0.042    8.522    0.000
```

```
##     GCA13             0.597    0.038   15.874    0.000
##     GCA17             0.459    0.040   11.460    0.000
##     GCA21             0.607    0.037   16.597    0.000
##     GCA24             0.445    0.123    3.620    0.000
##   factor2 =~
##     GCA6              0.647    0.033   19.803    0.000
##     GCA10             0.750    0.032   23.183    0.000
##     GCA11             0.649    0.034   19.146    0.000
##     GCA12             0.523    0.038   13.908    0.000
##     GCA14             0.495    0.037   13.360    0.000
##     GCA15             0.417    0.041   10.250    0.000
##     GCA16             0.610    0.033   18.571    0.000
##     GCA18             0.618    0.035   17.899    0.000
##     GCA20             0.441    0.045    9.878    0.000
##     GCA22             0.592    0.038   15.690    0.000
##     GCA23             0.692    0.033   20.705    0.000
##     GCA24             0.289    0.120    2.411    0.016
##
## Covariances:
##                    Estimate  Std.Err  z-value  P(>|z|)
##   factor1 ~~
##     factor2           0.843    0.025   33.428    0.000
##
## Intercepts:
##                    Estimate  Std.Err  z-value  P(>|z|)
##    .GCA1              0.000
##    .GCA4              0.000
##    .GCA7              0.000
##    .GCA8              0.000
##    .GCA9              0.000
##    .GCA13             0.000
##    .GCA17             0.000
##    .GCA21             0.000
##    .GCA24             0.000
##    .GCA6              0.000
##    .GCA10             0.000
##    .GCA11             0.000
##    .GCA12             0.000
##    .GCA14             0.000
##    .GCA15             0.000
##    .GCA16             0.000
##    .GCA18             0.000
##    .GCA20             0.000
##    .GCA22             0.000
##    .GCA23             0.000
##     factor1           0.000
##     factor2           0.000
##
## Thresholds:
##                    Estimate  Std.Err  z-value  P(>|z|)
##     GCA1|t1          -0.391    0.041   -9.566    0.000
##     GCA4|t1          -0.364    0.041   -8.938    0.000
##     GCA7|t1          -0.385    0.041   -9.440    0.000
##     GCA8|t1          -0.787    0.045  -17.676    0.000
```

```
##     GCA9|t1          -0.047    0.040   -1.171    0.242
##     GCA13|t1         -0.516    0.042  -12.377    0.000
##     GCA17|t1          0.069    0.040    1.741    0.082
##     GCA21|t1          0.029    0.040    0.728    0.467
##     GCA24|t1          0.266    0.040    6.608    0.000
##     GCA6|t1          -0.024    0.040   -0.601    0.548
##     GCA10|t1          0.374    0.041    9.189    0.000
##     GCA11|t1          0.132    0.040    3.323    0.001
##     GCA12|t1          0.102    0.040    2.564    0.010
##     GCA14|t1         -0.155    0.040   -3.892    0.000
##     GCA15|t1          0.181    0.040    4.524    0.000
##     GCA16|t1         -0.052    0.040   -1.298    0.194
##     GCA18|t1          0.072    0.040    1.804    0.071
##     GCA20|t1          0.499    0.042   12.004    0.000
##     GCA22|t1          0.310    0.040    7.680    0.000
##     GCA23|t1          0.258    0.040    6.419    0.000
##
## Variances:
##                   Estimate  Std.Err  z-value  P(>|z|)
##    .GCA1             0.623
##    .GCA4             0.700
##    .GCA7             0.566
##    .GCA8             0.682
##    .GCA9             0.871
##    .GCA13            0.644
##    .GCA17            0.790
##    .GCA21            0.632
##    .GCA24            0.501
##    .GCA6             0.581
##    .GCA10            0.437
##    .GCA11            0.578
##    .GCA12            0.727
##    .GCA14            0.755
##    .GCA15            0.826
##    .GCA16            0.628
##    .GCA18            0.618
##    .GCA20            0.805
##    .GCA22            0.650
##    .GCA23            0.521
##     factor1          1.000
##     factor2          1.000
##
## Scales y*:
##                   Estimate  Std.Err  z-value  P(>|z|)
##     GCA1             1.000
##     GCA4             1.000
##     GCA7             1.000
##     GCA8             1.000
##     GCA9             1.000
##     GCA13            1.000
##     GCA17            1.000
##     GCA21            1.000
##     GCA24            1.000
##     GCA6             1.000
```

```
##     GCA10             1.000
##     GCA11             1.000
##     GCA12             1.000
##     GCA14             1.000
##     GCA15             1.000
##     GCA16             1.000
##     GCA18             1.000
##     GCA20             1.000
##     GCA22             1.000
##     GCA23             1.000
```

```
mi <- modindices(fac3mod)
mi[mi$op == "=~",]
```

```
##         lhs op   rhs     mi mi.scaled    epc sepc.lv sepc.all sepc.nox
## 107 factor1 =~  GCA6  0.174     0.221  0.056   0.056    0.056    0.056
## 108 factor1 =~ GCA10  1.039     1.324 -0.143  -0.143   -0.143   -0.143
## 109 factor1 =~ GCA11  1.796     2.290  0.181   0.181    0.181    0.181
## 110 factor1 =~ GCA12  0.909     1.159 -0.127  -0.127   -0.127   -0.127
## 111 factor1 =~ GCA14  0.107     0.136  0.044   0.044    0.044    0.044
## 112 factor1 =~ GCA15  0.008     0.010  0.012   0.012    0.012    0.012
## 113 factor1 =~ GCA16  0.001     0.002  0.005   0.005    0.005    0.005
## 114 factor1 =~ GCA18  0.788     1.004 -0.119  -0.119   -0.119   -0.119
## 115 factor1 =~ GCA20  2.138     2.725 -0.204  -0.204   -0.204   -0.204
## 116 factor1 =~ GCA22 14.983    19.101  0.524   0.524    0.524    0.524
## 117 factor1 =~ GCA23  3.307     4.216 -0.250  -0.250   -0.250   -0.250
## 118 factor2 =~  GCA1  0.326     0.415 -0.083  -0.083   -0.083   -0.083
## 119 factor2 =~  GCA4  0.021     0.026 -0.020  -0.020   -0.020   -0.020
## 120 factor2 =~  GCA7  0.040     0.051 -0.030  -0.030   -0.030   -0.030
## 121 factor2 =~  GCA8  3.684     4.696  0.291   0.291    0.291    0.291
## 122 factor2 =~  GCA9  5.558     7.086 -0.311  -0.311   -0.311   -0.311
## 123 factor2 =~ GCA13  0.199     0.253  0.065   0.065    0.065    0.065
## 124 factor2 =~ GCA17  0.864     1.101 -0.125  -0.125   -0.125   -0.125
## 125 factor2 =~ GCA21  1.103     1.407  0.149   0.149    0.149    0.149
```

The fit of this model is pretty good. Of course, a problem is that I've played around with other possibilities that also fit equally well! Next step is to do a CFA based on mapping of items to intended learning objectives (1-8). Need at least two items per factor, so dropping GCA25 for now.

```
fac7_mod <-
'factor1 =~ GCA3 + GCA6 + GCA10 + GCA14 + GCA16 + GCA18
factor2 =~ GCA1 + GCA8 + GCA17
factor3 =~ GCA2 + GCA7 + GCA20 + GCA22 + GCA23
factor4 =~ GCA13 + GCA24
factor5 =~ GCA5 + GCA9 +GCA19
factor6 =~ GCA4 + GCA11 + GCA12
factor7 =~ GCA15 + GCA21
'
fac7mod <- cfa(model = fac7_mod, data = d2, ordered = names(d2) ,estimator = "DWLS", se = "robust", tes
```

```
## Warning in lav_object_post_check(object): lavaan WARNING: covariance matrix of latent variables
##                 is not positive definite;
##                 use inspect(fit,"cov.lv") to investigate.
```

```
summary(fac7mod,fit.measures = TRUE)
```

```
## lavaan (0.5-23.1097) converged normally after  52 iterations
```

```
##
##                                                   Used       Total
##   Number of observations                           997        1173
##
##   Estimator                                       DWLS      Robust
##   Minimum Function Test Statistic              281.843     366.437
##   Degrees of freedom                               231         231
##   P-value (Chi-square)                           0.012       0.000
##   Scaling correction factor                                  0.841
##   Shift parameter                                           31.480
##     for simple second-order correction (Mplus variant)
##
## Model test baseline model:
##
##   Minimum Function Test Statistic            10887.538    6969.583
##   Degrees of freedom                               276         276
##   P-value                                        0.000       0.000
##
## User model versus baseline model:
##
##   Comparative Fit Index (CFI)                    0.995       0.980
##   Tucker-Lewis Index (TLI)                       0.994       0.976
##
##   Robust Comparative Fit Index (CFI)                            NA
##   Robust Tucker-Lewis Index (TLI)                               NA
##
## Root Mean Square Error of Approximation:
##
##   RMSEA                                          0.015       0.024
##   90 Percent Confidence Interval          0.007  0.021       0.019  0.029
##   P-value RMSEA <= 0.05                          1.000       1.000
##
##   Robust RMSEA                                                  NA
##   90 Percent Confidence Interval                                NA     NA
##
## Standardized Root Mean Square Residual:
##
##   SRMR                                           0.048       0.048
##
## Weighted Root Mean Square Residual:
##
##   WRMR                                           0.969       0.969
##
## Parameter Estimates:
##
##   Information                                 Expected
##   Standard Errors                           Robust.sem
##
## Latent Variables:
##                    Estimate  Std.Err  z-value  P(>|z|)
##   factor1 =~
##     GCA3              0.351    0.042    8.300    0.000
##     GCA6              0.644    0.033   19.375    0.000
##     GCA10             0.753    0.033   22.735    0.000
```

```
##     GCA14             0.492    0.037   13.305    0.000
##     GCA16             0.619    0.033   18.998    0.000
##     GCA18             0.621    0.035   17.883    0.000
##   factor2 =~
##     GCA1              0.625    0.039   15.957    0.000
##     GCA8              0.556    0.041   13.596    0.000
##     GCA17             0.471    0.042   11.260    0.000
##   factor3 =~
##     GCA2              0.450    0.034   13.087    0.000
##     GCA7              0.624    0.032   19.507    0.000
##     GCA20             0.424    0.045    9.460    0.000
##     GCA22             0.583    0.038   15.401    0.000
##     GCA23             0.667    0.035   19.058    0.000
##   factor4 =~
##     GCA13             0.605    0.040   15.262    0.000
##     GCA24             0.752    0.045   16.535    0.000
##   factor5 =~
##     GCA5              0.708    0.054   13.038    0.000
##     GCA9              0.434    0.047    9.244    0.000
##     GCA19             0.262    0.058    4.538    0.000
##   factor6 =~
##     GCA4              0.538    0.039   13.809    0.000
##     GCA11             0.648    0.040   16.131    0.000
##     GCA12             0.512    0.041   12.642    0.000
##   factor7 =~
##     GCA15             0.413    0.052    7.966    0.000
##     GCA21             0.575    0.061    9.466    0.000
##
## Covariances:
##                   Estimate  Std.Err  z-value  P(>|z|)
##   factor1 ~~
##     factor2          0.827    0.054   15.291    0.000
##     factor3          0.985    0.031   31.402    0.000
##     factor4          0.890    0.050   17.751    0.000
##     factor5          0.679    0.065   10.379    0.000
##     factor6          0.951    0.045   21.038    0.000
##     factor7          0.936    0.092   10.138    0.000
##   factor2 ~~
##     factor3          0.952    0.059   16.113    0.000
##     factor4          0.936    0.069   13.596    0.000
##     factor5          0.850    0.083   10.252    0.000
##     factor6          0.921    0.068   13.520    0.000
##     factor7          0.904    0.117    7.757    0.000
##   factor3 ~~
##     factor4          0.893    0.057   15.782    0.000
##     factor5          0.765    0.070   10.976    0.000
##     factor6          0.954    0.051   18.542    0.000
##     factor7          0.959    0.101    9.529    0.000
##   factor4 ~~
##     factor5          0.761    0.078    9.705    0.000
##     factor6          0.870    0.064   13.599    0.000
##     factor7          0.929    0.107    8.661    0.000
##   factor5 ~~
##     factor6          0.798    0.080    9.993    0.000
```

```
##     factor7           0.866    0.114    7.597    0.000
##   factor6 ~~
##     factor7           0.972    0.106    9.155    0.000
##
## Intercepts:
##                    Estimate  Std.Err  z-value  P(>|z|)
##    .GCA3              0.000
##    .GCA6              0.000
##    .GCA10             0.000
##    .GCA14             0.000
##    .GCA16             0.000
##    .GCA18             0.000
##    .GCA1              0.000
##    .GCA8              0.000
##    .GCA17             0.000
##    .GCA2              0.000
##    .GCA7              0.000
##    .GCA20             0.000
##    .GCA22             0.000
##    .GCA23             0.000
##    .GCA13             0.000
##    .GCA24             0.000
##    .GCA5              0.000
##    .GCA9              0.000
##    .GCA19             0.000
##    .GCA4              0.000
##    .GCA11             0.000
##    .GCA12             0.000
##    .GCA15             0.000
##    .GCA21             0.000
##     factor1           0.000
##     factor2           0.000
##     factor3           0.000
##     factor4           0.000
##     factor5           0.000
##     factor6           0.000
##     factor7           0.000
##
## Thresholds:
##                    Estimate  Std.Err  z-value  P(>|z|)
##     GCA3|t1           0.271    0.040    6.734    0.000
##     GCA6|t1          -0.024    0.040   -0.601    0.548
##     GCA10|t1          0.374    0.041    9.189    0.000
##     GCA14|t1         -0.155    0.040   -3.892    0.000
##     GCA16|t1         -0.052    0.040   -1.298    0.194
##     GCA18|t1          0.072    0.040    1.804    0.071
##     GCA1|t1          -0.391    0.041   -9.566    0.000
##     GCA8|t1          -0.787    0.045  -17.676    0.000
##     GCA17|t1          0.069    0.040    1.741    0.082
##     GCA2|t1          -0.638    0.043  -14.906    0.000
##     GCA7|t1          -0.385    0.041   -9.440    0.000
##     GCA20|t1          0.499    0.042   12.004    0.000
##     GCA22|t1          0.310    0.040    7.680    0.000
##     GCA23|t1          0.258    0.040    6.419    0.000
```

```
##     GCA13|t1         -0.516    0.042  -12.377    0.000
##     GCA24|t1          0.266    0.040    6.608    0.000
##     GCA5|t1          -0.137    0.040   -3.449    0.001
##     GCA9|t1          -0.047    0.040   -1.171    0.242
##     GCA19|t1         -0.898    0.046  -19.474    0.000
##     GCA4|t1          -0.364    0.041   -8.938    0.000
##     GCA11|t1          0.132    0.040    3.323    0.001
##     GCA12|t1          0.102    0.040    2.564    0.010
##     GCA15|t1          0.181    0.040    4.524    0.000
##     GCA21|t1          0.029    0.040    0.728    0.467
##
## Variances:
##                    Estimate  Std.Err  z-value  P(>|z|)
##    .GCA3              0.877
##    .GCA6              0.585
##    .GCA10             0.433
##    .GCA14             0.758
##    .GCA16             0.616
##    .GCA18             0.614
##    .GCA1              0.609
##    .GCA8              0.691
##    .GCA17             0.779
##    .GCA2              0.797
##    .GCA7              0.610
##    .GCA20             0.821
##    .GCA22             0.660
##    .GCA23             0.554
##    .GCA13             0.633
##    .GCA24             0.435
##    .GCA5              0.499
##    .GCA9              0.812
##    .GCA19             0.932
##    .GCA4              0.710
##    .GCA11             0.581
##    .GCA12             0.738
##    .GCA15             0.829
##    .GCA21             0.669
##     factor1           1.000
##     factor2           1.000
##     factor3           1.000
##     factor4           1.000
##     factor5           1.000
##     factor6           1.000
##     factor7           1.000
##
## Scales y*:
##                    Estimate  Std.Err  z-value  P(>|z|)
##     GCA3              1.000
##     GCA6              1.000
##     GCA10             1.000
##     GCA14             1.000
##     GCA16             1.000
##     GCA18             1.000
##     GCA1              1.000
```

```
##     GCA8              1.000
##     GCA17             1.000
##     GCA2              1.000
##     GCA7              1.000
##     GCA20             1.000
##     GCA22             1.000
##     GCA23             1.000
##     GCA13             1.000
##     GCA24             1.000
##     GCA5              1.000
##     GCA9              1.000
##     GCA19             1.000
##     GCA4              1.000
##     GCA11             1.000
##     GCA12             1.000
##     GCA15             1.000
##     GCA21             1.000
```

```
inspect(fac7mod,"cov.lv")
```

```
##         factr1 factr2 factr3 factr4 factr5 factr6 factr7
## factor1 1.000
## factor2 0.827  1.000
## factor3 0.985  0.952  1.000
## factor4 0.890  0.936  0.893  1.000
## factor5 0.679  0.850  0.765  0.761  1.000
## factor6 0.951  0.921  0.954  0.870  0.798  1.000
## factor7 0.936  0.904  0.959  0.929  0.866  0.972  1.000
```