

# Confirmatory Factor Analysis

## A Case study

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### ABSTRACT

*Confirmatory Factor Analysis (CFA) is a particular form of factor analysis, most commonly used in social research. In confirmatory factor analysis, the researcher first develops a hypothesis about what factors they believe are underlying the used measures and may impose constraints on the model based on these a priori hypotheses. For example, if two factors are accounting for the covariance in the measures, and these factors are unrelated to one another, we can create a model where the correlation between factor X and factor Y is set to zero. Measures could then be obtained to assess how well the fitted model captured the covariance between all the items or measures in the model. Thus, if the results of statistical tests of the model fit indicate a poor fit, the model will be rejected. If the fit is weak, it may be due to a variety of reasons. We propose to introduce state of the art techniques to do CFA in R language. Then, we propose to do some examples of CFA with R and some datasets, revealing several scenarios where CFA is relevant.*

Keywords: Confirmatory Factor Analysis, Statistics, R Language, Mathematics, Factor Analysis

### INTRODUCTION

CFA and Exploratory Factor Analysis (EFA) are interconnected statistical techniques. Sometimes, when some concepts relation is to be tested, the researcher uses CFA to test a hypothetical model of the system he/she is trying to propose. Thus, CFA helps in identifying the factor structure we believe the phenomena follows or is described by. In these situations, some variables may not measure what we thought they should. If the theoretical factor structure is not confirmed with CFA, EFA is the logical next step. EFA allows us to determine what the factor structure looks like according to how a particular sample of phenomena measurements behaves, for example, through the use of a survey to an audience. Therefore, EFA is essential to determine underlying constructs for a set of measured variables, and CFA might be used apriori for the test or simulation of the model we think best approaches a specific concept or phenomena and then tests the hypothesis statistically.

Another possible approach, using both CFA and EFA, is to leverage the potential confirmation of the CFA after using EFA. Thus, by identifying factors that explain the majority of variance with EFA, we can confirm the model with the statistical tests available for CFA.

Some care should be taken when using CFA; the results change considerably when the hypothesis being tested is changed, even when just a little bit. Additionally, when some of the following list of requirements are discured, results might diverge:

- multivariate normality;
- good parameter identification;
- processing of outliers;
- processing of missing data.

## CFA vs. EFA

- CFA and EFA are linear statistical models;
- CFA and EFA assume a normal distribution;
- CFA and EFA incorporate measured variables;
- CFA requires specification of a model;
- CFA requires specification of the number of factors (theoretical, empirical or after EFA);
- CFA requires specification of which variables load on each factor (theoretical, empirical or after EFA),
- CFA requires specification of error explicitly.

## BACKGROUND

### Exploratory factor analysis

Exploratory Factor Analysis (EFA) is a statistical method used to describe variability among observed, correlated variables. The goal of performing exploratory factor analysis is to search for some unobserved variables called factors (Rui Sarmento & Costa, 2017). EFA analysis might lead to the conclusion that a reduced number of unobserved latent variables are reflected in the variations of a high number of observed variables. Observed variables are modeled as linear combinations of the possible factors, added the error quantification of this approximation.

EFA should start with the analysis of the correlation matrix. Depending on the variable type, different methods to obtain this matrix could be used: Pearson (for quantitative variables), Spearman (for ordinal variables) and Cramer's V (for nominal variables). Based on the correlation matrix, the researcher frequently discusses the existence or non-existence of at least two factors.

### *Sampling Adequacy*

#### Bartlett Sphericity test

Bartlett's test is used to test if several samples have equal variances. If so, this is called homogeneity of variances. In some statistical tests, as is the case of the analysis of variance, it is assumed that variances are equal between groups or samples. Bartlett test can be used to analyze that assumption. Thus, the hypotheses of this test are (Rui Sarmento & Costa, 2017):

$H_0$ : the matrix of population correlations is equal to the identity matrix

$H_1$ : the matrix of population correlations is different from the identity matrix

### KMO Measure

Kaiser-Meyer-Olkin (KMO) measure tests the sampling adequacy for each variable in the model and the complete model. This statistic is a measure of the proportion of variance among variables that might be common variance. KMO checks if it is possible to factorize the primary variables efficiently.

Thus, for reference, Kaiser suggested the following classification of the results (Rui Sarmento & Costa, 2017):

- 0 to 0.49 unacceptable
- 0.50 to 0.59 miserable
- 0.60 to 0.69 mediocre
- 0.70 to 0.79 middling
- 0.80 to 0.89 meritorious
- 0.90 to 1.00 marvelous.

### **Number of factors to be retained**

To perform EFA, the researcher should know how many factors should be maintained. Several methods are available to decide it:

- Kaiser criterion: according to this rule, only factors with eigenvalues higher than one are retained for interpretation;
- Scree plot: involves the visual exploration of a graphical representation of the eigenvalues. The point where the last significant drop or break takes place is used to define the number of factors;
- Variance explained criteria: this method consists in to retain the number of factors that account for a certain percent of the extracted variance. Depending on the research area, different values of the percent of the extracted variance could be defined.

### **Methods of communalities' estimates**

Diverse methods could be used to estimate the communalities. Based on this estimation, it is possible to obtain a matrix of factor weights. In this sense, some methods commonly used are (R. Sarmento & Costa, 2017):

- Principal Component Method
- Principal Axis Method of Factor Extraction
- Maximum Likelihood Method (ML)

### **Factor Rotation**

EFA solution is not always interpretable. The factor weights of the variables in common factors can be such that it is not possible to assign a meaning to extracted empirical factors. Thus, there are several methods to make the rotation of the factorial axes, such as:

- Varimax method
- Quartimax method
- Oblimin method

### **Confirmatory factor analysis**

#### ***Reliability and Validity***

After performing the EFA, it is necessary to confirm the obtained results, i.e., perform the Confirmatory Factor Analysis (CFA). More specifically CFA is a technique that “seeks to confirm if the number of factors (or constructs) and the loadings of observed (indicator) variables on them conform to what is expected on the basis of theory” (Malhotra, Hall, Shaw, & Oppenheim, 2007). Thus, to reach the confirmation and to accurately perceive the representation of the constructs by the observed variables, it is necessary to evaluate the reliability and validity of the scale (Joseph F. Hair, Black, Babin, Anderson, & Tatham, 2009). The most commonly used method is

Cronbach's Alpha, which measures reliability and internal consistency. A commonly accepted rule for describing internal consistency using Cronbach's alpha is (Rui Sarmento & Costa, 2017):

- 0 to 0.49 unacceptable
- 0.50 to 0.59 poor
- 0.60 to 0.69 questionable
- 0.70 to 0.79 acceptable
- 0.80 to 0.89 good
- from 0.9 to 1 excellent

However, other alternatives have been adopted, such as Construct Reliability (CR). Hair (2009) defines CR as the “measure of reliability and internal consistency of measured variables that represent a latent construct.” The CR should be measured before the validity of the construct be evaluated.

Regarding the validity, it is intended to estimate if the scale measures or operationalizes the construct that the researcher wishes to evaluate in reality. There are several types of validity methods which varies according to the research objectives. The main techniques are convergent validity and discriminant validity.

Convergent validity is based on the study of expected and plausible relationships with other measures related to two types of variables: i) relationship established with variables measured by different instruments that intentionally measure the same construct; ii) relationships with instruments that measure other aspects with which a positive or negative relationship is expected to exist (Silva, Macêdo, & Silva, 2013). This type of validity can be explained by Construct Reliability (CR) and Average Variance Extracted (AVE), a measure of consistency that reveals the mean percentage of explained variance between the items of a construct. According to Hair (2009), the convergent validity is observed when CR is higher than the AVE, and the AVE is higher than 0.5.

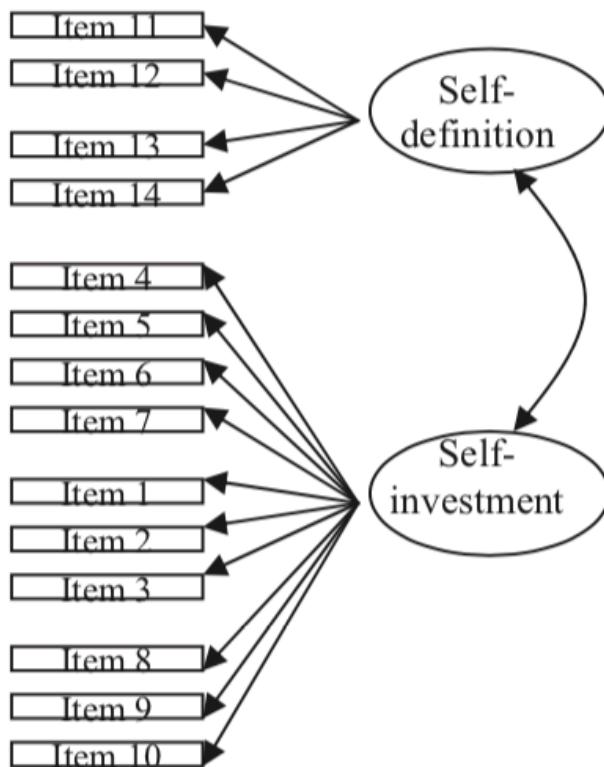
Discriminant validity, also mentioned as divergent validity, consists of the degree “to which a measure does not correlate with other measures from which it is assumed to diverge” (Sánchez, 1999). Additionally, careful planning of the validation process should be carried out during the preparation of the instrument to collect the necessary data simultaneously. Thus, in the validation process, it is required to specify the predicted hypotheses among the involved variables indicating: a) the expected meaning of the relationship, whether positive, negative, or lacking relationship and ii) the expected relative magnitude of the association, where it can be proved that there are more significant and more transparent relationships (Silva et al., 2013). This type of validity can be seen in the diagonal matrix that shows the square root of the AVE - there is a discriminant validity when this is higher to the correlations of the construct under analysis.

After checking and finalizing these points, it will be possible to advance to the structural model and, consequently, to the results of the whole analysis of the Structural Equations Model.

### *Model specification*

Two types of models should be explored in CFA: the **measurement model** and the **structural model**. The **measurement model** concerns the relations between measures of constructs, indicators, and the constructs they were designed to measure (i.e., factors). By examining three critical sets of results – parameter estimates, fit indices, and, potentially, modification indices – researchers formally test measurement hypotheses, and they can modify hypotheses to be more consistent with the actual structure of participants' responses to the scale. Thus, it is crucial starting by defining the measurement model.

To do this, researchers should start to specify at least three essential facets of a measurement model. First, they should determine the number of factors or latent variables (represented by ovals) hypothesized to underlie the scale's items (represented by rectangles). Second, they should specify the items linked to each factor, with at least one item related to each factor, and with each item linked to only one latent variable. Third, if a hypothesized model includes multiple factors, researchers should specify possible associations between factors (Furr, 2011). In this sense, some authors (Leach et al., 2008) present an example of a measurement model (Figure 1). This specification implies that two factors – Self-definition and Self-investment – are hypothesized to be correlated.



*Figure 1. Example of a measurement model (Leach et al., 2008)*

Another example is given by (Lewis, 2017). The author assumes that a researcher would like to test the construct validity of a 10-item instrument that measures social interest and lifestyle. His previous research suggests that two latent variables would be reasonable to include in the model: one latent variable for social interest and one latent variable for lifestyle. These latent variables are proposed to be defined by the observed (or indicator) variables, which in this case are specific items in the assessment. He assumes items 1, 3, 7, 9, and 10 are specified to load on the social interest latent variable, and items 2, 4, 5, 6, and 8 are defined to load on the lifestyle latent variable. It is also presented the measurement errors for each variable. Thus, his proposed model is shown in Figure 2.

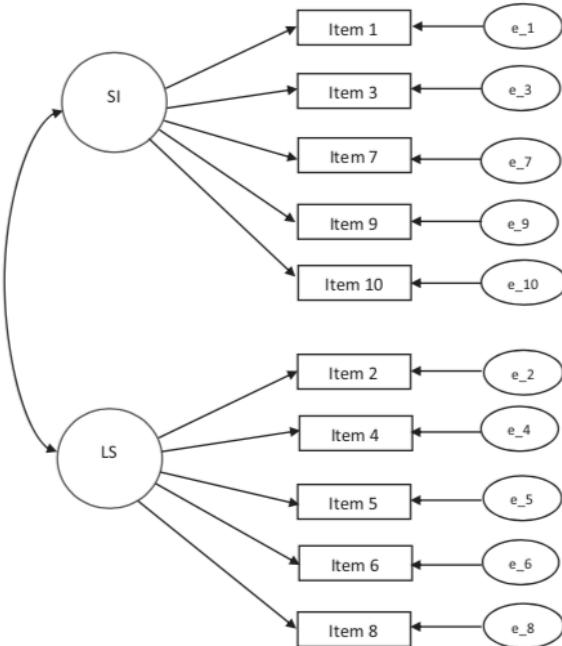


Figure 2. Example of a measurement model with two factors (Lewis, 2017)

After the elaboration of the measurement model, it is necessary to proceed with its specification, i.e., the **structural model**. The specification of the model is its formal “drawing,” which reflects, a priori, the assumptions about the measurement model. To this end, some rules must be followed. Latent common factors cause overt variables. The behavior of the manifested variables results from the manifestation of latent factors. Latent specific factors explain the variance of the displayed variables that are not defined by common latent factors (e.g., measurement errors). Measurement errors are generally independent (but may be correlated indicating a source of mutual variation of items not explained by common factors present in the model).

To synthesize, Figure 3 shows the measurement model and structural model, as well as its relationship.

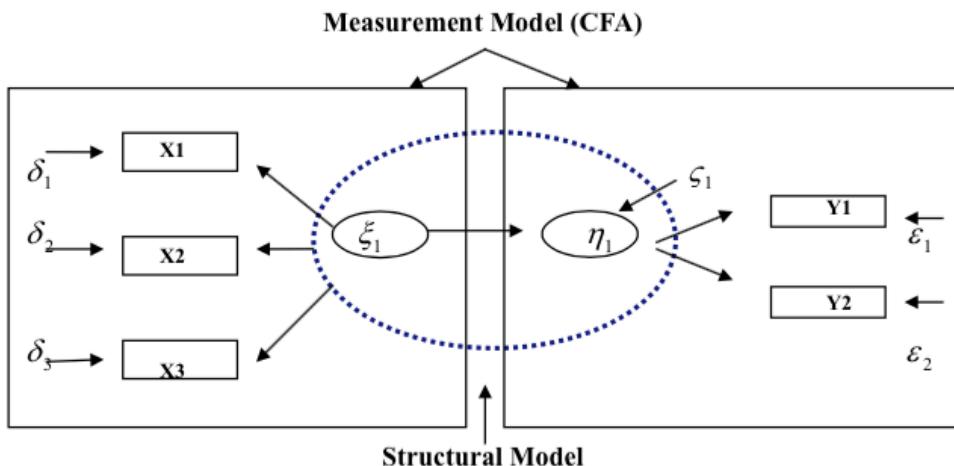


Figure 3. Relation between measurement and structural models (Gutierrez, 2005)

## *Quality of Model Adjustment*

### **Chi-squared test ( $X^2$ )**

Chi-squared test ( $X^2$ ) indicates the difference between observed and expected covariance matrices. Hypotheses of this model are (Gunzler & Morris, 2016):

$H_0$ : the proposed model and the data structure are similar (no differences)

$H_1$ : there is a difference between the proposed model and the data structure

Values nearer to zero indicate a better fit, i.e., a smaller difference between expected and observed covariance matrices. On the opposite, a sizeable chi-squared test with a corresponding small  $p - value$  indicates that the model does not fit the data (Suhr, 2006).

### **Normed Fit Index (NFI)**

Normed fit index (NFI) is also called Bentler-Bonett Normed Fit Index. It analyzes the discrepancy between the chi-squared value of the proposed model and the chi-squared value of the null model. NFI tends to be negatively biased. It is considered very good if it is equal to or greater than 0.95, good between 0.9 and 0.95, suffering between 0.8 and 0.9 and bad if it is less than 0.8 (Portela, 2012).

$$NFI = 1 - \frac{X^2 \text{ (proposed model)}}{X^2 \text{ (null model)}}$$

### **Comparative Fit Index (CFI)**

Comparative fit index (CFI) analyzes the model fit by examining the discrepancy between the data and the proposed model while adjusting for the issues of sample size intrinsic in the chi-squared test, and the normed fit index. It is considered very good if it is equal to or greater than 0.95, good between 0.9 and 0.95, suffering between 0.8 and 0.9 and bad if it is less than 0.8 (Portela, 2012).

$$CFI = 1 - \frac{\max [X^2_{\text{proposed model}} - df_{\text{proposed model}}, 0]}{\max [X^2_{\text{null model}} - df_{\text{null model}}, 0]}$$

### **Relative Fit Index (RFI)**

Relative fit indices (RFI) is also called “incremental fit indices” or “comparative fit indices.” It compares the chi-square for the proposed model to a null model. This null model almost always contains a model in which all of the variables are uncorrelated, and as a result, has a very large chi-square (indicating poor fit). It is considered very good if the nearest is 1 and bad if it is less than 0,9 (Portela, 2012).

$$RFI = 1 - \frac{X^2_{\text{proposed model}}/df_{\text{proposed model}}}{X^2_{\text{null model}}/df_{\text{null model}}}$$

### Tucker-Lewis Index (TLI)

Tucker-Lewis index (TLI) is also known as a non-normed fit index (NNFI). It is a combination of a measure of parsimony with a comparative index between the proposed model and the null model. It is considered very good if it is equal to or greater than 0.95, good between 0.9 and 0.95, suffering between 0.8 and 0.9 and bad if it is less than 0.8 (Portela, 2012).

$$TLI = \frac{\frac{X^2_{\text{null model}}}{df_{\text{null model}}} - \frac{X^2_{\text{proposed model}}}{df_{\text{proposed model}}}}{\frac{X^2_{\text{null model}}}{df_{\text{null model}}} - 1}$$

### Root Mean Square Error of Approximation (RMSEA)

Root Mean Square Error of Approximation (RMSEA) is a measure that attempts to correct the tendency of chi-square statistics to reject models with large samples. It avoids issues of sample size by analyzing the discrepancy between the proposed model, with optimally chosen parameter estimates, and the population covariance matrix. RMSEA is considered very good if it is equal to or less than 0,05, good between 0,05 and 0,08, mediocre between 0,08 and 0,10 and unacceptable if it is higher than 0,10 (Portela, 2012).

$$RMSEA = \sqrt{\max\left(\frac{X^2_{\text{proposed model}} - df_{\text{proposed model}}}{df_{\text{proposed model}} \times (N - 1)}, 0\right)}$$

Where N is the sample size and  $df$  the degrees of freedom. Additionally, RMSEA provides a one-sided test with the following hypotheses (MacCallum, Browne, & Sugawara, 1996):

$H_0$ : the RMSEA equals 0.05 (what is called a close-fitting model)

$H_1$ : the RMSEA is higher than 0.05

Thus,

- if  $p - \text{value} \geq 0.05$  (i.e., not statistically significant), the fit of the model is “close.”
- if  $p - \text{value} \leq 0.05$ , the fit of the model is worse than close fitting (i.e., the RMSEA is higher than 0.05).

Table 1. Summary of reference values for adjustment indices

	Very Good	Good	Suffering	Bad
$X^2/df$	$\leq 1$	$]1,2]$	$]2,5]$	$> 5$
NFI	$\geq 0.95$	$[0.9; 0.95[$	$[0.8; 0.9[$	$< 0.8$
CFI	$\geq 0.95$	$[0.9; 0.95[$	$[0.8; 0.9[$	$< 0.8$
RFI		the better the closer to 1		
TLI	$\geq 0.95$	$[0.9; 0.95[$	$[0.8; 0.9[$	$< 0.8$
RMSEA ( $p - \text{value} \geq 0.05$ )	$\leq 0.05$	$]0.05, 0.08]$	$]0.08, 0.10]$	$> 0.10$

## MAIN FOCUS OF THE CHAPTER

### Data

An example of confirmatory factor analysis will be given in this chapter. Data from a survey presented to 204 researchers will be considered. The goal of the surveys was to understand the researcher's behavior. The first six rows of data are given by:

```
head(data.df)
```

Corresponding output is represented in Table 4 in Appendix.

Description of variables should be performed in this type of analysis, which allows us discovering irregularities (for example, missing values or outliers). Thus, descriptive analysis of Q1 to Q21 variables is given by:

```
# Identification of the variables used in factor analysis  
survey<-data.df[, paste("Q", 1:21, sep="")]  
  
# Descriptive analysis for each variable  
summary(survey)
```

Table 5 (in the appendix) shows the output of descriptive analysis. It is possible to observe the non-existence of missing values since no count of "NAs" is presented. As answers are represented on a Likert scale, outliers should not exist, except when there are data errors. In this case, errors should be corrected, or the particular researcher's row data should be eliminated. Additionally, in case of missing values, the replacing by the mean or median of the corresponding variable could be made. However, some authors argue that the replacement can only occur when they are, in maximum, 20% of the total sample. As it can be seen, all variables vary between 1 and 7.

To finish the understanding of variables Q1 to Q21 the correlation matrix should be analyzed. Since Q1 to Q21 variables are ordinal, Spearman's correlation should be used (Rui Sarmento & Costa, 2017), and it is obtained using the code:

```
### Correlation between variables Q1 to Q10  
correlation <- cor(survey, method="spearman")  
correlation
```

The output (Table 6) show the correlations' matrix for Q1 to Q21 variables. The correlation values varies from 0.090 to 0.868 (excluding diagonal). This disparity of values shows that at least two factors should be used for the reduction of Q1 to Q21 variables. Thus, two or more factors will be considered, and the exploratory factor analysis makes sense with this database.

### Methodology

The present study has two main objectives: to uncover the underlying structure of our set of variables, and test whether measures of a construct are consistent with proposed researcher understanding of the nature of each factor, i.e., to test whether the data fits a proposed measurement model. The R code used to make all analysis is only an example. Probably, other packages or other expressions could be used.

To perform EFA the following steps will be used:

- determine number of factors to retain (with, for example, scree test or cumulative proportion);
- rotation – a transformation;
- interpret solution;
- calculate factor scores.

To perform EFA the following steps will be used (Suhr, 2006):

- review the relevant theory and research literature to support model specification;
- specify a model (e.g., diagram, equations);
- determine model identification;
- collect data;
- conduct preliminary descriptive statistical analysis;
- estimate parameters in the model;
- assess model fit;
- present and interpret the results.

## Results

### *Exploratory factor analysis*

Exploratory factor analysis starts with the application of two methods: Bartlett sphericity test and the KMO Measure (Rui Sarmento & Costa, 2017). Both methods could be used in R using PSYCH package.

The programming code for the Bartlett test and corresponding output are:

<i>Computer Code</i>	<pre>### Bartlett Sphericity test library (psych) cortest.bartlett(correlation, n=nrow(data.df))</pre>
<i>Output</i>	<pre>\$chisq [1] 3326.251  \$p.value [1] 0  \$df [1] 210</pre>

Previous output shows the rejection of the null hypothesis ( $p < 0.05$ ) of the Bartlett test, i.e., the matrix of population correlations is different from the identity matrix. Thus, we can conclude that factor analysis is appropriate to our data.

KMO measure is calculated similarly to Bartlett test:

<i>Computer Code</i>	<pre>### KMO Measure library (psych) KMO(correlation)</pre>																																																								
<i>Output</i>	<p>Kaiser-Meyer-Olkin factor adequacy  Call: KMO(r = correlation)  Overall MSA = 0.91  MSA for each item =</p> <table> <thead> <tr> <th>Q1</th> <th>Q2</th> <th>Q3</th> <th>Q4</th> <th>Q5</th> <th>Q6</th> <th>Q7</th> <th>Q8</th> <th>Q9</th> <th>Q10</th> <th>Q11</th> <th>Q12</th> <th>Q13</th> <th>Q14</th> </tr> </thead> <tbody> <tr> <td>0.92</td> <td>0.92</td> <td>0.95</td> <td>0.96</td> <td>0.91</td> <td>0.91</td> <td>0.95</td> <td>0.94</td> <td>0.96</td> <td>0.87</td> <td>0.77</td> <td>0.88</td> <td>0.81</td> <td>0.79</td> </tr> <tr> <th>Q15</th> <th>Q16</th> <th>Q17</th> <th>Q18</th> <th>Q19</th> <th>Q20</th> <th>Q21</th> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td>0.96</td> <td>0.89</td> <td>0.91</td> <td>0.92</td> <td>0.91</td> <td>0.87</td> <td>0.90</td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> </tr> </tbody> </table>	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	Q11	Q12	Q13	Q14	0.92	0.92	0.95	0.96	0.91	0.91	0.95	0.94	0.96	0.87	0.77	0.88	0.81	0.79	Q15	Q16	Q17	Q18	Q19	Q20	Q21								0.96	0.89	0.91	0.92	0.91	0.87	0.90							
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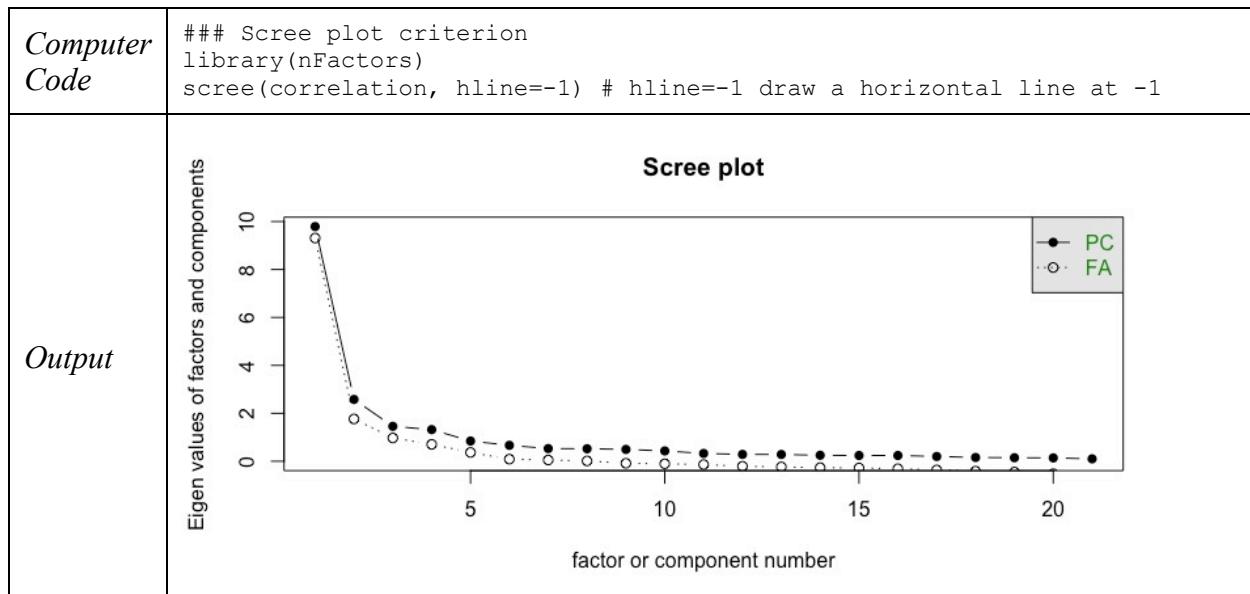
The output shows a marvelous KMO value (0.91), which means that EFA could be performed. Additionally, all variables present values of KMO higher than 0.5. Thus, all variables could be considered for EFA. If some variable presents KMO smaller than 5, it should be removed or discussed in detail by the analyst.

Seeing that EFA is appropriate for the presented data, the analysis of factors to be retained is explored. As described in (R. Sarmento & Costa, 2017), several methods could be used to define the number of factors. Following is the first method: Kaiser criteria.

```
## Kaiser criterion
library (psych)
eigen(correlation)
```

Table 7 presents the outputs divided into “values” and “vectors” which corresponds to eigenvalues and eigenvectors, respectively. Thus, four eigenvalues higher than one are observed. This means that accordingly this method, four factors should be retained.

The second method to be used is the scree plot:



Observing the previous scree plot and curves make an “elbow” toward a less steep decline in value 3. Thus, this method suggests retaining three factors. Since the scree plot is a visual method, some doubts could arise.

Another method can be used to help in the decision of the number of factors to be retained: variance explained criteria:

<i>Computer Code</i>	<pre>### Explained variance for each component pc &lt;- prcomp(survey, scale.=F) summary(pc)</pre>																																																																																																																
<i>Output</i>	<p>Importance of components:</p> <table> <thead> <tr> <th></th> <th>PC1</th> <th>PC2</th> <th>PC3</th> <th>PC4</th> <th>PC5</th> <th>PC6</th> </tr> </thead> <tbody> <tr> <td>Standard deviation</td> <td>5.2041</td> <td>2.19297</td> <td>1.93647</td> <td>1.69202</td> <td>1.44830</td> <td>1.21755</td> </tr> <tr> <td>Proportion of Variance</td> <td>0.5257</td> <td>0.09336</td> <td>0.07279</td> <td>0.05558</td> <td>0.04072</td> <td>0.02878</td> </tr> <tr> <td>Cumulative Proportion</td> <td>0.5257</td> <td>0.61909</td> <td>0.69189</td> <td>0.74746</td> <td>0.78818</td> <td>0.81696</td> </tr> <tr> <th></th> <th>PC7</th> <th>PC8</th> <th>PC9</th> <th>PC10</th> <th>PC11</th> <td></td> </tr> <tr> <td>Standard deviation</td> <td>1.14315</td> <td>1.03692</td> <td>1.03248</td> <td>0.91380</td> <td>0.87686</td> <td></td> </tr> <tr> <td>Proportion of Variance</td> <td>0.02537</td> <td>0.02087</td> <td>0.02069</td> <td>0.01621</td> <td>0.01493</td> <td></td> </tr> <tr> <td>Cumulative Proportion</td> <td>0.84232</td> <td>0.86320</td> <td>0.88389</td> <td>0.90010</td> <td>0.91503</td> <td></td> </tr> <tr> <th></th> <th>PC12</th> <th>PC13</th> <th>PC14</th> <th>PC15</th> <th>PC16</th> <td></td> </tr> <tr> <td>Standard deviation</td> <td>0.87483</td> <td>0.82893</td> <td>0.75825</td> <td>0.68115</td> <td>0.66079</td> <td></td> </tr> <tr> <td>Proportion of Variance</td> <td>0.01486</td> <td>0.01334</td> <td>0.01116</td> <td>0.00901</td> <td>0.00848</td> <td></td> </tr> <tr> <td>Cumulative Proportion</td> <td>0.92988</td> <td>0.94322</td> <td>0.95438</td> <td>0.96339</td> <td>0.97187</td> <td></td> </tr> <tr> <th></th> <th>PC17</th> <th>PC18</th> <th>PC19</th> <th>PC20</th> <th>PC21</th> <td></td> </tr> <tr> <td>Standard deviation</td> <td>0.62693</td> <td>0.59443</td> <td>0.54742</td> <td>0.5125</td> <td>0.37496</td> <td></td> </tr> <tr> <td>Proportion of Variance</td> <td>0.00763</td> <td>0.00686</td> <td>0.00582</td> <td>0.0051</td> <td>0.00273</td> <td></td> </tr> <tr> <td>Cumulative Proportion</td> <td>0.97950</td> <td>0.98635</td> <td>0.99217</td> <td>0.9973</td> <td>1.00000</td> <td></td> </tr> </tbody> </table>		PC1	PC2	PC3	PC4	PC5	PC6	Standard deviation	5.2041	2.19297	1.93647	1.69202	1.44830	1.21755	Proportion of Variance	0.5257	0.09336	0.07279	0.05558	0.04072	0.02878	Cumulative Proportion	0.5257	0.61909	0.69189	0.74746	0.78818	0.81696		PC7	PC8	PC9	PC10	PC11		Standard deviation	1.14315	1.03692	1.03248	0.91380	0.87686		Proportion of Variance	0.02537	0.02087	0.02069	0.01621	0.01493		Cumulative Proportion	0.84232	0.86320	0.88389	0.90010	0.91503			PC12	PC13	PC14	PC15	PC16		Standard deviation	0.87483	0.82893	0.75825	0.68115	0.66079		Proportion of Variance	0.01486	0.01334	0.01116	0.00901	0.00848		Cumulative Proportion	0.92988	0.94322	0.95438	0.96339	0.97187			PC17	PC18	PC19	PC20	PC21		Standard deviation	0.62693	0.59443	0.54742	0.5125	0.37496		Proportion of Variance	0.00763	0.00686	0.00582	0.0051	0.00273		Cumulative Proportion	0.97950	0.98635	0.99217	0.9973	1.00000	
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Previous output presents the importance of each component for the 21 variables in the study, i.e., the variance explained depending on the number of factors to be considered.

The minimum acceptable value of variance explained, according to several authors, is 75% (R. Sarmento & Costa, 2017). Thus, with four factors, approximately 75% of the variance is explained. However, the researcher must have critical thought and check if the number of suggested factors makes sense in the scope of the problem that is being analyzed. In our case study, four factors will be considered.

To analyze each factor, as well as the variables belonging to each factor, several methods could be used. The Principal Component method is used in this study:

```
### Principal Component method
library (psych)
principal(correlation,nfactors=4, rotate="none")
```

The output corresponding to the previous R code is presented in Table 8 (in the appendix). First four columns of the standardized loadings (pattern matrix) based upon correlation matrix, in the output, give us the variable's weight in each defined component. These weights allow us defining the variables belonging to each component, i.e., the variable should belong to the factor where it has the highest weight. Thus, following this rule, no variable would remain in factor 3. Also, the Q20 variable raises doubts because the weight in factors 1 and 4 is 0.61. To eliminate these doubts, the results should be analyzed after a factor rotation. In this study, a varimax rotation will be considered:

```
### Principal Component method with varimax rotation
library (psych)
principal(correlation,nfactors=4, rotate="varimax")
```

In this case (Table 9 in the appendix), no doubts remain. Factor 1 contains nine variables: Q1 to Q9. In the second factor, five variables: Q10 to Q14. The third factor has four variables: Q15 to Q18. Finally, fourth has three variables: Q19 to Q21.

The h2 column of the output is also essential. It represents the values of communalities which must be higher than 0.3. In case of lower values, the variable should be excluded from the model and the analyses reperformed.

Additionally, since the RMSR value is lower than 0.1 ( $RMSR = 0.05$ ), the retained factors are appropriate to describe the correlation structure.

### *Confirmatory factor analysis*

As discussed above (background section), to begin the confirmatory factor analysis, the researcher should have a model in mind. The idea of this model can be drawn from the literature review or the exploratory factorial analysis previously done. Thus, in the present case study, the model resulted from the EFA will be used.

### **Reliability of the model**

To perform CFA, the reliability and validity of the model should be analyzed. Several measures could be used. Internal consistency of Cronbach's alpha ( $\alpha$ ) is one of these measures. The coefficient ( $\alpha$ ) varies between 0 and 1, and measures the degree to which the items in an array of data are correlated.

Thus, the reliability analysis for the first factor is given by:

```
# PC1 (Q1, ..., Q9)
library (psych)
alpha(survey[c(paste("Q", 1:9, sep=""))])
```

Table 10 (in the appendix) show the results obtained for factor 1. As it is possible to verify, the value of alpha (raw\_alpha) is equal to 0.94, which means that this is an “excellent” value, according to some authors. The values of the “reliability if an item is dropped” show a lower or equal alpha value for all variables of this factor. This means that all of them contribute positively to the internal consistency of the factor. Hence, we can conclude that the first factor is well defined.

Regarding the second factor, the internal consistency is given by:

```
# PC2 (Q10...Q14)
library (psych)
alpha(survey[c(paste("Q", 10:14, sep=""))])
```

In the second factor (Table 11 in the appendix),  $\alpha = 0.88$ , i.e., a “good” value. Additionally, if some item/variable of this factor is dropped, the value of alpha decreases. Thus, it can be concluded that the second factor is well defined.

The internal consistency of the third factor is given by:

```
# PC2 (Q15...Q18)
library (psych)
alpha(survey[c(paste("Q",15:18,sep=""))])
```

We can observe an alpha value is equal to 0.91 (Table 12 in the appendix), which means that this is an “excellent” value. Additionally, if some item/variable of this factor is dropped, the value of alpha decreases, which means that all variables contribute positively to the factor. Thus, the third factor is also well defined.

Finally, the internal consistency of the fourth factor is given by:

```
# PC2 (Q19...Q21)
library (psych)
alpha(survey[c(paste("Q",19:21,sep=""))])
```

This factor (Table 13, in the appendix) presents a “good” value of the internal consistency ( $\alpha = 0.83$ ). Similar to previous cases, if some item/variable is dropped, the alpha values decreases. Again, it can be concluded that the third factor is also well defined.

To point out that if some alpha value increases (considering “if an item is dropped”), this means the internal consistency of the factor is better without the dropped variable. In that case, the variable is harming the factor and should be removed to the analysis.

To summarize, the following table (Table 2) presents the values of reliability for each factor, as well as for the factor if the variable is dropped.

*Table 2. Reliability and importance of each factor*

	Number of Items	Reliability of the factor ( $\alpha$ )	Variables	Reliability if an item is dropped ( $\alpha$ )
<b>Factor 1</b>	9	0.94	Q1	0.93
			Q2	0.93
			Q3	0.94
			Q4	0.94
			Q5	0.94
			Q6	0.94
			Q7	0.94
			Q8	0.94
			Q9	0.94
<b>Factor 2</b>	5	0.88	Q10	0.87
			Q11	0.86
			Q12	0.86
			Q13	0.85
			Q14	0.86
<b>Factor 3</b>	4	0.91	Q15	0.89
			Q16	0.86
			Q17	0.90
			Q18	0.89
<b>Factor 4</b>	3	0.83	Q19	0.82
			Q20	0.70
			Q21	0.76

## Convergent validity

As explained in previous section, convergent validity can be explained by Construct Reliability (CR) and Average Variance Extracted (AVE):

<i>Computer Code</i> <pre>pca.varimax &lt;- principal(correlation,nfactors=4, rotate="varimax")  pca.coefs &lt;- matrix(as.numeric(pca.varimax\$loadings[1:length(pca.varimax \\$loadings)]),nrow=21,ncol=4,byrow=FALSE)  nfactor &lt;- apply(pca.coefs,1,FUN=function(x) {   which.max(x) })  crave &lt;- data.frame(matrix(ncol=2,nrow=0),stringsAsFactors=FALSE)  sapply(unique(nfactor), function(x) {   coeff &lt;- pca.coefs[which(x==nfactor),x]   coeff2 &lt;- pca.coefs[which(x==nfactor),x]^2   e2 &lt;- 1-coeff2   cr &lt;- sum(coeff)^2 / (sum(coeff)^2+sum(e2))   ave &lt;- sum(coeff2) / (sum(coeff2)+sum(e2))   crave &lt;- rbind(crave,c(cr,ave)) }) names(crave) &lt;- c("CR", "AVE") crave</pre>	<i>Output</i> <table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th></th><th style="text-align: center;">CR</th><th style="text-align: center;">AVE</th></tr> </thead> <tbody> <tr> <td>1</td><td style="text-align: center;">0.9218027</td><td style="text-align: center;">0.5688222</td></tr> <tr> <td>2</td><td style="text-align: center;">0.8873831</td><td style="text-align: center;">0.6122406</td></tr> <tr> <td>3</td><td style="text-align: center;">0.8726442</td><td style="text-align: center;">0.6318886</td></tr> <tr> <td>4</td><td style="text-align: center;">0.8292765</td><td style="text-align: center;">0.6187450</td></tr> </tbody> </table>		CR	AVE	1	0.9218027	0.5688222	2	0.8873831	0.6122406	3	0.8726442	0.6318886	4	0.8292765	0.6187450
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The presented output gives CR and AVE values. As mentioned in background section, convergent validity is observed when CR is higher than the AVE, and the AVE is higher than 0.5. These conditions are verified in the present case study and, consequently, convergent validity is verified.

## Discriminant (divergent) validity

This type of validity can be seen in the diagonal matrix that shows the correlations between factors and square root of the AVE in the diagonal:

<i>Computer Code</i> <pre>library(psych) library(GPArotation) m.cor.ave &lt;- fa(correlation, nfactors=4)\$score.cor  for (i in 1:4){ +   m.cor.ave[i,i] &lt;- sqrt(crave[i,"AVE"]) + } m.cor.ave</pre>	<i>Output</i> <table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th></th><th style="text-align: center;">[,1]</th><th style="text-align: center;">[,2]</th><th style="text-align: center;">[,3]</th><th style="text-align: center;">[,4]</th></tr> </thead> <tbody> <tr> <td>[1,]</td><td style="text-align: center;">0.75420303</td><td style="text-align: center;">0.38879189</td><td style="text-align: center;">0.66329573</td><td style="text-align: center;">0.59926812</td></tr> <tr> <td>[2,]</td><td style="text-align: center;">0.38879189</td><td style="text-align: center;">0.78245805</td><td style="text-align: center;">0.29289469</td><td style="text-align: center;">0.32172374</td></tr> <tr> <td>[3,]</td><td style="text-align: center;">0.66329573</td><td style="text-align: center;">0.29289469</td><td style="text-align: center;">0.79491418</td><td style="text-align: center;">0.52559418</td></tr> <tr> <td>[4,]</td><td style="text-align: center;">0.59926812</td><td style="text-align: center;">0.32172374</td><td style="text-align: center;">0.52559418</td><td style="text-align: center;">0.78660345</td></tr> </tbody> </table>		[,1]	[,2]	[,3]	[,4]	[1,]	0.75420303	0.38879189	0.66329573	0.59926812	[2,]	0.38879189	0.78245805	0.29289469	0.32172374	[3,]	0.66329573	0.29289469	0.79491418	0.52559418	[4,]	0.59926812	0.32172374	0.52559418	0.78660345
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This output present the correlation matrix between factors, with the diagonal with square root of the AVE. Discriminant validity is verified when the diagonal is higher to the correlations of the construct under analysis. This condition is verified and, thus, we can conclude that the model presents discriminant validity.

### **Measurement model specification**

After verifying the convergent and discriminant validity of the constructs, the measurement model specification should be studied.

The following R code asks some quality measures for the measurement model. Results are presented in Table 14 in appendix.

```
## CFA with Lavaan package
library(lavaan)

Q.model <- 'FACTOR1 =~ Q1 + Q2 + Q3 + Q4 + Q5 + Q6 + Q7 + Q8 + Q9
FACTOR2 =~ Q10 + Q11 + Q12 + Q13 + Q14
FACTOR3 =~ Q15 + Q16 + Q17 + Q18
FACTOR4 =~ Q19 + Q20 + Q21'

fit <- sem(Q.model, data = data.df, std.lv=TRUE, missing="fiml")
summary(fit, fit.measures=TRUE)
```

Results of Table 14 show that the presented model has a  $X^2 = 593.222$ ,  $X^2/df = 3.24$  with  $p < 0.0001$ . Additionally, CFI=0.879, TLI=0.861, RMSEA=0.105. This means that the model is acceptable, but it needs some adjustments.

In this sense, variables with less contribution to its factor are removed from the model: Q5, Q10, Q11, Q19.

The R code used to analyze the measurement model with the first adjustment is:

```
#Adjusted Model
library(lavaan)

Q.model.2 <- 'FACTOR1 =~ Q1 + Q2 + Q3 + Q4 + Q6 + Q7 + Q8 + Q9
FACTOR2 =~ Q12 + Q13 + Q14
FACTOR3 =~ Q15 + Q16 + Q17 + Q18
FACTOR4 =~ Q20 + Q21'

fit <- sem(Q.model.2, data = data.df)
summary(fit, fit.measures=TRUE)
```

Table 15 in appendix present the results of the adjustment proposed. This model presents the following statistics:  $X^2 = 386.521$ ,  $X^2/df = 3.42$  with  $p < 0.0001$ . Additionally, CFI=0.900, TLI=0.879, RMSEA=0.109.

Table 3 summarize the comparison between these two models:

Table 3. Comparison between models

Statistic	Values		Fit of the Measurement Model	Fit of the Adjusted Measurement Model
$\chi^2/df$	> 5 ]2, 5] ]1, 2] ~1	Bad Suffering Good Very good	3.24	3.42
CFI TLI	< 0.8 [0.8, 0.9[ [0.9, 0.95[ $\geq 0.95$	Bad Suffering Good Very good	0.879 0.861	0.900 0.879
RMSEA (I.C. 90%) e p-value (H0: RMSEA $\leq 0.05$ )	> 0.10 ]0.08, 0.1] ]0.05, 0.08] $\leq 0.05$	Unacceptable Mediocre Good Very good	0.105	0.109

Measures obtained in both models allow us to conclude that the first model is better than the second, since it has better  $\chi^2/df$  and RMSEA. Figure 4 represents the best measurement model analyzed.

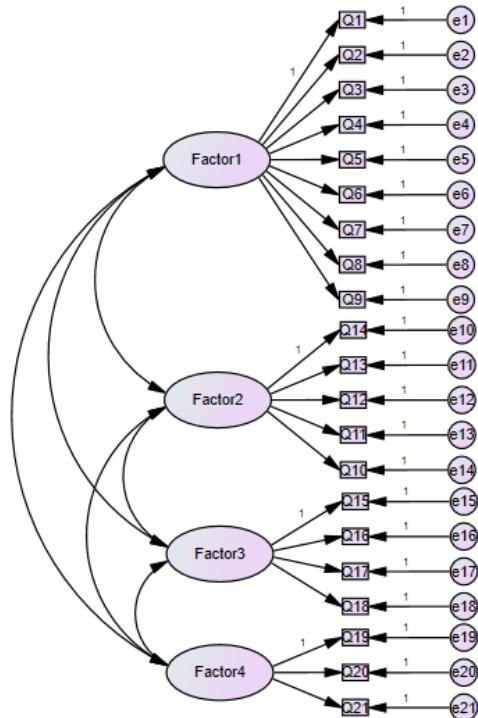


Figure 4. Measurement model in study

However, the obtained values indicates that both models are unsatisfactory and, therefore, some better adjustments should be performed. In this step, the researcher should explore several changes in the model (for example, associate correlated errors or remove variables) for to find the best

model. The best model should have  $X^2/df$  near to 1, CFI and TLI higher than 0.95 and RMSEA lower than 0.05.

### Structural model specification

Structural model specification consists on the formal “drawing” of the measurement model, which reflects, a priori, the assumptions about the measurement model. Thus, the best measurement model with some directional influences should be explored in order to understand the influence of one factor in another factor. The model to be tested is represented in Figure 5.

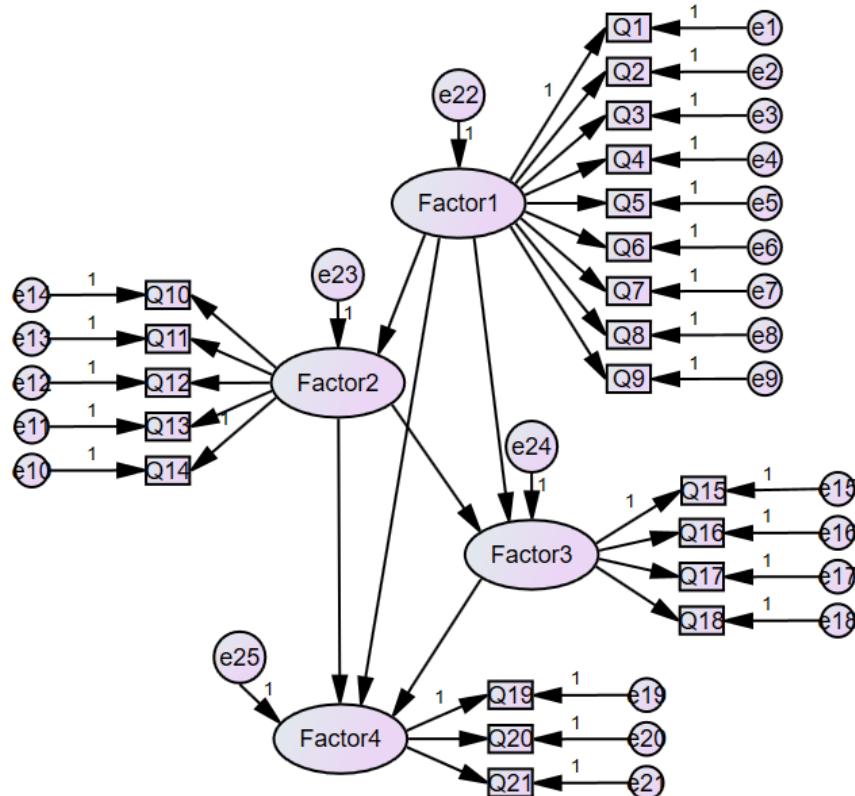


Figure 5. Mental structural model

R code used to perform the structural model is:

```

#with sem
library(sem)
cfa.model.2<-specifyModel("adjustedmodel.txt")
cfaOut.2<-sem(cfa.model.2,S=dataCov,N=204)
summary(cfaOut.2)
  
```

Table 16 presents the text file used as “adjusted model” introduced in the “specifyModel” function of the SEM R package. The output presented in Table 17 in appendix presents the result of the structural model specification.  $X^2/df = 3.23$ , which means it is very similar to the correspondent measurement model. In the end of the output are presented the following results:

	Estimate	Std Error	z value	Pr (> z )		
F1F2DIR	0.407736694	0.083275769	4.89622252	9.7696435e-07	F2	<--- F1
F1F3DIR	0.902724046	0.112598958	8.01716163	1.0821668e-15	F3	<--- F1
F1F4DIR	0.520806176	0.131646222	3.95610423	7.6181932e-05	F4	<--- F1
F2F3DIR	0.034731466	0.082356936	0.42171878	6.7323029e-01	F3	<--- F2
F2F4DIR	0.176535492	0.088746145	1.98921871	4.6677067e-02	F4	<--- F2
F3F4DIR	0.286376634	0.093034567	3.07817453	2.0827290e-03	F4	<--- F3

Based on the given values, it is possible to conclude that  $F1 \rightarrow F2$ ,  $F1 \rightarrow F3$ ,  $F1 \rightarrow F4$  and  $F3 \rightarrow F4$  are statistically significant, which means that the first factor have a significant influence in the second factor. On the opposite,  $F2$  does not statistically influence  $F3$  ( $p = 0.67 > 0.05$ ) because the null hypothesis of estimation equal to zero is rejected. By the same reason  $F2$  does not influence  $F4$  ( $p = 0.0467 \approx 0.05$ ).

Thus, the structural model is represented in Figure 6.

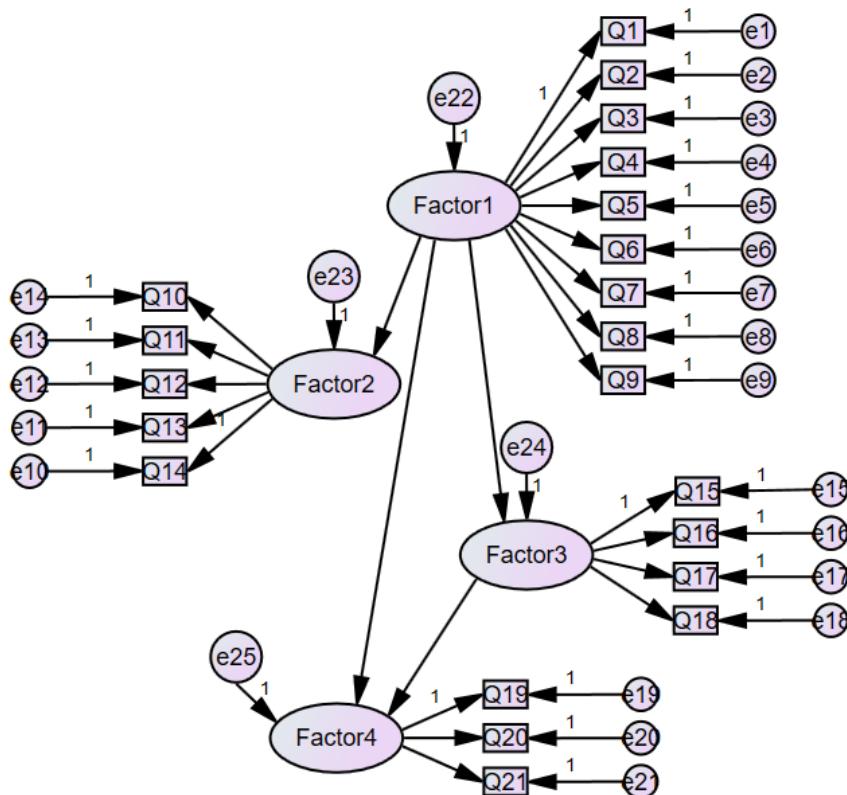


Figure 6. Final structural model

## SOLUTIONS AND RECOMMENDATIONS

As a recommendation in dealing with the eventual lack of knowledge of R language for statistical data analysis, specifically for the EFA, the reader might want to read the throughout R language application to statistics in (Sarmento & Costa, 2017).

## FUTURE RESEARCH DIRECTIONS

As future research direction, it can be useful for the researcher to explore other R packages available in CRAN repository, with the purpose to do EFA and CFA, or a more in depth research of both “sem” and “lavaan” R packages.

## CONCLUSION

Following the state of the art introduction, a throughout research template for CFA is written in this chapter. With the proposal of an example case study, the reader will hopefully appreciate the advantages within the use of CFA to explore his/her datasets regarding the hypothetical latent variables discovery and confirmation.

The authors presented a step by step approach to CFA, giving extreme importance to tasks like testing the fitness of the models and relevant statistical tests the reader might want to follow in their research. The reader is also introduced to the tasks he/she will have to do to explore even further the concept of CFA with their data.

## ACKNOWLEDGMENT

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## APPENDIX

Table 4

<i>Computer Code</i>	head(data.df)																																																																																																																																																																																																																																																																																								
<i>Output</i>	<table border="1"> <thead> <tr> <th></th> <th>Q1</th> <th>Q2</th> <th>Q3</th> <th>Q4</th> <th>Q5</th> <th>Q6</th> <th>Q7</th> <th>Q8</th> <th>Q9</th> <th>Q10</th> <th>Q11</th> <th>Q12</th> <th>Q13</th> <th>Q14</th> <th>Q15</th> <th>Q16</th> <th>Q17</th> <th>Q18</th> <th>Q19</th> </tr> </thead> <tbody> <tr> <td>1</td><td>4</td><td>4</td><td>6</td><td>4</td><td>5</td><td>5</td><td>5</td><td>2</td><td>4</td><td>5</td><td>4</td><td>6</td><td>4</td><td>4</td><td>5</td><td>3</td><td>1</td><td>6</td><td>7</td> </tr> <tr> <td>2</td><td>5</td><td>5</td><td>5</td><td>5</td><td>5</td><td>5</td><td>5</td><td>5</td><td>5</td><td>1</td><td>1</td><td>1</td><td>1</td><td>1</td><td>6</td><td>6</td><td>6</td><td>6</td><td>7</td> </tr> <tr> <td>3</td><td>2</td><td>2</td><td>2</td><td>2</td><td>4</td><td>2</td><td>2</td><td>2</td><td>2</td><td>5</td><td>4</td><td>4</td><td>4</td><td>4</td><td>3</td><td>3</td><td>3</td><td>3</td><td>5</td> </tr> <tr> <td>4</td><td>5</td><td>5</td><td>5</td><td>5</td><td>5</td><td>5</td><td>5</td><td>5</td><td>5</td><td>5</td><td>5</td><td>5</td><td>4</td><td>4</td><td>4</td><td>4</td><td>3</td><td>3</td><td>6</td> </tr> <tr> <td>5</td><td>2</td><td>5</td><td>5</td><td>4</td><td>4</td><td>4</td><td>3</td><td>4</td><td>2</td><td>5</td><td>4</td><td>4</td><td>3</td><td>3</td><td>5</td><td>4</td><td>5</td><td>3</td><td>5</td> </tr> <tr> <td>6</td><td>3</td><td>5</td><td>5</td><td>5</td><td>4</td><td>4</td><td>3</td><td>3</td><td>6</td><td>5</td><td>4</td><td>4</td><td>4</td><td>4</td><td>4</td><td>3</td><td>3</td><td>4</td><td>5</td> </tr> <tr> <td></td><td>Q20</td><td>Q21</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td> </tr> <tr> <td></td><td>1</td><td>2</td><td>5</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td> </tr> <tr> <td></td><td>2</td><td>5</td><td>5</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td> </tr> <tr> <td></td><td>3</td><td>3</td><td>2</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td> </tr> <tr> <td></td><td>4</td><td>6</td><td>5</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td> </tr> <tr> <td></td><td>5</td><td>4</td><td>2</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td> </tr> <tr> <td></td><td>6</td><td>2</td><td>3</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td> </tr> </tbody> </table>		Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	Q11	Q12	Q13	Q14	Q15	Q16	Q17	Q18	Q19	1	4	4	6	4	5	5	5	2	4	5	4	6	4	4	5	3	1	6	7	2	5	5	5	5	5	5	5	5	5	1	1	1	1	1	6	6	6	6	7	3	2	2	2	2	4	2	2	2	2	5	4	4	4	4	3	3	3	3	5	4	5	5	5	5	5	5	5	5	5	5	5	5	4	4	4	4	3	3	6	5	2	5	5	4	4	4	3	4	2	5	4	4	3	3	5	4	5	3	5	6	3	5	5	5	4	4	3	3	6	5	4	4	4	4	4	3	3	4	5		Q20	Q21																			1	2	5																		2	5	5																		3	3	2																		4	6	5																		5	4	2																		6	2	3																
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Table 5

<i>Computer Code</i>	<pre>#### Descriptive analysis of Q1 to Q21 variables # Identification of the variables used in factor analysis survey&lt;-data.df[, paste("Q", 1:21, sep="")]  # Descriptive analysis for each variable summary(survey)</pre>
----------------------	--

<i>Output</i>	Q1	Q2	Q3	Q4
	Min. :1.000	Min. :1.000	Min. :1.000	Min. :1.000
	1st Qu.:3.000	1st Qu.:3.000	1st Qu.:4.000	1st Qu.:4.000
	Median :5.000	Median :5.000	Median :5.000	Median :5.000
	Mean :4.392	Mean :4.471	Mean :4.892	Mean :4.608
	3rd Qu.:6.000	3rd Qu.:6.000	3rd Qu.:6.000	3rd Qu.:6.000
	Max. :7.000	Max. :7.000	Max. :7.000	Max. :7.000
	Q5	Q6	Q7	Q8
	Min. :1.000	Min. :1.00	Min. :1.000	Min. :1.000
	1st Qu.:4.000	1st Qu.:4.00	1st Qu.:3.000	1st Qu.:2.000
	Median :5.000	Median :5.00	Median :5.000	Median :4.000
	Mean :5.054	Mean :5.01	Mean :4.505	Mean :3.603
	3rd Qu.:6.000	3rd Qu.:6.00	3rd Qu.:6.000	3rd Qu.:5.000
	Max. :7.000	Max. :7.00	Max. :7.000	Max. :7.000
	Q9	Q10	Q11	Q12
	Min. :1.000	Min. :1.000	Min. :1.000	Min. :1.000
	1st Qu.:3.000	1st Qu.:5.000	1st Qu.:4.000	1st Qu.:4.000
	Median :4.000	Median :5.000	Median :4.000	Median :4.000
	Mean :4.176	Mean :4.789	Mean :4.015	Mean :3.936
	3rd Qu.:5.000	3rd Qu.:5.000	3rd Qu.:4.000	3rd Qu.:4.000
	Max. :7.000	Max. :7.000	Max. :7.000	Max. :7.000
	Q13	Q14	Q15	Q16
	Min. :1.000	Min. :1.000	Min. :1.000	Min. :1.000
	1st Qu.:4.000	1st Qu.:4.000	1st Qu.:3.000	1st Qu.:3.000
	Median :4.000	Median :4.000	Median :5.000	Median :4.000
	Mean :3.975	Mean :3.951	Mean :4.578	Mean :4.328
	3rd Qu.:4.000	3rd Qu.:4.000	3rd Qu.:6.000	3rd Qu.:6.000
	Max. :7.000	Max. :7.000	Max. :7.000	Max. :7.000
	Q17	Q18	Q19	Q20
	Min. :1.000	Min. :1.000	Min. :1.000	Min. :1.000
	1st Qu.:3.000	1st Qu.:3.000	1st Qu.:5.000	1st Qu.:4.000
	Median :4.000	Median :5.000	Median :6.000	Median :5.000
	Mean :3.941	Mean :4.461	Mean :5.627	Mean :4.721
	3rd Qu.:5.000	3rd Qu.:6.000	3rd Qu.:6.000	3rd Qu.:6.000
	Max. :7.000	Max. :7.000	Max. :7.000	Max. :7.000
	Q21			
	Min. :1.000			
	1st Qu.:3.000			
	Median :5.000			
	Mean :4.529			
	3rd Qu.:6.000			
	Max. :7.000			

*Table 6*

<i>Computer Code</i>	### Correlation between variables Q1 to Q10 correlation <- cor(survey, method="spearman") correlation
----------------------	---

Output	Q1	Q2	Q3	Q4	Q5	Q6
	Q1 1.0000000 0.8678069 0.7103314 0.6795034 0.6317822 0.7219436	Q2 0.8678069 1.0000000 0.7140347 0.6607190 0.6411241 0.6852318	Q3 0.7103314 0.7140347 1.0000000 0.6923580 0.6288720 0.7034031	Q4 0.6795034 0.6607190 0.6923580 1.0000000 0.5815030 0.6920358	Q5 0.6317822 0.6411241 0.6288720 0.5815030 1.0000000 0.8010300	Q6 0.7219436 0.6852318 0.7034031 0.6920358 0.8010300 1.0000000
	Q7 0.7019616 0.7270406 0.6654539 0.6484587 0.5664464 0.5753212	Q8 0.7181340 0.6549639 0.5127171 0.5824695 0.4838123 0.5698544	Q9 0.6789200 0.6922414 0.6301799 0.6198808 0.4999616 0.5347266	Q10 0.2734871 0.2466369 0.3735019 0.2986515 0.3344236 0.3587571	Q11 0.1983869 0.2414378 0.2923634 0.2050208 0.2923783 0.2222434	Q12 0.2958467 0.2768418 0.2966513 0.2690579 0.2634822 0.2925383
	Q13 0.2459464 0.2949535 0.2422306 0.2187331 0.3068287 0.2190018	Q14 0.2589249 0.2207151 0.3095463 0.2407727 0.3282584 0.2953405	Q15 0.5379912 0.5317333 0.5411050 0.4914183 0.4707387 0.5171374	Q16 0.5548849 0.4641767 0.5002715 0.4551067 0.4373705 0.5076297	Q17 0.4921372 0.4872918 0.3837584 0.4062902 0.3649162 0.3993855	Q18 0.5252167 0.4358864 0.5149534 0.4575959 0.4047356 0.4785591
	Q19 0.3469913 0.4003287 0.4503138 0.4144919 0.4303146 0.3974906	Q20 0.3451128 0.3693582 0.4061743 0.4837740 0.3534774 0.3804239	Q21 0.4577953 0.5093471 0.5774302 0.6110928 0.4573397 0.4600055	Q7 0.7019616 0.7181340 0.6789200 0.2734871 0.1983869 0.29584665	Q8 0.7270406 0.6549639 0.6922414 0.2466369 0.2414378 0.27684175	Q9 0.6654539 0.5127171 0.6301799 0.3735019 0.2923634 0.29665134
	Q10 0.6484587 0.5824695 0.6198808 0.2986515 0.2050208 0.26905787	Q11 0.5664464 0.4838123 0.4999616 0.3344236 0.2923783 0.26348222	Q12 0.5753212 0.5698544 0.5347266 0.3587571 0.2222434 0.29253828	Q13 1.0000000 0.6635452 0.7492209 0.2954756 0.2747056 0.27690266	Q14 0.6635452 1.0000000 0.5986723 0.1978725 0.1283247 0.18568166	Q15 0.7492209 0.5986723 1.0000000 0.2591136 0.3143535 0.27667083
	Q16 0.2954756 0.1978725 0.2591136 1.0000000 0.5729275 0.50225663	Q17 0.2747056 0.1283247 0.3143535 0.5729275 1.0000000 0.60452377	Q18 0.2769027 0.1856817 0.2766708 0.5022566 0.6045238 1.00000000	Q19 0.2882333 0.1373405 0.2526130 0.5044710 0.6843456 0.58692135	Q20 0.2120628 0.1930969 0.1777866 0.6030657 0.3998505 0.50390205	Q21 0.6189304 0.5194451 0.5336565 0.2718297 0.2406985 0.22294611
	Q22 0.5198095 0.5329469 0.4366183 0.2381233 0.2005993 0.22311055	Q23 0.5981843 0.5589763 0.5110475 0.1661340 0.1658558 0.09045817	Q24 0.5364725 0.4363748 0.4710596 0.2670542 0.1828065 0.23007770	Q25 0.5076996 0.2796218 0.4718240 0.2269147 0.2086547 0.22728771	Q26 0.4736844 0.3729992 0.4012173 0.2475175 0.1376753 0.25300100	Q27 0.5294104 0.3972187 0.4783270 0.2596550 0.2367676 0.20166012
	Q28 0.2459464 0.25892487 0.5379912 0.5548849 0.49213718 0.5252167	Q29 0.2949535 0.22071512 0.5317333 0.4641767 0.48729176 0.4358864	Q30 0.2422306 0.30954633 0.5411050 0.5002715 0.38375839 0.5149534	Q31 0.2187331 0.24077267 0.4914183 0.4551067 0.40629024 0.4575959	Q32 0.3068287 0.32825843 0.4707387 0.4373705 0.36491621 0.4047356	Q33 0.2190018 0.29534045 0.5171374 0.5076297 0.39938546 0.4785591
	Q34 0.2882333 0.21206282 0.6189304 0.5198095 0.59818431 0.5364725	Q35 0.1373405 0.19309690 0.5194451 0.5329469 0.55897635 0.4363748	Q36 0.2526130 0.17778659 0.5336565 0.4366183 0.51104746 0.4710596	Q37 0.5044710 0.60306566 0.2718297 0.2381233 0.16613402 0.2670542	Q38 0.6843456 0.39985053 0.2406985 0.2005993 0.16585577 0.1828065	Q39 0.5869213 0.50390205 0.2229461 0.2231106 0.09045817 0.2300777
	Q40 1.0000000 0.60438408 0.2859497 0.2460159 0.16990677 0.2287251	Q41 0.6043841 1.00000000 0.2157779 0.2292658 0.09505105 0.2101240	Q42 0.2859497 0.21577791 1.0000000 0.7628373 0.70033301 0.6967244	Q43 0.2460159 0.22926581 0.7628373 1.0000000 0.71835003 0.8041077	Q44 0.1699068 0.09505105 0.7003330 0.7183500 1.00000000 0.6313257	Q45 0.2287251 0.21012404 0.6967244 0.8041077 0.63132571 1.0000000

	Q19	0.1966188	0.16358945	0.4908673	0.3844242	0.38799527	0.4437708
	Q20	0.2015674	0.30205409	0.4592085	0.3880153	0.35790683	0.4098546
	Q21	0.2582761	0.26929830	0.4930299	0.3864878	0.30046152	0.3983685
		Q19	Q20	Q21			
	Q1	0.3469913	0.3451128	0.4577953			
	Q2	0.4003287	0.3693582	0.5093471			
	Q3	0.4503138	0.4061743	0.5774302			
	Q4	0.4144919	0.4837740	0.6110928			
	Q5	0.4303146	0.3534774	0.4573397			
	Q6	0.3974906	0.3804239	0.4600055			
	Q7	0.5076996	0.4736844	0.5294104			
	Q8	0.2796218	0.3729992	0.3972187			
	Q9	0.4718240	0.4012173	0.4783270			
	Q10	0.2269147	0.2475175	0.2596550			
	Q11	0.2086547	0.1376753	0.2367676			
	Q12	0.2272877	0.2530010	0.2016601			
	Q13	0.1966188	0.2015674	0.2582761			
	Q14	0.1635894	0.3020541	0.2692983			
	Q15	0.4908673	0.4592085	0.4930299			
	Q16	0.3844242	0.3880153	0.3864878			
	Q17	0.3879953	0.3579068	0.3004615			
	Q18	0.4437708	0.4098546	0.3983685			
	Q19	1.0000000	0.6595408	0.5836302			
	Q20	0.6595408	1.0000000	0.6988842			
	Q21	0.5836302	0.6988842	1.0000000			

Table 7

<i>Computer Code</i>	## Kaiser criterion library (psych) eigen(correlation)
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	<pre>\$values [1] 9.7900202 2.5793759 1.4564320 1.3194869 0.8433026 0.6650069 [7] 0.5292425 0.5214856 0.4940456 0.4299674 0.3260301 0.2866790 [13] 0.2835303 0.2498692 0.2411731 0.2402759 0.1989649 0.1578476 [19] 0.1475062 0.1396329 0.1001252</pre>
<i>Output</i>	<pre>\$vectors [,1]           [,2]           [,3]           [,4]           [,5] [1,] -0.2644054 -0.103713896 0.2518552377 0.172795263 -0.005945114 [2,] -0.2611277 -0.090076282 0.2770726345 0.086538519 -0.147572521 [3,] -0.2585339 -0.028900816 0.2008702172 -0.043383347 0.106441837 [4,] -0.2499055 -0.075651954 0.2141669207 -0.115359617 0.052091520 [5,] -0.2364852  0.008149364 0.2429626716 -0.001248406 0.293954529 [6,] -0.2516333 -0.045303963 0.2580419408 0.042526965 0.354572006 [7,] -0.2660270 -0.092468041 0.0521092567 0.019592551 -0.296973922 [8,] -0.2295898 -0.159379164 0.1184747655 0.181643877 -0.095004775 [9,] -0.2463834 -0.076653178 0.1169753726 0.021776400 -0.425368280 [10,] -0.1512541  0.390735969 -0.0138765940 0.034526475 0.205514113 [11,] -0.1330244  0.432986536 -0.0478578366 0.104100028 -0.348644414 [12,] -0.1406055  0.409655680 -0.0006854575 0.049422968 -0.150662571 [13,] -0.1406522  0.444233530 -0.0889495608 0.095818323 -0.157344511 [14,] -0.1348379  0.401696915 -0.0127032005 -0.020144984 0.379846551 [15,] -0.2441944 -0.098573894 -0.3320234666 0.106262161 0.036518088 [16,] -0.2301132 -0.109858480 -0.3786076579 0.245727258 0.216310533 [17,] -0.2098132 -0.180087909 -0.3516474497 0.255591359 -0.127028060 [18,] -0.2245834 -0.098232755 -0.3757778500 0.155086662 0.191295621 [19,] -0.1959508 -0.037841987 -0.2119704530 -0.459447396 -0.128857335 [20,] -0.1949735 -0.016517763 -0.2072220177 -0.534403190 0.028653871 [21,] -0.2177550 -0.019471863 -0.0255831386 -0.479594335 -0.006881026  [,6]           [,7]           [,8]           [,9]           [,10] [1,] 0.12457723 0.12086601 -0.118768110 -0.01823734 0.15932051 [2,] 0.03427313 0.16971433 0.047490641 0.07576608 0.19926305 [3,] -0.17977751 -0.22595406 -0.233619259 0.22788288 0.26743042 [4,] 0.06744192 -0.11963141 -0.256579984 0.21017011 -0.28920798 [5,] -0.37310128 0.24017152 0.382700039 -0.14317959 -0.11289798 [6,] -0.24101204 0.08285398 0.024299674 -0.17948715 -0.20266524 [7,] 0.08103093 -0.12872862 0.124290510 -0.05541144 0.15837814 [8,] 0.47775754 0.01668529 0.107977141 -0.19821434 -0.37205916 [9,] 0.01267051 -0.21162835 0.002971529 -0.05590552 0.27317883 [10,] 0.03702361 -0.70453367 0.101163017 -0.16089039 -0.07411916 [11,] -0.32486749 -0.10104438 0.060553372 0.14693651 -0.34666309 [12,] 0.02590782 0.28173577 -0.575316460 -0.42176319 -0.09688799 [13,] 0.01979179 0.38392878 0.228562964 0.33206926 0.10183554 [14,] 0.45620299 0.05651720 0.193552439 0.01633625 0.37280756 [15,] -0.08652328 0.02187092 0.065140250 0.14506606 -0.02830146 [16,] -0.02655728 0.10256753 -0.156758306 0.08532211 -0.07726191 [17,] 0.06958386 -0.06310267 0.307974476 -0.09869065 -0.13805103 [18,] -0.12311628 -0.04439791 -0.330393799 0.05092845 0.21301898 [19,] -0.29570884 0.03802657 0.141413670 -0.39845674 0.25619467 [20,] 0.27749397 0.09941307 -0.008902055 -0.16402062 -0.16761456 [21,] 0.07372829 0.01447918 -0.039580405 0.48723586 -0.19607492  [,11]          [,12]          [,13]          [,14]          [,15] [1,] -0.301998558 -0.04463061 -0.283638258 0.042376709 -0.15288710 [2,] -0.360204858 0.21131223 -0.291850346 0.101984107 -0.07997436 [3,] -0.162270494 0.07853730 0.297078197 0.304349422 0.34653975 [4,] 0.580259685 0.20253097 -0.288924577 0.030301239 -0.10438674 [5,] 0.127449838 -0.14100786 0.147175232 -0.094366695 0.14014376 [6,] 0.093511178 0.03184000 0.008482818 0.011602852 -0.13893157 [7,] 0.164256329 0.14336166 0.091667271 -0.418887810 0.59954284 [8,] -0.192320076 -0.34645611 0.166938375 -0.172633736 0.01351558 [9,] 0.345430864 -0.28767603 0.246996927 0.089568995 -0.45762803 [10,] -0.202264477 0.11449160 -0.253573396 -0.215948210 -0.10477723 [11,] -0.129609043 -0.27599167 0.082135200 0.262433165 0.06061117</pre>

[12,]	0.003695023	0.24173037	0.168728106	-0.004684864	0.06215031
[13,]	0.142375851	0.01506302	-0.285592381	-0.236650246	-0.01921524
[14,]	0.165345532	-0.05871857	0.231123699	0.245402983	-0.02428839
[15,]	-0.112484228	0.46394183	0.429988842	-0.315225846	-0.37717986
[16,]	-0.075197088	-0.16081363	0.022030854	0.104339422	-0.01514057
[17,]	0.129668968	0.29577521	-0.159298792	0.517501290	0.15893955
[18,]	0.104352860	-0.41641187	-0.236833164	-0.212300904	0.12542539
[19,]	-0.087662801	-0.04664906	-0.165422502	0.011804632	-0.13172318
[20,]	-0.016641223	-0.02312072	-0.071130845	0.120218987	0.10182202
[21,]	-0.220075474	-0.07645795	0.099330401	-0.049467588	-0.02374009
	[,16]	[,17]	[,18]	[,19]	[,20]
[1,]	0.06958498	0.030708684	0.242956159	0.035516681	-0.08719873
[2,]	0.14282045	0.019071124	0.138317064	-0.055775219	0.09914793
[3,]	-0.22574777	-0.313897951	-0.278360761	0.080662819	0.20907252
[4,]	-0.30677818	0.006454483	0.257821790	0.061848405	0.13502317
[5,]	0.20005690	0.214901438	0.112670807	0.258389479	0.40913761
[6,]	0.08131217	-0.197424677	-0.295840529	-0.368455773	-0.54769146
[7,]	0.06327764	0.054165621	0.182180151	0.005760193	-0.36273949
[8,]	-0.38450035	-0.076367055	-0.166379979	-0.081882085	0.19407008
[9,]	0.28101870	0.010167834	-0.177904596	0.150773645	-0.01856988
[10,]	0.10932535	0.053933731	-0.120668837	0.178105364	0.06281266
[11,]	-0.03020887	-0.121359160	0.402205604	-0.201561449	-0.09297739
[12,]	0.07229733	0.256458739	-0.135444752	0.035125269	0.08665805
[13,]	-0.11212039	-0.256719377	-0.402221608	0.109164493	0.03479825
[14,]	-0.11363812	0.138175325	0.254950027	-0.177546426	-0.09771485
[15,]	-0.02236043	-0.163476248	0.202455153	-0.153112955	0.14724912
[16,]	-0.08539113	0.017059638	0.077378864	0.638298070	-0.36890373
[17,]	0.07810167	0.224852868	-0.242713916	-0.144244085	0.09150319
[18,]	0.14515625	0.043960423	0.006328784	-0.413362078	0.25003041
[19,]	-0.53735037	0.083868833	0.027280569	-0.009488860	-0.05359209
[20,]	0.41789033	-0.510520905	0.097157407	0.086062147	0.08282710
[21,]	0.10158302	0.538993200	-0.218125705	-0.078989914	-0.12010117
	[,21]				
[1,]	0.695388552				
[2,]	-0.640917867				
[3,]	0.081799690				
[4,]	-0.041637997				
[5,]	0.050819930				
[6,]	-0.059831083				
[7,]	0.007236728				
[8,]	-0.085606648				
[9,]	-0.035775801				
[10,]	-0.021348293				
[11,]	-0.004806558				
[12,]	-0.008693214				
[13,]	0.092354400				
[14,]	-0.066957178				
[15,]	0.077323707				
[16,]	-0.187653522				
[17,]	0.135894453				
[18,]	-0.078678282				
[19,]	0.007140874				
[20,]	0.027189683				
[21,]	0.046938987				

Table 8

Computer Code	<pre>### Principal Component method library (psych) principal(correlation, nfactors=4, rotate="none")</pre>																																																																																																																																																																																																																																																																																																																														
Output	<p>Principal Components Analysis</p> <p>Call: principal(r = correlation, nfactors = 4, rotate = "none")</p> <p>Standardized loadings (pattern matrix) based upon correlation matrix</p> <table> <thead> <tr> <th></th> <th>PC1</th> <th>PC2</th> <th>PC3</th> <th>PC4</th> <th>h2</th> <th>u2</th> <th>com</th> </tr> </thead> <tbody> <tr><td>Q1</td><td>0.83</td><td>-0.17</td><td>-0.30</td><td>-0.20</td><td>0.84</td><td>0.16</td><td>1.5</td></tr> <tr><td>Q2</td><td>0.82</td><td>-0.14</td><td>-0.33</td><td>-0.10</td><td>0.81</td><td>0.19</td><td>1.4</td></tr> <tr><td>Q3</td><td>0.81</td><td>-0.05</td><td>-0.24</td><td>0.05</td><td>0.72</td><td>0.28</td><td>1.2</td></tr> <tr><td>Q4</td><td>0.78</td><td>-0.12</td><td>-0.26</td><td>0.13</td><td>0.71</td><td>0.29</td><td>1.3</td></tr> <tr><td>Q5</td><td>0.74</td><td>0.01</td><td>-0.29</td><td>0.00</td><td>0.63</td><td>0.37</td><td>1.3</td></tr> <tr><td>Q6</td><td>0.79</td><td>-0.07</td><td>-0.31</td><td>-0.05</td><td>0.72</td><td>0.28</td><td>1.3</td></tr> <tr><td>Q7</td><td>0.83</td><td>-0.15</td><td>-0.06</td><td>-0.02</td><td>0.72</td><td>0.28</td><td>1.1</td></tr> <tr><td>Q8</td><td>0.72</td><td>-0.26</td><td>-0.14</td><td>-0.21</td><td>0.65</td><td>0.35</td><td>1.5</td></tr> <tr><td>Q9</td><td>0.77</td><td>-0.12</td><td>-0.14</td><td>-0.03</td><td>0.63</td><td>0.37</td><td>1.1</td></tr> <tr><td>Q10</td><td>0.47</td><td>0.63</td><td>0.02</td><td>-0.04</td><td>0.62</td><td>0.38</td><td>1.9</td></tr> <tr><td>Q11</td><td>0.42</td><td>0.70</td><td>0.06</td><td>-0.12</td><td>0.67</td><td>0.33</td><td>1.7</td></tr> <tr><td>Q12</td><td>0.44</td><td>0.66</td><td>0.00</td><td>-0.06</td><td>0.63</td><td>0.37</td><td>1.8</td></tr> <tr><td>Q13</td><td>0.44</td><td>0.71</td><td>0.11</td><td>-0.11</td><td>0.73</td><td>0.27</td><td>1.8</td></tr> <tr><td>Q14</td><td>0.42</td><td>0.65</td><td>0.02</td><td>0.02</td><td>0.59</td><td>0.41</td><td>1.7</td></tr> <tr><td>Q15</td><td>0.76</td><td>-0.16</td><td>0.40</td><td>-0.12</td><td>0.78</td><td>0.22</td><td>1.7</td></tr> <tr><td>Q16</td><td>0.72</td><td>-0.18</td><td>0.46</td><td>-0.28</td><td>0.84</td><td>0.16</td><td>2.2</td></tr> <tr><td>Q17</td><td>0.66</td><td>-0.29</td><td>0.42</td><td>-0.29</td><td>0.78</td><td>0.22</td><td>2.6</td></tr> <tr><td>Q18</td><td>0.70</td><td>-0.16</td><td>0.45</td><td>-0.18</td><td>0.76</td><td>0.24</td><td>2.0</td></tr> <tr><td>Q19</td><td>0.61</td><td>-0.06</td><td>0.26</td><td>0.53</td><td>0.72</td><td>0.28</td><td>2.3</td></tr> <tr><td>Q20</td><td>0.61</td><td>-0.03</td><td>0.25</td><td>0.61</td><td>0.81</td><td>0.19</td><td>2.3</td></tr> <tr><td>Q21</td><td>0.68</td><td>-0.03</td><td>0.03</td><td>0.55</td><td>0.77</td><td>0.23</td><td>1.9</td></tr> </tbody> </table> <table> <thead> <tr> <th></th> <th>PC1</th> <th>PC2</th> <th>PC3</th> <th>PC4</th> </tr> </thead> <tbody> <tr><td>SS loadings</td><td>9.79</td><td>2.58</td><td>1.46</td><td>1.32</td></tr> <tr><td>Proportion Var</td><td>0.47</td><td>0.12</td><td>0.07</td><td>0.06</td></tr> <tr><td>Cumulative Var</td><td>0.47</td><td>0.59</td><td>0.66</td><td>0.72</td></tr> <tr><td>Proportion Explained</td><td>0.65</td><td>0.17</td><td>0.10</td><td>0.09</td></tr> <tr><td>Cumulative Proportion</td><td>0.65</td><td>0.82</td><td>0.91</td><td>1.00</td></tr> </tbody> </table> <p>Mean item complexity = 1.7</p> <p>Test of the hypothesis that 4 components are sufficient.</p> <p>The root mean square of the residuals (RMSR) is 0.05</p> <p>Fit based upon off diagonal values = 0.99</p> <p>Importance of components:</p> <table> <thead> <tr> <th></th> <th>PC1</th> <th>PC2</th> <th>PC3</th> <th>PC4</th> <th>PC5</th> <th>PC6</th> </tr> </thead> <tbody> <tr><td>Standard deviation</td><td>5.2041</td><td>2.19297</td><td>1.93647</td><td>1.69202</td><td>1.44830</td><td>1.21755</td></tr> <tr><td>Proportion of Variance</td><td>0.5257</td><td>0.09336</td><td>0.07279</td><td>0.05558</td><td>0.04072</td><td>0.02878</td></tr> <tr><td>Cumulative Proportion</td><td>0.5257</td><td>0.61909</td><td>0.69189</td><td>0.74746</td><td>0.78818</td><td>0.81696</td></tr> <tr> <th></th><th>PC7</th><th>PC8</th><th>PC9</th><th>PC10</th><th>PC11</th><th></th></tr> <tr><td>Standard deviation</td><td>1.14315</td><td>1.03692</td><td>1.03248</td><td>0.91380</td><td>0.87686</td><td></td></tr> <tr><td>Proportion of Variance</td><td>0.02537</td><td>0.02087</td><td>0.02069</td><td>0.01621</td><td>0.01493</td><td></td></tr> <tr><td>Cumulative Proportion</td><td>0.84232</td><td>0.86320</td><td>0.88389</td><td>0.90010</td><td>0.91503</td><td></td></tr> <tr> <th></th><th>PC12</th><th>PC13</th><th>PC14</th><th>PC15</th><th>PC16</th><th></th></tr> <tr><td>Standard deviation</td><td>0.87483</td><td>0.82893</td><td>0.75825</td><td>0.68115</td><td>0.66079</td><td></td></tr> <tr><td>Proportion of Variance</td><td>0.01486</td><td>0.01334</td><td>0.01116</td><td>0.00901</td><td>0.00848</td><td></td></tr> <tr><td>Cumulative Proportion</td><td>0.92988</td><td>0.94322</td><td>0.95438</td><td>0.96339</td><td>0.97187</td><td></td></tr> <tr> <th></th><th>PC17</th><th>PC18</th><th>PC19</th><th>PC20</th><th>PC21</th><th></th></tr> <tr><td>Standard deviation</td><td>0.62693</td><td>0.59443</td><td>0.54742</td><td>0.5125</td><td>0.37496</td><td></td></tr> <tr><td>Proportion of Variance</td><td>0.00763</td><td>0.00686</td><td>0.00582</td><td>0.0051</td><td>0.00273</td><td></td></tr> <tr><td>Cumulative Proportion</td><td>0.97950</td><td>0.98635</td><td>0.99217</td><td>0.9973</td><td>1.00000</td><td></td></tr> </tbody> </table>		PC1	PC2	PC3	PC4	h2	u2	com	Q1	0.83	-0.17	-0.30	-0.20	0.84	0.16	1.5	Q2	0.82	-0.14	-0.33	-0.10	0.81	0.19	1.4	Q3	0.81	-0.05	-0.24	0.05	0.72	0.28	1.2	Q4	0.78	-0.12	-0.26	0.13	0.71	0.29	1.3	Q5	0.74	0.01	-0.29	0.00	0.63	0.37	1.3	Q6	0.79	-0.07	-0.31	-0.05	0.72	0.28	1.3	Q7	0.83	-0.15	-0.06	-0.02	0.72	0.28	1.1	Q8	0.72	-0.26	-0.14	-0.21	0.65	0.35	1.5	Q9	0.77	-0.12	-0.14	-0.03	0.63	0.37	1.1	Q10	0.47	0.63	0.02	-0.04	0.62	0.38	1.9	Q11	0.42	0.70	0.06	-0.12	0.67	0.33	1.7	Q12	0.44	0.66	0.00	-0.06	0.63	0.37	1.8	Q13	0.44	0.71	0.11	-0.11	0.73	0.27	1.8	Q14	0.42	0.65	0.02	0.02	0.59	0.41	1.7	Q15	0.76	-0.16	0.40	-0.12	0.78	0.22	1.7	Q16	0.72	-0.18	0.46	-0.28	0.84	0.16	2.2	Q17	0.66	-0.29	0.42	-0.29	0.78	0.22	2.6	Q18	0.70	-0.16	0.45	-0.18	0.76	0.24	2.0	Q19	0.61	-0.06	0.26	0.53	0.72	0.28	2.3	Q20	0.61	-0.03	0.25	0.61	0.81	0.19	2.3	Q21	0.68	-0.03	0.03	0.55	0.77	0.23	1.9		PC1	PC2	PC3	PC4	SS loadings	9.79	2.58	1.46	1.32	Proportion Var	0.47	0.12	0.07	0.06	Cumulative Var	0.47	0.59	0.66	0.72	Proportion Explained	0.65	0.17	0.10	0.09	Cumulative Proportion	0.65	0.82	0.91	1.00		PC1	PC2	PC3	PC4	PC5	PC6	Standard deviation	5.2041	2.19297	1.93647	1.69202	1.44830	1.21755	Proportion of Variance	0.5257	0.09336	0.07279	0.05558	0.04072	0.02878	Cumulative Proportion	0.5257	0.61909	0.69189	0.74746	0.78818	0.81696		PC7	PC8	PC9	PC10	PC11		Standard deviation	1.14315	1.03692	1.03248	0.91380	0.87686		Proportion of Variance	0.02537	0.02087	0.02069	0.01621	0.01493		Cumulative Proportion	0.84232	0.86320	0.88389	0.90010	0.91503			PC12	PC13	PC14	PC15	PC16		Standard deviation	0.87483	0.82893	0.75825	0.68115	0.66079		Proportion of Variance	0.01486	0.01334	0.01116	0.00901	0.00848		Cumulative Proportion	0.92988	0.94322	0.95438	0.96339	0.97187			PC17	PC18	PC19	PC20	PC21		Standard deviation	0.62693	0.59443	0.54742	0.5125	0.37496		Proportion of Variance	0.00763	0.00686	0.00582	0.0051	0.00273		Cumulative Proportion	0.97950	0.98635	0.99217	0.9973	1.00000	
	PC1	PC2	PC3	PC4	h2	u2	com																																																																																																																																																																																																																																																																																																																								
Q1	0.83	-0.17	-0.30	-0.20	0.84	0.16	1.5																																																																																																																																																																																																																																																																																																																								
Q2	0.82	-0.14	-0.33	-0.10	0.81	0.19	1.4																																																																																																																																																																																																																																																																																																																								
Q3	0.81	-0.05	-0.24	0.05	0.72	0.28	1.2																																																																																																																																																																																																																																																																																																																								
Q4	0.78	-0.12	-0.26	0.13	0.71	0.29	1.3																																																																																																																																																																																																																																																																																																																								
Q5	0.74	0.01	-0.29	0.00	0.63	0.37	1.3																																																																																																																																																																																																																																																																																																																								
Q6	0.79	-0.07	-0.31	-0.05	0.72	0.28	1.3																																																																																																																																																																																																																																																																																																																								
Q7	0.83	-0.15	-0.06	-0.02	0.72	0.28	1.1																																																																																																																																																																																																																																																																																																																								
Q8	0.72	-0.26	-0.14	-0.21	0.65	0.35	1.5																																																																																																																																																																																																																																																																																																																								
Q9	0.77	-0.12	-0.14	-0.03	0.63	0.37	1.1																																																																																																																																																																																																																																																																																																																								
Q10	0.47	0.63	0.02	-0.04	0.62	0.38	1.9																																																																																																																																																																																																																																																																																																																								
Q11	0.42	0.70	0.06	-0.12	0.67	0.33	1.7																																																																																																																																																																																																																																																																																																																								
Q12	0.44	0.66	0.00	-0.06	0.63	0.37	1.8																																																																																																																																																																																																																																																																																																																								
Q13	0.44	0.71	0.11	-0.11	0.73	0.27	1.8																																																																																																																																																																																																																																																																																																																								
Q14	0.42	0.65	0.02	0.02	0.59	0.41	1.7																																																																																																																																																																																																																																																																																																																								
Q15	0.76	-0.16	0.40	-0.12	0.78	0.22	1.7																																																																																																																																																																																																																																																																																																																								
Q16	0.72	-0.18	0.46	-0.28	0.84	0.16	2.2																																																																																																																																																																																																																																																																																																																								
Q17	0.66	-0.29	0.42	-0.29	0.78	0.22	2.6																																																																																																																																																																																																																																																																																																																								
Q18	0.70	-0.16	0.45	-0.18	0.76	0.24	2.0																																																																																																																																																																																																																																																																																																																								
Q19	0.61	-0.06	0.26	0.53	0.72	0.28	2.3																																																																																																																																																																																																																																																																																																																								
Q20	0.61	-0.03	0.25	0.61	0.81	0.19	2.3																																																																																																																																																																																																																																																																																																																								
Q21	0.68	-0.03	0.03	0.55	0.77	0.23	1.9																																																																																																																																																																																																																																																																																																																								
	PC1	PC2	PC3	PC4																																																																																																																																																																																																																																																																																																																											
SS loadings	9.79	2.58	1.46	1.32																																																																																																																																																																																																																																																																																																																											
Proportion Var	0.47	0.12	0.07	0.06																																																																																																																																																																																																																																																																																																																											
Cumulative Var	0.47	0.59	0.66	0.72																																																																																																																																																																																																																																																																																																																											
Proportion Explained	0.65	0.17	0.10	0.09																																																																																																																																																																																																																																																																																																																											
Cumulative Proportion	0.65	0.82	0.91	1.00																																																																																																																																																																																																																																																																																																																											
	PC1	PC2	PC3	PC4	PC5	PC6																																																																																																																																																																																																																																																																																																																									
Standard deviation	5.2041	2.19297	1.93647	1.69202	1.44830	1.21755																																																																																																																																																																																																																																																																																																																									
Proportion of Variance	0.5257	0.09336	0.07279	0.05558	0.04072	0.02878																																																																																																																																																																																																																																																																																																																									
Cumulative Proportion	0.5257	0.61909	0.69189	0.74746	0.78818	0.81696																																																																																																																																																																																																																																																																																																																									
	PC7	PC8	PC9	PC10	PC11																																																																																																																																																																																																																																																																																																																										
Standard deviation	1.14315	1.03692	1.03248	0.91380	0.87686																																																																																																																																																																																																																																																																																																																										
Proportion of Variance	0.02537	0.02087	0.02069	0.01621	0.01493																																																																																																																																																																																																																																																																																																																										
Cumulative Proportion	0.84232	0.86320	0.88389	0.90010	0.91503																																																																																																																																																																																																																																																																																																																										
	PC12	PC13	PC14	PC15	PC16																																																																																																																																																																																																																																																																																																																										
Standard deviation	0.87483	0.82893	0.75825	0.68115	0.66079																																																																																																																																																																																																																																																																																																																										
Proportion of Variance	0.01486	0.01334	0.01116	0.00901	0.00848																																																																																																																																																																																																																																																																																																																										
Cumulative Proportion	0.92988	0.94322	0.95438	0.96339	0.97187																																																																																																																																																																																																																																																																																																																										
	PC17	PC18	PC19	PC20	PC21																																																																																																																																																																																																																																																																																																																										
Standard deviation	0.62693	0.59443	0.54742	0.5125	0.37496																																																																																																																																																																																																																																																																																																																										
Proportion of Variance	0.00763	0.00686	0.00582	0.0051	0.00273																																																																																																																																																																																																																																																																																																																										
Cumulative Proportion	0.97950	0.98635	0.99217	0.9973	1.00000																																																																																																																																																																																																																																																																																																																										

Table 9

<i>Computer Code</i>	<pre>### Principal Component method with varimax rotation library (psych) principal(correlation,nfactors=4, rotate="varimax")</pre>																																																																																																																																																																																																									
<i>Output</i>	<p>Principal Components Analysis</p> <p>Call: principal(r = correlation, nfactors = 4, rotate = "varimax")</p> <p>Standardized loadings (pattern matrix) based upon correlation matrix</p> <table> <thead> <tr> <th></th> <th>PC1</th> <th>PC2</th> <th>PC3</th> <th>PC4</th> <th>h2</th> <th>u2</th> <th>com</th> </tr> </thead> <tbody> <tr><td>Q1</td><td>0.86</td><td>0.13</td><td>0.30</td><td>0.06</td><td>0.84</td><td>0.16</td><td>1.3</td></tr> <tr><td>Q2</td><td>0.85</td><td>0.14</td><td>0.22</td><td>0.13</td><td>0.81</td><td>0.19</td><td>1.2</td></tr> <tr><td>Q3</td><td>0.74</td><td>0.22</td><td>0.19</td><td>0.28</td><td>0.72</td><td>0.28</td><td>1.6</td></tr> <tr><td>Q4</td><td>0.74</td><td>0.13</td><td>0.16</td><td>0.35</td><td>0.71</td><td>0.29</td><td>1.6</td></tr> <tr><td>Q5</td><td>0.72</td><td>0.25</td><td>0.13</td><td>0.20</td><td>0.63</td><td>0.37</td><td>1.5</td></tr> <tr><td>Q6</td><td>0.79</td><td>0.19</td><td>0.18</td><td>0.17</td><td>0.72</td><td>0.28</td><td>1.3</td></tr> <tr><td>Q7</td><td>0.68</td><td>0.15</td><td>0.39</td><td>0.28</td><td>0.72</td><td>0.28</td><td>2.1</td></tr> <tr><td>Q8</td><td>0.70</td><td>0.02</td><td>0.39</td><td>0.06</td><td>0.65</td><td>0.35</td><td>1.6</td></tr> <tr><td>Q9</td><td>0.68</td><td>0.15</td><td>0.30</td><td>0.23</td><td>0.63</td><td>0.37</td><td>1.8</td></tr> <tr><td>Q10</td><td>0.19</td><td>0.75</td><td>0.08</td><td>0.11</td><td>0.62</td><td>0.38</td><td>1.2</td></tr> <tr><td>Q11</td><td>0.11</td><td>0.81</td><td>0.10</td><td>0.03</td><td>0.67</td><td>0.33</td><td>1.1</td></tr> <tr><td>Q12</td><td>0.17</td><td>0.77</td><td>0.05</td><td>0.08</td><td>0.63</td><td>0.37</td><td>1.1</td></tr> <tr><td>Q13</td><td>0.09</td><td>0.83</td><td>0.14</td><td>0.06</td><td>0.73</td><td>0.27</td><td>1.1</td></tr> <tr><td>Q14</td><td>0.14</td><td>0.74</td><td>0.02</td><td>0.15</td><td>0.59</td><td>0.41</td><td>1.2</td></tr> <tr><td>Q15</td><td>0.35</td><td>0.16</td><td>0.74</td><td>0.29</td><td>0.78</td><td>0.22</td><td>1.9</td></tr> <tr><td>Q16</td><td>0.31</td><td>0.14</td><td>0.84</td><td>0.14</td><td>0.84</td><td>0.16</td><td>1.4</td></tr> <tr><td>Q17</td><td>0.31</td><td>0.02</td><td>0.82</td><td>0.11</td><td>0.78</td><td>0.22</td><td>1.3</td></tr> <tr><td>Q18</td><td>0.28</td><td>0.14</td><td>0.78</td><td>0.23</td><td>0.76</td><td>0.24</td><td>1.5</td></tr> <tr><td>Q19</td><td>0.23</td><td>0.11</td><td>0.27</td><td>0.77</td><td>0.72</td><td>0.28</td><td>1.5</td></tr> <tr><td>Q20</td><td>0.21</td><td>0.14</td><td>0.21</td><td>0.84</td><td>0.81</td><td>0.19</td><td>1.3</td></tr> <tr><td>Q21</td><td>0.41</td><td>0.15</td><td>0.12</td><td>0.75</td><td>0.77</td><td>0.23</td><td>1.7</td></tr> </tbody> </table> <p style="text-align: right;">PC1 PC2 PC3 PC4</p> <table> <tbody> <tr><td>SS loadings</td><td>5.89</td><td>3.42</td><td>3.35</td><td>2.49</td></tr> <tr><td>Proportion Var</td><td>0.28</td><td>0.16</td><td>0.16</td><td>0.12</td></tr> <tr><td>Cumulative Var</td><td>0.28</td><td>0.44</td><td>0.60</td><td>0.72</td></tr> <tr><td>Proportion Explained</td><td>0.39</td><td>0.23</td><td>0.22</td><td>0.16</td></tr> <tr><td>Cumulative Proportion</td><td>0.39</td><td>0.61</td><td>0.84</td><td>1.00</td></tr> </tbody> </table> <p>Mean item complexity = 1.4</p> <p>Test of the hypothesis that 4 components are sufficient.</p> <p>The root mean square of the residuals (RMSR) is 0.05</p> <p>Fit based upon off diagonal values = 0.99</p>		PC1	PC2	PC3	PC4	h2	u2	com	Q1	0.86	0.13	0.30	0.06	0.84	0.16	1.3	Q2	0.85	0.14	0.22	0.13	0.81	0.19	1.2	Q3	0.74	0.22	0.19	0.28	0.72	0.28	1.6	Q4	0.74	0.13	0.16	0.35	0.71	0.29	1.6	Q5	0.72	0.25	0.13	0.20	0.63	0.37	1.5	Q6	0.79	0.19	0.18	0.17	0.72	0.28	1.3	Q7	0.68	0.15	0.39	0.28	0.72	0.28	2.1	Q8	0.70	0.02	0.39	0.06	0.65	0.35	1.6	Q9	0.68	0.15	0.30	0.23	0.63	0.37	1.8	Q10	0.19	0.75	0.08	0.11	0.62	0.38	1.2	Q11	0.11	0.81	0.10	0.03	0.67	0.33	1.1	Q12	0.17	0.77	0.05	0.08	0.63	0.37	1.1	Q13	0.09	0.83	0.14	0.06	0.73	0.27	1.1	Q14	0.14	0.74	0.02	0.15	0.59	0.41	1.2	Q15	0.35	0.16	0.74	0.29	0.78	0.22	1.9	Q16	0.31	0.14	0.84	0.14	0.84	0.16	1.4	Q17	0.31	0.02	0.82	0.11	0.78	0.22	1.3	Q18	0.28	0.14	0.78	0.23	0.76	0.24	1.5	Q19	0.23	0.11	0.27	0.77	0.72	0.28	1.5	Q20	0.21	0.14	0.21	0.84	0.81	0.19	1.3	Q21	0.41	0.15	0.12	0.75	0.77	0.23	1.7	SS loadings	5.89	3.42	3.35	2.49	Proportion Var	0.28	0.16	0.16	0.12	Cumulative Var	0.28	0.44	0.60	0.72	Proportion Explained	0.39	0.23	0.22	0.16	Cumulative Proportion	0.39	0.61	0.84	1.00
	PC1	PC2	PC3	PC4	h2	u2	com																																																																																																																																																																																																			
Q1	0.86	0.13	0.30	0.06	0.84	0.16	1.3																																																																																																																																																																																																			
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Q6	0.79	0.19	0.18	0.17	0.72	0.28	1.3																																																																																																																																																																																																			
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Q16	0.31	0.14	0.84	0.14	0.84	0.16	1.4																																																																																																																																																																																																			
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Q18	0.28	0.14	0.78	0.23	0.76	0.24	1.5																																																																																																																																																																																																			
Q19	0.23	0.11	0.27	0.77	0.72	0.28	1.5																																																																																																																																																																																																			
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<i>Computer Code</i>	<pre>### Internal consistency # PC1 (Q1, ..., Q9) library (psych) alpha(survey[c(paste("Q",1:9,sep=""))])</pre>																																																																																																																																																																																																									
<i>Output</i>	<p>Reliability analysis</p> <p>Call: alpha(x = survey[c(paste("Q", 1:9, sep = ""))])</p> <table> <thead> <tr> <th>raw_alpha</th> <th>std.alpha</th> <th>G6(smc)</th> <th>average_r</th> <th>S/N</th> <th>ase</th> <th>mean</th> <th>sd</th> </tr> </thead> <tbody> <tr><td>0.94</td><td>0.94</td><td>0.95</td><td>0.65</td><td>17</td><td>0.017</td><td>4.5</td><td>1.4</td></tr> </tbody> </table> <p>lower alpha upper 95% confidence boundaries</p> <p>0.91 0.94 0.98</p>	raw_alpha	std.alpha	G6(smc)	average_r	S/N	ase	mean	sd	0.94	0.94	0.95	0.65	17	0.017	4.5	1.4																																																																																																																																																																																									
raw_alpha	std.alpha	G6(smc)	average_r	S/N	ase	mean	sd																																																																																																																																																																																																			
0.94	0.94	0.95	0.65	17	0.017	4.5	1.4																																																																																																																																																																																																			

Table 10

<i>Computer Code</i>	<pre>### Internal consistency # PC1 (Q1, ..., Q9) library (psych) alpha(survey[c(paste("Q",1:9,sep=""))])</pre>																
<i>Output</i>	<p>Reliability analysis</p> <p>Call: alpha(x = survey[c(paste("Q", 1:9, sep = ""))])</p> <table> <thead> <tr> <th>raw_alpha</th> <th>std.alpha</th> <th>G6(smc)</th> <th>average_r</th> <th>S/N</th> <th>ase</th> <th>mean</th> <th>sd</th> </tr> </thead> <tbody> <tr><td>0.94</td><td>0.94</td><td>0.95</td><td>0.65</td><td>17</td><td>0.017</td><td>4.5</td><td>1.4</td></tr> </tbody> </table> <p>lower alpha upper 95% confidence boundaries</p> <p>0.91 0.94 0.98</p>	raw_alpha	std.alpha	G6(smc)	average_r	S/N	ase	mean	sd	0.94	0.94	0.95	0.65	17	0.017	4.5	1.4
raw_alpha	std.alpha	G6(smc)	average_r	S/N	ase	mean	sd										
0.94	0.94	0.95	0.65	17	0.017	4.5	1.4										

	Reliability if an item is dropped: raw_alpha std.alpha G6(smc) average_r S/N alpha se Q1 0.93 0.93 0.94 0.64 14 0.020 Q2 0.93 0.93 0.94 0.64 14 0.020 Q3 0.94 0.94 0.94 0.65 15 0.020 Q4 0.94 0.94 0.94 0.66 15 0.020 Q5 0.94 0.94 0.95 0.67 16 0.019 Q6 0.94 0.94 0.94 0.65 15 0.020 Q7 0.94 0.94 0.94 0.65 15 0.020 Q8 0.94 0.94 0.94 0.66 16 0.020 Q9 0.94 0.94 0.94 0.66 15 0.020
	Item statistics n raw.r std.r r.cor r.drop mean sd Q1 204 0.90 0.90 0.90 0.87 4.4 1.8 Q2 204 0.89 0.89 0.89 0.86 4.5 1.7 Q3 204 0.83 0.84 0.81 0.79 4.9 1.6 Q4 204 0.82 0.81 0.78 0.76 4.6 1.8 Q5 204 0.75 0.76 0.72 0.69 5.1 1.5 Q6 204 0.82 0.83 0.82 0.78 5.0 1.5 Q7 204 0.85 0.84 0.83 0.80 4.5 1.8 Q8 204 0.81 0.80 0.77 0.75 3.6 1.8 Q9 204 0.82 0.81 0.78 0.76 4.2 1.8
	Non missing response frequency for each item 1 2 3 4 5 6 7 miss Q1 0.08 0.09 0.12 0.19 0.22 0.17 0.13 0 Q2 0.07 0.08 0.11 0.21 0.23 0.17 0.13 0 Q3 0.04 0.04 0.09 0.20 0.22 0.22 0.18 0 Q4 0.07 0.09 0.07 0.22 0.20 0.18 0.17 0 Q5 0.02 0.04 0.06 0.20 0.23 0.28 0.16 0 Q6 0.02 0.03 0.10 0.20 0.22 0.25 0.18 0 Q7 0.09 0.08 0.11 0.15 0.22 0.20 0.15 0 Q8 0.17 0.11 0.20 0.24 0.13 0.07 0.09 0 Q9 0.09 0.11 0.13 0.23 0.20 0.14 0.11 0

Table 11

Computer Code	## Internal consistency # PC2 (Q10...Q14) library (psych) alpha(survey[c(paste("Q",10:14,sep=""))]))
Output	Reliability analysis Call: alpha(x = survey[c(paste("Q", 10:14, sep = ""))])  raw_alpha std.alpha G6(smc) average_r S/N ase mean sd 0.88 0.89 0.88 0.61 7.8 0.035 4.1 0.83  lower alpha upper 95% confidence boundaries 0.82 0.88 0.95  Reliability if an item is dropped: raw_alpha std.alpha G6(smc) average_r S/N alpha se Q10 0.87 0.87 0.85 0.63 6.7 0.043 Q11 0.86 0.87 0.84 0.62 6.6 0.043 Q12 0.86 0.86 0.85 0.61 6.2 0.044 Q13 0.85 0.85 0.81 0.58 5.5 0.045 Q14 0.86 0.86 0.83 0.61 6.4 0.044  Item statistics n raw.r std.r r.cor r.drop mean sd

	Q10 204 0.81 0.80 0.73 0.69 4.8 1.08
	Q11 204 0.82 0.81 0.76 0.70 4.0 1.06
	Q12 204 0.83 0.83 0.77 0.73 3.9 1.01
	Q13 204 0.87 0.87 0.85 0.79 4.0 0.92
	Q14 204 0.81 0.82 0.77 0.71 4.0 0.91
	Non missing response frequency for each item
	1 2 3 4 5 6 7 miss
	Q10 0.05 0.01 0.02 0.05 0.79 0.03 0.04 0
	Q11 0.05 0.01 0.02 0.81 0.02 0.02 0.05 0
	Q12 0.06 0.00 0.04 0.80 0.03 0.03 0.02 0
	Q13 0.04 0.00 0.04 0.82 0.03 0.02 0.03 0
	Q14 0.04 0.00 0.05 0.83 0.02 0.02 0.03 0

Table 12

Computer Code	<pre>### Internal consistency # PC2 (Q15...Q18) library (psych) alpha(survey[c(paste("Q",15:18,sep=""))])</pre>																																																																																																																																															
Output	<p>Reliability analysis</p> <pre>Call: alpha(x = survey[c(paste("Q", 15:18, sep = ""))])</pre> <table> <thead> <tr> <th></th> <th>raw_alpha</th> <th>std.alpha</th> <th>G6(smc)</th> <th>average_r</th> <th>S/N</th> <th>ase</th> <th>mean</th> <th>sd</th> </tr> </thead> <tbody> <tr> <td></td> <td>0.91</td> <td>0.91</td> <td>0.89</td> <td>0.72</td> <td>10</td> <td>0.039</td> <td>4.3</td> <td>1.6</td> </tr> </tbody> </table> <p>lower alpha upper 95% confidence boundaries</p> <pre>0.83 0.91 0.99</pre> <p>Reliability if an item is dropped:</p> <table> <thead> <tr> <th></th> <th>raw_alpha</th> <th>std.alpha</th> <th>G6(smc)</th> <th>average_r</th> <th>S/N</th> <th>alpha</th> <th>se</th> </tr> </thead> <tbody> <tr> <td>Q15</td> <td>0.89</td> <td>0.89</td> <td>0.85</td> <td>0.72</td> <td>7.7</td> <td>0.054</td> <td></td> </tr> <tr> <td>Q16</td> <td>0.86</td> <td>0.86</td> <td>0.81</td> <td>0.67</td> <td>6.1</td> <td>0.056</td> <td></td> </tr> <tr> <td>Q17</td> <td>0.90</td> <td>0.90</td> <td>0.86</td> <td>0.75</td> <td>8.9</td> <td>0.052</td> <td></td> </tr> <tr> <td>Q18</td> <td>0.89</td> <td>0.89</td> <td>0.84</td> <td>0.72</td> <td>7.9</td> <td>0.053</td> <td></td> </tr> </tbody> </table> <p>Item statistics</p> <table> <thead> <tr> <th></th> <th>n</th> <th>raw.r</th> <th>std.r</th> <th>r.cor</th> <th>r.drop</th> <th>mean</th> <th>sd</th> </tr> </thead> <tbody> <tr> <td>Q15</td> <td>204</td> <td>0.88</td> <td>0.88</td> <td>0.82</td> <td>0.79</td> <td>4.6</td> <td>1.8</td> </tr> <tr> <td>Q16</td> <td>204</td> <td>0.93</td> <td>0.92</td> <td>0.91</td> <td>0.86</td> <td>4.3</td> <td>1.8</td> </tr> <tr> <td>Q17</td> <td>204</td> <td>0.86</td> <td>0.86</td> <td>0.79</td> <td>0.75</td> <td>3.9</td> <td>1.8</td> </tr> <tr> <td>Q18</td> <td>204</td> <td>0.88</td> <td>0.88</td> <td>0.83</td> <td>0.78</td> <td>4.5</td> <td>1.8</td> </tr> </tbody> </table> <p>Non missing response frequency for each item</p> <table> <thead> <tr> <th></th> <th>1</th> <th>2</th> <th>3</th> <th>4</th> <th>5</th> <th>6</th> <th>7</th> <th>miss</th> </tr> </thead> <tbody> <tr> <td>Q15</td> <td>0.07</td> <td>0.08</td> <td>0.12</td> <td>0.19</td> <td>0.19</td> <td>0.16</td> <td>0.19</td> <td>0</td> </tr> <tr> <td>Q16</td> <td>0.11</td> <td>0.06</td> <td>0.13</td> <td>0.21</td> <td>0.16</td> <td>0.19</td> <td>0.13</td> <td>0</td> </tr> <tr> <td>Q17</td> <td>0.13</td> <td>0.09</td> <td>0.19</td> <td>0.22</td> <td>0.16</td> <td>0.11</td> <td>0.10</td> <td>0</td> </tr> <tr> <td>Q18</td> <td>0.09</td> <td>0.07</td> <td>0.11</td> <td>0.22</td> <td>0.18</td> <td>0.19</td> <td>0.14</td> <td>0</td> </tr> </tbody> </table>		raw_alpha	std.alpha	G6(smc)	average_r	S/N	ase	mean	sd		0.91	0.91	0.89	0.72	10	0.039	4.3	1.6		raw_alpha	std.alpha	G6(smc)	average_r	S/N	alpha	se	Q15	0.89	0.89	0.85	0.72	7.7	0.054		Q16	0.86	0.86	0.81	0.67	6.1	0.056		Q17	0.90	0.90	0.86	0.75	8.9	0.052		Q18	0.89	0.89	0.84	0.72	7.9	0.053			n	raw.r	std.r	r.cor	r.drop	mean	sd	Q15	204	0.88	0.88	0.82	0.79	4.6	1.8	Q16	204	0.93	0.92	0.91	0.86	4.3	1.8	Q17	204	0.86	0.86	0.79	0.75	3.9	1.8	Q18	204	0.88	0.88	0.83	0.78	4.5	1.8		1	2	3	4	5	6	7	miss	Q15	0.07	0.08	0.12	0.19	0.19	0.16	0.19	0	Q16	0.11	0.06	0.13	0.21	0.16	0.19	0.13	0	Q17	0.13	0.09	0.19	0.22	0.16	0.11	0.10	0	Q18	0.09	0.07	0.11	0.22	0.18	0.19	0.14	0
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Table 13

Computer Code	<pre>### Internal consistency # PC2 (Q19...Q21) library (psych) alpha(survey[c(paste("Q",19:21,sep=""))])</pre>
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<i>Output</i>	<pre> Reliability analysis Call: alpha(x = survey[c(paste("Q", 19:21, sep = ""))])    raw_alpha std.alpha G6(smc) average_r S/N    ase mean   sd   0.83      0.84      0.79      0.64 5.4 0.059    5 1.4    lower alpha upper      95% confidence boundaries   0.72 0.83 0.95    Reliability if an item is dropped:   raw_alpha std.alpha G6(smc) average_r S/N alpha se Q19      0.82      0.82      0.70      0.70 4.6    0.092 Q20      0.70      0.73      0.58      0.58 2.8    0.103 Q21      0.76      0.79      0.65      0.65 3.8    0.098    Item statistics   n raw.r std.r r.cor r.drop mean   sd Q19 204 0.81 0.85 0.73 0.67 5.6 1.2 Q20 204 0.91 0.90 0.83 0.76 4.7 1.7 Q21 204 0.89 0.87 0.77 0.71 4.5 1.8    Non missing response frequency for each item   1   2   3   4   5   6   7 miss Q19 0.01 0.01 0.02 0.12 0.21 0.39 0.24 0 Q20 0.05 0.07 0.09 0.21 0.21 0.19 0.18 0 Q21 0.07 0.09 0.09 0.22 0.23 0.12 0.18 0 </pre>
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Table 14

<i>Computer Code</i>	<pre> ## CFA with Lavaan package library(lavaan)  Q.model &lt;- 'FACTOR1 =~ Q1 + Q2 + Q3 + Q4 + Q5 + Q6 + Q7 + Q8 + Q9             FACTOR2 =~ Q10 + Q11 + Q12 + Q13 + Q14             FACTOR3 =~ Q15 + Q16 + Q17 + Q18             FACTOR4 =~ Q19 + Q20 + Q21'  fit &lt;- sem(Q.model, data = data.df, std.lv=TRUE,            missing="fiml") summary(fit, fit.measures=TRUE) </pre>
<i>Output</i>	<pre> lavaan 0.6-2 ended normally after 29 iterations  Optimization method                           NLMINB Number of free parameters                      69  Number of observations                         204 Number of missing patterns                     1  Estimator                                    ML Model Fit Test Statistic                    593.222 Degrees of freedom                          183 P-value (Chi-square)                        0.000  Model test baseline model:  Minimum Function Test Statistic             3592.457 Degrees of freedom                           210 P-value                                     0.000  User model versus baseline model: </pre>

	Comparative Fit Index (CFI)	0.879	
	Tucker-Lewis Index (TLI)	0.861	
Loglikelihood and Information Criteria:			
	Loglikelihood user model (H0)	-6269.722	
	Loglikelihood unrestricted model (H1)	-5973.111	
	Number of free parameters	69	
	Akaike (AIC)	12677.444	
	Bayesian (BIC)	12906.394	
	Sample-size adjusted Bayesian (BIC)	12687.782	
Root Mean Square Error of Approximation:			
	RMSEA	0.105	
	90 Percent Confidence Interval	0.095 0.114	
	P-value RMSEA <= 0.05	0.000	
Standardized Root Mean Square Residual:			
	SRMR	0.057	
Parameter Estimates:			
	Information	Observed	
	Observed information based on	Hessian	
	Standard Errors	Standard	
Latent Variables:			
		Estimate Std.Err z-value P(> z )	
	FACTOR1 =~		
	Q1	1.605 0.096	16.631 0.000
	Q2	1.530 0.094	16.284 0.000
	Q3	1.299 0.094	13.766 0.000
	Q4	1.365 0.105	13.014 0.000
	Q5	1.046 0.091	11.520 0.000
	Q6	1.181 0.088	13.413 0.000
	Q7	1.513 0.105	14.372 0.000
	Q8	1.397 0.106	13.197 0.000
	Q9	1.374 0.103	13.281 0.000
	FACTOR2 =~		
	Q10	0.784 0.068	11.443 0.000
	Q11	0.804 0.065	12.286 0.000
	Q12	0.793 0.062	12.869 0.000
	Q13	0.785 0.054	14.652 0.000
	Q14	0.708 0.056	12.633 0.000
	FACTOR3 =~		
	Q15	1.520 0.105	14.449 0.000
	Q16	1.676 0.101	16.591 0.000
	Q17	1.417 0.107	13.194 0.000
	Q18	1.517 0.103	14.776 0.000
	FACTOR4 =~		
	Q19	0.887 0.075	11.784 0.000
	Q20	1.444 0.104	13.863 0.000
	Q21	1.458 0.109	13.324 0.000
Covariances:			
		Estimate Std.Err z-value P(> z )	
	FACTOR1 ~~		
	FACTOR2	0.378 0.066	5.700 0.000
	FACTOR3	0.676 0.043	15.540 0.000

FACTOR4	0.629	0.052	12.098	0.000
FACTOR2 ~~				
FACTOR3	0.279	0.072	3.877	0.000
FACTOR4	0.365	0.071	5.114	0.000
FACTOR3 ~~				
FACTOR4	0.584	0.056	10.361	0.000
Intercepts:				
.Q1	4.392	0.124	35.400	0.000
.Q2	4.471	0.120	37.331	0.000
.Q3	4.892	0.113	43.284	0.000
.Q4	4.608	0.123	37.373	0.000
.Q5	5.054	0.103	49.017	0.000
.Q6	5.010	0.104	47.966	0.000
.Q7	4.505	0.128	35.216	0.000
.Q8	3.603	0.125	28.810	0.000
.Q9	4.176	0.122	34.117	0.000
.Q10	4.789	0.076	63.338	0.000
.Q11	4.015	0.074	54.364	0.000
.Q12	3.936	0.071	55.655	0.000
.Q13	3.975	0.064	62.041	0.000
.Q14	3.951	0.064	61.907	0.000
.Q15	4.578	0.127	36.144	0.000
.Q16	4.328	0.128	33.689	0.000
.Q17	3.941	0.126	31.360	0.000
.Q18	4.461	0.125	35.674	0.000
.Q19	5.627	0.083	67.920	0.000
.Q20	4.721	0.120	39.345	0.000
.Q21	4.529	0.124	36.444	0.000
FACTOR1	0.000			
FACTOR2	0.000			
FACTOR3	0.000			
FACTOR4	0.000			
Variances:				
.Q1	0.565	0.074	7.650	0.000
.Q2	0.586	0.073	7.988	0.000
.Q3	0.917	0.101	9.123	0.000
.Q4	1.239	0.133	9.315	0.000
.Q5	1.074	0.112	9.556	0.000
.Q6	0.831	0.091	9.180	0.000
.Q7	1.049	0.117	8.932	0.000
.Q8	1.239	0.133	9.302	0.000
.Q9	1.170	0.126	9.255	0.000
.Q10	0.552	0.065	8.551	0.000
.Q11	0.466	0.057	8.226	0.000
.Q12	0.391	0.049	8.056	0.000
.Q13	0.221	0.034	6.454	0.000
.Q14	0.330	0.041	8.122	0.000
.Q15	0.964	0.124	7.773	0.000
.Q16	0.559	0.098	5.718	0.000
.Q17	1.215	0.140	8.656	0.000
.Q18	0.889	0.113	7.874	0.000
.Q19	0.613	0.077	7.925	0.000
.Q20	0.851	0.142	5.996	0.000
.Q21	1.026	0.158	6.479	0.000
FACTOR1	1.000			
FACTOR2	1.000			
FACTOR3	1.000			
FACTOR4	1.000			

Table 15

<i>Computer Code</i>	<pre>#Adjusted Model library(lavaan)  Q.model.2 &lt;-'FACTOR1 =~ Q1 + Q2 + Q3 + Q4 + Q6 + Q7 + Q8 + Q9            FACTOR2 =~ Q12 + Q13 + Q14            FACTOR3 =~ Q15 + Q16 + Q17 + Q18            FACTOR4 =~ Q20 + Q21'  fit &lt;- sem(Q.model.2, data = data.df) summary(fit, fit.measures=TRUE)</pre>																																																		
<i>Output</i>	<p>lavaan 0.6-2 ended normally after 47 iterations</p> <table> <tbody> <tr><td>Optimization method</td><td>NLMINB</td></tr> <tr><td>Number of free parameters</td><td>40</td></tr> <tr><td>Number of observations</td><td>204</td></tr> <tr><td>Estimator</td><td>ML</td></tr> <tr><td>Model Fit Test Statistic</td><td>386.521</td></tr> <tr><td>Degrees of freedom</td><td>113</td></tr> <tr><td>P-value (Chi-square)</td><td>0.000</td></tr> </tbody> </table> <p>Model test baseline model:</p> <table> <tbody> <tr><td>Minimum Function Test Statistic</td><td>2866.310</td></tr> <tr><td>Degrees of freedom</td><td>136</td></tr> <tr><td>P-value</td><td>0.000</td></tr> </tbody> </table> <p>User model versus baseline model:</p> <table> <tbody> <tr><td>Comparative Fit Index (CFI)</td><td>0.900</td></tr> <tr><td>Tucker-Lewis Index (TLI)</td><td>0.879</td></tr> </tbody> </table> <p>Loglikelihood and Information Criteria:</p> <table> <tbody> <tr><td>Loglikelihood user model (H0)</td><td>-5231.708</td></tr> <tr><td>Loglikelihood unrestricted model (H1)</td><td>-5038.448</td></tr> <tr><td>Number of free parameters</td><td>40</td></tr> <tr><td>Akaike (AIC)</td><td>10543.417</td></tr> <tr><td>Bayesian (BIC)</td><td>10676.142</td></tr> <tr><td>Sample-size adjusted Bayesian (BIC)</td><td>10549.410</td></tr> </tbody> </table> <p>Root Mean Square Error of Approximation:</p> <table> <tbody> <tr><td>RMSEA</td><td>0.109</td></tr> <tr><td>90 Percent Confidence Interval</td><td>0.097 0.121</td></tr> <tr><td>P-value RMSEA &lt;= 0.05</td><td>0.000</td></tr> </tbody> </table> <p>Standardized Root Mean Square Residual:</p> <table> <tbody> <tr><td>SRMR</td><td>0.053</td></tr> </tbody> </table> <p>Parameter Estimates:</p> <table> <tbody> <tr><td>Information</td><td>Expected</td></tr> <tr><td>Information saturated (h1) model</td><td>Structured</td></tr> <tr><td>Standard Errors</td><td>Standard</td></tr> </tbody> </table>	Optimization method	NLMINB	Number of free parameters	40	Number of observations	204	Estimator	ML	Model Fit Test Statistic	386.521	Degrees of freedom	113	P-value (Chi-square)	0.000	Minimum Function Test Statistic	2866.310	Degrees of freedom	136	P-value	0.000	Comparative Fit Index (CFI)	0.900	Tucker-Lewis Index (TLI)	0.879	Loglikelihood user model (H0)	-5231.708	Loglikelihood unrestricted model (H1)	-5038.448	Number of free parameters	40	Akaike (AIC)	10543.417	Bayesian (BIC)	10676.142	Sample-size adjusted Bayesian (BIC)	10549.410	RMSEA	0.109	90 Percent Confidence Interval	0.097 0.121	P-value RMSEA <= 0.05	0.000	SRMR	0.053	Information	Expected	Information saturated (h1) model	Structured	Standard Errors	Standard
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Latent Variables:					
	Estimate	Std.Err	z-value	P(> z )	
FACTOR1 =~					
Q1	1.000				
Q2	0.951	0.047	20.356	0.000	
Q3	0.799	0.051	15.656	0.000	
Q4	0.846	0.057	14.791	0.000	
Q6	0.717	0.048	14.780	0.000	
Q7	0.943	0.055	17.058	0.000	
Q8	0.874	0.057	15.311	0.000	
Q9	0.857	0.056	15.349	0.000	
FACTOR2 =~					
Q12	1.000				
Q13	0.975	0.085	11.525	0.000	
Q14	0.949	0.083	11.408	0.000	
FACTOR3 =~					
Q15	1.000				
Q16	1.108	0.067	16.664	0.000	
Q17	0.934	0.070	13.309	0.000	
Q18	1.001	0.067	14.914	0.000	
FACTOR4 =~					
Q20	1.000				
Q21	1.185	0.119	9.966	0.000	
Covariances:					
	Estimate	Std.Err	z-value	P(> z )	
FACTOR1 ~~					
FACTOR2	0.435	0.107	4.073	0.000	
FACTOR3	1.648	0.233	7.082	0.000	
FACTOR4	1.376	0.221	6.215	0.000	
FACTOR2 ~~					
FACTOR3	0.307	0.099	3.101	0.002	
FACTOR4	0.383	0.097	3.938	0.000	
FACTOR3 ~~					
FACTOR4	1.097	0.201	5.465	0.000	
Variances:					
	Estimate	Std.Err	z-value	P(> z )	
.Q1	0.542	0.071	7.676	0.000	
.Q2	0.574	0.072	8.028	0.000	
.Q3	0.947	0.103	9.221	0.000	
.Q4	1.240	0.133	9.348	0.000	
.Q6	0.891	0.095	9.350	0.000	
.Q7	1.028	0.115	8.971	0.000	
.Q8	1.205	0.130	9.274	0.000	
.Q9	1.150	0.124	9.268	0.000	
.Q12	0.399	0.054	7.335	0.000	
.Q13	0.248	0.043	5.796	0.000	
.Q14	0.271	0.043	6.332	0.000	
.Q15	0.977	0.121	8.103	0.000	
.Q16	0.546	0.095	5.756	0.000	
.Q17	1.217	0.139	8.727	0.000	
.Q18	0.888	0.113	7.883	0.000	
.Q20	1.145	0.184	6.236	0.000	
.Q21	0.635	0.212	2.992	0.003	
FACTOR1	2.598	0.310	8.390	0.000	
FACTOR2	0.621	0.100	6.199	0.000	
FACTOR3	2.296	0.318	7.231	0.000	
FACTOR4	1.792	0.304	5.891	0.000	

*Table 16*

<i>Computer Code</i>	F1 -> Q1, lam1, NA F1 -> Q2, lam2, NA F1 -> Q3, lam3, NA F1 -> Q4, lam4, NA F1 -> Q5, lam5, NA F1 -> Q6, lam6, NA F1 -> Q7, lam7, NA F1 -> Q8, lam8, NA F1 -> Q9, lam9, NA F2 -> Q10, lam10, NA F2 -> Q11, lam11, NA F2 -> Q12, lam12, NA F2 -> Q13, lam13, NA F2 -> Q14, lam14, NA F3 -> Q15, lam15, NA F3 -> Q16, lam16, NA F3 -> Q17, lam17, NA F3 -> Q18, lam18, NA F4 -> Q19, lam19, NA F4 -> Q20, lam20, NA F4 -> Q21, lam21, NA Q1 <-> Q1, e1, NA Q2 <-> Q2, e2, NA Q3 <-> Q3, e3, NA Q4 <-> Q4, e4, NA Q5 <-> Q5, e5, NA Q6 <-> Q6, e6, NA Q7 <-> Q7, e7, NA Q8 <-> Q8, e8, NA Q9 <-> Q9, e9, NA Q10 <-> Q10, e10, NA Q11 <-> Q11, e11, NA Q12 <-> Q12, e12, NA Q13 <-> Q13, e13, NA Q14 <-> Q14, e14, NA Q15 <-> Q15, e15, NA Q16 <-> Q16, e16, NA Q17 <-> Q17, e17, NA Q18 <-> Q18, e18, NA Q19 <-> Q19, e19, NA Q20 <-> Q20, e20, NA Q21 <-> Q21, e21, NA F1 <-> F1, NA, 1 F2 <-> F2, NA, 1 F3 <-> F3, NA, 1 F4 <-> F4, NA, 1 F1 -> F2, F1F2DIR, NA F1 -> F3, F1F3DIR, NA F1 -> F4, F1F4DIR, NA F2 -> F3, F2F3DIR, NA F2 -> F4, F2F4DIR, NA F3 -> F4, F3F4DIR, NA
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*Table 17*

<i>Computer Code</i>	#with sem library(sem) cfa.model.2<-specifyModel("adjustedmodel.txt") cfaOut.2<-sem(cfa.model.2,S=dataCov,N=204) summary(cfaOut.2)
----------------------	--

<i>Output</i>	<p>Model Chisquare = 590.31368 Df = 183 Pr(&gt;Chisq) = 2.3016422e-44  AIC = 686.31368  BIC = -382.90228</p> <p>Normalized Residuals</p> <table border="1"> <thead> <tr> <th></th><th>Min.</th><th>1st Qu.</th><th>Median</th><th>Mean</th><th>3rd Qu.</th><th>Max.</th></tr> </thead> <tbody> <tr> <td>-1.76324751</td><td>-0.35685432</td><td>0.00000837</td><td>0.12497110</td><td>0.63869184</td><td>2.81328769</td><td></td></tr> </tbody> </table> <p>R-square for Endogenous Variables</p> <table border="1"> <thead> <tr> <th>Q1</th><th>Q2</th><th>Q3</th><th>Q4</th><th>Q5</th><th>F3</th><th>Q15</th><th>Q16</th><th>Q17</th><th>F2</th></tr> </thead> <tbody> <tr> <td>Q10</td><td>Q11</td><td>Q12</td><td>Q13</td><td>Q14</td><td></td><td></td><td></td><td></td><td></td></tr> <tr> <td>0.8199</td><td>0.7997</td><td>0.6480</td><td>0.6004</td><td>0.5048</td><td>0.6264</td><td>0.6857</td><td>0.6115</td><td>0.6173</td><td>0.1426</td></tr> <tr> <td>0.5267</td><td>0.5814</td><td>0.6167</td><td>0.7366</td><td>0.6026</td><td>0.4571</td><td>0.7056</td><td>0.8340</td><td>0.6228</td><td></td></tr> <tr> <td>Q18</td><td>F4</td><td>Q19</td><td>Q20</td><td>Q21</td><td></td><td></td><td></td><td></td><td></td></tr> <tr> <td>0.7213</td><td>0.4590</td><td>0.5620</td><td>0.7101</td><td>0.6745</td><td></td><td></td><td></td><td></td><td></td></tr> </tbody> </table> <p>Parameter Estimates</p> <table border="1"> <thead> <tr> <th></th><th>Estimate</th><th>Std Error</th><th>z value</th><th>Pr(&gt; z )</th><th></th></tr> </thead> <tbody> <tr> <td>lam1</td><td>1.608582711</td><td>0.096797094</td><td>16.61808882</td><td>5.1549930e-62</td><td>Q1 &lt;--- F1</td></tr> <tr> <td>lam2</td><td>1.533298744</td><td>0.094265385</td><td>16.26576646</td><td>1.7269253e-59</td><td>Q2 &lt;--- F1</td></tr> <tr> <td>lam3</td><td>1.302664145</td><td>0.094715887</td><td>13.75338590</td><td>4.8600669e-43</td><td>Q3 &lt;--- F1</td></tr> <tr> <td>lam4</td><td>1.367859225</td><td>0.105220976</td><td>12.99987199</td><td>1.2254824e-38</td><td>Q4 &lt;--- F1</td></tr> <tr> <td>lam5</td><td>1.048897739</td><td>0.091100541</td><td>11.51362793</td><td>1.1263809e-30</td><td>Q5 &lt;--- F1</td></tr> <tr> <td>lam6</td><td>1.183556732</td><td>0.088259377</td><td>13.40998286</td><td>5.2851042e-41</td><td>Q6 &lt;--- F1</td></tr> <tr> <td>lam7</td><td>1.516650456</td><td>0.105613336</td><td>14.36040675</td><td>9.1687448e-47</td><td>Q7 &lt;--- F1</td></tr> <tr> <td>lam8</td><td>1.400204107</td><td>0.106277223</td><td>13.17501596</td><td>1.2220159e-39</td><td>Q8 &lt;--- F1</td></tr> <tr> <td>lam9</td><td>1.377112371</td><td>0.103805008</td><td>13.26633847</td><td>3.6288320e-40</td><td>Q9 &lt;--- F1</td></tr> <tr> <td>lam10</td><td>0.727571362</td><td>0.063832319</td><td>11.39816584</td><td>4.2702074e-30</td><td>Q10 &lt;--- F2</td></tr> <tr> <td>lam11</td><td>0.746581481</td><td>0.061222614</td><td>12.19453777</td><td>3.3238467e-34</td><td>Q11 &lt;--- F2</td></tr> <tr> <td>lam12</td><td>0.736412509</td><td>0.057946665</td><td>12.70845379</td><td>5.3073466e-37</td><td>Q12 &lt;--- F2</td></tr> <tr> <td>lam13</td><td>0.729131564</td><td>0.050471794</td><td>14.44631768</td><td>2.6445096e-47</td><td>Q13 &lt;--- F2</td></tr> <tr> <td>lam14</td><td>0.656864351</td><td>0.052537122</td><td>12.50286122</td><td>7.2011974e-36</td><td>Q14 &lt;--- F2</td></tr> <tr> <td>lam15</td><td>1.122573895</td><td>0.082504802</td><td>13.60616438</td><td>3.6805948e-42</td><td>Q15 &lt;--- F3</td></tr> <tr> <td>lam16</td><td>1.237868212</td><td>0.081432478</td><td>15.20116105</td><td>3.4740855e-52</td><td>Q16 &lt;--- F3</td></tr> <tr> <td>lam17</td><td>1.046342686</td><td>0.083641448</td><td>12.50985862</td><td>6.5941490e-36</td><td>Q17 &lt;--- F3</td></tr> <tr> <td>lam18</td><td>1.120414800</td><td>0.081118318</td><td>13.81210586</td><td>2.1544020e-43</td><td>Q18 &lt;--- F3</td></tr> <tr> <td>lam19</td><td>0.654116109</td><td>0.059562463</td><td>10.98201910</td><td>4.6638156e-28</td><td>Q19 &lt;--- F4</td></tr> <tr> <td>lam20</td><td>1.064748301</td><td>0.085659917</td><td>12.42994786</td><td>1.7975157e-35</td><td>Q20 &lt;--- F4</td></tr> <tr> <td>lam21</td><td>1.074937856</td><td>0.088508858</td><td>12.14497493</td><td>6.1001285e-34</td><td>Q21 &lt;--- F4</td></tr> <tr> <td>e1</td><td>0.568261817</td><td>0.072260791</td><td>7.86404086</td><td>3.7193614e-15</td><td>Q1 &lt;--&gt; Q1</td></tr> <tr> <td>e2</td><td>0.589012268</td><td>0.072390036</td><td>8.13664837</td><td>4.0637075e-16</td><td>Q2 &lt;--&gt; Q2</td></tr> <tr> <td>e3</td><td>0.921920938</td><td>0.100352137</td><td>9.18685908</td><td>4.0447915e-20</td><td>Q3 &lt;--&gt; Q3</td></tr> <tr> <td>e4</td><td>1.245352450</td><td>0.133178260</td><td>9.35101909</td><td>8.6807243e-21</td><td>Q4 &lt;--&gt; Q4</td></tr> <tr> <td>e5</td><td>1.079156341</td><td>0.112592438</td><td>9.58462541</td><td>9.2793754e-22</td><td>Q5 &lt;--&gt; Q5</td></tr> <tr> <td>e6</td><td>0.835549656</td><td>0.090168081</td><td>9.26657913</td><td>1.9221171e-20</td><td>Q6 &lt;--&gt; Q6</td></tr> <tr> <td>e7</td><td>1.054427368</td><td>0.116885817</td><td>9.02100355</td><td>1.8637404e-19</td><td>Q7 &lt;--&gt; Q7</td></tr> <tr> <td>e8</td><td>1.245527888</td><td>0.133693832</td><td>9.31627039</td><td>1.2050172e-20</td><td>Q8 &lt;--&gt; Q8</td></tr> <tr> <td>e9</td><td>1.175714719</td><td>0.126456396</td><td>9.29739224</td><td>1.4393243e-20</td><td>Q9 &lt;--&gt; Q9</td></tr> <tr> <td>e10</td><td>0.554733476</td><td>0.063445756</td><td>8.74342923</td><td>2.2613954e-18</td><td>Q10 &lt;--&gt; Q10</td></tr> <tr> <td>e11</td><td>0.467959800</td><td>0.055688186</td><td>8.40321500</td><td>4.3441829e-17</td><td>Q11 &lt;--&gt; Q11</td></tr> <tr> <td>e12</td><td>0.393014520</td><td>0.048344009</td><td>8.12953929</td><td>4.3092507e-16</td><td>Q12 &lt;--&gt; Q12</td></tr> <tr> <td>e13</td><td>0.221743796</td><td>0.033134028</td><td>6.69232836</td><td>2.1964731e-11</td><td>Q13 &lt;--&gt; Q13</td></tr> <tr> <td>e14</td><td>0.331820883</td><td>0.040244589</td><td>8.24510562</td><td>1.6501439e-16</td><td>Q14 &lt;--&gt; Q14</td></tr> <tr> <td>e15</td><td>0.968292549</td><td>0.120364329</td><td>8.04468035</td><td>8.6470830e-16</td><td>Q15 &lt;--&gt; Q15</td></tr> <tr> <td>e16</td><td>0.561857872</td><td>0.095905395</td><td>5.85845952</td><td>4.6718045e-09</td><td>Q16 &lt;--&gt; Q16</td></tr> <tr> <td>e17</td><td>1.221343907</td><td>0.140347007</td><td>8.70231532</td><td>3.2518057e-18</td><td>Q17 &lt;--&gt; Q17</td></tr> <tr> <td>e18</td><td>0.893177527</td><td>0.113469641</td><td>7.87151100</td><td>3.5038332e-15</td><td>Q18 &lt;--&gt; Q18</td></tr> <tr> <td>e19</td><td>0.616437482</td><td>0.076967253</td><td>8.00908772</td><td>1.1556246e-15</td><td>Q19 &lt;--&gt; Q19</td></tr> <tr> <td>e20</td><td>0.855556466</td><td>0.141520582</td><td>6.04545612</td><td>1.4898790e-09</td><td>Q20 &lt;--&gt; Q20</td></tr> <tr> <td>e21</td><td>1.030772948</td><td>0.155468876</td><td>6.63009200</td><td>3.3547771e-11</td><td>Q21 &lt;--&gt; Q21</td></tr> <tr> <td>F1F2DIR</td><td>0.407736694</td><td>0.083275769</td><td>4.89622252</td><td>9.7696435e-07</td><td>F2 &lt;--- F1</td></tr> <tr> <td>F1F3DIR</td><td>0.902724046</td><td>0.112598958</td><td>8.01716163</td><td>1.0821668e-15</td><td>F3 &lt;--- F1</td></tr> <tr> <td>F1F4DIR</td><td>0.520806176</td><td>0.131646222</td><td>3.95610423</td><td>7.6181932e-05</td><td>F4 &lt;--- F1</td></tr> </tbody> </table>		Min.	1st Qu.	Median	Mean	3rd Qu.	Max.	-1.76324751	-0.35685432	0.00000837	0.12497110	0.63869184	2.81328769		Q1	Q2	Q3	Q4	Q5	F3	Q15	Q16	Q17	F2	Q10	Q11	Q12	Q13	Q14						0.8199	0.7997	0.6480	0.6004	0.5048	0.6264	0.6857	0.6115	0.6173	0.1426	0.5267	0.5814	0.6167	0.7366	0.6026	0.4571	0.7056	0.8340	0.6228		Q18	F4	Q19	Q20	Q21						0.7213	0.4590	0.5620	0.7101	0.6745							Estimate	Std Error	z value	Pr(> z )		lam1	1.608582711	0.096797094	16.61808882	5.1549930e-62	Q1 <--- F1	lam2	1.533298744	0.094265385	16.26576646	1.7269253e-59	Q2 <--- F1	lam3	1.302664145	0.094715887	13.75338590	4.8600669e-43	Q3 <--- F1	lam4	1.367859225	0.105220976	12.99987199	1.2254824e-38	Q4 <--- F1	lam5	1.048897739	0.091100541	11.51362793	1.1263809e-30	Q5 <--- F1	lam6	1.183556732	0.088259377	13.40998286	5.2851042e-41	Q6 <--- F1	lam7	1.516650456	0.105613336	14.36040675	9.1687448e-47	Q7 <--- F1	lam8	1.400204107	0.106277223	13.17501596	1.2220159e-39	Q8 <--- F1	lam9	1.377112371	0.103805008	13.26633847	3.6288320e-40	Q9 <--- F1	lam10	0.727571362	0.063832319	11.39816584	4.2702074e-30	Q10 <--- F2	lam11	0.746581481	0.061222614	12.19453777	3.3238467e-34	Q11 <--- F2	lam12	0.736412509	0.057946665	12.70845379	5.3073466e-37	Q12 <--- F2	lam13	0.729131564	0.050471794	14.44631768	2.6445096e-47	Q13 <--- F2	lam14	0.656864351	0.052537122	12.50286122	7.2011974e-36	Q14 <--- F2	lam15	1.122573895	0.082504802	13.60616438	3.6805948e-42	Q15 <--- F3	lam16	1.237868212	0.081432478	15.20116105	3.4740855e-52	Q16 <--- F3	lam17	1.046342686	0.083641448	12.50985862	6.5941490e-36	Q17 <--- F3	lam18	1.120414800	0.081118318	13.81210586	2.1544020e-43	Q18 <--- F3	lam19	0.654116109	0.059562463	10.98201910	4.6638156e-28	Q19 <--- F4	lam20	1.064748301	0.085659917	12.42994786	1.7975157e-35	Q20 <--- F4	lam21	1.074937856	0.088508858	12.14497493	6.1001285e-34	Q21 <--- F4	e1	0.568261817	0.072260791	7.86404086	3.7193614e-15	Q1 <--> Q1	e2	0.589012268	0.072390036	8.13664837	4.0637075e-16	Q2 <--> Q2	e3	0.921920938	0.100352137	9.18685908	4.0447915e-20	Q3 <--> Q3	e4	1.245352450	0.133178260	9.35101909	8.6807243e-21	Q4 <--> Q4	e5	1.079156341	0.112592438	9.58462541	9.2793754e-22	Q5 <--> Q5	e6	0.835549656	0.090168081	9.26657913	1.9221171e-20	Q6 <--> Q6	e7	1.054427368	0.116885817	9.02100355	1.8637404e-19	Q7 <--> Q7	e8	1.245527888	0.133693832	9.31627039	1.2050172e-20	Q8 <--> Q8	e9	1.175714719	0.126456396	9.29739224	1.4393243e-20	Q9 <--> Q9	e10	0.554733476	0.063445756	8.74342923	2.2613954e-18	Q10 <--> Q10	e11	0.467959800	0.055688186	8.40321500	4.3441829e-17	Q11 <--> Q11	e12	0.393014520	0.048344009	8.12953929	4.3092507e-16	Q12 <--> Q12	e13	0.221743796	0.033134028	6.69232836	2.1964731e-11	Q13 <--> Q13	e14	0.331820883	0.040244589	8.24510562	1.6501439e-16	Q14 <--> Q14	e15	0.968292549	0.120364329	8.04468035	8.6470830e-16	Q15 <--> Q15	e16	0.561857872	0.095905395	5.85845952	4.6718045e-09	Q16 <--> Q16	e17	1.221343907	0.140347007	8.70231532	3.2518057e-18	Q17 <--> Q17	e18	0.893177527	0.113469641	7.87151100	3.5038332e-15	Q18 <--> Q18	e19	0.616437482	0.076967253	8.00908772	1.1556246e-15	Q19 <--> Q19	e20	0.855556466	0.141520582	6.04545612	1.4898790e-09	Q20 <--> Q20	e21	1.030772948	0.155468876	6.63009200	3.3547771e-11	Q21 <--> Q21	F1F2DIR	0.407736694	0.083275769	4.89622252	9.7696435e-07	F2 <--- F1	F1F3DIR	0.902724046	0.112598958	8.01716163	1.0821668e-15	F3 <--- F1	F1F4DIR	0.520806176	0.131646222	3.95610423	7.6181932e-05	F4 <--- F1
	Min.	1st Qu.	Median	Mean	3rd Qu.	Max.																																																																																																																																																																																																																																																																																																																																																									
-1.76324751	-0.35685432	0.00000837	0.12497110	0.63869184	2.81328769																																																																																																																																																																																																																																																																																																																																																										
Q1	Q2	Q3	Q4	Q5	F3	Q15	Q16	Q17	F2																																																																																																																																																																																																																																																																																																																																																						
Q10	Q11	Q12	Q13	Q14																																																																																																																																																																																																																																																																																																																																																											
0.8199	0.7997	0.6480	0.6004	0.5048	0.6264	0.6857	0.6115	0.6173	0.1426																																																																																																																																																																																																																																																																																																																																																						
0.5267	0.5814	0.6167	0.7366	0.6026	0.4571	0.7056	0.8340	0.6228																																																																																																																																																																																																																																																																																																																																																							
Q18	F4	Q19	Q20	Q21																																																																																																																																																																																																																																																																																																																																																											
0.7213	0.4590	0.5620	0.7101	0.6745																																																																																																																																																																																																																																																																																																																																																											
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lam1	1.608582711	0.096797094	16.61808882	5.1549930e-62	Q1 <--- F1																																																																																																																																																																																																																																																																																																																																																										
lam2	1.533298744	0.094265385	16.26576646	1.7269253e-59	Q2 <--- F1																																																																																																																																																																																																																																																																																																																																																										
lam3	1.302664145	0.094715887	13.75338590	4.8600669e-43	Q3 <--- F1																																																																																																																																																																																																																																																																																																																																																										
lam4	1.367859225	0.105220976	12.99987199	1.2254824e-38	Q4 <--- F1																																																																																																																																																																																																																																																																																																																																																										
lam5	1.048897739	0.091100541	11.51362793	1.1263809e-30	Q5 <--- F1																																																																																																																																																																																																																																																																																																																																																										
lam6	1.183556732	0.088259377	13.40998286	5.2851042e-41	Q6 <--- F1																																																																																																																																																																																																																																																																																																																																																										
lam7	1.516650456	0.105613336	14.36040675	9.1687448e-47	Q7 <--- F1																																																																																																																																																																																																																																																																																																																																																										
lam8	1.400204107	0.106277223	13.17501596	1.2220159e-39	Q8 <--- F1																																																																																																																																																																																																																																																																																																																																																										
lam9	1.377112371	0.103805008	13.26633847	3.6288320e-40	Q9 <--- F1																																																																																																																																																																																																																																																																																																																																																										
lam10	0.727571362	0.063832319	11.39816584	4.2702074e-30	Q10 <--- F2																																																																																																																																																																																																																																																																																																																																																										
lam11	0.746581481	0.061222614	12.19453777	3.3238467e-34	Q11 <--- F2																																																																																																																																																																																																																																																																																																																																																										
lam12	0.736412509	0.057946665	12.70845379	5.3073466e-37	Q12 <--- F2																																																																																																																																																																																																																																																																																																																																																										
lam13	0.729131564	0.050471794	14.44631768	2.6445096e-47	Q13 <--- F2																																																																																																																																																																																																																																																																																																																																																										
lam14	0.656864351	0.052537122	12.50286122	7.2011974e-36	Q14 <--- F2																																																																																																																																																																																																																																																																																																																																																										
lam15	1.122573895	0.082504802	13.60616438	3.6805948e-42	Q15 <--- F3																																																																																																																																																																																																																																																																																																																																																										
lam16	1.237868212	0.081432478	15.20116105	3.4740855e-52	Q16 <--- F3																																																																																																																																																																																																																																																																																																																																																										
lam17	1.046342686	0.083641448	12.50985862	6.5941490e-36	Q17 <--- F3																																																																																																																																																																																																																																																																																																																																																										
lam18	1.120414800	0.081118318	13.81210586	2.1544020e-43	Q18 <--- F3																																																																																																																																																																																																																																																																																																																																																										
lam19	0.654116109	0.059562463	10.98201910	4.6638156e-28	Q19 <--- F4																																																																																																																																																																																																																																																																																																																																																										
lam20	1.064748301	0.085659917	12.42994786	1.7975157e-35	Q20 <--- F4																																																																																																																																																																																																																																																																																																																																																										
lam21	1.074937856	0.088508858	12.14497493	6.1001285e-34	Q21 <--- F4																																																																																																																																																																																																																																																																																																																																																										
e1	0.568261817	0.072260791	7.86404086	3.7193614e-15	Q1 <--> Q1																																																																																																																																																																																																																																																																																																																																																										
e2	0.589012268	0.072390036	8.13664837	4.0637075e-16	Q2 <--> Q2																																																																																																																																																																																																																																																																																																																																																										
e3	0.921920938	0.100352137	9.18685908	4.0447915e-20	Q3 <--> Q3																																																																																																																																																																																																																																																																																																																																																										
e4	1.245352450	0.133178260	9.35101909	8.6807243e-21	Q4 <--> Q4																																																																																																																																																																																																																																																																																																																																																										
e5	1.079156341	0.112592438	9.58462541	9.2793754e-22	Q5 <--> Q5																																																																																																																																																																																																																																																																																																																																																										
e6	0.835549656	0.090168081	9.26657913	1.9221171e-20	Q6 <--> Q6																																																																																																																																																																																																																																																																																																																																																										
e7	1.054427368	0.116885817	9.02100355	1.8637404e-19	Q7 <--> Q7																																																																																																																																																																																																																																																																																																																																																										
e8	1.245527888	0.133693832	9.31627039	1.2050172e-20	Q8 <--> Q8																																																																																																																																																																																																																																																																																																																																																										
e9	1.175714719	0.126456396	9.29739224	1.4393243e-20	Q9 <--> Q9																																																																																																																																																																																																																																																																																																																																																										
e10	0.554733476	0.063445756	8.74342923	2.2613954e-18	Q10 <--> Q10																																																																																																																																																																																																																																																																																																																																																										
e11	0.467959800	0.055688186	8.40321500	4.3441829e-17	Q11 <--> Q11																																																																																																																																																																																																																																																																																																																																																										
e12	0.393014520	0.048344009	8.12953929	4.3092507e-16	Q12 <--> Q12																																																																																																																																																																																																																																																																																																																																																										
e13	0.221743796	0.033134028	6.69232836	2.1964731e-11	Q13 <--> Q13																																																																																																																																																																																																																																																																																																																																																										
e14	0.331820883	0.040244589	8.24510562	1.6501439e-16	Q14 <--> Q14																																																																																																																																																																																																																																																																																																																																																										
e15	0.968292549	0.120364329	8.04468035	8.6470830e-16	Q15 <--> Q15																																																																																																																																																																																																																																																																																																																																																										
e16	0.561857872	0.095905395	5.85845952	4.6718045e-09	Q16 <--> Q16																																																																																																																																																																																																																																																																																																																																																										
e17	1.221343907	0.140347007	8.70231532	3.2518057e-18	Q17 <--> Q17																																																																																																																																																																																																																																																																																																																																																										
e18	0.893177527	0.113469641	7.87151100	3.5038332e-15	Q18 <--> Q18																																																																																																																																																																																																																																																																																																																																																										
e19	0.616437482	0.076967253	8.00908772	1.1556246e-15	Q19 <--> Q19																																																																																																																																																																																																																																																																																																																																																										
e20	0.855556466	0.141520582	6.04545612	1.4898790e-09	Q20 <--> Q20																																																																																																																																																																																																																																																																																																																																																										
e21	1.030772948	0.155468876	6.63009200	3.3547771e-11	Q21 <--> Q21																																																																																																																																																																																																																																																																																																																																																										
F1F2DIR	0.407736694	0.083275769	4.89622252	9.7696435e-07	F2 <--- F1																																																																																																																																																																																																																																																																																																																																																										
F1F3DIR	0.902724046	0.112598958	8.01716163	1.0821668e-15	F3 <--- F1																																																																																																																																																																																																																																																																																																																																																										
F1F4DIR	0.520806176	0.131646222	3.95610423	7.6181932e-05	F4 <--- F1																																																																																																																																																																																																																																																																																																																																																										

	F2F3DIR 0.034731466 0.082356936 0.42171878 6.7323029e-01 F3 <--- F2 F2F4DIR 0.176535492 0.088746145 1.98921871 4.6677067e-02 F4 <--- F2 F3F4DIR 0.286376634 0.093034567 3.07817453 2.0827290e-03 F4 <--- F3
	Iterations = 36