

# Exploratory Factor Analysis III

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## 1 Preliminaries

*In this section, the RStudio workspace and console panes are cleared of old output, variables, and other miscellaneous debris. Packages are loaded.*

```
options(replace.assign = TRUE, width = 65, digits = 4, scipen = 4, fig.width = 4,
        fig.height = 4)
# Clear the workspace and console.
rm(list = ls(all = TRUE))
cat("\f")
```

```
# Turn off showing of significance asterisks.
options(show.signif.stars = F)
# Set the contrast option; important for ANOVAs.
options(contrasts = c("contr.sum", "contr.poly"))
how_long <- Sys.time()
set.seed(123)
library(knitr)
```

### 1.1 Packages

```
library(psych)
library(car)

## Loading required package: carData
##
## Attaching package: 'car'
## The following object is masked from 'package:psych':
##
##   logit

library(multcomp)

## Loading required package: mvtnorm
## Loading required package: survival
## Loading required package: TH.data
## Loading required package: MASS
##
## Attaching package: 'TH.data'
## The following object is masked from 'package:MASS':
##
##   geyser
```

```

library(ggplot2)

##
## Attaching package: 'ggplot2'
## The following objects are masked from 'package:psych':
##
##    %+%, alpha

library(MASS)
library(parallel)
library(ellipse)

##
## Attaching package: 'ellipse'
## The following object is masked from 'package:car':
##
##    ellipse
## The following object is masked from 'package:graphics':
##
##    pairs

library(FactoMineR)

## Warning: package 'FactoMineR' was built under R version 3.5.1

library(PerformanceAnalytics)

## Warning: package 'PerformanceAnalytics' was built under R version 3.5.1
## Loading required package: xts
## Loading required package: zoo
##
## Attaching package: 'zoo'
## The following objects are masked from 'package:base':
##
##    as.Date, as.Date.numeric
##
## Attaching package: 'PerformanceAnalytics'
## The following object is masked from 'package:graphics':
##
##    legend

library(plotpc)

## Loading required package: grid

library(sciplot)
library(GPArotation)
library(GGally)
library(MVN)

## sROC 0.1-2 loaded

library(qqplotr)
library(scatterplot3d)
library(rgl)

## Warning: package 'rgl' was built under R version 3.5.1

library(cowplot)

```

```
##  
## Attaching package: 'cowplot'  
## The following object is masked from 'package:ggplot2':  
##  
## ggsave
```

## 1.2 Data File

*The example data set comes from a sample of 538 university students who completed the Schwartz Values Inventory (1992). Participants rated the importance of 46 values representing 10 basic groups of values:*

- 1. Universalism*
- 2. Benevolence*
- 3. Tradition*
- 4. Conformity*
- 5. Security*
- 6. Power*
- 7. Achievement*
- 8. Hedonism*
- 9. Stimulation*
- 10. Self-Direction*

*Each value was rated using the following rating scale:*

- 1 = not at all important*
- 2 = slightly important*
- 3 = somewhat important*
- 4 = moderately important*
- 5 = very important*
- 6 = extremely important*
- 7 = completely important*

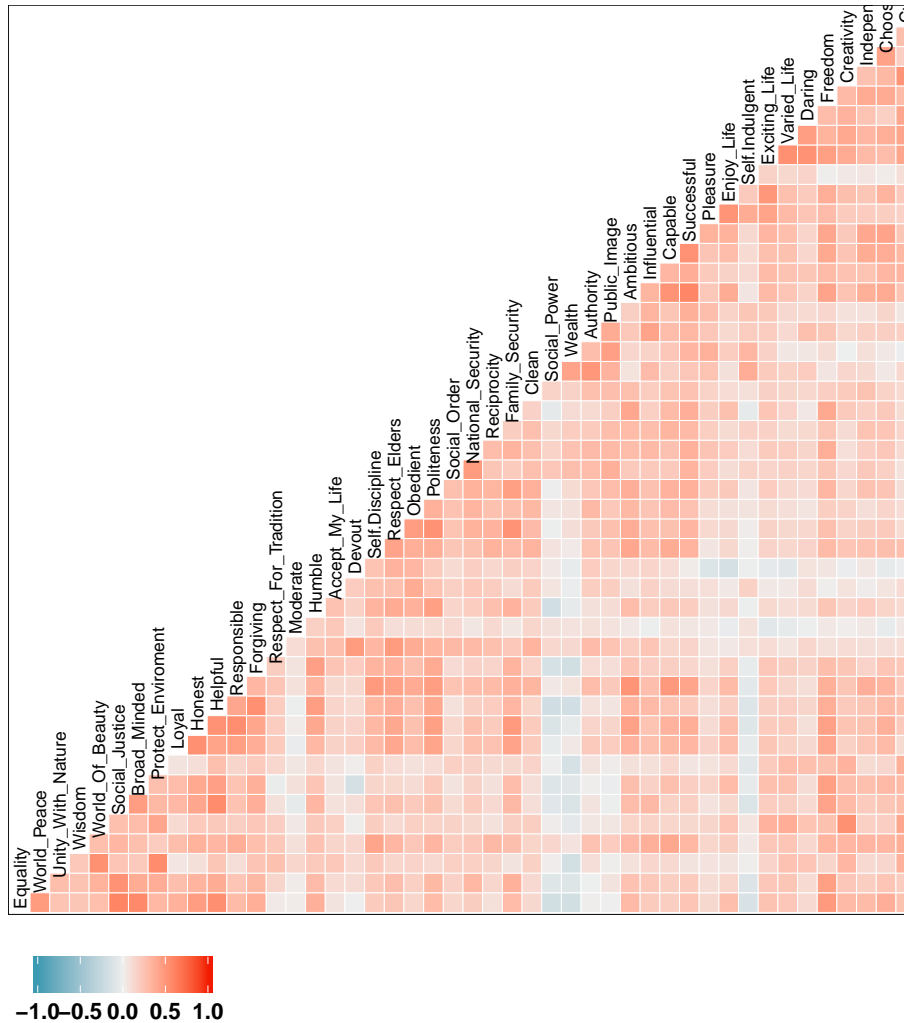
```
# Get the drug use data from the working directory.
setwd("C:\\Courses\\Psychology 516\\PowerPoint\\2018")
SVI <- read.table("values.csv", sep = ",", header = TRUE)
SVI <- as.data.frame(SVI)
SVI <- na.omit(SVI)
names(SVI) <- c("ID", "Equality", "World_Peace", "Unity_With_Nature",
  "Wisdom", "World_Of_Beauty", "Social_Justice", "Broad_Minded",
  "Protect_Enviroment", "Loyal", "Honest", "Helpful", "Responsible",
  "Forgiving", "Respect_For_Tradition", "Moderate", "Humble", "Accept_My_Life",
  "Devout", "Self-Discipline", "Respect_Elders", "Obedient", "Politeness",
  "Social_Order", "National_Security", "Reciprocity", "Family_Security",
  "Clean", "Social_Power", "Wealth", "Authority", "Public_Image",
  "Ambitious", "Influential", "Capable", "Successful", "Pleasure",
  "Enjoy_Life", "Self-Indulgent", "Exciting_Life", "Varied_Life",
  "Daring", "Freedom", "Creativity", "Independent", "Choose_Own_Goals",
  "Curious", "Age_In_Months", "Sex")
```

## 2 Correlations

*A heat map for the correlation matrix easily identifies the pattern of correlations in the simulated data.*

```
ggcorr(SVI[, 2:47], label = FALSE, angle = 90, hjust = 0.1, size = 2.5,
  digits = 2) + theme(text = element_text(size = 14, family = "sans",
  color = "black", face = "bold"), axis.text.y = element_text(colour = "black",
  size = 12, face = "bold"), axis.text.x = element_text(colour = "black",
  size = 12, face = "bold", angle = 0), axis.title.x = element_text(margin = margin(15,
  0, 0, 0), size = 16), axis.title.y = element_text(margin = margin(0,
  15, 0, 0), size = 16), axis.line.x = element_blank(), axis.line.y = element_blank(),
  plot.title = element_text(size = 16, face = "bold", margin = margin(0,
  0, 20, 0), hjust = 0.5), panel.background = element_rect(fill = "white",
  linetype = 1, color = "black"), panel.grid.major = element_blank(),
  panel.grid.minor = element_blank(), plot.background = element_rect(fill = "white"),
  plot.margin = unit(c(1, 1, 1, 1), "cm"), legend.position = "bottom",
  legend.title = element_blank()) + ggtitle("Intercorrelations Among Items")
```

## Intercorrelations Among Items



### 3 Rotated Solutions in the Values Study

*Oblique rotation can be carried out in a number of ways. The oblimin and promax solutions are the most common. Promax raises the loading to a power to better separate high loadings from low loadings. Then when simple structure is found, the axes are rotated to the position of those loadings using least squares, which induces correlations among the factors.*

*Oblimin seeks to minimize the covariance among squared loadings of separate columns. This will also induce a correlations.*

### 3.1 No Rotation

*First, here is the unrotated solution.*

```
fit_FA_1 <- fa(SVI[, 2:47], nfactors = 4, rotate = "none", fm = "minres")
fit_FA_1

## Factor Analysis using method = minres
## Call: fa(r = SVI[, 2:47], nfactors = 4, rotate = "none", fm = "minres")
## Standardized loadings (pattern matrix) based upon correlation matrix
##
```

	MR1	MR2	MR3	MR4	h2	u2	com
## Equality	0.55	-0.48	0.07	-0.13	0.549	0.45	2.1
## World_Peace	0.50	-0.33	0.00	0.05	0.361	0.64	1.8
## Unity_With_Nature	0.36	-0.21	0.16	0.57	0.524	0.48	2.2
## Wisdom	0.55	0.01	0.01	0.05	0.308	0.69	1.0
## World_Of_Beauty	0.44	-0.21	0.30	0.37	0.458	0.54	3.3
## Social_Justice	0.52	-0.42	0.00	-0.01	0.446	0.55	1.9
## Broad_Minded	0.48	-0.39	0.18	-0.16	0.442	0.56	2.5
## Protect_Enviroment	0.36	-0.27	0.24	0.38	0.405	0.59	3.5
## Loyal	0.56	-0.08	-0.20	-0.21	0.409	0.59	1.6
## Honest	0.63	-0.23	-0.20	-0.25	0.553	0.45	1.8
## Helpful	0.59	-0.41	-0.16	-0.05	0.539	0.46	2.0
## Responsible	0.63	0.03	-0.20	-0.17	0.472	0.53	1.4
## Forgiving	0.51	-0.29	-0.17	0.07	0.385	0.62	1.9
## Respect_For_Tradition	0.40	0.23	-0.33	0.37	0.458	0.54	3.6
## Moderate	0.11	0.09	-0.13	0.16	0.061	0.94	3.4
## Humble	0.50	-0.19	-0.29	0.06	0.373	0.63	2.0
## Accept_My_Life	0.29	0.11	-0.22	0.30	0.232	0.77	3.1
## Devout	0.21	0.11	-0.43	0.27	0.317	0.68	2.4
## Self-Discipline	0.57	0.07	-0.23	0.12	0.391	0.61	1.5
## Respect_Elders	0.59	0.08	-0.41	0.06	0.517	0.48	1.8
## Obedient	0.48	0.14	-0.34	0.17	0.389	0.61	2.3
## Politeness	0.61	0.05	-0.31	-0.06	0.472	0.53	1.5
## Social_Order	0.40	0.29	-0.05	0.12	0.262	0.74	2.1
## National_Security	0.50	0.22	-0.10	0.04	0.311	0.69	1.5
## Reciprocity	0.43	0.22	-0.13	0.04	0.258	0.74	1.7
## Family_Security	0.55	-0.06	-0.21	-0.18	0.380	0.62	1.5
## Clean	0.42	0.21	-0.12	0.14	0.254	0.75	1.9
## Social_Power	0.13	0.60	0.26	0.12	0.463	0.54	1.6
## Wealth	0.14	0.64	0.09	-0.18	0.464	0.54	1.3
## Authority	0.39	0.45	-0.01	0.11	0.369	0.63	2.1
## Public_Image	0.36	0.49	-0.06	0.01	0.372	0.63	1.9
## Ambitious	0.63	0.08	-0.04	-0.26	0.468	0.53	1.4
## Influential	0.51	0.19	0.06	0.04	0.305	0.69	1.3
## Capable	0.58	0.18	0.04	-0.17	0.396	0.60	1.4
## Successful	0.60	0.30	0.07	-0.29	0.535	0.46	2.0
## Pleasure	0.37	0.30	0.33	-0.14	0.351	0.65	3.3
## Enjoy_Life	0.44	0.07	0.32	-0.27	0.377	0.62	2.6
## Self-Indulgent	0.10	0.43	0.19	0.07	0.240	0.76	1.6
## Exciting_Life	0.51	0.09	0.48	-0.04	0.500	0.50	2.1
## Varied_Life	0.45	-0.01	0.47	0.08	0.435	0.57	2.1
## Daring	0.36	0.08	0.37	0.22	0.323	0.68	2.7
## Freedom	0.65	-0.11	0.18	-0.21	0.505	0.50	1.4
## Creativity	0.48	-0.12	0.37	0.20	0.419	0.58	2.4
## Independent	0.48	0.04	0.15	-0.15	0.277	0.72	1.4

```
## Choose_Own_Goals      0.52 -0.03  0.17 -0.19 0.343 0.66 1.5
## Curious                0.46 -0.10  0.39  0.23 0.436 0.56 2.6
##
##              MR1  MR2  MR3  MR4
## SS loadings      10.37 3.23 2.65 1.85
## Proportion Var    0.23 0.07 0.06 0.04
## Cumulative Var    0.23 0.30 0.35 0.39
## Proportion Explained 0.57 0.18 0.15 0.10
## Cumulative Proportion 0.57 0.75 0.90 1.00
##
## Mean item complexity = 2
## Test of the hypothesis that 4 factors are sufficient.
##
## The degrees of freedom for the null model are 1035 and the objective function was 19.86 with Chi S
## The degrees of freedom for the model are 857 and the objective function was 4.29
##
## The root mean square of the residuals (RMSR) is 0.04
## The df corrected root mean square of the residuals is 0.05
##
## The harmonic number of observations is 538 with the empirical chi square 1946 with prob < 2e-86
## The total number of observations was 538 with Likelihood Chi Square = 2221 with prob < 1.1e-121
##
## Tucker Lewis Index of factoring reliability = 0.822
## RMSEA index = 0.056 and the 90 % confidence intervals are 0.052 0.057
## BIC = -3167
## Fit based upon off diagonal values = 0.97
## Measures of factor score adequacy
##
##              MR1  MR2  MR3
## Correlation of (regression) scores with factors 0.97 0.92 0.91
## Multiple R square of scores with factors        0.95 0.85 0.82
## Minimum correlation of possible factor scores    0.90 0.70 0.64
##
##              MR4
## Correlation of (regression) scores with factors 0.88
## Multiple R square of scores with factors        0.77
## Minimum correlation of possible factor scores    0.54
```

## 3.2 Varimax Rotation

*Varimax rotation is the most common orthogonal approach. Note that some software performs "Kaiser normalization" as part of the rotation. The `fa()` function does not. This usually makes no practical difference. There is a `kaiser()` function that can be used if desired. This will make the output equivalent to what software such as SPSS produces.*

```
fit_FA_2 <- fa(SVI[, 2:47], nfactors = 4, rotate = "varimax", fm = "minres")
fit_FA_2

## Factor Analysis using method = minres
## Call: fa(r = SVI[, 2:47], nfactors = 4, rotate = "varimax", fm = "minres")
## Standardized loadings (pattern matrix) based upon correlation matrix
##
##              MR1  MR2  MR3  MR4  h2  u2 com
## Equality      0.64 -0.15 0.34 -0.03 0.549 0.45 1.7
## World_Peace    0.46 -0.11 0.34  0.14 0.361 0.64 2.2
```

```

## Unity_With_Nature      0.01 -0.11  0.64  0.31 0.524 0.48 1.5
## Wisdom                 0.38  0.19  0.26  0.25 0.308 0.69 3.2
## World_Of_Beauty        0.15  0.01  0.65  0.14 0.458 0.54 1.2
## Social_Justice         0.55 -0.17  0.33  0.09 0.446 0.55 1.9
## Broad_Minded           0.55 -0.05  0.35 -0.12 0.442 0.56 1.8
## Protect_Enviroment     0.12 -0.10  0.60  0.13 0.405 0.59 1.2
## Loyal                  0.59  0.10  0.01  0.21 0.409 0.59 1.3
## Honest                 0.72  0.00  0.06  0.18 0.553 0.45 1.1
## Helpful                0.64 -0.19  0.24  0.20 0.539 0.46 1.7
## Responsible            0.59  0.20  0.03  0.30 0.472 0.53 1.7
## Forgiving              0.48 -0.15  0.24  0.28 0.385 0.62 2.4
## Respect_For_Tradition  0.07  0.12  0.10  0.66 0.458 0.54 1.1
## Moderate               -0.02  0.03  0.03  0.24 0.061 0.94 1.1
## Humble                 0.46 -0.11  0.11  0.37 0.373 0.63 2.2
## Accept_My_Life         0.05  0.04  0.12  0.46 0.232 0.77 1.2
## Devout                 0.05 -0.06 -0.06  0.55 0.317 0.68 1.1
## Self-Discipline        0.37  0.14  0.14  0.47 0.391 0.61 2.3
## Respect_Elders         0.45  0.09 -0.01  0.56 0.517 0.48 2.0
## Obedient               0.27  0.11  0.03  0.55 0.389 0.61 1.6
## Politeness             0.52  0.14  0.00  0.43 0.472 0.53 2.1
## Social_Order           0.13  0.33  0.11  0.35 0.262 0.74 2.5
## National_Security      0.29  0.31  0.09  0.35 0.311 0.69 3.1
## Reciprocity            0.24  0.27  0.05  0.35 0.258 0.74 2.8
## Family_Security        0.56  0.09  0.01  0.24 0.380 0.62 1.4
## Clean                  0.18  0.24  0.12  0.39 0.254 0.75 2.3
## Social_Power           -0.23  0.62  0.10  0.13 0.463 0.54 1.4
## Wealth                 -0.05  0.65 -0.18  0.08 0.464 0.54 1.2
## Authority              0.06  0.48  0.08  0.36 0.369 0.63 2.0
## Public_Image           0.09  0.50 -0.04  0.33 0.372 0.63 1.8
## Ambitious              0.58  0.32  0.06  0.15 0.468 0.53 1.7
## Influential            0.28  0.35  0.21  0.25 0.305 0.69 3.5
## Capable                0.45  0.40  0.10  0.16 0.396 0.60 2.4
## Successful             0.48  0.54  0.03  0.12 0.535 0.46 2.1
## Pleasure               0.18  0.53  0.18 -0.06 0.351 0.65 1.5
## Enjoy_Life             0.39  0.39  0.20 -0.17 0.377 0.62 2.9
## Self-Indulgent         -0.16  0.45  0.07  0.08 0.240 0.76 1.3
## Exciting_Life          0.29  0.44  0.46 -0.10 0.500 0.50 2.8
## Varied_Life            0.22  0.31  0.53 -0.08 0.435 0.57 2.0
## Daring                 0.05  0.29  0.49  0.06 0.323 0.68 1.7
## Freedom                0.60  0.25  0.29  0.00 0.505 0.50 1.8
## Creativity             0.23  0.16  0.58  0.03 0.419 0.58 1.5
## Independent            0.39  0.29  0.20  0.02 0.277 0.72 2.4
## Choose_Own_Goals       0.47  0.26  0.22 -0.02 0.343 0.66 2.0
## Curious                0.19  0.18  0.61  0.04 0.436 0.56 1.4
##
##
## MR1 MR2 MR3 MR4
## SS loadings      6.73 3.91 3.74 3.72
## Proportion Var   0.15 0.09 0.08 0.08
## Cumulative Var   0.15 0.23 0.31 0.39
## Proportion Explained 0.37 0.22 0.21 0.21
## Cumulative Proportion 0.37 0.59 0.79 1.00
##
## Mean item complexity = 1.9
## Test of the hypothesis that 4 factors are sufficient.

```



```

##
## The degrees of freedom for the null model are 1035 and the objective function was 19.86 with Chi S
## The degrees of freedom for the model are 857 and the objective function was 4.29
##
## The root mean square of the residuals (RMSR) is 0.04
## The df corrected root mean square of the residuals is 0.05
##
## The harmonic number of observations is 538 with the empirical chi square 1946 with prob < 2e-86
## The total number of observations was 538 with Likelihood Chi Square = 2221 with prob < 1.1e-121
##
## Tucker Lewis Index of factoring reliability = 0.822
## RMSEA index = 0.056 and the 90 % confidence intervals are 0.052 0.057
## BIC = -3167
## Fit based upon off diagonal values = 0.97
## Measures of factor score adequacy
##
## Correlation of (regression) scores with factors MR1 MR2 MR3
## Multiple R square of scores with factors 0.94 0.92 0.91
## Minimum correlation of possible factor scores 0.88 0.85 0.83
##
## Correlation of (regression) scores with factors MR4
## Multiple R square of scores with factors 0.77 0.71 0.66
## Minimum correlation of possible factor scores 0.91
## Multiple R square of scores with factors 0.82
## Minimum correlation of possible factor scores 0.64

fa.sort(fit_FA_2, polar = FALSE)

## Factor Analysis using method = minres
## Call: fa(r = SVI[, 2:47], nfactors = 4, rotate = "varimax", fm = "minres")
## Standardized loadings (pattern matrix) based upon correlation matrix
##
## MR1 MR2 MR3 MR4 h2 u2 com
## Honest 0.72 0.00 0.06 0.18 0.553 0.45 1.1
## Helpful 0.64 -0.19 0.24 0.20 0.539 0.46 1.7
## Equality 0.64 -0.15 0.34 -0.03 0.549 0.45 1.7
## Freedom 0.60 0.25 0.29 0.00 0.505 0.50 1.8
## Loyal 0.59 0.10 0.01 0.21 0.409 0.59 1.3
## Responsible 0.59 0.20 0.03 0.30 0.472 0.53 1.7
## Ambitious 0.58 0.32 0.06 0.15 0.468 0.53 1.7
## Family_Security 0.56 0.09 0.01 0.24 0.380 0.62 1.4
## Broad_Minded 0.55 -0.05 0.35 -0.12 0.442 0.56 1.8
## Social_Justice 0.55 -0.17 0.33 0.09 0.446 0.55 1.9
## Politeness 0.52 0.14 0.00 0.43 0.472 0.53 2.1
## Forgiving 0.48 -0.15 0.24 0.28 0.385 0.62 2.4
## Choose_Own_Goals 0.47 0.26 0.22 -0.02 0.343 0.66 2.0
## World_Peace 0.46 -0.11 0.34 0.14 0.361 0.64 2.2
## Humble 0.46 -0.11 0.11 0.37 0.373 0.63 2.2
## Capable 0.45 0.40 0.10 0.16 0.396 0.60 2.4
## Independent 0.39 0.29 0.20 0.02 0.277 0.72 2.4
## Enjoy_Life 0.39 0.39 0.20 -0.17 0.377 0.62 2.9
## Wisdom 0.38 0.19 0.26 0.25 0.308 0.69 3.2
## Wealth -0.05 0.65 -0.18 0.08 0.464 0.54 1.2
## Social_Power -0.23 0.62 0.10 0.13 0.463 0.54 1.4
## Successful 0.48 0.54 0.03 0.12 0.535 0.46 2.1
## Pleasure 0.18 0.53 0.18 -0.06 0.351 0.65 1.5
## Public_Image 0.09 0.50 -0.04 0.33 0.372 0.63 1.8

```

```

## Authority          0.06  0.48  0.08  0.36  0.369  0.63  2.0
## Self-Indulgent     -0.16  0.45  0.07  0.08  0.240  0.76  1.3
## Influential        0.28  0.35  0.21  0.25  0.305  0.69  3.5
## World_Of_Beauty    0.15  0.01  0.65  0.14  0.458  0.54  1.2
## Unity_With_Nature  0.01 -0.11  0.64  0.31  0.524  0.48  1.5
## Curious            0.19  0.18  0.61  0.04  0.436  0.56  1.4
## Protect_Enviroment 0.12 -0.10  0.60  0.13  0.405  0.59  1.2
## Creativity         0.23  0.16  0.58  0.03  0.419  0.58  1.5
## Varied_Life        0.22  0.31  0.53 -0.08  0.435  0.57  2.0
## Daring             0.05  0.29  0.49  0.06  0.323  0.68  1.7
## Exciting_Life      0.29  0.44  0.46 -0.10  0.500  0.50  2.8
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## Respect_Elders     0.45  0.09 -0.01  0.56  0.517  0.48  2.0
## Devout             0.05 -0.06 -0.06  0.55  0.317  0.68  1.1
## Obedient           0.27  0.11  0.03  0.55  0.389  0.61  1.6
## Self-Discipline    0.37  0.14  0.14  0.47  0.391  0.61  2.3
## Accept_My_Life     0.05  0.04  0.12  0.46  0.232  0.77  1.2
## Clean              0.18  0.24  0.12  0.39  0.254  0.75  2.3
## National_Security  0.29  0.31  0.09  0.35  0.311  0.69  3.1
## Reciprocity        0.24  0.27  0.05  0.35  0.258  0.74  2.8
## Social_Order       0.13  0.33  0.11  0.35  0.262  0.74  2.5
## Moderate           -0.02  0.03  0.03  0.24  0.061  0.94  1.1
##
##
##              MR1  MR2  MR3  MR4
## SS loadings      6.73 3.91 3.74 3.72
## Proportion Var    0.15 0.09 0.08 0.08
## Cumulative Var    0.15 0.23 0.31 0.39
## Proportion Explained 0.37 0.22 0.21 0.21
## Cumulative Proportion 0.37 0.59 0.79 1.00
##
## Mean item complexity = 1.9
## Test of the hypothesis that 4 factors are sufficient.
##
## The degrees of freedom for the null model are 1035 and the objective function was 19.86 with Chi S
## The degrees of freedom for the model are 857 and the objective function was 4.29
##
## The root mean square of the residuals (RMSR) is 0.04
## The df corrected root mean square of the residuals is 0.05
##
## The harmonic number of observations is 538 with the empirical chi square 1946 with prob < 2e-86
## The total number of observations was 538 with Likelihood Chi Square = 2221 with prob < 1.1e-121
##
## Tucker Lewis Index of factoring reliability = 0.822
## RMSEA index = 0.056 and the 90 % confidence intervals are 0.052 0.057
## BIC = -3167
## Fit based upon off diagonal values = 0.97
## Measures of factor score adequacy
##
##              MR1  MR2  MR3
## Correlation of (regression) scores with factors 0.94 0.92 0.91
## Multiple R square of scores with factors 0.88 0.85 0.83
## Minimum correlation of possible factor scores 0.77 0.71 0.66
##
##              MR4
## Correlation of (regression) scores with factors 0.91
## Multiple R square of scores with factors 0.82

```

```
## Minimum correlation of possible factor scores      0.64
```

### 3.3 Oblimin Rotation

*Direct oblimin seeks to minimize the covariance among squared loadings of separate columns. This will also induce a correlations.*

```
fit_FA_3 <- fa(SVI[, 2:47], nfactors = 4, rotate = "oblimin", fm = "minres",
  scores = "tenberge")
fit_FA_3

## Factor Analysis using method = minres
## Call: fa(r = SVI[, 2:47], nfactors = 4, rotate = "oblimin", scores = "tenberge",
##      fm = "minres")
## Standardized loadings (pattern matrix) based upon correlation matrix
##
##      MR1   MR2   MR4   MR3   h2   u2 com
## Equality      0.64 -0.22  0.23 -0.14 0.549 0.45 1.6
## World_Peace    0.44 -0.17  0.28  0.05 0.361 0.64 2.1
## Unity_With_Nature -0.13 -0.15  0.71  0.26 0.524 0.48 1.4
## Wisdom         0.33  0.15  0.22  0.16 0.308 0.69 2.8
## World_Of_Beauty  0.03 -0.03  0.66  0.06 0.458 0.54 1.0
## Social_Justice  0.53 -0.23  0.25 -0.01 0.446 0.55 1.8
## Broad_Minded    0.55 -0.11  0.24 -0.23 0.442 0.56 1.9
## Protect_Enviroment 0.01 -0.14  0.63  0.07 0.405 0.59 1.1
## Loyal          0.62  0.05 -0.09  0.12 0.409 0.59 1.1
## Honest         0.75 -0.06 -0.06  0.07 0.553 0.45 1.0
## Helpful        0.64 -0.25  0.15  0.10 0.539 0.46 1.5
## Responsible    0.59  0.15 -0.06  0.20 0.472 0.53 1.4
## Forgiving      0.46 -0.20  0.19  0.20 0.385 0.62 2.2
## Respect_For_Tradition -0.01  0.10  0.15  0.63 0.458 0.54 1.2
## Moderate      -0.05  0.03  0.06  0.24 0.061 0.94 1.2
## Humble         0.45 -0.16  0.07  0.31 0.373 0.63 2.1
## Accept_My_Life -0.01  0.02  0.16  0.45 0.232 0.77 1.3
## Devout         0.02 -0.07 -0.02  0.56 0.317 0.68 1.0
## Self-Discipline 0.32  0.10  0.11  0.40 0.391 0.61 2.3
## Respect_Elders  0.43  0.05 -0.04  0.49 0.517 0.48 2.0
## Obedient       0.23  0.08  0.03  0.50 0.389 0.61 1.5
## Politeness     0.51  0.10 -0.06  0.35 0.472 0.53 1.9
## Social_Order   0.07  0.32  0.12  0.30 0.262 0.74 2.4
## National_Security 0.24  0.28  0.07  0.28 0.311 0.69 3.1
## Reciprocity    0.21  0.25  0.03  0.29 0.258 0.74 2.8
## Family_Security 0.58  0.05 -0.08  0.15 0.380 0.62 1.2
## Clean         0.12  0.22  0.12  0.34 0.254 0.75 2.3
## Social_Power   -0.32  0.64  0.16  0.11 0.463 0.54 1.7
## Wealth        -0.06  0.67 -0.19  0.05 0.464 0.54 1.2
## Authority      0.00  0.47  0.10  0.31 0.369 0.63 1.8
## Public_Image   0.04  0.50 -0.04  0.29 0.372 0.63 1.6
## Ambitious     0.59  0.28 -0.05  0.04 0.468 0.53 1.4
## Influential    0.22  0.32  0.18  0.16 0.305 0.69 3.0
## Capable       0.43  0.37  0.03  0.06 0.396 0.60 2.0
## Successful     0.47  0.51 -0.06  0.01 0.535 0.46 2.0
## Pleasure      0.14  0.52  0.14 -0.14 0.351 0.65 1.5
## Enjoy_Life     0.38  0.36  0.11 -0.27 0.377 0.62 3.0
```

```

## Self-Indulgent      -0.22  0.47  0.10  0.06 0.240 0.76 1.6
## Exciting_Life       0.21  0.40  0.41 -0.22 0.500 0.50 3.0
## Varied_Life         0.12  0.28  0.50 -0.18 0.435 0.57 2.0
## Daring              -0.06  0.26  0.50 -0.02 0.323 0.68 1.5
## Freedom             0.58  0.19  0.18 -0.13 0.505 0.50 1.6
## Creativity          0.13  0.12  0.57 -0.06 0.419 0.58 1.2
## Independent         0.37  0.25  0.13 -0.08 0.277 0.72 2.1
## Choose_Own_Goals    0.46  0.22  0.13 -0.13 0.343 0.66 1.8
## Curious             0.08  0.14  0.60 -0.06 0.436 0.56 1.2
##
##                      MR1  MR2  MR4  MR3
## SS loadings          7.07 3.92 3.85 3.26
## Proportion Var       0.15 0.09 0.08 0.07
## Cumulative Var       0.15 0.24 0.32 0.39
## Proportion Explained 0.39 0.22 0.21 0.18
## Cumulative Proportion 0.39 0.61 0.82 1.00
##
## With factor correlations of
##      MR1  MR2  MR4  MR3
## MR1 1.00 0.16 0.36 0.21
## MR2 0.16 1.00 0.10 0.10
## MR4 0.36 0.10 1.00 0.05
## MR3 0.21 0.10 0.05 1.00
##
## Mean item complexity = 1.8
## Test of the hypothesis that 4 factors are sufficient.
##
## The degrees of freedom for the null model are 1035 and the objective function was 19.86 with Chi S
## The degrees of freedom for the model are 857 and the objective function was 4.29
##
## The root mean square of the residuals (RMSR) is 0.04
## The df corrected root mean square of the residuals is 0.05
##
## The harmonic number of observations is 538 with the empirical chi square 1946 with prob < 2e-86
## The total number of observations was 538 with Likelihood Chi Square = 2221 with prob < 1.1e-121
##
## Tucker Lewis Index of factoring reliability = 0.822
## RMSEA index = 0.056 and the 90 % confidence intervals are 0.052 0.057
## BIC = -3167
## Fit based upon off diagonal values = 0.97
## Measures of factor score adequacy
##                      MR1  MR2  MR4
## Correlation of (regression) scores with factors 0.96 0.93 0.93
## Multiple R square of scores with factors         0.92 0.86 0.86
## Minimum correlation of possible factor scores     0.84 0.72 0.72
##                      MR3
## Correlation of (regression) scores with factors 0.91
## Multiple R square of scores with factors         0.83
## Minimum correlation of possible factor scores     0.65

fa.sort(fit_FA_3, polar = FALSE)

## Factor Analysis using method = minres
## Call: fa(r = SVI[, 2:47], nfactors = 4, rotate = "oblimin", scores = "tenberge",

```

```

##      fm = "minres")
## Standardized loadings (pattern matrix) based upon correlation matrix
##      MR1   MR2   MR4   MR3   h2   u2   com
## Honest      0.75 -0.06 -0.06  0.07 0.553 0.45 1.0
## Helpful      0.64 -0.25  0.15  0.10 0.539 0.46 1.5
## Equality     0.64 -0.22  0.23 -0.14 0.549 0.45 1.6
## Loyal        0.62  0.05 -0.09  0.12 0.409 0.59 1.1
## Responsible  0.59  0.15 -0.06  0.20 0.472 0.53 1.4
## Ambitious    0.59  0.28 -0.05  0.04 0.468 0.53 1.4
## Family_Security 0.58  0.05 -0.08  0.15 0.380 0.62 1.2
## Freedom      0.58  0.19  0.18 -0.13 0.505 0.50 1.6
## Broad_Minded 0.55 -0.11  0.24 -0.23 0.442 0.56 1.9
## Social_Justice 0.53 -0.23  0.25 -0.01 0.446 0.55 1.8
## Politeness   0.51  0.10 -0.06  0.35 0.472 0.53 1.9
## Choose_Own_Goals 0.46  0.22  0.13 -0.13 0.343 0.66 1.8
## Forgiving     0.46 -0.20  0.19  0.20 0.385 0.62 2.2
## Humble        0.45 -0.16  0.07  0.31 0.373 0.63 2.1
## World_Peace   0.44 -0.17  0.28  0.05 0.361 0.64 2.1
## Capable       0.43  0.37  0.03  0.06 0.396 0.60 2.0
## Enjoy_Life    0.38  0.36  0.11 -0.27 0.377 0.62 3.0
## Independent   0.37  0.25  0.13 -0.08 0.277 0.72 2.1
## Wisdom        0.33  0.15  0.22  0.16 0.308 0.69 2.8
## Wealth       -0.06  0.67 -0.19  0.05 0.464 0.54 1.2
## Social_Power -0.32  0.64  0.16  0.11 0.463 0.54 1.7
## Pleasure      0.14  0.52  0.14 -0.14 0.351 0.65 1.5
## Successful    0.47  0.51 -0.06  0.01 0.535 0.46 2.0
## Public_Image  0.04  0.50 -0.04  0.29 0.372 0.63 1.6
## Authority     0.00  0.47  0.10  0.31 0.369 0.63 1.8
## Self-Indulgent -0.22  0.47  0.10  0.06 0.240 0.76 1.6
## Influential   0.22  0.32  0.18  0.16 0.305 0.69 3.0
## Social_Order  0.07  0.32  0.12  0.30 0.262 0.74 2.4
## Unity_With_Nature -0.13 -0.15  0.71  0.26 0.524 0.48 1.4
## World_Of_Beauty 0.03 -0.03  0.66  0.06 0.458 0.54 1.0
## Protect_Enviroment 0.01 -0.14  0.63  0.07 0.405 0.59 1.1
## Curious       0.08  0.14  0.60 -0.06 0.436 0.56 1.2
## Creativity    0.13  0.12  0.57 -0.06 0.419 0.58 1.2
## Varied_Life   0.12  0.28  0.50 -0.18 0.435 0.57 2.0
## Daring        -0.06  0.26  0.50 -0.02 0.323 0.68 1.5
## Exciting_Life 0.21  0.40  0.41 -0.22 0.500 0.50 3.0
## Respect_For_Tradition -0.01  0.10  0.15  0.63 0.458 0.54 1.2
## Devout        0.02 -0.07 -0.02  0.56 0.317 0.68 1.0
## Obedient      0.23  0.08  0.03  0.50 0.389 0.61 1.5
## Respect_Elders 0.43  0.05 -0.04  0.49 0.517 0.48 2.0
## Accept_My_Life -0.01  0.02  0.16  0.45 0.232 0.77 1.3
## Self-Discipline 0.32  0.10  0.11  0.40 0.391 0.61 2.3
## Clean         0.12  0.22  0.12  0.34 0.254 0.75 2.3
## Reciprocity   0.21  0.25  0.03  0.29 0.258 0.74 2.8
## National_Security 0.24  0.28  0.07  0.28 0.311 0.69 3.1
## Moderate     -0.05  0.03  0.06  0.24 0.061 0.94 1.2
##
##      MR1   MR2   MR4   MR3
## SS loadings      7.07 3.92 3.85 3.26
## Proportion Var   0.15 0.09 0.08 0.07

```

```

## Cumulative Var          0.15 0.24 0.32 0.39
## Proportion Explained   0.39 0.22 0.21 0.18
## Cumulative Proportion 0.39 0.61 0.82 1.00
##
## With factor correlations of
##      MR1  MR2  MR4  MR3
## MR1 1.00 0.16 0.36 0.21
## MR2 0.16 1.00 0.10 0.10
## MR4 0.36 0.10 1.00 0.05
## MR3 0.21 0.10 0.05 1.00
##
## Mean item complexity = 1.8
## Test of the hypothesis that 4 factors are sufficient.
##
## The degrees of freedom for the null model are 1035 and the objective function was 19.86 with Chi S
## The degrees of freedom for the model are 857 and the objective function was 4.29
##
## The root mean square of the residuals (RMSR) is 0.04
## The df corrected root mean square of the residuals is 0.05
##
## The harmonic number of observations is 538 with the empirical chi square 1946 with prob < 2e-86
## The total number of observations was 538 with Likelihood Chi Square = 2221 with prob < 1.1e-121
##
## Tucker Lewis Index of factoring reliability = 0.822
## RMSEA index = 0.056 and the 90 % confidence intervals are 0.052 0.057
## BIC = -3167
## Fit based upon off diagonal values = 0.97
## Measures of factor score adequacy
##
## Correlation of (regression) scores with factors   MR1  MR2  MR4
## Multiple R square of scores with factors          0.96 0.93 0.93
## Minimum correlation of possible factor scores      0.84 0.72 0.72
##
## Correlation of (regression) scores with factors   MR3
## Multiple R square of scores with factors          0.91
## Minimum correlation of possible factor scores      0.83
##
cor(fit_FA_3$scores)

##      MR1      MR2      MR4      MR3
## MR1 1.0000 0.1618 0.36414 0.20960
## MR2 0.1618 1.0000 0.10020 0.10342
## MR4 0.3641 0.1002 1.00000 0.04785
## MR3 0.2096 0.1034 0.04785 1.00000

```

### 3.4 Promax Rotation

*Promax raises the loading to a power to better separate high loadings from low loadings. Then when simple structure is found, the axes are rotated to the position of those loadings using least squares, which induces correlations among the factors.*

```

fit_FA_4 <- fa(SVI[, 2:47], nfactors = 4, rotate = "promax", fm = "minres")
fit_FA_4

```

```

## Factor Analysis using method = minres
## Call: fa(r = SVI[, 2:47], nfactors = 4, rotate = "promax", fm = "minres")
## Standardized loadings (pattern matrix) based upon correlation matrix
##
##      MR1    MR2    MR3    MR4    h2    u2    com
## Equality      0.70 -0.29  0.21 -0.15 0.549 0.45 1.6
## World_Peace    0.47 -0.22  0.25  0.07 0.361 0.64 2.1
## Unity_With_Nature -0.18 -0.17  0.72  0.35 0.524 0.48 1.7
## Wisdom         0.32  0.12  0.17  0.17 0.308 0.69 2.4
## World_Of_Beauty -0.01 -0.05  0.67  0.12 0.458 0.54 1.1
## Social_Justice  0.58 -0.29  0.23  0.00 0.446 0.55 1.8
## Broad_Minded    0.60 -0.17  0.22 -0.24 0.442 0.56 1.8
## Protect_Enviroment -0.02 -0.16  0.64  0.14 0.405 0.59 1.2
## Loyal           0.66  0.00 -0.16  0.08 0.409 0.59 1.2
## Honest          0.82 -0.13 -0.13  0.03 0.553 0.45 1.1
## Helpful         0.70 -0.32  0.11  0.10 0.539 0.46 1.5
## Responsible     0.62  0.10 -0.14  0.16 0.472 0.53 1.3
## Forgiving       0.49 -0.26  0.15  0.21 0.385 0.62 2.2
## Respect_For_Tradition -0.06  0.09  0.10  0.66 0.458 0.54 1.1
## Moderate       -0.07  0.02  0.04  0.26 0.061 0.94 1.2
## Humble          0.47 -0.21  0.02  0.31 0.373 0.63 2.2
## Accept_My_Life  -0.04  0.01  0.13  0.47 0.232 0.77 1.2
## Devout          0.00 -0.09 -0.06  0.58 0.317 0.68 1.1
## Self-Discipline 0.32  0.06  0.05  0.40 0.391 0.61 2.0
## Respect_Elders  0.44  0.01 -0.12  0.47 0.517 0.48 2.1
## Obedient        0.22  0.05 -0.03  0.50 0.389 0.61 1.4
## Politeness      0.53  0.05 -0.14  0.32 0.472 0.53 1.8
## Social_Order    0.03  0.32  0.07  0.30 0.262 0.74 2.1
## National_Security 0.22  0.26  0.01  0.27 0.311 0.69 2.9
## Reciprocity     0.19  0.24 -0.03  0.28 0.258 0.74 2.8
## Family_Security 0.62 -0.01 -0.14  0.12 0.380 0.62 1.2
## Clean           0.09  0.21  0.07  0.34 0.254 0.75 1.9
## Social_Power    -0.41  0.69  0.13  0.11 0.463 0.54 1.8
## Wealth          -0.11  0.71 -0.24  0.01 0.464 0.54 1.3
## Authority       -0.06  0.48  0.04  0.30 0.369 0.63 1.7
## Public_Image    0.00  0.51 -0.10  0.27 0.372 0.63 1.6
## Ambitious       0.62  0.23 -0.13  0.00 0.468 0.53 1.4
## Influential     0.20  0.31  0.13  0.16 0.305 0.69 2.7
## Capable         0.43  0.34 -0.04  0.03 0.396 0.60 1.9
## Successful      0.48  0.49 -0.15 -0.04 0.535 0.46 2.2
## Pleasure        0.11  0.53  0.10 -0.16 0.351 0.65 1.4
## Enjoy_Life      0.39  0.34  0.07 -0.30 0.377 0.62 3.0
## Self-Indulgent  -0.28  0.50  0.08  0.06 0.240 0.76 1.7
## Exciting_Life   0.18  0.40  0.39 -0.21 0.500 0.50 2.9
## Varied_Life     0.09  0.27  0.50 -0.16 0.435 0.57 1.9
## Daring          -0.11  0.27  0.50  0.02 0.323 0.68 1.7
## Freedom         0.61  0.15  0.13 -0.16 0.505 0.50 1.4
## Creativity      0.10  0.10  0.56 -0.02 0.419 0.58 1.1
## Independent     0.38  0.23  0.08 -0.09 0.277 0.72 1.9
## Choose_Own_Goals 0.48  0.19  0.09 -0.15 0.343 0.66 1.6
## Curious         0.04  0.12  0.60 -0.01 0.436 0.56 1.1
##
##      MR1    MR2    MR3    MR4
## SS loadings      7.40 3.90 3.47 3.34
## Proportion Var   0.16 0.08 0.08 0.07

```

```

## Cumulative Var          0.16 0.25 0.32 0.39
## Proportion Explained   0.41 0.22 0.19 0.18
## Cumulative Proportion 0.41 0.62 0.82 1.00
##
## With factor correlations of
##      MR1  MR2  MR3  MR4
## MR1 1.00 0.36 0.47 0.34
## MR2 0.36 1.00 0.22 0.21
## MR3 0.47 0.22 1.00 0.08
## MR4 0.34 0.21 0.08 1.00
##
## Mean item complexity = 1.7
## Test of the hypothesis that 4 factors are sufficient.
##
## The degrees of freedom for the null model are 1035 and the objective function was 19.86 with Chi S
## The degrees of freedom for the model are 857 and the objective function was 4.29
##
## The root mean square of the residuals (RMSR) is 0.04
## The df corrected root mean square of the residuals is 0.05
##
## The harmonic number of observations is 538 with the empirical chi square 1946 with prob < 2e-86
## The total number of observations was 538 with Likelihood Chi Square = 2221 with prob < 1.1e-121
##
## Tucker Lewis Index of factoring reliability = 0.822
## RMSEA index = 0.056 and the 90 % confidence intervals are 0.052 0.057
## BIC = -3167
## Fit based upon off diagonal values = 0.97
## Measures of factor score adequacy
##
## Correlation of (regression) scores with factors   MR1  MR2  MR3
## Multiple R square of scores with factors          0.97 0.93 0.93
## Minimum correlation of possible factor scores      0.93 0.87 0.86
##
## Correlation of (regression) scores with factors   MR4
## Multiple R square of scores with factors          0.86 0.74 0.73
## Minimum correlation of possible factor scores      0.86 0.74 0.73
##
## Correlation of (regression) scores with factors   MR4
## Multiple R square of scores with factors          0.92
## Minimum correlation of possible factor scores      0.84
##
## Correlation of (regression) scores with factors   MR4
## Multiple R square of scores with factors          0.84
## Minimum correlation of possible factor scores      0.68

fa.sort(fit_FA_4, polar = FALSE)

## Factor Analysis using method = minres
## Call: fa(r = SVI[, 2:47], nfactors = 4, rotate = "promax", fm = "minres")
## Standardized loadings (pattern matrix) based upon correlation matrix
##
##      MR1  MR2  MR3  MR4  h2  u2 com
## Honest      0.82 -0.13 -0.13  0.03 0.553 0.45 1.1
## Equality     0.70 -0.29  0.21 -0.15 0.549 0.45 1.6
## Helpful      0.70 -0.32  0.11  0.10 0.539 0.46 1.5
## Loyal        0.66  0.00 -0.16  0.08 0.409 0.59 1.2
## Responsible  0.62  0.10 -0.14  0.16 0.472 0.53 1.3
## Family_Security 0.62 -0.01 -0.14  0.12 0.380 0.62 1.2
## Ambitious    0.62  0.23 -0.13  0.00 0.468 0.53 1.4
## Freedom      0.61  0.15  0.13 -0.16 0.505 0.50 1.4
## Broad_Minded 0.60 -0.17  0.22 -0.24 0.442 0.56 1.8
## Social_Justice 0.58 -0.29  0.23  0.00 0.446 0.55 1.8
## Politeness   0.53  0.05 -0.14  0.32 0.472 0.53 1.8

```



```

## Forgiving      0.49 -0.26  0.15  0.21  0.385 0.62 2.2
## Choose_Own_Goals 0.48  0.19  0.09 -0.15 0.343 0.66 1.6
## Humble         0.47 -0.21  0.02  0.31  0.373 0.63 2.2
## World_Peace    0.47 -0.22  0.25  0.07  0.361 0.64 2.1
## Capable        0.43  0.34 -0.04  0.03  0.396 0.60 1.9
## Enjoy_Life     0.39  0.34  0.07 -0.30 0.377 0.62 3.0
## Independent    0.38  0.23  0.08 -0.09 0.277 0.72 1.9
## Wisdom         0.32  0.12  0.17  0.17  0.308 0.69 2.4
## Wealth        -0.11  0.71 -0.24  0.01  0.464 0.54 1.3
## Social_Power   -0.41  0.69  0.13  0.11  0.463 0.54 1.8
## Pleasure       0.11  0.53  0.10 -0.16 0.351 0.65 1.4
## Public_Image   0.00  0.51 -0.10  0.27  0.372 0.63 1.6
## Self-Indulgent -0.28  0.50  0.08  0.06  0.240 0.76 1.7
## Successful     0.48  0.49 -0.15 -0.04 0.535 0.46 2.2
## Authority      -0.06  0.48  0.04  0.30  0.369 0.63 1.7
## Exciting_Life  0.18  0.40  0.39 -0.21 0.500 0.50 2.9
## Social_Order   0.03  0.32  0.07  0.30  0.262 0.74 2.1
## Influential    0.20  0.31  0.13  0.16  0.305 0.69 2.7
## Unity_With_Nature -0.18 -0.17  0.72  0.35  0.524 0.48 1.7
## World_Of_Beauty -0.01 -0.05  0.67  0.12  0.458 0.54 1.1
## Protect_Enviroment -0.02 -0.16  0.64  0.14  0.405 0.59 1.2
## Curious        0.04  0.12  0.60 -0.01 0.436 0.56 1.1
## Creativity     0.10  0.10  0.56 -0.02 0.419 0.58 1.1
## Varied_Life    0.09  0.27  0.50 -0.16 0.435 0.57 1.9
## Daring         -0.11  0.27  0.50  0.02  0.323 0.68 1.7
## Respect_For_Tradition -0.06  0.09  0.10  0.66  0.458 0.54 1.1
## Devout         0.00 -0.09 -0.06  0.58  0.317 0.68 1.1
## Obedient       0.22  0.05 -0.03  0.50  0.389 0.61 1.4
## Respect_Elders 0.44  0.01 -0.12  0.47  0.517 0.48 2.1
## Accept_My_Life -0.04  0.01  0.13  0.47  0.232 0.77 1.2
## Self-Discipline 0.32  0.06  0.05  0.40  0.391 0.61 2.0
## Clean          0.09  0.21  0.07  0.34  0.254 0.75 1.9
## Reciprocity    0.19  0.24 -0.03  0.28  0.258 0.74 2.8
## National_Security 0.22  0.26  0.01  0.27  0.311 0.69 2.9
## Moderate      -0.07  0.02  0.04  0.26  0.061 0.94 1.2
##
##
##          MR1  MR2  MR3  MR4
## SS loadings      7.40 3.90 3.47 3.34
## Proportion Var    0.16 0.08 0.08 0.07
## Cumulative Var    0.16 0.25 0.32 0.39
## Proportion Explained 0.41 0.22 0.19 0.18
## Cumulative Proportion 0.41 0.62 0.82 1.00
##
## With factor correlations of
##          MR1  MR2  MR3  MR4
## MR1 1.00 0.36 0.47 0.34
## MR2 0.36 1.00 0.22 0.21
## MR3 0.47 0.22 1.00 0.08
## MR4 0.34 0.21 0.08 1.00
##
## Mean item complexity = 1.7
## Test of the hypothesis that 4 factors are sufficient.
##
## The degrees of freedom for the null model are 1035 and the objective function was 19.86 with Chi S

```

```
## The degrees of freedom for the model are 857 and the objective function was 4.29
##
## The root mean square of the residuals (RMSR) is 0.04
## The df corrected root mean square of the residuals is 0.05
##
## The harmonic number of observations is 538 with the empirical chi square 1946 with prob < 2e-86
## The total number of observations was 538 with Likelihood Chi Square = 2221 with prob < 1.1e-121
##
## Tucker Lewis Index of factoring reliability = 0.822
## RMSEA index = 0.056 and the 90 % confidence intervals are 0.052 0.057
## BIC = -3167
## Fit based upon off diagonal values = 0.97
## Measures of factor score adequacy
##
## Correlation of (regression) scores with factors      MR1  MR2  MR3
## Multiple R square of scores with factors            0.97 0.93 0.93
## Minimum correlation of possible factor scores        0.93 0.87 0.86
## Correlation of (regression) scores with factors      MR4
## Multiple R square of scores with factors            0.86 0.74 0.73
## Minimum correlation of possible factor scores        0.92
## Correlation of (regression) scores with factors      MR4
## Multiple R square of scores with factors            0.84
## Minimum correlation of possible factor scores        0.68
```

## 4 Cross-Validation

*Cross-validation in separate samples is highly recommended with factor analysis, which can capitalize on chance and lead to fragile interpretations, especially for minor factors. We do not have a second data set available for the values study, but given the size of the original sample, we can split it into two random halves and perform cross-validation with the two.*

### 4.1 Select the Samples

```
SVI_1 <- SVI[sample(1:nrow(SVI), 269, replace = FALSE), ]
SVI_1[, 2:47] <- scale(SVI_1[, 2:47])
SVI_2 <- SVI[!(SVI$ID %in% SVI_1$ID), ]
SVI_2[, 2:47] <- scale(SVI_2[, 2:47])
```

### 4.2 Sample 1

```
fit_FA_5a <- fa(SVI_1[, 2:47], nfactors = 4, rotate = "none", fm = "minres",
  scores = "tenberge")
fit_FA_5a

## Factor Analysis using method = minres
## Call: fa(r = SVI_1[, 2:47], nfactors = 4, rotate = "none", scores = "tenberge",
##      fm = "minres")
## Standardized loadings (pattern matrix) based upon correlation matrix
##
##          MR1  MR2  MR3  MR4  h2  u2 com
## Equality    0.51 -0.38 -0.23  0.08 0.47 0.53 2.4
```

```

## World_Peace      0.50 -0.34  0.00  0.10 0.38 0.62 1.9
## Unity_With_Nature 0.27  0.05  0.14  0.73 0.62 0.38 1.4
## Wisdom           0.60 -0.03 -0.03  0.02 0.36 0.64 1.0
## World_Of_Beauty  0.43  0.08 -0.12  0.51 0.47 0.53 2.1
## Social_Justice   0.47 -0.36 -0.14  0.06 0.37 0.63 2.1
## Broad_Minded     0.47 -0.32 -0.28  0.01 0.40 0.60 2.5
## Protect_Enviroment 0.37 -0.01 -0.02  0.51 0.40 0.60 1.8
## Loyal            0.54 -0.26  0.08 -0.20 0.40 0.60 1.8
## Honest           0.62 -0.36 -0.03 -0.21 0.56 0.44 1.9
## Helpful          0.56 -0.47 -0.08  0.04 0.54 0.46 2.0
## Responsible      0.66 -0.13  0.05 -0.16 0.48 0.52 1.2
## Forgiving        0.49 -0.37  0.07  0.08 0.38 0.62 2.0
## Respect_For_Tradition 0.37  0.21  0.55  0.18 0.52 0.48 2.3
## Moderate         0.14  0.08  0.21  0.17 0.10 0.90 3.0
## Humble           0.54 -0.27  0.16  0.03 0.40 0.60 1.7
## Accept_My_Life   0.36  0.07  0.44  0.08 0.34 0.66 2.1
## Devout           0.17 -0.04  0.55  0.12 0.34 0.66 1.3
## Self-Discipline  0.60 -0.02  0.22  0.06 0.41 0.59 1.3
## Respect_Elders   0.58 -0.12  0.37 -0.09 0.49 0.51 1.9
## Obedient         0.53 -0.02  0.46 -0.04 0.49 0.51 2.0
## Politeness       0.65 -0.26  0.24 -0.12 0.56 0.44 1.7
## Social_Order     0.44  0.25  0.22  0.06 0.31 0.69 2.2
## National_Security 0.57  0.09  0.16 -0.11 0.37 0.63 1.3
## Reciprocity      0.48  0.12  0.18 -0.05 0.28 0.72 1.4
## Family_Security  0.56 -0.24  0.06 -0.14 0.40 0.60 1.5
## Clean            0.39  0.16  0.26  0.04 0.24 0.76 2.1
## Social_Power     0.16  0.64  0.05 -0.07 0.45 0.55 1.2
## Wealth           0.16  0.50  0.01 -0.30 0.37 0.63 1.9
## Authority        0.38  0.38  0.19 -0.18 0.36 0.64 2.9
## Public_Image     0.38  0.30  0.19 -0.20 0.31 0.69 3.1
## Ambitious        0.62 -0.02 -0.08 -0.19 0.43 0.57 1.2
## Influential      0.55  0.22 -0.03 -0.10 0.36 0.64 1.4
## Capable          0.57  0.07 -0.05 -0.11 0.35 0.65 1.1
## Successful       0.65  0.16 -0.15 -0.22 0.52 0.48 1.5
## Pleasure         0.45  0.35 -0.18 -0.09 0.36 0.64 2.3
## Enjoy_Life       0.48  0.18 -0.36 -0.08 0.40 0.60 2.2
## Self-Indulgent   0.18  0.48  0.06 -0.04 0.26 0.74 1.3
## Exciting_Life    0.61  0.27 -0.36 -0.05 0.58 0.42 2.1
## Varied_Life      0.52  0.22 -0.31  0.15 0.44 0.56 2.3
## Daring           0.43  0.39 -0.16  0.16 0.38 0.62 2.6
## Freedom          0.64 -0.07 -0.23 -0.13 0.49 0.51 1.4
## Creativity       0.49  0.23 -0.26  0.35 0.48 0.52 2.9
## Independent      0.56  0.07 -0.20 -0.06 0.36 0.64 1.3
## Choose_Own_Goals 0.55  0.06 -0.30 -0.11 0.41 0.59 1.7
## Curious          0.50  0.20 -0.26  0.36 0.49 0.51 2.8
##
##
## MR1 MR2 MR3 MR4
## SS loadings      11.16 3.20 2.56 1.95
## Proportion Var   0.24 0.07 0.06 0.04
## Cumulative Var   0.24 0.31 0.37 0.41
## Proportion Explained 0.59 0.17 0.14 0.10
## Cumulative Proportion 0.59 0.76 0.90 1.00
##
## Mean item complexity = 1.9

```

```

## Test of the hypothesis that 4 factors are sufficient.
##
## The degrees of freedom for the null model are 1035 and the objective function was 23.07 with Chi S
## The degrees of freedom for the model are 857 and the objective function was 6.41
##
## The root mean square of the residuals (RMSR) is 0.05
## The df corrected root mean square of the residuals is 0.05
##
## The harmonic number of observations is 269 with the empirical chi square 1264 with prob < 3.4e-18
## The total number of observations was 269 with Likelihood Chi Square = 1596 with prob < 3.6e-47
##
## Tucker Lewis Index of factoring reliability = 0.811
## RMSEA index = 0.061 and the 90 % confidence intervals are 0.052 NA
## BIC = -3198
## Fit based upon off diagonal values = 0.97
## Measures of factor score adequacy
##
## Correlation of (regression) scores with factors MR1 MR2 MR3
## Multiple R square of scores with factors 0.98 0.92 0.91
## Minimum correlation of possible factor scores 0.95 0.85 0.82
## MR4
## Correlation of (regression) scores with factors 0.91 0.70 0.64
## Multiple R square of scores with factors 0.89
## Minimum correlation of possible factor scores 0.80
##
fa.sort(fit_FA_5a, polar = FALSE)

## Factor Analysis using method = minres
## Call: fa(r = SVI_1[, 2:47], nfactors = 4, rotate = "none", scores = "tenberge",
## fm = "minres")
## Standardized loadings (pattern matrix) based upon correlation matrix
##
## MR1 MR2 MR3 MR4 h2 u2 com
## Responsible 0.66 -0.13 0.05 -0.16 0.48 0.52 1.2
## Politeness 0.65 -0.26 0.24 -0.12 0.56 0.44 1.7
## Successful 0.65 0.16 -0.15 -0.22 0.52 0.48 1.5
## Freedom 0.64 -0.07 -0.23 -0.13 0.49 0.51 1.4
## Ambitious 0.62 -0.02 -0.08 -0.19 0.43 0.57 1.2
## Honest 0.62 -0.36 -0.03 -0.21 0.56 0.44 1.9
## Exciting_Life 0.61 0.27 -0.36 -0.05 0.58 0.42 2.1
## Wisdom 0.60 -0.03 -0.03 0.02 0.36 0.64 1.0
## Self-Discipline 0.60 -0.02 0.22 0.06 0.41 0.59 1.3
## Respect_Elders 0.58 -0.12 0.37 -0.09 0.49 0.51 1.9
## Capable 0.57 0.07 -0.05 -0.11 0.35 0.65 1.1
## National_Security 0.57 0.09 0.16 -0.11 0.37 0.63 1.3
## Family_Security 0.56 -0.24 0.06 -0.14 0.40 0.60 1.5
## Helpful 0.56 -0.47 -0.08 0.04 0.54 0.46 2.0
## Independent 0.56 0.07 -0.20 -0.06 0.36 0.64 1.3
## Choose_Own_Goals 0.55 0.06 -0.30 -0.11 0.41 0.59 1.7
## Influential 0.55 0.22 -0.03 -0.10 0.36 0.64 1.4
## Humble 0.54 -0.27 0.16 0.03 0.40 0.60 1.7
## Loyal 0.54 -0.26 0.08 -0.20 0.40 0.60 1.8
## Obedient 0.53 -0.02 0.46 -0.04 0.49 0.51 2.0
## Varied_Life 0.52 0.22 -0.31 0.15 0.44 0.56 2.3
## Equality 0.51 -0.38 -0.23 0.08 0.47 0.53 2.4

```

```

## Curious      0.50  0.20 -0.26  0.36 0.49 0.51 2.8
## World_Peace  0.50 -0.34  0.00  0.10 0.38 0.62 1.9
## Creativity   0.49  0.23 -0.26  0.35 0.48 0.52 2.9
## Forgiving    0.49 -0.37  0.07  0.08 0.38 0.62 2.0
## Enjoy_Life   0.48  0.18 -0.36 -0.08 0.40 0.60 2.2
## Reciprocity  0.48  0.12  0.18 -0.05 0.28 0.72 1.4
## Social_Justice 0.47 -0.36 -0.14  0.06 0.37 0.63 2.1
## Broad_Minded 0.47 -0.32 -0.28  0.01 0.40 0.60 2.5
## Pleasure     0.45  0.35 -0.18 -0.09 0.36 0.64 2.3
## Social_Order 0.44  0.25  0.22  0.06 0.31 0.69 2.2
## Daring       0.43  0.39 -0.16  0.16 0.38 0.62 2.6
## Clean        0.39  0.16  0.26  0.04 0.24 0.76 2.1
## Public_Image 0.38  0.30  0.19 -0.20 0.31 0.69 3.1
## Social_Power 0.16  0.64  0.05 -0.07 0.45 0.55 1.2
## Wealth       0.16  0.50  0.01 -0.30 0.37 0.63 1.9
## Self-Indulgent 0.18  0.48  0.06 -0.04 0.26 0.74 1.3
## Authority    0.38  0.38  0.19 -0.18 0.36 0.64 2.9
## Respect_For_Tradition 0.37  0.21  0.55  0.18 0.52 0.48 2.3
## Devout       0.17 -0.04  0.55  0.12 0.34 0.66 1.3
## Accept_My_Life 0.36  0.07  0.44  0.08 0.34 0.66 2.1
## Moderate     0.14  0.08  0.21  0.17 0.10 0.90 3.0
## Unity_With_Nature 0.27  0.05  0.14  0.73 0.62 0.38 1.4
## Protect_Enviroment 0.37 -0.01 -0.02  0.51 0.40 0.60 1.8
## World_Of_Beauty 0.43  0.08 -0.12  0.51 0.47 0.53 2.1
##
##              MR1  MR2  MR3  MR4
## SS loadings    11.16 3.20 2.56 1.95
## Proportion Var   0.24 0.07 0.06 0.04
## Cumulative Var   0.24 0.31 0.37 0.41
## Proportion Explained 0.59 0.17 0.14 0.10
## Cumulative Proportion 0.59 0.76 0.90 1.00
##
## Mean item complexity = 1.9
## Test of the hypothesis that 4 factors are sufficient.
##
## The degrees of freedom for the null model are 1035 and the objective function was 23.07 with Chi S
## The degrees of freedom for the model are 857 and the objective function was 6.41
##
## The root mean square of the residuals (RMSR) is 0.05
## The df corrected root mean square of the residuals is 0.05
##
## The harmonic number of observations is 269 with the empirical chi square 1264 with prob < 3.4e-18
## The total number of observations was 269 with Likelihood Chi Square = 1596 with prob < 3.6e-47
##
## Tucker Lewis Index of factoring reliability = 0.811
## RMSEA index = 0.061 and the 90 % confidence intervals are 0.052 NA
## BIC = -3198
## Fit based upon off diagonal values = 0.97
## Measures of factor score adequacy
##              MR1  MR2  MR3
## Correlation of (regression) scores with factors 0.98 0.92 0.91
## Multiple R square of scores with factors 0.95 0.85 0.82
## Minimum correlation of possible factor scores 0.91 0.70 0.64
##              MR4

```

```

## Correlation of (regression) scores with factors      0.89
## Multiple R square of scores with factors            0.80
## Minimum correlation of possible factor scores       0.60

fit_FA_5b <- fa(SVI_1[, 2:47], nfactors = 4, rotate = "varimax", fm = "minres",
  scores = "tenberge")
fit_FA_5b

## Factor Analysis using method = minres
## Call: fa(r = SVI_1[, 2:47], nfactors = 4, rotate = "varimax", scores = "tenberge",
##      fm = "minres")
## Standardized loadings (pattern matrix) based upon correlation matrix
##
##      MR1    MR2    MR3    MR4    h2    u2 com
## Equality      0.64  0.02 -0.07  0.23 0.47 0.53 1.3
## World_Peace    0.56 -0.03  0.14  0.19 0.38 0.62 1.4
## Unity_With_Nature 0.00 -0.11  0.32  0.71 0.62 0.38 1.4
## Wisdom         0.45  0.29  0.19  0.20 0.36 0.64 2.5
## World_Of_Beauty 0.18  0.15  0.12  0.63 0.47 0.53 1.4
## Social_Justice 0.58  0.00  0.00  0.19 0.37 0.63 1.2
## Broad_Minded   0.58  0.08 -0.13  0.18 0.40 0.60 1.3
## Protect_Enviroment 0.18  0.02  0.18  0.58 0.40 0.60 1.4
## Loyal          0.58  0.13  0.21 -0.08 0.40 0.60 1.4
## Honest         0.73  0.13  0.12 -0.04 0.56 0.44 1.1
## Helpful        0.72 -0.05  0.07  0.16 0.54 0.46 1.1
## Responsible    0.58  0.29  0.25  0.02 0.48 0.52 1.9
## Forgiving      0.56 -0.06  0.19  0.15 0.38 0.62 1.4
## Respect_For_Tradition 0.01  0.13  0.69  0.15 0.52 0.48 1.2
## Moderate       -0.02  0.01  0.28  0.15 0.10 0.90 1.6
## Humble         0.54  0.02  0.31  0.11 0.40 0.60 1.7
## Accept_My_Life 0.13  0.08  0.56  0.07 0.34 0.66 1.2
## Devout         0.04 -0.14  0.57  0.01 0.34 0.66 1.1
## Self-Discipline 0.40  0.21  0.42  0.17 0.41 0.59 2.8
## Respect_Elders 0.45  0.13  0.52 -0.03 0.49 0.51 2.1
## Obedient       0.33  0.13  0.61  0.00 0.49 0.51 1.7
## Politeness     0.62  0.12  0.40 -0.01 0.56 0.44 1.8
## Social_Order   0.11  0.32  0.41  0.16 0.31 0.69 2.4
## National_Security 0.35  0.35  0.36  0.04 0.37 0.63 3.0
## Reciprocity    0.25  0.30  0.35  0.07 0.28 0.72 2.9
## Family_Security 0.58  0.14  0.21 -0.01 0.40 0.60 1.4
## Clean         0.13  0.23  0.40  0.10 0.24 0.76 2.0
## Social_Power   -0.30  0.56  0.20  0.05 0.45 0.55 1.8
## Wealth         -0.16  0.55  0.11 -0.17 0.37 0.63 1.5
## Authority      0.03  0.48  0.35 -0.06 0.36 0.64 1.9
## Public_Image   0.08  0.43  0.34 -0.09 0.31 0.69 2.1
## Ambitious      0.51  0.39  0.13  0.03 0.43 0.57 2.0
## Influential    0.27  0.49  0.20  0.10 0.36 0.64 2.0
## Capable        0.39  0.40  0.16  0.09 0.35 0.65 2.4
## Successful     0.42  0.57  0.10  0.05 0.52 0.48 1.9
## Pleasure       0.14  0.57  0.05  0.13 0.36 0.64 1.2
## Enjoy_Life     0.29  0.51 -0.13  0.18 0.40 0.60 2.0
## Self-Indulgent -0.19  0.43  0.19  0.06 0.26 0.74 1.8
## Exciting_Life  0.32  0.63 -0.07  0.26 0.58 0.42 1.9
## Varied_Life    0.25  0.47 -0.04  0.39 0.44 0.56 2.5
## Daring         0.05  0.49  0.09  0.36 0.38 0.62 1.9

```

```

## Freedom      0.57  0.39  0.00  0.11  0.49  0.51  1.9
## Creativity   0.18  0.37  0.02  0.56  0.48  0.52  2.0
## Independent  0.40  0.42  0.03  0.17  0.36  0.64  2.3
## Choose_Own_Goals 0.42  0.46 -0.08  0.14  0.41  0.59  2.2
## Curious      0.20  0.36  0.02  0.56  0.49  0.51  2.0
##
##              MR1  MR2  MR3  MR4
## SS loadings   7.25  5.12  3.73  2.78
## Proportion Var 0.16  0.11  0.08  0.06
## Cumulative Var 0.16  0.27  0.35  0.41
## Proportion Explained 0.38  0.27  0.20  0.15
## Cumulative Proportion 0.38  0.65  0.85  1.00
##
## Mean item complexity = 1.8
## Test of the hypothesis that 4 factors are sufficient.
##
## The degrees of freedom for the null model are 1035 and the objective function was 23.07 with Chi S
## The degrees of freedom for the model are 857 and the objective function was 6.41
##
## The root mean square of the residuals (RMSR) is 0.05
## The df corrected root mean square of the residuals is 0.05
##
## The harmonic number of observations is 269 with the empirical chi square 1264 with prob < 3.4e-18
## The total number of observations was 269 with Likelihood Chi Square = 1596 with prob < 3.6e-47
##
## Tucker Lewis Index of factoring reliability = 0.811
## RMSEA index = 0.061 and the 90 % confidence intervals are 0.052 NA
## BIC = -3198
## Fit based upon off diagonal values = 0.97
## Measures of factor score adequacy
##
##              MR1  MR2  MR3
## Correlation of (regression) scores with factors 0.95 0.93 0.92
## Multiple R square of scores with factors 0.90 0.87 0.84
## Minimum correlation of possible factor scores 0.81 0.73 0.68
##
##              MR4
## Correlation of (regression) scores with factors 0.90
## Multiple R square of scores with factors 0.82
## Minimum correlation of possible factor scores 0.63

fa.sort(fit_FA_5b, polar = FALSE)

## Factor Analysis using method = minres
## Call: fa(r = SVI_1[, 2:47], nfactors = 4, rotate = "varimax", scores = "tenberge",
##       fm = "minres")
## Standardized loadings (pattern matrix) based upon correlation matrix
##
##              MR1  MR2  MR3  MR4  h2  u2 com
## Honest      0.73  0.13  0.12 -0.04  0.56  0.44  1.1
## Helpful      0.72 -0.05  0.07  0.16  0.54  0.46  1.1
## Equality     0.64  0.02 -0.07  0.23  0.47  0.53  1.3
## Politeness   0.62  0.12  0.40 -0.01  0.56  0.44  1.8
## Broad_Minded 0.58  0.08 -0.13  0.18  0.40  0.60  1.3
## Social_Justice 0.58  0.00  0.00  0.19  0.37  0.63  1.2
## Loyal        0.58  0.13  0.21 -0.08  0.40  0.60  1.4
## Responsible  0.58  0.29  0.25  0.02  0.48  0.52  1.9

```

```

## Family_Security      0.58  0.14  0.21 -0.01  0.40  0.60  1.4
## Freedom              0.57  0.39  0.00  0.11  0.49  0.51  1.9
## World_Peace          0.56 -0.03  0.14  0.19  0.38  0.62  1.4
## Forgiving            0.56 -0.06  0.19  0.15  0.38  0.62  1.4
## Humble               0.54  0.02  0.31  0.11  0.40  0.60  1.7
## Ambitious            0.51  0.39  0.13  0.03  0.43  0.57  2.0
## Wisdom               0.45  0.29  0.19  0.20  0.36  0.64  2.5
## Exciting_Life        0.32  0.63 -0.07  0.26  0.58  0.42  1.9
## Pleasure             0.14  0.57  0.05  0.13  0.36  0.64  1.2
## Successful           0.42  0.57  0.10  0.05  0.52  0.48  1.9
## Social_Power         -0.30  0.56  0.20  0.05  0.45  0.55  1.8
## Wealth               -0.16  0.55  0.11 -0.17  0.37  0.63  1.5
## Enjoy_Life           0.29  0.51 -0.13  0.18  0.40  0.60  2.0
## Daring               0.05  0.49  0.09  0.36  0.38  0.62  1.9
## Influential          0.27  0.49  0.20  0.10  0.36  0.64  2.0
## Authority            0.03  0.48  0.35 -0.06  0.36  0.64  1.9
## Varied_Life          0.25  0.47 -0.04  0.39  0.44  0.56  2.5
## Choose_Own_Goals     0.42  0.46 -0.08  0.14  0.41  0.59  2.2
## Self-Indulgent       -0.19  0.43  0.19  0.06  0.26  0.74  1.8
## Public_Image         0.08  0.43  0.34 -0.09  0.31  0.69  2.1
## Independent          0.40  0.42  0.03  0.17  0.36  0.64  2.3
## Capable              0.39  0.40  0.16  0.09  0.35  0.65  2.4
## Respect_For_Tradition 0.01  0.13  0.69  0.15  0.52  0.48  1.2
## Obedient             0.33  0.13  0.61  0.00  0.49  0.51  1.7
## Devout               0.04 -0.14  0.57  0.01  0.34  0.66  1.1
## Accept_My_Life       0.13  0.08  0.56  0.07  0.34  0.66  1.2
## Respect_Elders       0.45  0.13  0.52 -0.03  0.49  0.51  2.1
## Self-Discipline      0.40  0.21  0.42  0.17  0.41  0.59  2.8
## Social_Order         0.11  0.32  0.41  0.16  0.31  0.69  2.4
## Clean                0.13  0.23  0.40  0.10  0.24  0.76  2.0
## National_Security    0.35  0.35  0.36  0.04  0.37  0.63  3.0
## Reciprocity          0.25  0.30  0.35  0.07  0.28  0.72  2.9
## Moderate             -0.02  0.01  0.28  0.15  0.10  0.90  1.6
## Unity_With_Nature    0.00 -0.11  0.32  0.71  0.62  0.38  1.4
## World_Of_Beauty      0.18  0.15  0.12  0.63  0.47  0.53  1.4
## Protect_Enviroment   0.18  0.02  0.18  0.58  0.40  0.60  1.4
## Curious              0.20  0.36  0.02  0.56  0.49  0.51  2.0
## Creativity           0.18  0.37  0.02  0.56  0.48  0.52  2.0
##
##
## MR1  MR2  MR3  MR4
## SS loadings      7.25 5.12 3.73 2.78
## Proportion Var   0.16 0.11 0.08 0.06
## Cumulative Var   0.16 0.27 0.35 0.41
## Proportion Explained 0.38 0.27 0.20 0.15
## Cumulative Proportion 0.38 0.65 0.85 1.00
##
## Mean item complexity = 1.8
## Test of the hypothesis that 4 factors are sufficient.
##
## The degrees of freedom for the null model are 1035 and the objective function was 23.07 with Chi S
## The degrees of freedom for the model are 857 and the objective function was 6.41
##
## The root mean square of the residuals (RMSR) is 0.05
## The df corrected root mean square of the residuals is 0.05

```



```

##
## The harmonic number of observations is 269 with the empirical chi square 1264 with prob < 3.4e-18
## The total number of observations was 269 with Likelihood Chi Square = 1596 with prob < 3.6e-47
##
## Tucker Lewis Index of factoring reliability = 0.811
## RMSEA index = 0.061 and the 90 % confidence intervals are 0.052 NA
## BIC = -3198
## Fit based upon off diagonal values = 0.97
## Measures of factor score adequacy
##
## Correlation of (regression) scores with factors MR1 MR2 MR3
## Multiple R square of scores with factors 0.95 0.93 0.92
## Minimum correlation of possible factor scores 0.90 0.87 0.84
##
## Correlation of (regression) scores with factors MR4
## Multiple R square of scores with factors 0.81 0.73 0.68
## Minimum correlation of possible factor scores 0.90
## Multiple R square of scores with factors 0.82
## Minimum correlation of possible factor scores 0.63

fit_FA_5c <- fa(SVI_1[, 2:47], nfactors = 4, rotate = "oblimin", fm = "minres",
  scores = "tenberge")
fit_FA_5c

## Factor Analysis using method = minres
## Call: fa(r = SVI_1[, 2:47], nfactors = 4, rotate = "oblimin", scores = "tenberge",
## fm = "minres")
## Standardized loadings (pattern matrix) based upon correlation matrix
##
## MR1 MR2 MR3 MR4 h2 u2 com
## Equality 0.63 0.05 -0.17 0.16 0.47 0.53 1.3
## World_Peace 0.56 -0.06 0.06 0.16 0.38 0.62 1.2
## Unity_With_Nature -0.07 -0.14 0.20 0.77 0.62 0.38 1.2
## Wisdom 0.37 0.27 0.13 0.13 0.36 0.64 2.4
## World_Of_Beauty 0.07 0.16 0.02 0.61 0.47 0.53 1.2
## Social_Justice 0.58 0.00 -0.08 0.13 0.37 0.63 1.1
## Broad_Minded 0.57 0.12 -0.21 0.09 0.40 0.60 1.4
## Protect_Enviroment 0.11 0.02 0.07 0.58 0.40 0.60 1.1
## Loyal 0.57 0.08 0.18 -0.14 0.40 0.60 1.4
## Honest 0.72 0.10 0.07 -0.12 0.56 0.44 1.1
## Helpful 0.73 -0.06 -0.03 0.11 0.54 0.46 1.1
## Responsible 0.52 0.24 0.21 -0.06 0.48 0.52 1.8
## Forgiving 0.57 -0.11 0.11 0.13 0.38 0.62 1.3
## Respect_For_Tradition -0.07 -0.01 0.69 0.21 0.52 0.48 1.2
## Moderate -0.06 -0.04 0.26 0.18 0.10 0.90 2.0
## Humble 0.52 -0.05 0.25 0.09 0.40 0.60 1.5
## Accept_My_Life 0.08 -0.03 0.55 0.11 0.34 0.66 1.1
## Devout 0.04 -0.27 0.56 0.09 0.34 0.66 1.5
## Self-Discipline 0.32 0.13 0.37 0.15 0.41 0.59 2.6
## Respect_Elders 0.41 0.01 0.50 -0.03 0.49 0.51 1.9
## Obedient 0.27 0.00 0.59 0.01 0.49 0.51 1.4
## Politeness 0.59 0.02 0.36 -0.04 0.56 0.44 1.7
## Social_Order 0.00 0.25 0.40 0.14 0.31 0.69 2.0
## National_Security 0.25 0.28 0.34 -0.01 0.37 0.63 2.8
## Reciprocity 0.16 0.23 0.34 0.03 0.28 0.72 2.3
## Family_Security 0.55 0.10 0.17 -0.07 0.40 0.60 1.3
## Clean 0.05 0.15 0.39 0.10 0.24 0.76 1.5

```

```

## Social_Power      -0.46  0.55  0.25  0.01  0.45  0.55  2.4
## Wealth            -0.28  0.54  0.18 -0.23  0.37  0.63  2.2
## Authority         -0.09  0.41  0.39 -0.10  0.36  0.64  2.2
## Public_Image      -0.03  0.36  0.37 -0.13  0.31  0.69  2.2
## Ambitious         0.43  0.37  0.10 -0.07  0.43  0.57  2.1
## Influential       0.14  0.47  0.18  0.02  0.36  0.64  1.5
## Capable           0.30  0.38  0.13  0.00  0.35  0.65  2.2
## Successful        0.29  0.57  0.08 -0.07  0.52  0.48  1.6
## Pleasure          0.00  0.59  0.04  0.03  0.36  0.64  1.0
## Enjoy_Life        0.17  0.57 -0.16  0.06  0.40  0.60  1.4
## Self-Indulgent    -0.31  0.42  0.22  0.03  0.26  0.74  2.4
## Exciting_Life     0.16  0.69 -0.11  0.12  0.58  0.42  1.2
## Varied_Life       0.11  0.52 -0.11  0.29  0.44  0.56  1.8
## Daring            -0.11  0.52  0.05  0.29  0.38  0.62  1.7
## Freedom           0.48  0.40 -0.05  0.00  0.49  0.51  2.0
## Creativity        0.03  0.42 -0.07  0.49  0.48  0.52  2.0
## Independent       0.29  0.43 -0.02  0.06  0.36  0.64  1.8
## Choose_Own_Goals  0.32  0.49 -0.12  0.02  0.41  0.59  1.9
## Curious           0.06  0.40 -0.07  0.49  0.49  0.51  2.0
##
##              MR1  MR2  MR3  MR4
## SS loadings    6.75 5.63 3.86 2.64
## Proportion Var  0.15 0.12 0.08 0.06
## Cumulative Var  0.15 0.27 0.35 0.41
## Proportion Explained 0.36 0.30 0.20 0.14
## Cumulative Proportion 0.36 0.66 0.86 1.00
##
## With factor correlations of
##      MR1  MR2  MR3  MR4
## MR1 1.00 0.28 0.19 0.21
## MR2 0.28 1.00 0.22 0.17
## MR3 0.19 0.22 1.00 0.10
## MR4 0.21 0.17 0.10 1.00
##
## Mean item complexity = 1.7
## Test of the hypothesis that 4 factors are sufficient.
##
## The degrees of freedom for the null model are 1035 and the objective function was 23.07 with Chi S
## The degrees of freedom for the model are 857 and the objective function was 6.41
##
## The root mean square of the residuals (RMSR) is 0.05
## The df corrected root mean square of the residuals is 0.05
##
## The harmonic number of observations is 269 with the empirical chi square 1264 with prob < 3.4e-18
## The total number of observations was 269 with Likelihood Chi Square = 1596 with prob < 3.6e-47
##
## Tucker Lewis Index of factoring reliability = 0.811
## RMSEA index = 0.061 and the 90 % confidence intervals are 0.052 NA
## BIC = -3198
## Fit based upon off diagonal values = 0.97
## Measures of factor score adequacy
##              MR1  MR2  MR3
## Correlation of (regression) scores with factors 0.96 0.95 0.92
## Multiple R square of scores with factors 0.92 0.89 0.85

```

```

## Minimum correlation of possible factor scores      0.83 0.79 0.71
##                                                    MR4
## Correlation of (regression) scores with factors    0.91
## Multiple R square of scores with factors          0.83
## Minimum correlation of possible factor scores      0.65

fa.sort(fit_FA_5c, polar = FALSE)

## Factor Analysis using method = minres
## Call: fa(r = SVI_1[, 2:47], nfactors = 4, rotate = "oblimin", scores = "tenberge",
##       fm = "minres")
## Standardized loadings (pattern matrix) based upon correlation matrix
##
##           MR1    MR2    MR3    MR4    h2    u2 com
## Helpful      0.73 -0.06 -0.03  0.11 0.54 0.46 1.1
## Honest       0.72  0.10  0.07 -0.12 0.56 0.44 1.1
## Equality     0.63  0.05 -0.17  0.16 0.47 0.53 1.3
## Politeness   0.59  0.02  0.36 -0.04 0.56 0.44 1.7
## Social_Justice 0.58  0.00 -0.08  0.13 0.37 0.63 1.1
## Forgiving    0.57 -0.11  0.11  0.13 0.38 0.62 1.3
## Broad_Minded 0.57  0.12 -0.21  0.09 0.40 0.60 1.4
## Loyal        0.57  0.08  0.18 -0.14 0.40 0.60 1.4
## World_Peace  0.56 -0.06  0.06  0.16 0.38 0.62 1.2
## Family_Security 0.55  0.10  0.17 -0.07 0.40 0.60 1.3
## Humble       0.52 -0.05  0.25  0.09 0.40 0.60 1.5
## Responsible  0.52  0.24  0.21 -0.06 0.48 0.52 1.8
## Freedom      0.48  0.40 -0.05  0.00 0.49 0.51 2.0
## Ambitious    0.43  0.37  0.10 -0.07 0.43 0.57 2.1
## Wisdom       0.37  0.27  0.13  0.13 0.36 0.64 2.4
## Exciting_Life 0.16  0.69 -0.11  0.12 0.58 0.42 1.2
## Pleasure     0.00  0.59  0.04  0.03 0.36 0.64 1.0
## Enjoy_Life   0.17  0.57 -0.16  0.06 0.40 0.60 1.4
## Successful   0.29  0.57  0.08 -0.07 0.52 0.48 1.6
## Social_Power -0.46  0.55  0.25  0.01 0.45 0.55 2.4
## Wealth       -0.28  0.54  0.18 -0.23 0.37 0.63 2.2
## Varied_Life  0.11  0.52 -0.11  0.29 0.44 0.56 1.8
## Daring       -0.11  0.52  0.05  0.29 0.38 0.62 1.7
## Choose_Own_Goals 0.32  0.49 -0.12  0.02 0.41 0.59 1.9
## Influential  0.14  0.47  0.18  0.02 0.36 0.64 1.5
## Independent  0.29  0.43 -0.02  0.06 0.36 0.64 1.8
## Self-Indulgent -0.31  0.42  0.22  0.03 0.26 0.74 2.4
## Authority    -0.09  0.41  0.39 -0.10 0.36 0.64 2.2
## Capable      0.30  0.38  0.13  0.00 0.35 0.65 2.2
## Respect_For_Tradition -0.07 -0.01 0.69  0.21 0.52 0.48 1.2
## Obedient     0.27  0.00  0.59  0.01 0.49 0.51 1.4
## Devout       0.04 -0.27  0.56  0.09 0.34 0.66 1.5
## Accept_My_Life 0.08 -0.03  0.55  0.11 0.34 0.66 1.1
## Respect_Elders 0.41  0.01  0.50 -0.03 0.49 0.51 1.9
## Social_Order 0.00  0.25  0.40  0.14 0.31 0.69 2.0
## Clean        0.05  0.15  0.39  0.10 0.24 0.76 1.5
## Self-Discipline 0.32  0.13  0.37  0.15 0.41 0.59 2.6
## Public_Image -0.03  0.36  0.37 -0.13 0.31 0.69 2.2
## National_Security 0.25  0.28  0.34 -0.01 0.37 0.63 2.8
## Reciprocity  0.16  0.23  0.34  0.03 0.28 0.72 2.3
## Moderate    -0.06 -0.04  0.26  0.18 0.10 0.90 2.0

```

```

## Unity_With_Nature      -0.07 -0.14  0.20  0.77 0.62 0.38 1.2
## World_Of_Beauty        0.07  0.16  0.02  0.61 0.47 0.53 1.2
## Protect_Enviroment     0.11  0.02  0.07  0.58 0.40 0.60 1.1
## Curious                0.06  0.40 -0.07  0.49 0.49 0.51 2.0
## Creativity             0.03  0.42 -0.07  0.49 0.48 0.52 2.0
##
##                      MR1  MR2  MR3  MR4
## SS loadings          6.75 5.63 3.86 2.64
## Proportion Var       0.15 0.12 0.08 0.06
## Cumulative Var       0.15 0.27 0.35 0.41
## Proportion Explained 0.36 0.30 0.20 0.14
## Cumulative Proportion 0.36 0.66 0.86 1.00
##
## With factor correlations of
##      MR1  MR2  MR3  MR4
## MR1 1.00 0.28 0.19 0.21
## MR2 0.28 1.00 0.22 0.17
## MR3 0.19 0.22 1.00 0.10
## MR4 0.21 0.17 0.10 1.00
##
## Mean item complexity = 1.7
## Test of the hypothesis that 4 factors are sufficient.
##
## The degrees of freedom for the null model are 1035 and the objective function was 23.07 with Chi S
## The degrees of freedom for the model are 857 and the objective function was 6.41
##
## The root mean square of the residuals (RMSR) is 0.05
## The df corrected root mean square of the residuals is 0.05
##
## The harmonic number of observations is 269 with the empirical chi square 1264 with prob < 3.4e-18
## The total number of observations was 269 with Likelihood Chi Square = 1596 with prob < 3.6e-47
##
## Tucker Lewis Index of factoring reliability = 0.811
## RMSEA index = 0.061 and the 90 % confidence intervals are 0.052 NA
## BIC = -3198
## Fit based upon off diagonal values = 0.97
## Measures of factor score adequacy
##
##                      MR1  MR2  MR3
## Correlation of (regression) scores with factors 0.96 0.95 0.92
## Multiple R square of scores with factors        0.92 0.89 0.85
## Minimum correlation of possible factor scores    0.83 0.79 0.71
##
##                      MR4
## Correlation of (regression) scores with factors 0.91
## Multiple R square of scores with factors        0.83
## Minimum correlation of possible factor scores    0.65

```

### 4.3 Sample 2

```

fit_FA_6a <- fa(SVI_2[, 2:47], nfactors = 4, rotate = "none", fm = "minres",
  scores = "tenberge")
fit_FA_6a

```

```

## Factor Analysis using method = minres
## Call: fa(r = SVI_2[, 2:47], nfactors = 4, rotate = "none", scores = "tenberge",
##       fm = "minres")
## Standardized loadings (pattern matrix) based upon correlation matrix
##
##      MR1   MR2   MR3   MR4   h2   u2 com
## Equality      0.59 -0.46 -0.06 -0.22 0.617 0.38 2.2
## World_Peace    0.51 -0.34  0.02  0.03 0.374 0.63 1.8
## Unity_With_Nature 0.47 -0.35  0.12  0.39 0.506 0.49 3.0
## Wisdom         0.52  0.04  0.03  0.12 0.285 0.71 1.1
## World_Of_Beauty 0.44 -0.38  0.23  0.26 0.460 0.54 3.2
## Social_Justice 0.58 -0.40 -0.12 -0.01 0.512 0.49 1.9
## Broad_Minded   0.50 -0.43  0.13 -0.22 0.504 0.50 2.5
## Protect_Enviroment 0.35 -0.47  0.19  0.30 0.464 0.54 3.0
## Loyal          0.59  0.06 -0.15 -0.23 0.431 0.57 1.5
## Honest         0.65 -0.10 -0.24 -0.24 0.546 0.45 1.6
## Helpful        0.62 -0.29 -0.26  0.00 0.539 0.46 1.8
## Responsible    0.61  0.18 -0.22 -0.14 0.468 0.53 1.6
## Forgiving      0.55 -0.20 -0.21  0.09 0.391 0.61 1.7
## Respect_For_Tradition 0.43  0.24 -0.30  0.28 0.400 0.60 3.2
## Moderate       0.08  0.13 -0.12  0.09 0.046 0.95 3.5
## Humble         0.46 -0.08 -0.38  0.06 0.362 0.64 2.0
## Accept_My_Life 0.20  0.04 -0.13  0.28 0.138 0.86 2.4
## Devout         0.26  0.23 -0.36  0.22 0.297 0.70 3.3
## Self-Discipline 0.53  0.16 -0.25  0.16 0.390 0.61 1.8
## Respect_Elders 0.60  0.22 -0.37  0.08 0.546 0.45 2.0
## Obedient       0.42  0.19 -0.24  0.18 0.300 0.70 2.5
## Politeness     0.55  0.26 -0.18  0.00 0.404 0.60 1.7
## Social_Order   0.34  0.30  0.08  0.08 0.221 0.78 2.2
## National_Security 0.42  0.27  0.01  0.12 0.262 0.74 1.9
## Reciprocity    0.38  0.29 -0.06  0.06 0.234 0.77 2.0
## Family_Security 0.54  0.08 -0.19 -0.19 0.370 0.63 1.6
## Clean         0.44  0.21 -0.02  0.15 0.265 0.74 1.7
## Social_Power   0.10  0.47  0.46  0.22 0.494 0.51 2.5
## Wealth         0.11  0.66  0.30 -0.10 0.551 0.45 1.5
## Authority      0.41  0.42  0.18  0.30 0.465 0.53 3.2
## Public_Image   0.32  0.55  0.16  0.15 0.453 0.55 2.0
## Ambitious      0.63  0.19 -0.03 -0.28 0.509 0.49 1.6
## Influential    0.49  0.16  0.09  0.15 0.301 0.70 1.5
## Capable        0.57  0.27  0.14 -0.18 0.456 0.54 1.8
## Successful     0.54  0.41  0.14 -0.25 0.542 0.46 2.5
## Pleasure       0.28  0.21  0.46 -0.20 0.372 0.63 2.6
## Enjoy_Life     0.40  0.03  0.27 -0.41 0.399 0.60 2.7
## Self-Indulgent 0.00  0.32  0.34  0.04 0.223 0.78 2.0
## Exciting_Life  0.40 -0.13  0.50  0.01 0.429 0.57 2.1
## Varied_Life    0.37 -0.23  0.47  0.07 0.415 0.59 2.5
## Daring         0.29 -0.18  0.31  0.24 0.271 0.73 3.6
## Freedom        0.66 -0.15  0.19 -0.21 0.535 0.46 1.5
## Creativity     0.48 -0.33  0.22  0.11 0.394 0.61 2.4
## Independent    0.40  0.03  0.13 -0.16 0.202 0.80 1.6
## Choose_Own_Goals 0.50 -0.06  0.07 -0.18 0.286 0.71 1.3
## Curious        0.43 -0.29  0.30  0.18 0.386 0.61 3.1
##
##      MR1   MR2   MR3   MR4
## SS loadings      9.76 3.86 2.69 1.70

```

```

## Proportion Var      0.21 0.08 0.06 0.04
## Cumulative Var      0.21 0.30 0.35 0.39
## Proportion Explained 0.54 0.21 0.15 0.09
## Cumulative Proportion 0.54 0.76 0.91 1.00
##
## Mean item complexity = 2.2
## Test of the hypothesis that 4 factors are sufficient.
##
## The degrees of freedom for the null model are 1035 and the objective function was 21.95 with Chi S
## The degrees of freedom for the model are 857 and the objective function was 6.34
##
## The root mean square of the residuals (RMSR) is 0.05
## The df corrected root mean square of the residuals is 0.05
##
## The harmonic number of observations is 269 with the empirical chi square 1392 with prob < 3.4e-28
## The total number of observations was 269 with Likelihood Chi Square = 1579 with prob < 1.9e-45
##
## Tucker Lewis Index of factoring reliability = 0.803
## RMSEA index = 0.061 and the 90 % confidence intervals are 0.052 NA
## BIC = -3215
## Fit based upon off diagonal values = 0.96
## Measures of factor score adequacy
##
## Correlation of (regression) scores with factors MR1 MR2 MR3
## Multiple R square of scores with factors 0.97 0.94 0.91
## Minimum correlation of possible factor scores 0.89 0.76 0.65
##
## Correlation of (regression) scores with factors MR4
## Multiple R square of scores with factors 0.87
## Minimum correlation of possible factor scores 0.75
##
## Minimum correlation of possible factor scores 0.51

fa.sort(fit_FA_6a, polar = FALSE)

## Factor Analysis using method = minres
## Call: fa(r = SVI_2[, 2:47], nfactors = 4, rotate = "none", scores = "tenberge",
## fm = "minres")
## Standardized loadings (pattern matrix) based upon correlation matrix
##
## MR1 MR2 MR3 MR4 h2 u2 com
## Freedom 0.66 -0.15 0.19 -0.21 0.535 0.46 1.5
## Honest 0.65 -0.10 -0.24 -0.24 0.546 0.45 1.6
## Ambitious 0.63 0.19 -0.03 -0.28 0.509 0.49 1.6
## Helpful 0.62 -0.29 -0.26 0.00 0.539 0.46 1.8
## Responsible 0.61 0.18 -0.22 -0.14 0.468 0.53 1.6
## Respect_Elders 0.60 0.22 -0.37 0.08 0.546 0.45 2.0
## Loyal 0.59 0.06 -0.15 -0.23 0.431 0.57 1.5
## Equality 0.59 -0.46 -0.06 -0.22 0.617 0.38 2.2
## Social_Justice 0.58 -0.40 -0.12 -0.01 0.512 0.49 1.9
## Capable 0.57 0.27 0.14 -0.18 0.456 0.54 1.8
## Politeness 0.55 0.26 -0.18 0.00 0.404 0.60 1.7
## Forgiving 0.55 -0.20 -0.21 0.09 0.391 0.61 1.7
## Family_Security 0.54 0.08 -0.19 -0.19 0.370 0.63 1.6
## Successful 0.54 0.41 0.14 -0.25 0.542 0.46 2.5
## Self-Discipline 0.53 0.16 -0.25 0.16 0.390 0.61 1.8
## Wisdom 0.52 0.04 0.03 0.12 0.285 0.71 1.1

```

```

## World_Peace      0.51 -0.34  0.02  0.03 0.374 0.63 1.8
## Broad_Minded     0.50 -0.43  0.13 -0.22 0.504 0.50 2.5
## Choose_Own_Goals 0.50 -0.06  0.07 -0.18 0.286 0.71 1.3
## Influential      0.49  0.16  0.09  0.15 0.301 0.70 1.5
## Creativity       0.48 -0.33  0.22  0.11 0.394 0.61 2.4
## Unity_With_Nature 0.47 -0.35  0.12  0.39 0.506 0.49 3.0
## Humble           0.46 -0.08 -0.38  0.06 0.362 0.64 2.0
## World_Of_Beauty  0.44 -0.38  0.23  0.26 0.460 0.54 3.2
## Clean            0.44  0.21 -0.02  0.15 0.265 0.74 1.7
## Respect_For_Tradition 0.43  0.24 -0.30  0.28 0.400 0.60 3.2
## Curious          0.43 -0.29  0.30  0.18 0.386 0.61 3.1
## National_Security 0.42  0.27  0.01  0.12 0.262 0.74 1.9
## Obedient         0.42  0.19 -0.24  0.18 0.300 0.70 2.5
## Independent      0.40  0.03  0.13 -0.16 0.202 0.80 1.6
## Reciprocity      0.38  0.29 -0.06  0.06 0.234 0.77 2.0
## Social_Order     0.34  0.30  0.08  0.08 0.221 0.78 2.2
## Wealth           0.11  0.66  0.30 -0.10 0.551 0.45 1.5
## Public_Image     0.32  0.55  0.16  0.15 0.453 0.55 2.0
## Social_Power     0.10  0.47  0.46  0.22 0.494 0.51 2.5
## Protect_Enviroment 0.35 -0.47  0.19  0.30 0.464 0.54 3.0
## Authority        0.41  0.42  0.18  0.30 0.465 0.53 3.2
## Moderate         0.08  0.13 -0.12  0.09 0.046 0.95 3.5
## Exciting_Life    0.40 -0.13  0.50  0.01 0.429 0.57 2.1
## Varied_Life      0.37 -0.23  0.47  0.07 0.415 0.59 2.5
## Pleasure         0.28  0.21  0.46 -0.20 0.372 0.63 2.6
## Devout           0.26  0.23 -0.36  0.22 0.297 0.70 3.3
## Self-Indulgent   0.00  0.32  0.34  0.04 0.223 0.78 2.0
## Daring           0.29 -0.18  0.31  0.24 0.271 0.73 3.6
## Enjoy_Life       0.40  0.03  0.27 -0.41 0.399 0.60 2.7
## Accept_My_Life   0.20  0.04 -0.13  0.28 0.138 0.86 2.4
##
##
## MR1 MR2 MR3 MR4
## SS loadings      9.76 3.86 2.69 1.70
## Proportion Var   0.21 0.08 0.06 0.04
## Cumulative Var   0.21 0.30 0.35 0.39
## Proportion Explained 0.54 0.21 0.15 0.09
## Cumulative Proportion 0.54 0.76 0.91 1.00
##
## Mean item complexity = 2.2
## Test of the hypothesis that 4 factors are sufficient.
##
## The degrees of freedom for the null model are 1035 and the objective function was 21.95 with Chi 2
## The degrees of freedom for the model are 857 and the objective function was 6.34
##
## The root mean square of the residuals (RMSR) is 0.05
## The df corrected root mean square of the residuals is 0.05
##
## The harmonic number of observations is 269 with the empirical chi square 1392 with prob < 3.4e-28
## The total number of observations was 269 with Likelihood Chi Square = 1579 with prob < 1.9e-45
##
## Tucker Lewis Index of factoring reliability = 0.803
## RMSEA index = 0.061 and the 90 % confidence intervals are 0.052 NA
## BIC = -3215
## Fit based upon off diagonal values = 0.96

```

```

## Measures of factor score adequacy
##
## Correlation of (regression) scores with factors    MR1  MR2  MR3
## Multiple R square of scores with factors          0.97 0.94 0.91
## Minimum correlation of possible factor scores      0.89 0.76 0.65
##
## Correlation of (regression) scores with factors    MR4
## Multiple R square of scores with factors          0.87
## Minimum correlation of possible factor scores      0.75
##
fit_FA_6b <- fa(SVI_2[, 2:47], nfactors = 4, rotate = "varimax", fm = "minres",
  scores = "tenberge")
fit_FA_6b

## Factor Analysis using method = minres
## Call: fa(r = SVI_2[, 2:47], nfactors = 4, rotate = "varimax", scores = "tenberge",
## fm = "minres")
## Standardized loadings (pattern matrix) based upon correlation matrix
##
## MR1  MR4  MR3  MR2  h2  u2  com
## Equality      0.56  0.07  0.45 -0.31 0.617 0.38 2.5
## World_Peace   0.32  0.15  0.48 -0.16 0.374 0.63 2.2
## Unity_With_Nature 0.01  0.25  0.66 -0.06 0.506 0.49 1.3
## Wisdom        0.25  0.34  0.30  0.14 0.285 0.71 3.2
## World_Of_Beauty 0.10  0.09  0.66 -0.03 0.460 0.54 1.1
## Social_Justice 0.40  0.23  0.47 -0.29 0.512 0.49 3.2
## Broad_Minded   0.50 -0.07  0.47 -0.17 0.504 0.50 2.3
## Protect_Enviroment 0.00  0.05  0.67 -0.12 0.464 0.54 1.1
## Loyal          0.57  0.32  0.09  0.00 0.431 0.57 1.6
## Honest         0.62  0.34  0.16 -0.17 0.546 0.45 1.9
## Helpful        0.42  0.38  0.36 -0.30 0.539 0.46 3.8
## Responsible    0.50  0.46  0.03  0.05 0.468 0.53 2.0
## Forgiving      0.30  0.39  0.33 -0.20 0.391 0.61 3.5
## Respect_For_Tradition 0.08  0.62  0.06  0.05 0.400 0.60 1.1
## Moderate       -0.02  0.20 -0.05  0.03 0.046 0.95 1.2
## Humble         0.26  0.46  0.13 -0.25 0.362 0.64 2.4
## Accept_My_Life -0.07  0.34  0.14 -0.01 0.138 0.86 1.4
## Devout         0.01  0.54 -0.08 -0.03 0.297 0.70 1.0
## Self-Discipline 0.24  0.57  0.12  0.04 0.390 0.61 1.4
## Respect_Elders 0.34  0.66  0.03  0.00 0.546 0.45 1.5
## Obedient       0.15  0.52  0.06  0.04 0.300 0.70 1.2
## Politeness     0.36  0.50  0.04  0.13 0.404 0.60 2.0
## Social_Order   0.16  0.29  0.06  0.33 0.221 0.78 2.5
## National_Security 0.19  0.38  0.11  0.27 0.262 0.74 2.5
## Reciprocity    0.21  0.38  0.02  0.22 0.234 0.77 2.3
## Family_Security 0.50  0.34  0.05 -0.01 0.370 0.63 1.8
## Clean         0.18  0.41  0.15  0.21 0.265 0.74 2.3
## Social_Power   -0.11  0.08  0.08  0.69 0.494 0.51 1.1
## Wealth        0.14  0.09 -0.24  0.68 0.551 0.45 1.4
## Authority      0.03  0.42  0.17  0.51 0.465 0.53 2.2
## Public_Image   0.09  0.36 -0.03  0.56 0.453 0.55 1.8
## Ambitious      0.62  0.29  0.06  0.17 0.509 0.49 1.6
## Influential    0.21  0.35  0.26  0.26 0.301 0.70 3.5
## Capable        0.51  0.25  0.11  0.36 0.456 0.54 2.4
## Successful     0.54  0.25 -0.02  0.44 0.542 0.46 2.4

```



```

## Pleasure      0.32 -0.12  0.14  0.48 0.372 0.63 2.1
## Enjoy_Life    0.56 -0.13  0.13  0.23 0.399 0.60 1.5
## Self-Indulgent -0.04 -0.06 -0.02  0.47 0.223 0.78 1.0
## Exciting_Life 0.25 -0.11  0.52  0.30 0.429 0.57 2.2
## Varied_Life   0.18 -0.12  0.57  0.21 0.415 0.59 1.6
## Daring        0.00  0.03  0.50  0.14 0.271 0.73 1.2
## Freedom       0.59  0.09  0.41  0.10 0.535 0.46 1.9
## Creativity    0.23  0.06  0.58 -0.01 0.394 0.61 1.3
## Independent   0.38  0.07  0.17  0.15 0.202 0.80 1.8
## Choose_Own_Goals 0.46  0.12  0.24  0.05 0.286 0.71 1.7
## Curious       0.14  0.04  0.60  0.08 0.386 0.61 1.2
##
##              MR1  MR4  MR3  MR2
## SS loadings    5.21 4.72 4.67 3.41
## Proportion Var 0.11 0.10 0.10 0.07
## Cumulative Var 0.11 0.22 0.32 0.39
## Proportion Explained 0.29 0.26 0.26 0.19
## Cumulative Proportion 0.29 0.55 0.81 1.00
##
## Mean item complexity = 1.9
## Test of the hypothesis that 4 factors are sufficient.
##
## The degrees of freedom for the null model are 1035 and the objective function was 21.95 with Chi S
## The degrees of freedom for the model are 857 and the objective function was 6.34
##
## The root mean square of the residuals (RMSR) is 0.05
## The df corrected root mean square of the residuals is 0.05
##
## The harmonic number of observations is 269 with the empirical chi square 1392 with prob < 3.4e-28
## The total number of observations was 269 with Likelihood Chi Square = 1579 with prob < 1.9e-45
##
## Tucker Lewis Index of factoring reliability = 0.803
## RMSEA index = 0.061 and the 90 % confidence intervals are 0.052 NA
## BIC = -3215
## Fit based upon off diagonal values = 0.96
## Measures of factor score adequacy
##
##              MR1  MR4  MR3
## Correlation of (regression) scores with factors 0.92 0.92 0.93
## Multiple R square of scores with factors 0.84 0.84 0.86
## Minimum correlation of possible factor scores 0.69 0.69 0.72
##
##              MR2
## Correlation of (regression) scores with factors 0.93
## Multiple R square of scores with factors 0.86
## Minimum correlation of possible factor scores 0.71

fa.sort(fit_FA_6b, polar = FALSE)

## Factor Analysis using method = minres
## Call: fa(r = SVI_2[, 2:47], nfactors = 4, rotate = "varimax", scores = "tenberge",
## fm = "minres")
## Standardized loadings (pattern matrix) based upon correlation matrix
##              MR1  MR4  MR3  MR2  h2  u2 com
## Ambitious    0.62  0.29  0.06  0.17 0.509 0.49 1.6
## Honest       0.62  0.34  0.16 -0.17 0.546 0.45 1.9

```

```

## Freedom      0.59  0.09  0.41  0.10  0.535  0.46  1.9
## Loyal        0.57  0.32  0.09  0.00  0.431  0.57  1.6
## Equality     0.56  0.07  0.45 -0.31  0.617  0.38  2.5
## Enjoy_Life   0.56 -0.13  0.13  0.23  0.399  0.60  1.5
## Successful   0.54  0.25 -0.02  0.44  0.542  0.46  2.4
## Capable      0.51  0.25  0.11  0.36  0.456  0.54  2.4
## Responsible  0.50  0.46  0.03  0.05  0.468  0.53  2.0
## Family_Security 0.50  0.34  0.05 -0.01  0.370  0.63  1.8
## Broad_Minded 0.50 -0.07  0.47 -0.17  0.504  0.50  2.3
## Choose_Own_Goals 0.46  0.12  0.24  0.05  0.286  0.71  1.7
## Helpful      0.42  0.38  0.36 -0.30  0.539  0.46  3.8
## Independent  0.38  0.07  0.17  0.15  0.202  0.80  1.8
## Respect_Elders 0.34  0.66  0.03  0.00  0.546  0.45  1.5
## Respect_For_Tradition 0.08  0.62  0.06  0.05  0.400  0.60  1.1
## Self-Discipline 0.24  0.57  0.12  0.04  0.390  0.61  1.4
## Devout       0.01  0.54 -0.08 -0.03  0.297  0.70  1.0
## Obedient     0.15  0.52  0.06  0.04  0.300  0.70  1.2
## Politeness   0.36  0.50  0.04  0.13  0.404  0.60  2.0
## Humble       0.26  0.46  0.13 -0.25  0.362  0.64  2.4
## Clean        0.18  0.41  0.15  0.21  0.265  0.74  2.3
## Forgiving    0.30  0.39  0.33 -0.20  0.391  0.61  3.5
## National_Security 0.19  0.38  0.11  0.27  0.262  0.74  2.5
## Reciprocity  0.21  0.38  0.02  0.22  0.234  0.77  2.3
## Influential  0.21  0.35  0.26  0.26  0.301  0.70  3.5
## Wisdom       0.25  0.34  0.30  0.14  0.285  0.71  3.2
## Accept_My_Life -0.07  0.34  0.14 -0.01  0.138  0.86  1.4
## Moderate     -0.02  0.20 -0.05  0.03  0.046  0.95  1.2
## Protect_Enviroment 0.00  0.05  0.67 -0.12  0.464  0.54  1.1
## Unity_With_Nature 0.01  0.25  0.66 -0.06  0.506  0.49  1.3
## World_Of_Beauty 0.10  0.09  0.66 -0.03  0.460  0.54  1.1
## Curious      0.14  0.04  0.60  0.08  0.386  0.61  1.2
## Creativity    0.23  0.06  0.58 -0.01  0.394  0.61  1.3
## Varied_Life   0.18 -0.12  0.57  0.21  0.415  0.59  1.6
## Exciting_Life 0.25 -0.11  0.52  0.30  0.429  0.57  2.2
## Daring       0.00  0.03  0.50  0.14  0.271  0.73  1.2
## World_Peace   0.32  0.15  0.48 -0.16  0.374  0.63  2.2
## Social_Justice 0.40  0.23  0.47 -0.29  0.512  0.49  3.2
## Social_Power  -0.11  0.08  0.08  0.69  0.494  0.51  1.1
## Wealth       0.14  0.09 -0.24  0.68  0.551  0.45  1.4
## Public_Image  0.09  0.36 -0.03  0.56  0.453  0.55  1.8
## Authority    0.03  0.42  0.17  0.51  0.465  0.53  2.2
## Pleasure     0.32 -0.12  0.14  0.48  0.372  0.63  2.1
## Self-Indulgent -0.04 -0.06 -0.02  0.47  0.223  0.78  1.0
## Social_Order  0.16  0.29  0.06  0.33  0.221  0.78  2.5
##
##
## MR1  MR4  MR3  MR2
## SS loadings  5.21  4.72  4.67  3.41
## Proportion Var  0.11  0.10  0.10  0.07
## Cumulative Var  0.11  0.22  0.32  0.39
## Proportion Explained 0.29  0.26  0.26  0.19
## Cumulative Proportion 0.29  0.55  0.81  1.00
##
## Mean item complexity = 1.9
## Test of the hypothesis that 4 factors are sufficient.

```

```

##
## The degrees of freedom for the null model are 1035 and the objective function was 21.95 with Chi S
## The degrees of freedom for the model are 857 and the objective function was 6.34
##
## The root mean square of the residuals (RMSR) is 0.05
## The df corrected root mean square of the residuals is 0.05
##
## The harmonic number of observations is 269 with the empirical chi square 1392 with prob < 3.4e-2
## The total number of observations was 269 with Likelihood Chi Square = 1579 with prob < 1.9e-45
##
## Tucker Lewis Index of factoring reliability = 0.803
## RMSEA index = 0.061 and the 90 % confidence intervals are 0.052 NA
## BIC = -3215
## Fit based upon off diagonal values = 0.96
## Measures of factor score adequacy
##
## Correlation of (regression) scores with factors MR1 MR4 MR3
## Multiple R square of scores with factors 0.92 0.92 0.93
## Minimum correlation of possible factor scores 0.84 0.84 0.86
##
## Correlation of (regression) scores with factors MR2
## Multiple R square of scores with factors 0.69 0.69 0.72
## Minimum correlation of possible factor scores 0.93
##
## Correlation of (regression) scores with factors 0.86
## Multiple R square of scores with factors 0.71
## Minimum correlation of possible factor scores 0.93

fit_FA_6c <- fa(SVI_2[, 2:47], nfactors = 4, rotate = "oblimin", fm = "minres",
  scores = "tenberge")
fit_FA_6c

## Factor Analysis using method = minres
## Call: fa(r = SVI_2[, 2:47], nfactors = 4, rotate = "oblimin", scores = "tenberge",
## fm = "minres")
## Standardized loadings (pattern matrix) based upon correlation matrix
##
## Equality MR1 MR3 MR4 MR2 h2 u2 com
## World_Peace 0.08 0.34 0.46 -0.39 0.617 0.38 2.9
## Unity_With_Nature 0.14 0.43 0.19 -0.18 0.374 0.63 2.0
## Wisdom 0.20 0.69 -0.17 0.00 0.506 0.49 1.3
## World_Of_Beauty 0.31 0.27 0.12 0.14 0.285 0.71 2.7
## Social_Justice 0.04 0.68 -0.03 -0.01 0.460 0.54 1.0
## Broad_Minded 0.24 0.39 0.23 -0.32 0.512 0.49 3.4
## Protect_Enviroment -0.09 0.39 0.45 -0.25 0.504 0.50 2.7
## Loyal 0.01 0.70 -0.13 -0.09 0.464 0.54 1.1
## Honest 0.33 -0.02 0.47 -0.06 0.431 0.57 1.8
## Helpful 0.37 0.04 0.48 -0.24 0.546 0.45 2.4
## Responsible 0.42 0.28 0.22 -0.31 0.539 0.46 3.3
## Forgiving 0.48 -0.06 0.38 0.00 0.468 0.53 1.9
## Respect_For_Tradition 0.41 0.28 0.11 -0.20 0.391 0.61 2.5
## Moderate 0.64 0.04 -0.13 0.12 0.400 0.60 1.2
## Humble 0.22 -0.05 -0.07 0.06 0.046 0.95 1.5
## Accept_My_Life 0.52 0.07 0.07 -0.23 0.362 0.64 1.5
## Devout 0.34 0.16 -0.21 0.05 0.138 0.86 2.2
## Self-Discipline 0.58 -0.09 -0.16 0.03 0.297 0.70 1.2
## Respect_Elders 0.58 0.08 0.04 0.06 0.390 0.61 1.1
## Obedient 0.69 -0.04 0.13 0.02 0.546 0.45 1.1
## Obedient 0.54 0.04 -0.02 0.08 0.300 0.70 1.1

```

```

## Politeness      0.51 -0.02  0.22  0.12 0.404 0.60 1.5
## Social_Order    0.25  0.06  0.10  0.33 0.221 0.78 2.2
## National_Security 0.35  0.09  0.09  0.28 0.262 0.74 2.2
## Reciprocity     0.36 -0.01  0.12  0.23 0.234 0.77 1.9
## Family_Security 0.36 -0.05  0.40 -0.07 0.370 0.63 2.1
## Clean           0.38  0.13  0.06  0.23 0.265 0.74 2.0
## Social_Power    -0.04  0.15 -0.06  0.71 0.494 0.51 1.1
## Wealth          0.02 -0.24  0.24  0.65 0.551 0.45 1.6
## Authority       0.35  0.20 -0.07  0.55 0.465 0.53 2.0
## Public_Image    0.30 -0.02  0.06  0.58 0.453 0.55 1.5
## Ambitious       0.28 -0.05  0.57  0.09 0.509 0.49 1.5
## Influential     0.30  0.25  0.10  0.27 0.301 0.70 3.1
## Capable         0.20  0.04  0.48  0.29 0.456 0.54 2.0
## Successful      0.20 -0.10  0.54  0.36 0.542 0.46 2.1
## Pleasure        -0.22  0.11  0.42  0.40 0.372 0.63 2.7
## Enjoy_Life      -0.18  0.03  0.64  0.10 0.399 0.60 1.2
## Self-Indulgent  -0.13  0.02  0.04  0.46 0.223 0.78 1.2
## Exciting_Life   -0.21  0.51  0.26  0.26 0.429 0.57 2.4
## Varied_Life     -0.21  0.58  0.18  0.18 0.415 0.59 1.7
## Daring          -0.04  0.53 -0.06  0.16 0.271 0.73 1.2
## Freedom         0.05  0.32  0.54  0.01 0.535 0.46 1.7
## Creativity      0.01  0.56  0.14 -0.02 0.394 0.61 1.1
## Independent     0.04  0.12  0.37  0.09 0.202 0.80 1.4
## Choose_Own_Goals 0.10  0.16  0.41 -0.02 0.286 0.71 1.4
## Curious        -0.03  0.61  0.06  0.08 0.386 0.61 1.1
##
##
##          MR1  MR3  MR4  MR2
## SS loadings    5.38 4.70 4.55 3.38
## Proportion Var  0.12 0.10 0.10 0.07
## Cumulative Var  0.12 0.22 0.32 0.39
## Proportion Explained 0.30 0.26 0.25 0.19
## Cumulative Proportion 0.30 0.56 0.81 1.00
##
## With factor correlations of
##          MR1  MR3  MR4  MR2
## MR1 1.00  0.21 0.34  0.04
## MR3 0.21  1.00 0.33 -0.09
## MR4 0.34  0.33 1.00  0.08
## MR2 0.04 -0.09 0.08  1.00
##
## Mean item complexity = 1.8
## Test of the hypothesis that 4 factors are sufficient.
##
## The degrees of freedom for the null model are 1035 and the objective function was 21.95 with Chi S
## The degrees of freedom for the model are 857 and the objective function was 6.34
##
## The root mean square of the residuals (RMSR) is 0.05
## The df corrected root mean square of the residuals is 0.05
##
## The harmonic number of observations is 269 with the empirical chi square 1392 with prob < 3.4e-28
## The total number of observations was 269 with Likelihood Chi Square = 1579 with prob < 1.9e-45
##
## Tucker Lewis Index of factoring reliability = 0.803
## RMSEA index = 0.061 and the 90 % confidence intervals are 0.052 NA

```

```

## BIC = -3215
## Fit based upon off diagonal values = 0.96
## Measures of factor score adequacy
##
## Correlation of (regression) scores with factors    MR1  MR3  MR4
## Multiple R square of scores with factors          0.94 0.94 0.93
## Minimum correlation of possible factor scores      0.89 0.88 0.87
##
## Correlation of (regression) scores with factors    MR2
## Multiple R square of scores with factors          0.77 0.77 0.75
## Minimum correlation of possible factor scores      0.93
##
## Correlation of (regression) scores with factors    0.86
## Multiple R square of scores with factors          0.72
## Minimum correlation of possible factor scores

fa.sort(fit_FA_6c, polar = FALSE)

## Factor Analysis using method = minres
## Call: fa(r = SVI_2[, 2:47], nfactors = 4, rotate = "oblimin", scores = "tenberge",
##       fm = "minres")
## Standardized loadings (pattern matrix) based upon correlation matrix
##
## MR1  MR3  MR4  MR2  h2  u2 com
## Respect_Elders      0.69 -0.04  0.13  0.02 0.546 0.45 1.1
## Respect_For_Tradition 0.64  0.04 -0.13  0.12 0.400 0.60 1.2
## Devout              0.58 -0.09 -0.16  0.03 0.297 0.70 1.2
## Self-Discipline      0.58  0.08  0.04  0.06 0.390 0.61 1.1
## Obedient             0.54  0.04 -0.02  0.08 0.300 0.70 1.1
## Humble              0.52  0.07  0.07 -0.23 0.362 0.64 1.5
## Politeness          0.51 -0.02  0.22  0.12 0.404 0.60 1.5
## Responsible         0.48 -0.06  0.38  0.00 0.468 0.53 1.9
## Helpful             0.42  0.28  0.22 -0.31 0.539 0.46 3.3
## Forgiving           0.41  0.28  0.11 -0.20 0.391 0.61 2.5
## Clean              0.38  0.13  0.06  0.23 0.265 0.74 2.0
## Reciprocity         0.36 -0.01  0.12  0.23 0.234 0.77 1.9
## National_Security   0.35  0.09  0.09  0.28 0.262 0.74 2.2
## Accept_My_Life      0.34  0.16 -0.21  0.05 0.138 0.86 2.2
## Wisdom             0.31  0.27  0.12  0.14 0.285 0.71 2.7
## Influential         0.30  0.25  0.10  0.27 0.301 0.70 3.1
## Moderate           0.22 -0.05 -0.07  0.06 0.046 0.95 1.5
## Protect_Enviroment  0.01  0.70 -0.13 -0.09 0.464 0.54 1.1
## Unity_With_Nature   0.20  0.69 -0.17  0.00 0.506 0.49 1.3
## World_Of_Beauty     0.04  0.68 -0.03 -0.01 0.460 0.54 1.0
## Curious            -0.03  0.61  0.06  0.08 0.386 0.61 1.1
## Varied_Life        -0.21  0.58  0.18  0.18 0.415 0.59 1.7
## Creativity          0.01  0.56  0.14 -0.02 0.394 0.61 1.1
## Daring            -0.04  0.53 -0.06  0.16 0.271 0.73 1.2
## Exciting_Life      -0.21  0.51  0.26  0.26 0.429 0.57 2.4
## World_Peace        0.14  0.43  0.19 -0.18 0.374 0.63 2.0
## Social_Justice     0.24  0.39  0.23 -0.32 0.512 0.49 3.4
## Enjoy_Life        -0.18  0.03  0.64  0.10 0.399 0.60 1.2
## Ambitious          0.28 -0.05  0.57  0.09 0.509 0.49 1.5
## Successful         0.20 -0.10  0.54  0.36 0.542 0.46 2.1
## Freedom           0.05  0.32  0.54  0.01 0.535 0.46 1.7
## Honest            0.37  0.04  0.48 -0.24 0.546 0.45 2.4
## Capable           0.20  0.04  0.48  0.29 0.456 0.54 2.0
## Loyal             0.33 -0.02  0.47 -0.06 0.431 0.57 1.8
## Equality          0.08  0.34  0.46 -0.39 0.617 0.38 2.9

```

```

## Broad_Minded      -0.09  0.39  0.45 -0.25 0.504 0.50 2.7
## Pleasure          -0.22  0.11  0.42  0.40 0.372 0.63 2.7
## Choose_Own_Goals   0.10  0.16  0.41 -0.02 0.286 0.71 1.4
## Family_Security    0.36 -0.05  0.40 -0.07 0.370 0.63 2.1
## Independent        0.04  0.12  0.37  0.09 0.202 0.80 1.4
## Social_Power       -0.04  0.15 -0.06  0.71 0.494 0.51 1.1
## Wealth            0.02 -0.24  0.24  0.65 0.551 0.45 1.6
## Public_Image       0.30 -0.02  0.06  0.58 0.453 0.55 1.5
## Authority         0.35  0.20 -0.07  0.55 0.465 0.53 2.0
## Self-Indulgent     -0.13  0.02  0.04  0.46 0.223 0.78 1.2
## Social_Order       0.25  0.06  0.10  0.33 0.221 0.78 2.2
##
##
##          MR1  MR3  MR4  MR2
## SS loadings      5.38 4.70 4.55 3.38
## Proportion Var   0.12 0.10 0.10 0.07
## Cumulative Var   0.12 0.22 0.32 0.39
## Proportion Explained 0.30 0.26 0.25 0.19
## Cumulative Proportion 0.30 0.56 0.81 1.00
##
## With factor correlations of
##          MR1  MR3  MR4  MR2
## MR1 1.00  0.21 0.34  0.04
## MR3 0.21  1.00 0.33 -0.09
## MR4 0.34  0.33 1.00  0.08
## MR2 0.04 -0.09 0.08  1.00
##
## Mean item complexity = 1.8
## Test of the hypothesis that 4 factors are sufficient.
##
## The degrees of freedom for the null model are 1035 and the objective function was 21.95 with Chi S
## The degrees of freedom for the model are 857 and the objective function was 6.34
##
## The root mean square of the residuals (RMSR) is 0.05
## The df corrected root mean square of the residuals is 0.05
##
## The harmonic number of observations is 269 with the empirical chi square 1392 with prob < 3.4e-28
## The total number of observations was 269 with Likelihood Chi Square = 1579 with prob < 1.9e-45
##
## Tucker Lewis Index of factoring reliability = 0.803
## RMSEA index = 0.061 and the 90 % confidence intervals are 0.052 NA
## BIC = -3215
## Fit based upon off diagonal values = 0.96
## Measures of factor score adequacy
##
##          MR1  MR3  MR4
## Correlation of (regression) scores with factors 0.94 0.94 0.93
## Multiple R square of scores with factors 0.89 0.88 0.87
## Minimum correlation of possible factor scores 0.77 0.77 0.75
##
##          MR2
## Correlation of (regression) scores with factors 0.93
## Multiple R square of scores with factors 0.86
## Minimum correlation of possible factor scores 0.72

```

## 4.4 Factor Congruence

Three ways to determine factor replication are to (a) correlate the factor loadings across samples, (b) calculate Tucker's factor congruence coefficient for corresponding factors, and (c) estimate and correlate factor scores using weights from the other sample.

Because the analyses with the full sample did not make a particularly compelling case for correlated factors, we'll focus on orthogonal rotation in the cross-validation.

### 4.4.1 Loading Correlations

Loading correlations are intuitively appealing but they have some short-comings that are overcome by Tucker's approach.

```
# cor(fit_FA_5a$loadings[,],fit_FA_6a$loadings)
cor(fit_FA_5b$loadings[, ], fit_FA_6b$loadings)

##          MR1      MR4      MR3      MR2
## MR1  0.83187  0.1964  0.1711 -0.62857
## MR2  0.02325 -0.4476 -0.1707  0.81534
## MR3 -0.47353  0.8163 -0.4922  0.05344
## MR4 -0.25441 -0.4366  0.8529 -0.33315

# cor(fit_FA_5c$loadings[,],fit_FA_6c$loadings)
```

### 4.4.2 Tucker's Factor Congruence

From the documentation for the `factor.congruence()` function:

Factor congruences are the cosines of pairs of vectors defined by the loadings matrix and based at the origin. Thus, for loadings that differ only by a scalar (e.g. the size of the eigen value), the factor congruences will be 1. For factor loading vectors of  $F_1$  and  $F_2$  the measure of factor congruence,  $\phi$ , is

$$\phi = \frac{\sum_{j=1}^K ((F_{1j} - a)(F_{2j} - b))}{\sqrt{\sum_{j=1}^K (F_{1j} - a)^2 \sum_{j=1}^K (F_{2j} - b)^2}}$$

Factor congruences are based upon the raw cross products, while correlations are based upon centered cross products. That is, correlations of factor loadings are cosines of the vectors based at the mean loading for each factor.

For congruence coefficients,  $a = b = 0$ . For correlations  $a = \text{mean } F_1$ ,  $b = \text{mean } F_2$ ."

Tucker's approach has some distinct advantages: First, the numerator is insensitive to scalar multiplication of the loadings. This means that  $\phi$  measures factor similarity independently of the mean absolute size of the loadings. This is a desirable feature because factor interpretations should be independent of the amount of variance explained

by the factor. Second, the numerator is sensitive to additive constants. This is a desirable feature because factor interpretations are should also be sensitive to additive constants. For example, the loadings (.6, .5, .1) would be interpreted differently than would the loadings (.1, .0, -.4).

Tucker suggested the following guidelines for judging factor replication:

.98 to 1.00 = excellent  
 .92 to .98 = good  
 .82 to .92 = borderline  
 .68 to .82 = poor  
 below .68 = terrible

```
# factor.congruence(fit_FA_5a$loadings[,],fit_FA_6a$loadings)
factor.congruence(fit_FA_5b$loadings[, ], fit_FA_6b$loadings)

##      MR1  MR4  MR3  MR2
## MR1 0.93 0.67 0.62 -0.03
## MR2 0.62 0.40 0.46 0.79
## MR3 0.36 0.91 0.25 0.33
## MR4 0.37 0.25 0.91 0.02

# factor.congruence(fit_FA_5c$loadings[,],fit_FA_6c$loadings)
```

#### 4.4.3 Factor Score Correlations

```
options(scipen = 999, digits = 2)
Sample_1_Actual <- as.data.frame(fit_FA_5b$scores)
Sample_1_Estimated <- as.matrix(SVI_1[, 2:47]) %*% fit_FA_6b$weights
Sample_1 <- cbind(Sample_1_Actual, Sample_1_Estimated)
names(Sample_1) <- c("FA1_Actual", "FA2_Actual", "FA3_Actual", "FA4_Actual",
  "FA1_Estimate", "FA2_Estimate", "FA3_Estimate", "FA4_Estimate")
R_1 <- cor(Sample_1)

Sample_2_Actual <- as.data.frame(fit_FA_6b$scores)
Sample_2_Estimated <- as.matrix(SVI_2[, 2:47]) %*% fit_FA_5b$weights
Sample_2 <- cbind(Sample_2_Actual, Sample_2_Estimated)
names(Sample_2) <- c("FA1_Actual", "FA2_Actual", "FA3_Actual", "FA4_Actual",
  "FA1_Estimate", "FA2_Estimate", "FA3_Estimate", "FA4_Estimate")
R_2 <- cor(Sample_2)
```

Factor Score Correlations, Sample 1								
	Actual Factor Scores				Estimated Factor Scores			
Factor Score	1	2	3	4	1	2	3	4
Actual 1	1	0	0	0	0.85	0.29	0.19	-0.31
Actual 2	0	1	0	0	0.36	-0.06	0.29	0.91
Actual 3	0	0	1	0	-0.24	0.93	0.08	0.19
Actual 4	0	0	0	1	-0.15	0.01	0.9	0.03
Estimated 1	0.85	0.36	-0.24	-0.15	1	-0.04	0.07	0.01
Estimated 2	0.29	-0.06	0.93	0.01	-0.04	1	0.14	0.02
Estimated 3	0.19	0.29	0.08	0.9	0.07	0.14	1	0.25
Estimated 4	-0.31	0.91	0.19	0.03	0.01	0.02	0.25	1



Factor Score Correlations, Sample 2								
	Actual Factor Scores				Estimated Factor Scores			
Factor Score	1	2	3	4	1	2	3	4
Actual 1	1	0	0	0	0.8	0.31	-0.13	-0.09
Actual 2	0	1	0	0	0.34	-0.07	0.94	-0.09
Actual 3	0	0	1	0	0.27	0.06	-0.13	0.94
Actual 4	0	0	0	1	-0.37	0.93	0.19	-0.2
Estimated 1	0.8	0.34	0.27	-0.37	1	-0.11	0.09	0.2
Estimated 2	0.31	-0.07	0.06	0.93	-0.11	1	0.04	-0.16
Estimated 3	-0.13	0.94	-0.13	0.19	0.09	0.04	1	-0.22
Estimated 4	-0.09	-0.09	0.94	-0.2	0.2	-0.16	-0.22	1

## 5 Cross-Validation Example 2

*Cross-validation is especially important when small or weak factors are extracted, perhaps those very close to the rubble in the scree plot or just barely outside the confidence intervals in a parallel analysis. Here we will extract 8 factors from the values data and examine how well the minor factors replicate.*

### 5.1 Select the Samples

```
SVI_1 <- SVI[sample(1:nrow(SVI), 269, replace = FALSE), ]
SVI_1[, 2:47] <- scale(SVI_1[, 2:47])
SVI_2 <- SVI[!(SVI$ID %in% SVI_1$ID), ]
SVI_2[, 2:47] <- scale(SVI_2[, 2:47])
```

### 5.2 Sample 1

```
fit_FA_5b <- fa(SVI_1[, 2:47], nfactors = 8, rotate = "varimax", fm = "minres",
  scores = "tenberge")
fit_FA_5b

## Factor Analysis using method = minres
## Call: fa(r = SVI_1[, 2:47], nfactors = 8, rotate = "varimax", scores = "tenberge",
##      fm = "minres")
## Standardized loadings (pattern matrix) based upon correlation matrix
##
##      MR1  MR5  MR3  MR2  MR8  MR4  MR6
## Equality      0.23 0.69 0.06 -0.05 0.11 0.18 0.03
## World_Peace    0.12 0.65 0.08 0.07 0.00 0.30 -0.03
## Unity_With_Nature -0.05 0.16 0.18 0.00 0.16 0.66 -0.10
## Wisdom         0.36 0.24 0.21 0.14 0.23 0.04 -0.05
## World_Of_Beauty  0.06 0.18 0.13 -0.01 0.36 0.50 0.11
## Social_Justice  0.18 0.74 0.14 -0.05 0.09 0.17 -0.11
## Broad_Minded    0.24 0.62 -0.10 -0.05 0.16 0.19 0.17
## Protect_Enviroment 0.02 0.25 0.01 -0.03 0.16 0.66 0.04
## Loyal           0.30 0.42 0.35 0.12 0.08 -0.16 0.14
## Honest          0.49 0.43 0.29 0.02 0.13 -0.10 0.23
```

## Helpful	0.26	0.63	0.27	-0.16	0.17	0.08	0.11
## Responsible	0.69	0.17	0.27	0.06	0.12	0.07	0.11
## Forgiving	0.09	0.35	0.35	-0.05	0.23	0.12	0.26
## Respect_For_Tradition	0.04	0.01	0.70	0.17	0.06	0.19	-0.02
## Moderate	0.10	0.02	0.17	0.05	-0.05	0.19	-0.06
## Humble	0.24	0.36	0.39	-0.01	0.01	-0.01	0.17
## Accept_My_Life	-0.03	0.02	0.43	0.12	-0.02	0.05	0.06
## Devout	-0.04	0.01	0.64	-0.08	0.00	0.05	-0.14
## Self-Discipline	0.47	0.13	0.41	0.09	0.07	0.19	-0.08
## Respect_Elders	0.27	0.25	0.64	0.19	-0.07	-0.01	0.10
## Obedient	0.26	0.03	0.51	0.15	0.10	0.07	0.01
## Politeness	0.30	0.36	0.42	0.21	0.04	-0.06	0.06
## Social_Order	0.20	0.06	0.16	0.50	0.02	0.22	-0.20
## National_Security	0.26	0.21	0.29	0.48	-0.03	0.21	-0.10
## Reciprocity	0.31	0.23	0.18	0.40	-0.06	0.08	-0.05
## Family_Security	0.32	0.35	0.36	0.16	0.07	-0.01	0.30
## Clean	0.26	0.11	0.25	0.27	0.07	0.23	-0.06
## Social_Power	0.02	-0.25	0.05	0.44	0.37	0.01	-0.40
## Wealth	0.12	-0.15	0.00	0.67	0.01	-0.10	-0.02
## Authority	0.17	-0.09	0.32	0.33	0.33	-0.02	-0.34
## Public_Image	0.12	0.00	0.20	0.61	0.10	-0.03	0.03
## Ambitious	0.66	0.21	0.16	0.15	0.14	-0.02	0.08
## Influential	0.26	0.28	0.29	0.24	0.26	-0.06	-0.24
## Capable	0.62	0.14	0.12	0.17	0.27	0.07	-0.01
## Successful	0.60	0.15	0.10	0.42	0.13	-0.04	-0.03
## Pleasure	0.09	0.06	-0.03	0.62	0.32	-0.06	0.22
## Enjoy_Life	0.36	0.14	0.03	0.37	0.36	0.02	0.34
## Self-Indulgent	-0.04	-0.18	0.00	0.40	0.20	-0.10	0.02
## Exciting_Life	0.18	0.16	0.05	0.30	0.67	0.02	0.14
## Varied_Life	0.21	0.14	-0.06	0.12	0.55	0.15	0.02
## Daring	0.04	0.05	0.06	0.07	0.59	0.07	-0.13
## Freedom	0.47	0.49	0.02	0.23	0.28	0.12	-0.03
## Creativity	0.31	0.16	0.07	0.02	0.48	0.33	0.02
## Independent	0.49	0.30	-0.07	0.12	0.22	0.03	-0.15
## Choose_Own_Goals	0.47	0.32	-0.05	0.11	0.11	0.04	-0.05
## Curious	0.25	0.12	0.03	-0.07	0.57	0.28	0.02
##	MR7	h2	u2	com			
## Equality	0.02	0.59	0.41	1.5			
## World_Peace	-0.05	0.54	0.46	1.6			
## Unity_With_Nature	0.20	0.58	0.42	1.7			
## Wisdom	0.16	0.33	0.67	4.3			
## World_Of_Beauty	0.02	0.45	0.55	2.4			
## Social_Justice	0.02	0.65	0.35	1.4			
## Broad_Minded	0.01	0.54	0.46	1.9			
## Protect_Enviroment	0.00	0.53	0.47	1.4			
## Loyal	-0.10	0.46	0.54	4.0			
## Honest	-0.05	0.59	0.41	3.5			
## Helpful	0.18	0.64	0.36	2.5			
## Responsible	-0.02	0.61	0.39	1.6			
## Forgiving	0.23	0.44	0.56	4.8			
## Respect_For_Tradition	0.00	0.56	0.44	1.3			
## Moderate	0.33	0.20	0.80	2.6			
## Humble	0.35	0.49	0.51	4.1			
## Accept_My_Life	0.34	0.33	0.67	2.2			

```

## Devout          0.05 0.45 0.55 1.2
## Self-Discipline 0.20 0.50 0.50 3.1
## Respect_Elders  0.04 0.60 0.40 2.0
## Obedient        0.05 0.37 0.63 1.9
## Politeness      0.15 0.47 0.53 3.8
## Social_Order    -0.02 0.40 0.60 2.4
## National_Security -0.11 0.50 0.50 3.5
## Reciprocity     0.23 0.41 0.59 4.0
## Family_Security -0.16 0.50 0.50 4.9
## Clean           0.00 0.28 0.72 4.5
## Social_Power    -0.04 0.56 0.44 3.6
## Wealth          -0.06 0.50 0.50 1.2
## Authority       0.03 0.48 0.52 4.6
## Public_Image    0.07 0.44 0.56 1.4
## Ambitious       -0.04 0.55 0.45 1.6
## Influential     0.04 0.42 0.58 6.1
## Capable         0.10 0.53 0.47 1.8
## Successful      0.08 0.60 0.40 2.2
## Pleasure        0.16 0.58 0.42 2.0
## Enjoy_Life      -0.04 0.54 0.46 4.3
## Self-Indulgent  0.32 0.35 0.65 3.1
## Exciting_Life   -0.12 0.64 0.36 1.9
## Varied_Life     -0.02 0.41 0.59 1.7
## Daring          0.09 0.39 0.61 1.2
## Freedom         -0.11 0.63 0.37 3.3
## Creativity      -0.06 0.46 0.54 3.0
## Independent     0.13 0.45 0.55 2.8
## Choose_Own_Goals 0.00 0.35 0.65 2.1
## Curious         0.03 0.50 0.50 2.0
##
##
## MR1 MR5 MR3 MR2 MR8 MR4 MR6 MR7
## SS loadings      4.4 4.33 3.52 3.27 2.96 1.92 1.03 0.90
## Proportion Var   0.1 0.09 0.08 0.07 0.06 0.04 0.02 0.02
## Cumulative Var   0.1 0.19 0.27 0.34 0.40 0.44 0.47 0.49
## Proportion Explained 0.2 0.19 0.16 0.15 0.13 0.09 0.05 0.04
## Cumulative Proportion 0.2 0.39 0.55 0.70 0.83 0.91 0.96 1.00
##
## Mean item complexity = 2.7
## Test of the hypothesis that 8 factors are sufficient.
##
## The degrees of freedom for the null model are 1035 and the objective function was 23 with Chi Square = 1035.000
## The degrees of freedom for the model are 695 and the objective function was 3.8
##
## The root mean square of the residuals (RMSR) is 0.03
## The df corrected root mean square of the residuals is 0.04
##
## The harmonic number of observations is 269 with the empirical chi square 513 with prob < 1
## The total number of observations was 269 with Likelihood Chi Square = 924 with prob < 0.0000000
##
## Tucker Lewis Index of factoring reliability = 0.92
## RMSEA index = 0.041 and the 90 % confidence intervals are 0.029 0.041
## BIC = -2964
## Fit based upon off diagonal values = 0.99
## Measures of factor score adequacy

```

```

##                                MR1  MR5  MR3
## Correlation of (regression) scores with factors  0.89 0.91 0.90
## Multiple R square of scores with factors         0.79 0.82 0.82
## Minimum correlation of possible factor scores     0.57 0.64 0.64
##                                MR2  MR8  MR4
## Correlation of (regression) scores with factors  0.90 0.89 0.86
## Multiple R square of scores with factors         0.81 0.79 0.74
## Minimum correlation of possible factor scores     0.62 0.58 0.48
##                                MR6  MR7
## Correlation of (regression) scores with factors  0.81 0.77
## Multiple R square of scores with factors         0.65 0.59
## Minimum correlation of possible factor scores     0.30 0.18

fa.sort(fit_FA_5b, polar = FALSE)

## Factor Analysis using method = minres
## Call: fa(r = SVI_1[, 2:47], nfactors = 8, rotate = "varimax", scores = "tenberge",
##       fm = "minres")
## Standardized loadings (pattern matrix) based upon correlation matrix
##                                MR1  MR5  MR3  MR2  MR8  MR4  MR6
## Responsible                    0.69 0.17 0.27 0.06 0.12 0.07 0.11
## Ambitious                      0.66 0.21 0.16 0.15 0.14 -0.02 0.08
## Capable                        0.62 0.14 0.12 0.17 0.27 0.07 -0.01
## Successful                     0.60 0.15 0.10 0.42 0.13 -0.04 -0.03
## Independent                    0.49 0.30 -0.07 0.12 0.22 0.03 -0.15
## Honest                        0.49 0.43 0.29 0.02 0.13 -0.10 0.23
## Self-Discipline                0.47 0.13 0.41 0.09 0.07 0.19 -0.08
## Choose_Own_Goals               0.47 0.32 -0.05 0.11 0.11 0.04 -0.05
## Wisdom                        0.36 0.24 0.21 0.14 0.23 0.04 -0.05
## Social_Justice                 0.18 0.74 0.14 -0.05 0.09 0.17 -0.11
## Equality                      0.23 0.69 0.06 -0.05 0.11 0.18 0.03
## World_Peace                   0.12 0.65 0.08 0.07 0.00 0.30 -0.03
## Helpful                       0.26 0.63 0.27 -0.16 0.17 0.08 0.11
## Broad_Minded                  0.24 0.62 -0.10 -0.05 0.16 0.19 0.17
## Freedom                       0.47 0.49 0.02 0.23 0.28 0.12 -0.03
## Loyal                         0.30 0.42 0.35 0.12 0.08 -0.16 0.14
## Forgiving                     0.09 0.35 0.35 -0.05 0.23 0.12 0.26
## Respect_For_Tradition          0.04 0.01 0.70 0.17 0.06 0.19 -0.02
## Devout                       -0.04 0.01 0.64 -0.08 0.00 0.05 -0.14
## Respect_Elders                0.27 0.25 0.64 0.19 -0.07 -0.01 0.10
## Obedient                      0.26 0.03 0.51 0.15 0.10 0.07 0.01
## Accept_My_Life                -0.03 0.02 0.43 0.12 -0.02 0.05 0.06
## Politeness                    0.30 0.36 0.42 0.21 0.04 -0.06 0.06
## Humble                       0.24 0.36 0.39 -0.01 0.01 -0.01 0.17
## Family_Security               0.32 0.35 0.36 0.16 0.07 -0.01 0.30
## Influential                   0.26 0.28 0.29 0.24 0.26 -0.06 -0.24
## Wealth                        0.12 -0.15 0.00 0.67 0.01 -0.10 -0.02
## Pleasure                      0.09 0.06 -0.03 0.62 0.32 -0.06 0.22
## Public_Image                  0.12 0.00 0.20 0.61 0.10 -0.03 0.03
## Social_Order                  0.20 0.06 0.16 0.50 0.02 0.22 -0.20
## National_Security             0.26 0.21 0.29 0.48 -0.03 0.21 -0.10
## Social_Power                  0.02 -0.25 0.05 0.44 0.37 0.01 -0.40
## Reciprocity                   0.31 0.23 0.18 0.40 -0.06 0.08 -0.05
## Self-Indulgent                -0.04 -0.18 0.00 0.40 0.20 -0.10 0.02

```

## Enjoy_Life	0.36	0.14	0.03	0.37	0.36	0.02	0.34
## Clean	0.26	0.11	0.25	0.27	0.07	0.23	-0.06
## Exciting_Life	0.18	0.16	0.05	0.30	0.67	0.02	0.14
## Daring	0.04	0.05	0.06	0.07	0.59	0.07	-0.13
## Curious	0.25	0.12	0.03	-0.07	0.57	0.28	0.02
## Varied_Life	0.21	0.14	-0.06	0.12	0.55	0.15	0.02
## Creativity	0.31	0.16	0.07	0.02	0.48	0.33	0.02
## Protect_Enviroment	0.02	0.25	0.01	-0.03	0.16	0.66	0.04
## Unity_With_Nature	-0.05	0.16	0.18	0.00	0.16	0.66	-0.10
## World_Of_Beauty	0.06	0.18	0.13	-0.01	0.36	0.50	0.11
## Authority	0.17	-0.09	0.32	0.33	0.33	-0.02	-0.34
## Moderate	0.10	0.02	0.17	0.05	-0.05	0.19	-0.06
##	MR7	h2	u2	com			
## Responsible	-0.02	0.61	0.39	1.6			
## Ambitious	-0.04	0.55	0.45	1.6			
## Capable	0.10	0.53	0.47	1.8			
## Successful	0.08	0.60	0.40	2.2			
## Independent	0.13	0.45	0.55	2.8			
## Honest	-0.05	0.59	0.41	3.5			
## Self-Discipline	0.20	0.50	0.50	3.1			
## Choose_Own_Goals	0.00	0.35	0.65	2.1			
## Wisdom	0.16	0.33	0.67	4.3			
## Social_Justice	0.02	0.65	0.35	1.4			
## Equality	0.02	0.59	0.41	1.5			
## World_Peace	-0.05	0.54	0.46	1.6			
## Helpful	0.18	0.64	0.36	2.5			
## Broad_Minded	0.01	0.54	0.46	1.9			
## Freedom	-0.11	0.63	0.37	3.3			
## Loyal	-0.10	0.46	0.54	4.0			
## Forgiving	0.23	0.44	0.56	4.8			
## Respect_For_Tradition	0.00	0.56	0.44	1.3			
## Devout	0.05	0.45	0.55	1.2			
## Respect_Elders	0.04	0.60	0.40	2.0			
## Obedient	0.05	0.37	0.63	1.9			
## Accept_My_Life	0.34	0.33	0.67	2.2			
## Politeness	0.15	0.47	0.53	3.8			
## Humble	0.35	0.49	0.51	4.1			
## Family_Security	-0.16	0.50	0.50	4.9			
## Influential	0.04	0.42	0.58	6.1			
## Wealth	-0.06	0.50	0.50	1.2			
## Pleasure	0.16	0.58	0.42	2.0			
## Public_Image	0.07	0.44	0.56	1.4			
## Social_Order	-0.02	0.40	0.60	2.4			
## National_Security	-0.11	0.50	0.50	3.5			
## Social_Power	-0.04	0.56	0.44	3.6			
## Reciprocity	0.23	0.41	0.59	4.0			
## Self-Indulgent	0.32	0.35	0.65	3.1			
## Enjoy_Life	-0.04	0.54	0.46	4.3			
## Clean	0.00	0.28	0.72	4.5			
## Exciting_Life	-0.12	0.64	0.36	1.9			
## Daring	0.09	0.39	0.61	1.2			
## Curious	0.03	0.50	0.50	2.0			
## Varied_Life	-0.02	0.41	0.59	1.7			
## Creativity	-0.06	0.46	0.54	3.0			

```

## Protect_Enviroment      0.00 0.53 0.47 1.4
## Unity_With_Nature      0.20 0.58 0.42 1.7
## World_Of_Beauty        0.02 0.45 0.55 2.4
## Authority               0.03 0.48 0.52 4.6
## Moderate                0.33 0.20 0.80 2.6
##
##
##          MR1  MR5  MR3  MR2  MR8  MR4  MR6  MR7
## SS loadings          4.4 4.33 3.52 3.27 2.96 1.92 1.03 0.90
## Proportion Var       0.1 0.09 0.08 0.07 0.06 0.04 0.02 0.02
## Cumulative Var       0.1 0.19 0.27 0.34 0.40 0.44 0.47 0.49
## Proportion Explained 0.2 0.19 0.16 0.15 0.13 0.09 0.05 0.04
## Cumulative Proportion 0.2 0.39 0.55 0.70 0.83 0.91 0.96 1.00
##
## Mean item complexity = 2.7
## Test of the hypothesis that 8 factors are sufficient.
##
## The degrees of freedom for the null model are 1035 and the objective function was 23 with Chi Square
## The degrees of freedom for the model are 695 and the objective function was 3.8
##
## The root mean square of the residuals (RMSR) is 0.03
## The df corrected root mean square of the residuals is 0.04
##
## The harmonic number of observations is 269 with the empirical chi square 513 with prob < 1
## The total number of observations was 269 with Likelihood Chi Square = 924 with prob < 0.0000000
##
## Tucker Lewis Index of factoring reliability = 0.92
## RMSEA index = 0.041 and the 90 % confidence intervals are 0.029 0.041
## BIC = -2964
## Fit based upon off diagonal values = 0.99
## Measures of factor score adequacy
##
##          MR1  MR5  MR3
## Correlation of (regression) scores with factors 0.89 0.91 0.90
## Multiple R square of scores with factors        0.79 0.82 0.82
## Minimum correlation of possible factor scores    0.57 0.64 0.64
##
##          MR2  MR8  MR4
## Correlation of (regression) scores with factors 0.90 0.89 0.86
## Multiple R square of scores with factors        0.81 0.79 0.74
## Minimum correlation of possible factor scores    0.62 0.58 0.48
##
##          MR6  MR7
## Correlation of (regression) scores with factors 0.81 0.77
## Multiple R square of scores with factors        0.65 0.59
## Minimum correlation of possible factor scores    0.30 0.18

```

### 5.3 Sample 2

```

fit_FA_6b <- fa(SVI_2[, 2:47], nfactors = 8, rotate = "varimax", fm = "minres",
  scores = "tenberge")
fit_FA_6b

## Factor Analysis using method = minres
## Call: fa(r = SVI_2[, 2:47], nfactors = 8, rotate = "varimax", scores = "tenberge",
##      fm = "minres")

```

```

## Standardized loadings (pattern matrix) based upon correlation matrix
##
##      MR6   MR1   MR4   MR8   MR2   MR3   MR5
## Equality      0.67 -0.05  0.24  0.17 -0.15  0.16  0.15
## World_Peace    0.43  0.13  0.30  0.08 -0.09  0.04  0.42
## Unity_With_Nature 0.09  0.21  0.71  0.00 -0.12 -0.01  0.08
## Wisdom         0.27  0.19  0.36  0.42  0.18 -0.16  0.00
## World_Of_Beauty  0.12  0.09  0.69  0.10 -0.09  0.17  0.19
## Social_Justice  0.69 -0.01  0.26 -0.01  0.07 -0.06  0.12
## Broad_Minded    0.57 -0.09  0.23  0.16  0.01  0.25  0.04
## Protect_Enviroment 0.19  0.05  0.62  0.02  0.02 -0.02  0.14
## Loyal           0.45  0.35 -0.03  0.29  0.02  0.16  0.03
## Honest          0.61  0.27  0.04  0.29 -0.07  0.00  0.11
## Helpful         0.69  0.26  0.11  0.10 -0.03  0.02 -0.06
## Responsible     0.37  0.45 -0.04  0.43  0.06  0.01  0.00
## Forgiving       0.60  0.39  0.14  0.06 -0.12  0.05 -0.07
## Respect_For_Tradition -0.06  0.57  0.15  0.05  0.18 -0.13  0.18
## Moderate       -0.11  0.19  0.00 -0.03  0.04  0.04  0.00
## Humble          0.38  0.44  0.15  0.05 -0.14  0.05  0.12
## Accept_My_Life  0.11  0.43  0.22 -0.10  0.15  0.03  0.02
## Devout         -0.03  0.47 -0.07  0.05  0.07 -0.29  0.19
## Self-Discipline  0.20  0.47  0.18  0.35  0.07 -0.12 -0.06
## Respect_Elders  0.25  0.59  0.05  0.24  0.03  0.02  0.18
## Obedient        0.24  0.60  0.03  0.06  0.10 -0.08  0.14
## Politeness      0.29  0.57 -0.02  0.26 -0.02  0.18  0.25
## Social_Order    0.03  0.30  0.14  0.10  0.24  0.01  0.45
## National_Security 0.17  0.30  0.06  0.06  0.25  0.11  0.46
## Reciprocity     0.00  0.43  0.10  0.25  0.19  0.03 -0.11
## Family_Security 0.33  0.29 -0.02  0.29 -0.06  0.12  0.42
## Clean          -0.03  0.50  0.10  0.17  0.15  0.06  0.02
## Social_Power   -0.22 -0.01  0.04  0.10  0.71  0.09  0.01
## Wealth         -0.24  0.03 -0.20  0.19  0.55  0.25  0.18
## Authority       0.11  0.27  0.01  0.16  0.62  0.00  0.01
## Public_Image   -0.04  0.34 -0.04  0.15  0.50  0.03  0.20
## Ambitious       0.23  0.29  0.06  0.55  0.07  0.16  0.11
## Influential     0.25  0.13  0.22  0.21  0.54 -0.02 -0.05
## Capable         0.09  0.19  0.04  0.63  0.22  0.05  0.03
## Successful      0.11  0.09  0.04  0.67  0.27  0.16  0.25
## Pleasure        0.11 -0.03  0.11  0.12  0.25  0.63  0.10
## Enjoy_Life      0.20 -0.12  0.08  0.23 -0.02  0.67  0.01
## Self-Indulgent -0.21  0.07  0.09 -0.04  0.40  0.34  0.05
## Exciting_Life   0.10  0.06  0.39  0.18  0.10  0.61  0.05
## Varied_Life     0.07  0.03  0.52  0.23  0.07  0.35  0.11
## Daring          0.00  0.20  0.47  0.01  0.19  0.35 -0.03
## Freedom         0.44  0.04  0.18  0.26  0.09  0.25  0.27
## Creativity      0.16  0.03  0.60  0.15  0.04  0.17 -0.07
## Independent     0.04  0.12  0.17  0.47  0.04  0.14  0.06
## Choose_Own_Goals 0.22  0.07  0.26  0.54  0.08  0.21 -0.04
## Curious         0.20  0.03  0.65  0.18  0.22  0.05 -0.18
##
##      MR7   h2   u2 com
## Equality      0.00 0.61 0.39 1.8
## World_Peace    0.11 0.50 0.50 3.3
## Unity_With_Nature -0.12 0.59 0.41 1.4
## Wisdom        -0.02 0.47 0.53 4.0

```

```

## World_Of_Beauty      -0.11 0.59 0.41 1.5
## Social_Justice       0.11 0.58 0.42 1.4
## Broad_Minded        -0.21 0.51 0.49 2.4
## Protect_Enviroment  -0.01 0.44 0.56 1.3
## Loyal               0.17 0.46 0.54 3.4
## Honest              0.04 0.55 0.45 2.0
## Helpful             0.07 0.58 0.42 1.4
## Responsible        -0.08 0.54 0.46 3.1
## Forgiving           0.06 0.56 0.44 2.0
## Respect_For_Tradition 0.07 0.44 0.56 1.8
## Moderate           -0.38 0.19 0.81 1.7
## Humble             -0.12 0.42 0.58 2.8
## Accept_My_Life     -0.21 0.32 0.68 2.7
## Devout             0.24 0.41 0.59 2.8
## Self-Discipline    -0.03 0.44 0.56 2.9
## Respect_Elders     0.14 0.52 0.48 2.1
## Obedient          -0.12 0.48 0.52 1.7
## Politeness        -0.09 0.58 0.42 2.7
## Social_Order      -0.11 0.40 0.60 2.9
## National_Security  0.05 0.42 0.58 3.0
## Reciprocity       -0.01 0.31 0.69 2.3
## Family_Security    0.02 0.48 0.52 3.9
## Clean            -0.14 0.33 0.67 1.8
## Social_Power      -0.05 0.57 0.43 1.3
## Wealth           -0.10 0.54 0.46 2.8
## Authority         0.03 0.50 0.50 1.6
## Public_Image      0.04 0.43 0.57 2.4
## Ambitious         0.05 0.49 0.51 2.3
## Influential       0.19 0.51 0.49 2.7
## Capable          -0.13 0.52 0.48 1.6
## Successful        0.01 0.63 0.37 1.9
## Pleasure         -0.08 0.51 0.49 1.6
## Enjoy_Life       -0.06 0.56 0.44 1.5
## Self-Indulgent   -0.11 0.35 0.65 2.9
## Exciting_Life    0.30 0.68 0.32 2.7
## Varied_Life      0.26 0.54 0.46 3.0
## Daring           0.39 0.58 0.42 3.6
## Freedom          0.20 0.48 0.52 4.2
## Creativity        0.05 0.45 0.55 1.5
## Independent      0.11 0.31 0.69 1.8
## Choose_Own_Goals  0.17 0.49 0.51 2.6
## Curious          0.08 0.58 0.42 1.9
##
##
## MR6 MR1 MR4 MR8 MR2 MR3 MR5 MR7
## SS loadings      4.35 4.08 3.65 3.15 2.60 2.23 1.40 0.98
## Proportion Var   0.09 0.09 0.08 0.07 0.06 0.05 0.03 0.02
## Cumulative Var   0.09 0.18 0.26 0.33 0.39 0.44 0.47 0.49
## Proportion Explained 0.19 0.18 0.16 0.14 0.12 0.10 0.06 0.04
## Cumulative Proportion 0.19 0.38 0.54 0.68 0.79 0.89 0.96 1.00
##
## Mean item complexity = 2.3
## Test of the hypothesis that 8 factors are sufficient.
##
## The degrees of freedom for the null model are 1035 and the objective function was 22 with Chi Squa

```



```

## The degrees of freedom for the model are 695 and the objective function was 3.8
##
## The root mean square of the residuals (RMSR) is 0.03
## The df corrected root mean square of the residuals is 0.04
##
## The harmonic number of observations is 269 with the empirical chi square 501 with prob < 1
## The total number of observations was 269 with Likelihood Chi Square = 927 with prob < 0.0000000
##
## Tucker Lewis Index of factoring reliability = 0.92
## RMSEA index = 0.041 and the 90 % confidence intervals are 0.029 0.041
## BIC = -2961
## Fit based upon off diagonal values = 0.98
## Measures of factor score adequacy
##
## Correlation of (regression) scores with factors MR6 MR1 MR4
## Multiple R square of scores with factors 0.92 0.90 0.92
## Minimum correlation of possible factor scores 0.84 0.82 0.85
##
## Correlation of (regression) scores with factors MR8 MR2 MR3
## Multiple R square of scores with factors 0.68 0.64 0.70
## Minimum correlation of possible factor scores 0.88 0.89 0.88
##
## Correlation of (regression) scores with factors 0.77 0.79 0.78
## Multiple R square of scores with factors 0.54 0.59 0.56
## Minimum correlation of possible factor scores 0.82 0.80
##
## Correlation of (regression) scores with factors 0.67 0.64
## Multiple R square of scores with factors 0.33 0.28
## Minimum correlation of possible factor scores

fa.sort(fit_FA_6b, polar = FALSE)

## Factor Analysis using method = minres
## Call: fa(r = SVI_2[, 2:47], nfactors = 8, rotate = "varimax", scores = "tenberge",
## fm = "minres")
## Standardized loadings (pattern matrix) based upon correlation matrix
##
## MR6 MR1 MR4 MR8 MR2 MR3 MR5
## Social_Justice 0.69 -0.01 0.26 -0.01 0.07 -0.06 0.12
## Helpful 0.69 0.26 0.11 0.10 -0.03 0.02 -0.06
## Equality 0.67 -0.05 0.24 0.17 -0.15 0.16 0.15
## Honest 0.61 0.27 0.04 0.29 -0.07 0.00 0.11
## Forgiving 0.60 0.39 0.14 0.06 -0.12 0.05 -0.07
## Broad_Minded 0.57 -0.09 0.23 0.16 0.01 0.25 0.04
## Loyal 0.45 0.35 -0.03 0.29 0.02 0.16 0.03
## Freedom 0.44 0.04 0.18 0.26 0.09 0.25 0.27
## World_Peace 0.43 0.13 0.30 0.08 -0.09 0.04 0.42
## Obedient 0.24 0.60 0.03 0.06 0.10 -0.08 0.14
## Respect_Elders 0.25 0.59 0.05 0.24 0.03 0.02 0.18
## Respect_For_Tradition -0.06 0.57 0.15 0.05 0.18 -0.13 0.18
## Politeness 0.29 0.57 -0.02 0.26 -0.02 0.18 0.25
## Clean -0.03 0.50 0.10 0.17 0.15 0.06 0.02
## Self-Discipline 0.20 0.47 0.18 0.35 0.07 -0.12 -0.06
## Devout -0.03 0.47 -0.07 0.05 0.07 -0.29 0.19
## Responsible 0.37 0.45 -0.04 0.43 0.06 0.01 0.00
## Humble 0.38 0.44 0.15 0.05 -0.14 0.05 0.12
## Reciprocity 0.00 0.43 0.10 0.25 0.19 0.03 -0.11
## Accept_My_Life 0.11 0.43 0.22 -0.10 0.15 0.03 0.02
## Unity_With_Nature 0.09 0.21 0.71 0.00 -0.12 -0.01 0.08

```

## World_Of_Beauty	0.12	0.09	0.69	0.10	-0.09	0.17	0.19
## Curious	0.20	0.03	0.65	0.18	0.22	0.05	-0.18
## Protect_Enviroment	0.19	0.05	0.62	0.02	0.02	-0.02	0.14
## Creativity	0.16	0.03	0.60	0.15	0.04	0.17	-0.07
## Varied_Life	0.07	0.03	0.52	0.23	0.07	0.35	0.11
## Daring	0.00	0.20	0.47	0.01	0.19	0.35	-0.03
## Successful	0.11	0.09	0.04	0.67	0.27	0.16	0.25
## Capable	0.09	0.19	0.04	0.63	0.22	0.05	0.03
## Ambitious	0.23	0.29	0.06	0.55	0.07	0.16	0.11
## Choose_Own_Goals	0.22	0.07	0.26	0.54	0.08	0.21	-0.04
## Independent	0.04	0.12	0.17	0.47	0.04	0.14	0.06
## Wisdom	0.27	0.19	0.36	0.42	0.18	-0.16	0.00
## Social_Power	-0.22	-0.01	0.04	0.10	0.71	0.09	0.01
## Authority	0.11	0.27	0.01	0.16	0.62	0.00	0.01
## Wealth	-0.24	0.03	-0.20	0.19	0.55	0.25	0.18
## Influential	0.25	0.13	0.22	0.21	0.54	-0.02	-0.05
## Public_Image	-0.04	0.34	-0.04	0.15	0.50	0.03	0.20
## Self-Indulgent	-0.21	0.07	0.09	-0.04	0.40	0.34	0.05
## Enjoy_Life	0.20	-0.12	0.08	0.23	-0.02	0.67	0.01
## Pleasure	0.11	-0.03	0.11	0.12	0.25	0.63	0.10
## Exciting_Life	0.10	0.06	0.39	0.18	0.10	0.61	0.05
## National_Security	0.17	0.30	0.06	0.06	0.25	0.11	0.46
## Social_Order	0.03	0.30	0.14	0.10	0.24	0.01	0.45
## Family_Security	0.33	0.29	-0.02	0.29	-0.06	0.12	0.42
## Moderate	-0.11	0.19	0.00	-0.03	0.04	0.04	0.00
##	MR7	h2	u2	com			
## Social_Justice	0.11	0.58	0.42	1.4			
## Helpful	0.07	0.58	0.42	1.4			
## Equality	0.00	0.61	0.39	1.8			
## Honest	0.04	0.55	0.45	2.0			
## Forgiving	0.06	0.56	0.44	2.0			
## Broad_Minded	-0.21	0.51	0.49	2.4			
## Loyal	0.17	0.46	0.54	3.4			
## Freedom	0.20	0.48	0.52	4.2			
## World_Peace	0.11	0.50	0.50	3.3			
## Obedient	-0.12	0.48	0.52	1.7			
## Respect_Elders	0.14	0.52	0.48	2.1			
## Respect_For_Tradition	0.07	0.44	0.56	1.8			
## Politeness	-0.09	0.58	0.42	2.7			
## Clean	-0.14	0.33	0.67	1.8			
## Self-Discipline	-0.03	0.44	0.56	2.9			
## Devout	0.24	0.41	0.59	2.8			
## Responsible	-0.08	0.54	0.46	3.1			
## Humble	-0.12	0.42	0.58	2.8			
## Reciprocity	-0.01	0.31	0.69	2.3			
## Accept_My_Life	-0.21	0.32	0.68	2.7			
## Unity_With_Nature	-0.12	0.59	0.41	1.4			
## World_Of_Beauty	-0.11	0.59	0.41	1.5			
## Curious	0.08	0.58	0.42	1.9			
## Protect_Enviroment	-0.01	0.44	0.56	1.3			
## Creativity	0.05	0.45	0.55	1.5			
## Varied_Life	0.26	0.54	0.46	3.0			
## Daring	0.39	0.58	0.42	3.6			
## Successful	0.01	0.63	0.37	1.9			

```

## Capable -0.13 0.52 0.48 1.6
## Ambitious 0.05 0.49 0.51 2.3
## Choose_Own_Goals 0.17 0.49 0.51 2.6
## Independent 0.11 0.31 0.69 1.8
## Wisdom -0.02 0.47 0.53 4.0
## Social_Power -0.05 0.57 0.43 1.3
## Authority 0.03 0.50 0.50 1.6
## Wealth -0.10 0.54 0.46 2.8
## Influential 0.19 0.51 0.49 2.7
## Public_Image 0.04 0.43 0.57 2.4
## Self-Indulgent -0.11 0.35 0.65 2.9
## Enjoy_Life -0.06 0.56 0.44 1.5
## Pleasure -0.08 0.51 0.49 1.6
## Exciting_Life 0.30 0.68 0.32 2.7
## National_Security 0.05 0.42 0.58 3.0
## Social_Order -0.11 0.40 0.60 2.9
## Family_Security 0.02 0.48 0.52 3.9
## Moderate -0.38 0.19 0.81 1.7
##
## MR6 MR1 MR4 MR8 MR2 MR3 MR5 MR7
## SS loadings 4.35 4.08 3.65 3.15 2.60 2.23 1.40 0.98
## Proportion Var 0.09 0.09 0.08 0.07 0.06 0.05 0.03 0.02
## Cumulative Var 0.09 0.18 0.26 0.33 0.39 0.44 0.47 0.49
## Proportion Explained 0.19 0.18 0.16 0.14 0.12 0.10 0.06 0.04
## Cumulative Proportion 0.19 0.38 0.54 0.68 0.79 0.89 0.96 1.00
##
## Mean item complexity = 2.3
## Test of the hypothesis that 8 factors are sufficient.
##
## The degrees of freedom for the null model are 1035 and the objective function was 22 with Chi Square
## The degrees of freedom for the model are 695 and the objective function was 3.8
##
## The root mean square of the residuals (RMSR) is 0.03
## The df corrected root mean square of the residuals is 0.04
##
## The harmonic number of observations is 269 with the empirical chi square 501 with prob < 1
## The total number of observations was 269 with Likelihood Chi Square = 927 with prob < 0.0000000
##
## Tucker Lewis Index of factoring reliability = 0.92
## RMSEA index = 0.041 and the 90 % confidence intervals are 0.029 0.041
## BIC = -2961
## Fit based upon off diagonal values = 0.98
## Measures of factor score adequacy
## MR6 MR1 MR4
## Correlation of (regression) scores with factors 0.92 0.90 0.92
## Multiple R square of scores with factors 0.84 0.82 0.85
## Minimum correlation of possible factor scores 0.68 0.64 0.70
## MR8 MR2 MR3
## Correlation of (regression) scores with factors 0.88 0.89 0.88
## Multiple R square of scores with factors 0.77 0.79 0.78
## Minimum correlation of possible factor scores 0.54 0.59 0.56
## MR5 MR7
## Correlation of (regression) scores with factors 0.82 0.80
## Multiple R square of scores with factors 0.67 0.64

```

```
## Minimum correlation of possible factor scores      0.33 0.28
```

## 5.4 Factor Congruence

### 5.4.1 Loading Correlations

```
cor(fit_FA_5b$loadings[, ], fit_FA_6b$loadings)

##          MR6      MR1      MR4      MR8      MR2      MR3      MR5      MR7
## MR1  0.318  0.0488 -0.258  0.882 -0.148  0.021 -0.062  0.055
## MR5  0.892 -0.1446  0.144  0.115 -0.646 -0.055  0.133  0.196
## MR3  0.076  0.8693 -0.367 -0.169 -0.115 -0.601  0.147 -0.013
## MR2 -0.578 -0.0642 -0.444  0.107  0.693  0.374  0.293 -0.108
## MR8 -0.091 -0.5348  0.554  0.043  0.146  0.523 -0.403  0.425
## MR4  0.020 -0.1574  0.740 -0.335 -0.363 -0.218  0.061 -0.161
## MR6  0.435  0.0099 -0.036  0.068 -0.607  0.399  0.031 -0.110
## MR7 -0.132  0.2462 -0.006 -0.251 -0.068 -0.182 -0.387 -0.444
```

### 5.4.2 Tucker's Factor Congruence

```
factor.congruence(fit_FA_5b$loadings[, ], fit_FA_6b$loadings)

##          MR6 MR1 MR4 MR8 MR2 MR3 MR5 MR7
## MR1 0.66 0.61 0.40 0.95 0.35 0.42 0.41 0.12
## MR5 0.94 0.45 0.53 0.57 -0.02 0.32 0.46 0.22
## MR3 0.50 0.94 0.26 0.44 0.32 0.00 0.48 0.07
## MR2 0.09 0.46 0.17 0.54 0.79 0.58 0.55 -0.01
## MR8 0.40 0.27 0.75 0.54 0.47 0.68 0.15 0.38
## MR4 0.34 0.29 0.82 0.18 0.01 0.10 0.33 -0.08
## MR6 0.37 0.05 0.01 0.09 -0.48 0.37 0.06 -0.10
## MR7 0.17 0.45 0.26 0.14 0.17 0.06 -0.07 -0.36
```

### 5.4.3 Factor Score Correlations

```
options(scipen = 999, digits = 2)
Sample_1_Actual <- as.data.frame(fit_FA_5b$scores)
Sample_1_Estimated <- as.matrix(SVI_1[, 2:47]) %*% fit_FA_6b$weights
Sample_1 <- cbind(Sample_1_Actual, Sample_1_Estimated)
names(Sample_1) <- c("FA1_Actual", "FA2_Actual", "FA3_Actual", "FA4_Actual",
  "FA5_Actual", "FA6_Actual", "FA7_Actual", "FA8_Actual", "FA1_Estimate",
  "FA2_Estimate", "FA3_Estimate", "FA4_Estimate", "FA5_Estimate",
  "FA6_Estimate", "FA7_Estimate", "FA8_Estimate")
R_1 <- cor(Sample_1)

Sample_2_Actual <- as.data.frame(fit_FA_6b$scores)
Sample_2_Estimated <- as.matrix(SVI_2[, 2:47]) %*% fit_FA_5b$weights
Sample_2 <- cbind(Sample_2_Actual, Sample_2_Estimated)
names(Sample_2) <- c("FA1_Actual", "FA2_Actual", "FA3_Actual", "FA4_Actual",
  "FA5_Actual", "FA6_Actual", "FA7_Actual", "FA8_Actual", "FA1_Estimate",
```

```

"FA2_Estimate", "FA3_Estimate", "FA4_Estimate", "FA5_Estimate",
"FA6_Estimate", "FA7_Estimate", "FA8_Estimate")
R_2 <- cor(Sample_2)

```

Factor Score Correlations, Sample 1								
	<i>Actual Factor Scores</i>							
<i>Factor Score</i>	1	2	3	4	5	6	7	8
Estimated 1	0.24	0.13	-0.04	0.93	0.02	0.06	-0.06	-0.13
Estimated 2	0.88	-0.08	0.13	0.08	-0.09	0.01	0.33	0.1
Estimated 3	0.16	0.87	-0.02	-0.12	0.12	-0.12	0.11	0.13
Estimated 4	-0.15	0.15	-0.14	0.1	0.67	0.55	0.54	-0.2
Estimated 5	0.08	0.03	0.52	0.07	0.34	0.51	-0.37	0.38
Estimated 6	-0.04	0.02	0.78	-0.06	-0.11	-0.22	0.32	-0.42
Estimated 7	0.13	0.12	-0.15	0	-0.51	0.5	-0.08	-0.21
Estimated 8	0.03	0.29	0.13	-0.05	0.04	0.06	-0.35	-0.44

Factor Score Correlations, Sample 2								
	<i>Actual Factor Scores</i>							
<i>Factor Score</i>	1	2	3	4	5	6	7	8
Estimated 1	0.09	0.87	0.15	-0.18	0.11	-0.12	0.15	-0.01
Estimated 2	0.22	-0.11	0.86	0.07	-0.09	0.1	0.05	0.28
Estimated 3	-0.08	0.13	-0.04	-0.09	0.6	0.8	-0.03	0.21
Estimated 4	0.9	-0.09	-0.06	0.07	0.03	-0.04	-0.03	0
Estimated 5	0	-0.08	0.1	0.59	0.27	-0.18	-0.63	0.03
Estimated 6	-0.11	0.14	-0.29	0.52	0.51	-0.13	0.56	0.06
Estimated 7	-0.09	0.26	0.15	0.48	-0.28	0.26	0.02	-0.45
Estimated 8	-0.14	0.2	0.16	-0.14	0.35	-0.3	-0.25	-0.51