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DSC424

Assignment #2 (DUE SUNDAY, January 31, 2021 by Midnight)

Deliverables: Turn in your answers in a single PDF file. Use KnitR or Copy any R output relevant to your answer into your Word document and explain your answer thoroughly and include a copy of the full analysis in your report along with your conclusions. Also, provide your R code files.

Problem 1 (10 points) Answer each of the following questions:

a) How do we check for and treat multicollinearity?

You could use the corrpot function in R to display the graphical representation of the correlation matrix, which would define the variable correlation as strongly correlated either positively or negatively and this always acts as a sign of multicollinearity amongst independent variables.

You could also use a scatterplot matrix, which exhibits types of relationships between independent variables. If one of the individual scatterplots in the matrix shows a linear relationship between variables, this is an indication that those variables are exhibiting multicollinearity.

Check for obvious correlations in the independent variables when you use the pearson correlation with the cor() function in R, any high values should be looked at. Values between 0.7 and 1 or -0.7 and -1 always indicate a strong correlation among the independent variables and that too is considered as multicollinearity.

You can use the Variance Inflation Factor, any values greater than 5 or greater than 10 are worrisome, which calls to do investigation amongst the independent variables.

Very high standard errors for regression coefficients; when standard errors are orders of magnitude higher than their coefficients, that is an indicator.

Betas not significantly different from 0 that is large variance causes t-test to fail.

Betas that have “wrong” sign… that is different from what the correlation plots or simple regression indicates.

Large changes in coefficients when adding predictors. If the predictors are

completely independent of each other, their coefficients won't change at all when you add or remove one.

Coefficients on different samples are wildly different.

High Condition indices: If you ran a Principal Component Analysis on the independent variables. The first Principle Component will be much higher than the last if they have a lot of shared information. Their ratio, the Condition Index, will be high if multicollinearity is present.

There are several ways to treat multicollinearity which are:

Remove one of highly correlated independent variables from the model; if you have two or more factors with a high VIF, remove one from the model.

You can use Principle Component Analysis (PCA). Instead of using highly correlated variables, use components in the model whose eigen values are greater than 1.This reduces the number of interdependent variables to a smaller set of uncorrelated components.

Apply ridge regression, which is a technique for analyzing multiple regression data that suffers from multicollinearity.

Center the variables if you are including an interaction term. This means that subtract the mean from the independent variables before creating the interaction term.

Linearly combine the independent variables, such as adding them together,

b) What is the purpose of checking for multicollinearity?

Multicollinearity makes it tedious to assess the relative importance of the independent variables in explaining the variation caused by the dependent variable; this creates an overfitting problem, which makes it hard to interpret.

c) What are some causes of overfitting?

When you have to many variables and not enough sample size.

Large standard errors, which lead to very inadequate beta coefficients.

Overfitting occurs when we have highly correlated variables.

When we have data sets that are really good for training, but horrible for testing.

Situation where the data gets asymptotic and goes towards zero in which it may not be convertible.

Not only large beta coefficients or unstable beta coefficients, but also we can have noise and if we can't make a distinction between noise and the model that can also lead to overfitting.

How do we diagnose and treat overfitting in regression models?

When we have too many variables with overlapping information, might consider doing something like regularized regression.

Remove one of highly correlated independent variables from the model; if you have two or more factors with a high VIF, remove one from the model.

You can use Principle Component Analysis (PCA). Instead of using highly correlated variables, use components in the model whose eigen values are greater than 1.This reduces the number of interdependent variables to a smaller set of uncorrelated components.

Draw a random sample that is large enough to handle all the terms that you expect to include in your regression model.

You could use Lasso for feature selection if you have some large unknown subset of features that are irrelevant.

d) Name 2 regularized regressions.

Ridge regression.

Lasso regression.

What are the differences between the regressions?

Lasso regression model is a type of linear regression model that uses shrinkage in which variable selection and regularization occur simultaneously whereas ridge regression is a type of model that requires a separate strategy for finding a parsimonious model, because all the explanatory variables remain in the model, so ridge regression doesn't have the impact that some of the variables will be equal to zero like how lasso does.

Lasso is better for future selection because it identifies the set of non-zero coefficients and then fit unrestricted linear model to the selected set of features.

In Lasso regression, alpha is equal to 1 whereas in ridge regression alpha is equal to 0.

Lasso yields sparse models, that is, models that involve only a subset of the variables, which are generally much easier to interpret where as in ridge regression, not performing feature selection may not be a problem for prediction accuracy, but it can create a challenge in model interpretation in which the number of variables is quite large.

Lasso regression does a good job in correcting overfitting than ridge regression.

Lasso tends to perform better because many of the betas end up being equal to zero when the number of variables are many so only a few of the estimated betas are practically different from zero whereas in ridge regression tends to perform better when the betas do not vary dramatically in substantive size.

Problem 3 (Paper review) (10 Points) An academic paper from a conference or Journal will be posted to the Homework 2 content section of D2L. Review the paper and evaluate their usage of Factor Analysis. In particular address the following: **(See article on Psychometric Properties of Attitude towards e-Learning Scale among Nursing Students)**

- **How are they applying Factoring Analysis?**

  They are using exploratory analysis through principle component analysis to determine the attitude of students in order achieve a successful transition and transformation to e-learning.

- **What kind of factor rotation do they use?**

  They are using varimax rotation.

- **How many factors do they concentrate on in their analysis?**

  It is a one (1) factor solution.

  How did they arrive at these number of factors?

  Components with eigenvalue of greater than 1.0 was used to examine the factors in each sub-scale.

  Explain the breakdown of the factors and the significance of their names.

Table 2: Factor loadings of attitude towards e-learning scale

S.No.	*Item*	*Factor loading*
1.	I am interested in studying courses that utilize e-learning	0.752
2.	I think that e-learning promotes my learning experiences	0.762
3.	Presenting courses on the internet makes learning more efficient	0.700
4.	I intend to use e-learning tools during the semester if available	0.632
5.	I am positive about e-learning.	0.810
6.	E-learning environment needs advanced technical knowledge on computer use.	-0.907
7.	I would prefer to have courses on the internet rather than in the classroom or face-to-face.	0.781
8.	Online learning is more comfortable and enjoying to me.	0.793
9.	E-learning is a favorable alternative to the pen-paper based system	0.893
10.	E-learning is not an efficient learning method	0.748
11.	Over-all, I prefer e-learning and I believe that it is better than traditional method of learning.	0.492

Since there is only one principle component, all the items were loaded on it as shown above in the screenshot.

So, if we were looking at the following items: I am interested in studying courses that utilize e-learning, I think that e-learning promotes my learning experiences, Presenting courses on the internet makes learning more efficient, which all have a positive direction meaning that if you

scored higher or rated higher on those three items then your component score for component one is going to go up.

Also, looking at item number 6, E-learning environment needs advanced technical knowledge on computer use, with a negative direction meaning that if you scored higher on E-learning environment needs advanced technical knowledge on computer use, your component score is going to go down.

- **How do they evaluate the stability of the components (i.e. factorability)?**

  Kaiser-Meyer-Olkin (KMO) test of 0.60 was used to assess the adequacy of the sample and Bartlett's test of sphericity was used in order to assume factorability of correlation matrix.

- **Do they use these factors in later analysis, such as regression?**

  Yes, they use these factors in the evaluation of the principle component analysis, which leads to the deletion of item number 6 and 11 due to their low factor loading.

  If so, what do they discover?

  The deletion of the item improved the item total correlation ranging from 0.409 to 0.854 and this demonstrated an acceptable value.

  Furthermore, a value of 0.6 and higher for the factor loading was needed in order to retain an item in scale and this led to the deletion of items number 6 and 11 reducing the 11- item scale to 9-item scale which were loaded in one component. The reliability of attitude towards e-learning scale among nursing students was 0.917, which value showed an acceptable internal consistency and this value was higher than the recommended Cronbach's alpha coefficient for an instrument.

- **What overall conclusions does Factor Analysis allow them to draw?**

  It was found out that the instrument could be used to determine the attitude or perception of students towards e-learning achieve successful transition and transformation to e-learning, however, confirmatory factor analysis and other measures of validity and reliability were not done; thus, additional studies should be conducted further to determine the psychometric properties of this 9-item instrument.

  Also, two nursing colleges were included in this study, where a purposive sample of 111 nursing students enrolled in the selected colleges of nursing in the Philippines were included in

the study; due to the lack of random sampling, purposive sampling is sometime open to selection bias and error so additional studies should be conducted with a large sample size of data.

Problem 4 (Principal Component Analysis - 20 points): The data given in the file ‘Big5.csv’ are 5-point Likert items taken from the Big Five Personality Test web-based personality assessment. Techniques, such as Principal Component Analysis (PCA), can be used to determine different types of personalities. There are 19,719 subjects in the file and 50 variable items as follows:

E1	I am the life of the party.
E2	I don't talk a lot.
E3	I feel comfortable around people.
E4	I keep in the background.
E5	I start conversations.
E6	I have little to say.
E7	I talk to a lot of different people at parties.
E8	I don't like to draw attention to myself.
E9	I don't mind being the center of attention.
E10	I am quiet around strangers.
N1	I get stressed out easily.
N2	I am relaxed most of the time.
N3	I worry about things.
N4	I seldom feel blue.
N5	I am easily disturbed.
N6	I get upset easily.
N7	I change my mood a lot.

N8	I have frequent mood swings.
N9	I get irritated easily.
N10	I often feel blue.
A1	I feel little concern for others.
A2	I am interested in people.
A3	I insult people.
A4	I sympathize with others' feelings.
A5	I am not interested in other people's problems.
A6	I have a soft heart.
A7	I am not really interested in others.
A8	I take time out for others.
A9	I feel others' emotions.
A10	I make people feel at ease.
C1	I am always prepared.
C2	I leave my belongings around.
C3	I pay attention to details.
C4	I make a mess of things.
C5	I get chores done right away.
C6	I often forget to put things back in their proper place.
C7	I like order.
C8	I shirk my duties.
C9	I follow a schedule.
C10	I am exacting in my work.
O1	I have a rich vocabulary.
O2	I have difficulty understanding abstract ideas.
O3	I have a vivid imagination.
O4	I am not interested in abstract ideas.
O5	I have excellent ideas.
O6	I do not have a good imagination.
O7	I am quick to understand things.

O8 I use difficult words.

O9 I spend time reflecting on things.

O10 I am full of ideas.

A) How many components are need to explain 100% of total variation for this data?

Using eigen values greater than 1, there are 7 components needed to explain 100% of the variation of this data as indicated below:

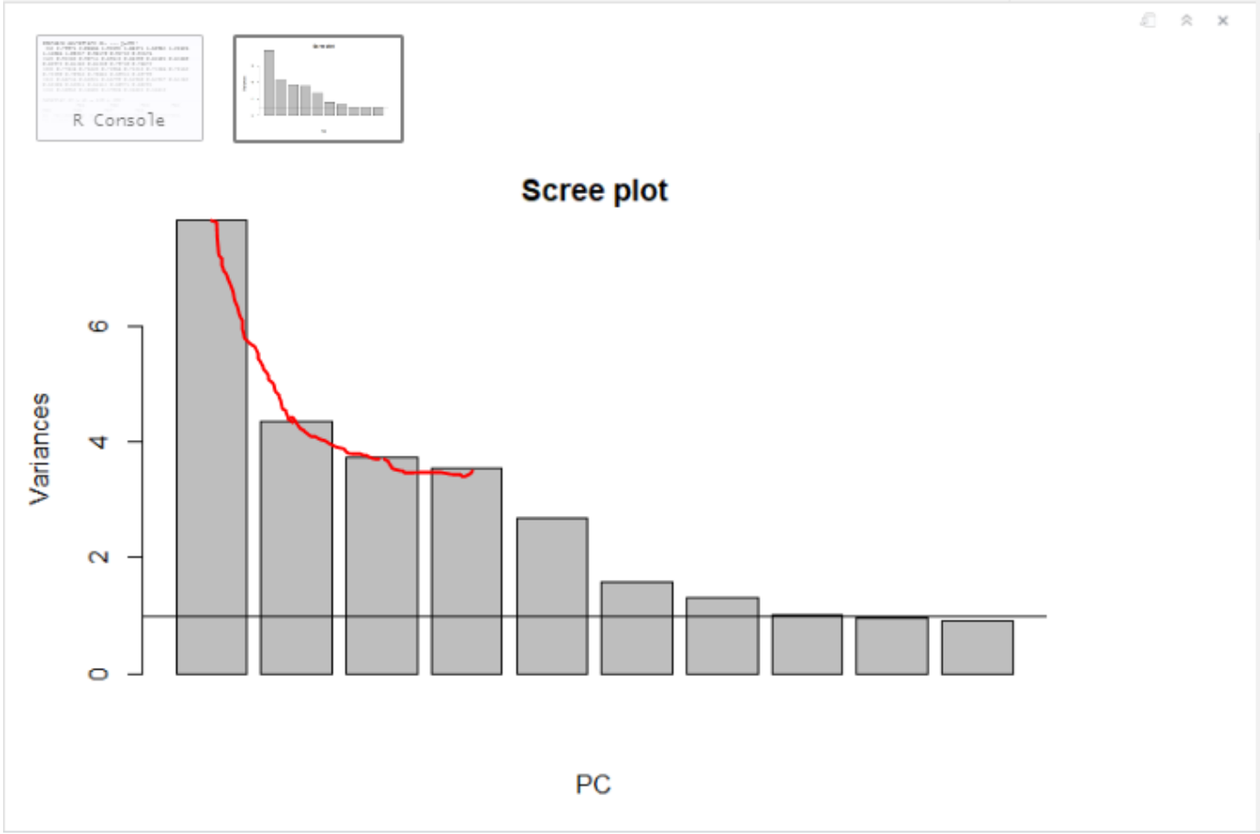
```
#This tells me automatically that there are 7 components with eigen values greater than 1
```{r}
table(p3$values > 1)
```
```

```
FALSE  TRUE
   36     7
```

Using the Knee or elbow of the Screen plot as indicated below:

```
#Create PCA
# we want to center to zero because some of the items might be scalled differently
# we also want to standardize the original data set.
# On this data set What this means is when we go later on using the principal function
# to get the scores that those scores are going to be standardized
# because we're standardizing the original data set to create the principal component analysis.
```{r}
p = prcomp(likeditems, center = T, scale = T)
p

# Check the scree plot
plot(p, main="Scree plot", xlab="PC")
#when we use the abline() one zero that's creating a horizontal line at #one, and so, if we looked
at this , we can look at nine or 10 components and so.
abline(1,0)
```
```



I can choose 3-4 principal components to explain 100% of the total variation of this data by connecting the dots and if we connect the dots, we look at the elbow which is around fourth component.

Using the cumulative proportional variance of between 95% and 99%, I would use PC42, PC43, PC44, PC45, PC46, PC47 and PC48 as indicated in the screenshot below:

```
# Check the PCA summary function
# for the cummulative proportional variances of the different pcs.
```{r}
summary(p)
```
```

```
Importance of components:
                          PC1    PC2    PC3    PC4    PC5    PC6    PC7    PC8    PC9   PC10   PC11
Standard deviation     2.80 2.0867 1.9359 1.8837 1.6398 1.2563 1.151 1.0026 0.9817 0.9575 0.9468
Proportion of Variance 0.16 0.0889 0.0765 0.0724 0.0549 0.0322 0.027 0.0205 0.0197 0.0187 0.0183
Cumulative Proportion  0.16 0.2488 0.3253 0.3977 0.4526 0.4848 0.512 0.5324 0.5520 0.5707 0.5890
                         PC12   PC13   PC14   PC15  PC16   PC17   PC18   PC19   PC20  PC21   PC22
Standard deviation     0.9248 0.9071 0.8964 0.8839 0.856 0.8488 0.8397 0.8148 0.8135 0.797 0.7887
Proportion of Variance 0.0175 0.0168 0.0164 0.0159 0.015 0.0147 0.0144 0.0135 0.0135 0.013 0.0127
Cumulative Proportion  0.6065 0.6233 0.6397 0.6556 0.671 0.6853 0.6997 0.7132 0.7267 0.740 0.7524
                         PC23   PC24   PC25   PC26   PC27   PC28   PC29   PC30   PC31    PC32
Standard deviation     0.7785 0.765 0.7597 0.7521 0.7429 0.7316 0.7239 0.7096 0.7088 0.69915
Proportion of Variance 0.0124 0.012 0.0118 0.0115 0.0113 0.0109 0.0107 0.0103 0.0102 0.00998
Cumulative Proportion  0.7648 0.777 0.7885 0.8000 0.8113 0.8222 0.8329 0.8432 0.8534 0.86342
                          PC33    PC34    PC35    PC36    PC37    PC38    PC39    PC40   PC41
Standard deviation     0.69799 0.68716 0.66921 0.66799 0.65960 0.64937 0.64482 0.63508 0.6301
Proportion of Variance 0.00994 0.00964 0.00914 0.00911 0.00888 0.00861 0.00849 0.00823 0.0081
Cumulative Proportion  0.87336 0.88300 0.89214 0.90125 0.91012 0.91873 0.92722 0.93545 0.9435
                          PC42    PC43    PC44    PC45    PC46    PC47    PC48    PC49
Standard deviation     0.61614 0.60971 0.60295 0.5896 0.58605 0.57028 0.56833 0.55842
Proportion of Variance 0.00775 0.00759 0.00742 0.0071 0.00701 0.00664 0.00659 0.00636
Cumulative Proportion  0.95130 0.95888 0.96630 0.9734 0.98041 0.98704 0.99364 1.00000
```

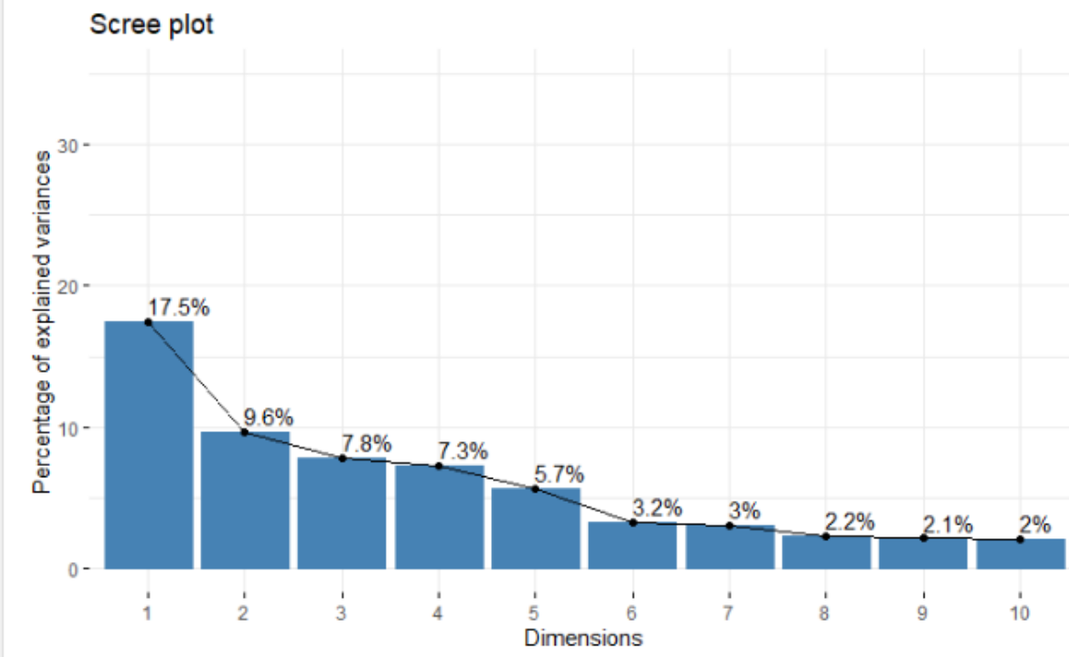
So, in total these would be 7 principle components to explain 100% of the total variation of this data.

Parallel analysis suggests seven (7) number of components to be used to explain 100% of the total variation of this data.

How many components are determined from the scree plot?

```r
#Scree plot visualization with the number of
#components kept in teh result
```{r}
library(ade4)
p5 <- dudi.pca(likeditemsWithReducedVars,
               scannf = FALSE,   # Hide scree plot
               nf = 3           # Number of components kept in the results
)
fviz_screeplot(p5, addlabels = TRUE, ylim = c(0, 35))

variables2 <- get_pca_var(p5)
```
```



From the above scree plot, I would use 4 components because when the dots are connected around the elbow, which is around dimension number 4.

What number of components would you use in the model?

From the scree plot above, I would use 4 components by looking at the elbow.

B) For the number of components in part A, give the formula for first component and abrief interpretation after rotating the components.

RC1 = 0.652E1 + (-0.690)E2 + 0.717E3 + (-0.675)E4 + 0.759E5 + (-0.608)E6 + 0.742E7 + (-0.528)E8 + 0.578E9 + (-0.631)E10 + 0.594A2 + (-0.602)A7 + 0.503A10 + 0.404A4 + (-0.458)A5 + 0.435A9 + $\mathcal{E}$

If we are looking at E1 (I am the life of the party), E3 (I feel comfortable around people), E5 (I start conversations) which both have a positive magnitude meaning that if you scored higher or rated higher on of the scale of one to five on I am the life of the party, I feel comfortable around and I start conversations, then you component scores for one are going to go up.

Also, looking at E2 (I don't talk a lot), E4 (I keep in the background), E6 (I have little to say), E8 (I don't like to draw attention to myself), E10 (I am quite around strangers), A7 (I am not really interested in others) which both have negative magnitudes meaning that if you scored higher on I don't talk a lot, I keep in the background, I have little to say, I don't like to draw attention to myself, I am quite around strangers, and I am not really interested in others, your score is going to go down.

What names might you give for each of the components?

RC1 - Introvert and extrovert

RC2 – depressed

RC4 – Nervous

RC3 - Resourceful

C) What subjects have the highest and lowest values for each principal component (only include the number of components specified in part A.

For RC1 - E5 has highest value and A9 has the lowest value.

For RC2 - N6 has the highest value and N2 has the lowest value.

For RC4 - Both C9 and C5 have the same highest value and A3 has the lowest value.

For RC3 – 010 has the highest value and 04 has the lowest value.

For each of those subjects, give the principal component scores (again only for the number of components specified in part A).

The principle component scores are for the components specified in A are given below:

```
#Summary of the overall scores
```{r}
summary(scores)
```
```

```
      RC1                RC2                RC4                RC3          
 Min.   :-3.5208   Min.   :-4.404   Min.   :-4.0972   Min.   :-4.3223  
 1st Qu.:-0.6859   1st Qu.:-0.704   1st Qu.:-0.6779   1st Qu.:-0.6552  
 Median : 0.0377   Median : 0.018   Median : 0.0208   Median : 0.0648  
 Mean   : 0.0000   Mean   : 0.000   Mean   : 0.0000   Mean   : 0.0000  
 3rd Qu.: 0.7374   3rd Qu.: 0.722   3rd Qu.: 0.6902   3rd Qu.: 0.7505  
 Max.   : 2.7341   Max.   : 2.839   Max.   : 3.0389   Max.   : 2.2881  
```

D) Finally, run a common factor analysis on the same data.

Running a common factor analysis on the same data set: I get the following output:

```
Loadings:
    Factor1 Factor2 Factor3 Factor4
E1   0.664                        
E2  -0.681          -0.108        
E3   0.657  -0.279   0.255        
E4  -0.701   0.133               
E5   0.723           0.224        
E6  -0.576          -0.136  -0.223
E7   0.735           0.156        
E8  -0.557                       
E9   0.604                   0.119
E10 -0.657   0.166               
N1  -0.157   0.632   0.137        
N3  -0.182   0.544   0.238        
N5           0.539          -0.126
N6  -0.116   0.703   0.102        
N7           0.652               
N9  -0.113   0.656               
N10 -0.273   0.610               
C4           0.555  -0.134        
A2   0.370           0.500        
A4                   0.768        
A5  -0.171          -0.615        
A6           0.116   0.604        
A7  -0.347          -0.572        
A8   0.140           0.577        
A9   0.118           0.710        
O1                           0.579
O2           0.176          -0.528
O3           0.152           0.522
O5   0.188                   0.622
O7          -0.189           0.506
O8           0.114  -0.121   0.533
O10  0.188                   0.683
N2   0.157  -0.442               
N4   0.147  -0.333               
A1                  -0.399        
A3           0.321  -0.406        
A10  0.338  -0.174   0.397   0.112
C1          -0.336   0.147   0.177
C2   0.115   0.320               
C3          -0.156   0.184   0.296
C5          -0.336   0.209        
C6           0.397  -0.119        
C7  -0.114  -0.152   0.166        
C8           0.392  -0.233        
C9          -0.234   0.242        
C10         -0.199   0.172   0.273
O4                          -0.447
O6  -0.114                  -0.497
O9  -0.140   0.148   0.193   0.339

                Factor1 Factor2 Factor3 Factor4
SS loadings       5.147   4.565   3.880   3.214
Proportion Var    0.105   0.093   0.079   0.066
Cumulative Var    0.105   0.198   0.277   0.343
```

What difference, if any, do you find?

There is a lot of cross loading between the subjects and the factors.

We notice that the loadings are a lot lower than the principal component analysis because factor analysis is only looking at one type of variance, which is the shared variance.

Does the factor analysis change your ability to interpret the results practically?

Yes, it does because increasing the cutoff point doesn't reduce the cross loadings.

Appendix R code

Problem4PCA

Ronaldlee Ejalu

1/29/2021

#HomeWork2 Problem4: Principal Component Analysis (PCA) and Factor Analysis in R

#Using 5-point liked items taken from the Big Five #Personality Test web-based personality assessment
#Note: Run Shortcut: CTRL+Enter
#Libraries

```
library(DescTools)
```

```
## Warning: package 'DescTools' was built under R version 4.0.3
```

```
library(Hmisc) #Describe Function
```

```
## Warning: package 'Hmisc' was built under R version 4.0.3
```

```
## Loading required package: lattice
```

```
## Loading required package: survival
```

```
## Warning: package 'survival' was built under R version 4.0.3
```

```
## Loading required package: Formula
```

```
## Warning: package 'Formula' was built under R version 4.0.3
```

```
## Loading required package: ggplot2
```

```
## Warning: package 'ggplot2' was built under R version 4.0.3
```

```
##
## Attaching package: 'Hmisc'
```

```
## The following objects are masked from 'package:DescTools':
##
##     %nin%, Label, Mean, Quantile

## The following objects are masked from 'package:base':
##
##     format.pval, units

library(psych) #Multiple Functions for Statistics and Multivariate Analysis

## Warning: package 'psych' was built under R version 4.0.3

##
## Attaching package: 'psych'

## The following object is masked from 'package:Hmisc':
##
##     describe

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

## The following objects are masked from 'package:DescTools':
##
##     AUC, ICC, SD

library(GGally) #ggpairs Function

## Warning: package 'GGally' was built under R version 4.0.3

## Registered S3 method overwritten by 'GGally':
##   method from
##   +.gg   ggplot2

library(ggplot2) #ggplot2 Functions
library(vioplot) #Violin Plot Function

## Warning: package 'vioplot' was built under R version 4.0.3

## Loading required package: sm

## Warning: package 'sm' was built under R version 4.0.3

## Package 'sm', version 2.2-5.6: type help(sm) for summary information

## Loading required package: zoo

## Warning: package 'zoo' was built under R version 4.0.3

##
## Attaching package: 'zoo'

## The following objects are masked from 'package:base':
##
##     as.Date, as.Date.numeric
```

```
library(corrplot) #Plot Correlations
```

```
## Warning: package 'corrplot' was built under R version 4.0.3
```

```
## corrplot 0.84 loaded
```

```
library(REdaS) #Bartlett's Test of Sphericity
```

```
## Warning: package 'REdaS' was built under R version 4.0.3
```

```
## Loading required package: grid
```

```
library(psych) #PCA/FA functions
library(factoextra) #PCA Visualizations
```

```
## Warning: package 'factoextra' was built under R version 4.0.3
```

```
## Welcome! Want to learn more? See two factoextra-related books at
https://goo.gl/ve3WBa
```

```
library("FactoMineR") #PCA functions
```

```
## Warning: package 'FactoMineR' was built under R version 4.0.3
```

```
library(ade4) #PCA Visualizations
```

```
## Warning: package 'ade4' was built under R version 4.0.3
```

```
##
## Attaching package: 'ade4'
```

```
## The following object is masked from 'package:FactoMineR':
##
##     reconst
```

Load the data set

```
BIG5 <- read.csv("C:/Users/rejalu1/OneDrive - Henry Ford Health
System/DSC424/Data Sets/BIG5.csv")
```

#Make a copy of the data set

```
likeditems <- BIG5
```

#Check the Sample Size and the Number of variables

```
dim(likeditems)
```

```
## [1] 19719    50
```

#Show the first 6 rows of the data

```
head(likeditems)
```

```
##   E1 E2 E3 E4 E5 E6 E7 E8 E9 E10 N1 N2 N3 N4 N5 N6 N7 N8 N9 N10 A1 A2 A3 A4
A5
## 1  4  2  5  2  5  1  4  3  5   1  1  5  2  5  1  1  1  1  1   1  1  5  1  5
2
## 2  2  2  3  3  3  3  1  5  1   5  2  3  4  2  3  4  3  2  2   4  1  3  3  4
```

```
4
## 3  5  1  1  4  5  1  1  5  5   1  5  1  5  5  5  5  5  5  5   5  5  1  5  5
1
## 4  2  5  2  4  3  4  3  4  4   5  5  4  4  2  4  5  5  5  4   5  2  5  4  4
3
## 5  3  1  3  3  3  1  3  1  3   5  3  3  3  4  3  3  3  3  3   4  5  5  3  5
1
## 6  1  5  2  4  1  3  2  4  1   5  1  5  4  5  1  4  4  1  5   2  2  2  3  4
3
##   A6 A7 A8 A9 A10 C1 C2 C3 C4 C5 C6 C7 C8 C9 C10 O1 O2 O3 O4 O5 O6 O7 O8 O9
O10
## 1  3  1  5  4   5  4  1  5  1  5  1  4  1  4   5  4  1  3  1  5  1  4  2  5
5
## 2  4  2  3  4   3  4  1  3  2  3  1  5  1  4   4  3  3  3  3  2  3  3  1  3
2
## 3  5  1  5  5   5  4  1  5  1  5  1  5  1  5   5  4  5  5  1  5  1  5  5  5
5
## 4  5  3  4  4   3  3  3  4  5  1  4  5  4  2   3  4  3  5  2  4  2  5  2  5
5
## 5  5  1  5  5   5  3  1  5  3  3  1  1  3  3   3  3  1  1  1  3  1  3  1  5
3
## 6  4  3  5  5   3  2  5  4  3  3  4  5  3  5   3  4  2  1  3  3  5  5  4  5
3
```

#Show the column headers or variable names

```
names(likeditems)
```

```
##  [1] "E1"  "E2"  "E3"  "E4"  "E5"  "E6"  "E7"  "E8"  "E9"  "E10" "N1"  "N2"
## [13] "N3"  "N4"  "N5"  "N6"  "N7"  "N8"  "N9"  "N10" "A1"  "A2"  "A3"  "A4"
## [25] "A5"  "A6"  "A7"  "A8"  "A9"  "A10" "C1"  "C2"  "C3"  "C4"  "C5"  "C6"
## [37] "C7"  "C8"  "C9"  "C10" "O1"  "O2"  "O3"  "O4"  "O5"  "O6"  "O7"  "O8"
## [49] "O9"  "O10"
```

#Check for missing values (i.e NAs)

```
sum(is.na(likeditems))
```

```
## [1] 0
```

display the structure of the data set
list.len - defines the maximum nuber of list elements to display within a level.

```
str(likeditems, list.len=ncol(likeditems))
```

```
## 'data.frame':    19719 obs. of  50 variables:
##  $ E1 : int  4 2 5 2 3 1 5 4 3 1 ...
##  $ E2 : int  2 2 1 5 1 5 1 3 1 4 ...
##  $ E3 : int  5 3 1 2 3 2 5 5 5 2 ...
##  $ E4 : int  2 3 4 4 3 4 1 3 1 5 ...
##  $ E5 : int  5 3 5 3 3 1 5 5 5 2 ...
##  $ E6 : int  1 3 1 4 1 3 1 1 1 4 ...
##  $ E7 : int  4 1 1 3 3 2 5 4 5 1 ...
##  $ E8 : int  3 5 5 4 1 4 4 3 2 4 ...
##  $ E9 : int  5 1 5 4 3 1 4 4 5 1 ...
```

```
##  $ E10: int  1 5 1 5 5 5 1 3 3 5 ...
##  $ N1 : int  1 2 5 5 3 1 2 1 2 5 ...
##  $ N2 : int  5 3 1 4 3 5 4 4 4 2 ...
##  $ N3 : int  2 4 5 4 3 4 2 4 5 5 ...
##  $ N4 : int  5 2 5 2 4 5 4 4 3 2 ...
##  $ N5 : int  1 3 5 4 3 1 2 1 3 3 ...
##  $ N6 : int  1 4 5 5 3 4 2 1 5 4 ...
##  $ N7 : int  1 3 5 5 3 4 3 1 5 3 ...
##  $ N8 : int  1 2 5 5 3 1 2 1 4 2 ...
##  $ N9 : int  1 2 5 4 3 5 2 1 3 3 ...
##  $ N10: int  1 4 5 5 4 2 2 1 3 4 ...
##  $ A1 : int  1 1 5 2 5 2 5 2 1 2 ...
##  $ A2 : int  5 3 1 5 5 2 5 5 5 3 ...
##  $ A3 : int  1 3 5 4 3 3 1 1 1 1 ...
##  $ A4 : int  5 4 5 4 5 4 5 4 5 4 ...
##  $ A5 : int  2 4 1 3 1 3 1 3 1 2 ...
##  $ A6 : int  3 4 5 5 5 4 5 3 5 4 ...
##  $ A7 : int  1 2 1 3 1 3 1 1 1 3 ...
##  $ A8 : int  5 3 5 4 5 5 5 3 5 3 ...
##  $ A9 : int  4 4 5 4 5 5 4 4 5 3 ...
##  $ A10: int  5 3 5 3 5 3 5 5 4 2 ...
##  $ C1 : int  4 4 4 3 3 2 2 4 4 5 ...
##  $ C2 : int  1 1 1 3 1 5 4 2 3 2 ...
##  $ C3 : int  5 3 5 4 5 4 3 5 5 4 ...
##  $ C4 : int  1 2 1 5 3 3 3 1 2 2 ...
##  $ C5 : int  5 3 5 1 3 3 3 4 5 3 ...
##  $ C6 : int  1 1 1 4 1 4 3 1 2 2 ...
##  $ C7 : int  4 5 5 5 1 5 3 4 5 4 ...
##  $ C8 : int  1 1 1 4 3 3 3 1 2 2 ...
##  $ C9 : int  4 4 5 2 3 5 3 3 4 4 ...
##  $ C10: int  5 4 5 3 3 3 3 5 3 4 ...
##  $ O1 : int  4 3 4 4 3 4 3 3 3 4 ...
##  $ O2 : int  1 3 5 3 1 2 1 1 3 2 ...
##  $ O3 : int  3 3 5 5 1 1 5 5 5 5 ...
##  $ O4 : int  1 3 1 2 1 3 1 1 3 2 ...
##  $ O5 : int  5 2 5 4 3 3 4 4 5 4 ...
##  $ O6 : int  1 3 1 2 1 5 1 1 1 1 ...
##  $ O7 : int  4 3 5 5 3 5 4 5 5 4 ...
##  $ O8 : int  2 1 5 2 1 4 3 3 3 3 ...
##  $ O9 : int  5 3 5 5 5 5 3 2 4 4 ...
##  $ O10: int  5 2 5 5 3 3 4 5 5 4 ...
```

Show descriptive statistics
Since our sample is more than 3000
I created a list of the JarqueBeraTest results
ran the test for the first 10 variables, which were not normally distributed.

```
oshap <- lapply(likeditems, JarqueBeraTest)
oshap[[10]]

##
##  Robust Jarque Bera Test
##
```

```
## data:  X[[i]]
## X-squared = 1123.7, df = 2, p-value < 2.2e-16
```

```
describe(likeditems$E1)
```

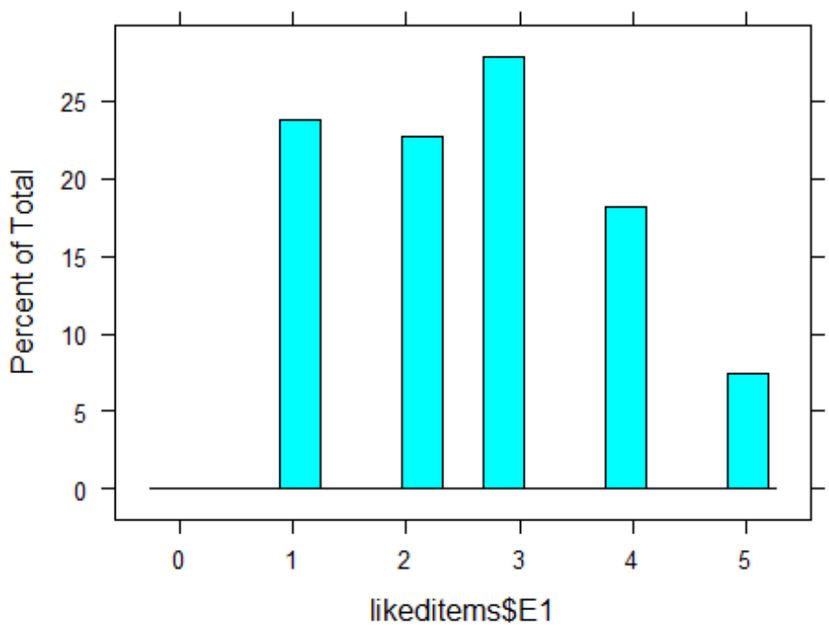
```
##    vars     n mean   sd median trimmed  mad min max range skew kurtosis
se
## X1    1 19719 2.63 1.23      3    2.57 1.48   0   5     5 0.21    -0.96
0.01
```

```
summary(likeditems$E1)
```

```
##    Min. 1st Qu.  Median    Mean 3rd Qu.    Max.
##   0.000   2.000   3.000   2.629   4.000   5.000
```

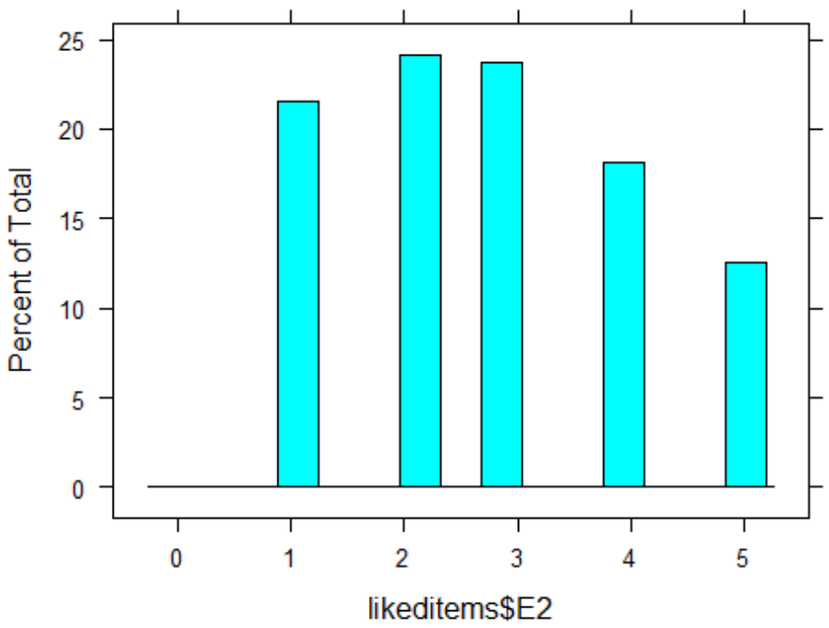
drawing a histogram for the E1 will show you
there are some outliers outside of Q1-1.5*IQR # for the variable E1 (I am the life of the party)

```
histogram(likeditems$E1)
```



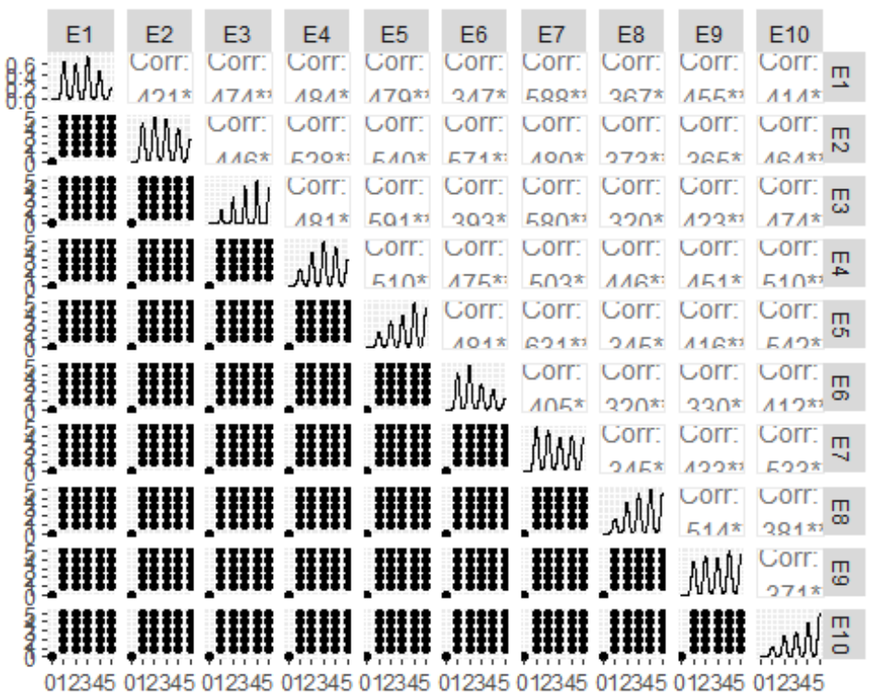
#histogram for E2

```
histogram(likeditems$E2)
```



Explanatory graphing Analysis

```
p1 <- ggpairs(likeditems[,1:10])
p1
```



#Check for Multicollineaity # This show that there multicollinearity between N8 and N7

```
M <- cor(likeditems, method="spearman")
#M
options(scipen=999) # removing off scientific notation
round(M,2)
```

```
##        E1    E2    E3    E4    E5    E6    E7    E8    E9   E10    N1    N2
## E1   1.00 -0.43  0.48 -0.49  0.48 -0.35  0.59 -0.37  0.45 -0.42 -0.12  0.15
## E2  -0.43  1.00 -0.45  0.53 -0.54  0.57 -0.48  0.38 -0.37  0.46  0.06 -0.03
## E3   0.48 -0.45  1.00 -0.48  0.59 -0.39  0.59 -0.32  0.42 -0.48 -0.24  0.28
## E4  -0.49  0.53 -0.48  1.00 -0.51  0.47 -0.50  0.45 -0.45  0.51  0.16 -0.09
## E5   0.48 -0.54  0.59 -0.51  1.00 -0.48  0.63 -0.35  0.42 -0.55 -0.13  0.13
## E6  -0.35  0.57 -0.39  0.47 -0.48  1.00 -0.40  0.33 -0.34  0.41  0.10 -0.05
## E7   0.59 -0.48  0.59 -0.50  0.63 -0.40  1.00 -0.35  0.43 -0.53 -0.14  0.15
## E8  -0.37  0.38 -0.32  0.45 -0.35  0.33 -0.35  1.00 -0.52  0.39  0.09 -0.05
## E9   0.45 -0.37  0.42 -0.45  0.42 -0.34  0.43 -0.52  1.00 -0.37 -0.13  0.13
## E10 -0.42  0.46 -0.48  0.51 -0.55  0.41 -0.53  0.39 -0.37  1.00  0.19 -0.09
## N1  -0.12  0.06 -0.24  0.16 -0.13  0.10 -0.14  0.09 -0.13  0.19  1.00 -0.47
## N2   0.15 -0.03  0.28 -0.09  0.13 -0.05  0.15 -0.05  0.13 -0.09 -0.47  1.00
## N3  -0.13  0.05 -0.20  0.19 -0.09  0.08 -0.14  0.12 -0.11  0.21  0.55 -0.40
## N4   0.14 -0.07  0.20 -0.11  0.12 -0.05  0.13 -0.09  0.12 -0.12 -0.25  0.26
## N5  -0.07  0.04 -0.18  0.13 -0.10  0.13 -0.11  0.05 -0.06  0.15  0.39 -0.26
## N6  -0.11  0.04 -0.22  0.15 -0.12  0.12 -0.14  0.06 -0.08  0.18  0.54 -0.38
## N7  -0.05  0.04 -0.21  0.14 -0.10  0.10 -0.09  0.03 -0.02  0.17  0.42 -0.29
## N8  -0.06  0.05 -0.23  0.14 -0.12  0.12 -0.11  0.02 -0.04  0.16  0.44 -0.32
## N9  -0.10  0.04 -0.25  0.15 -0.14  0.11 -0.15  0.07 -0.07  0.21  0.49 -0.34
## N10 -0.20  0.19 -0.36  0.27 -0.24  0.20 -0.24  0.13 -0.15  0.25  0.42 -0.35
## A1  -0.03  0.13 -0.14  0.12 -0.13  0.19 -0.10 -0.01  0.01  0.10  0.00  0.02
## A2   0.27 -0.29  0.42 -0.25  0.39 -0.30  0.36 -0.17  0.22 -0.24 -0.05  0.12
## A3   0.05 -0.04 -0.12  0.01 -0.04  0.01 -0.02 -0.05  0.06  0.05  0.11 -0.06
## A4   0.08 -0.11  0.21 -0.05  0.20 -0.14  0.14  0.00  0.05 -0.06  0.06  0.02
## A5  -0.11  0.21 -0.24  0.16 -0.25  0.24 -0.18  0.07 -0.07  0.14  0.00  0.00
## A6   0.06 -0.07  0.12  0.00  0.11 -0.03  0.08  0.02  0.01  0.01  0.13 -0.01
## A7  -0.23  0.30 -0.40  0.28 -0.36  0.35 -0.36  0.16 -0.17  0.25  0.05 -0.06
## A8   0.15 -0.15  0.26 -0.11  0.25 -0.17  0.21  0.01  0.07 -0.10 -0.01  0.07
## A9   0.13 -0.14  0.21 -0.09  0.23 -0.16  0.17 -0.05  0.13 -0.08  0.06  0.00
## A10  0.31 -0.25  0.39 -0.24  0.40 -0.26  0.35 -0.14  0.23 -0.24 -0.13  0.17
## C1   0.05 -0.01  0.16 -0.05  0.11 -0.06  0.07  0.01  0.04 -0.06 -0.08  0.08
## C2   0.04 -0.05 -0.03  0.02  0.01 -0.02  0.02 -0.06  0.05  0.02  0.09  0.03
## C3   0.01  0.02  0.08  0.03  0.08 -0.07  0.03  0.06  0.00  0.02 -0.02  0.04
## C4  -0.06  0.04 -0.21  0.16 -0.13  0.12 -0.09  0.03 -0.04  0.14  0.26 -0.14
## C5   0.09 -0.02  0.17 -0.07  0.14 -0.02  0.13 -0.02  0.05 -0.09 -0.10  0.04
## C6  -0.01 -0.01 -0.10  0.06 -0.05  0.06 -0.04 -0.01  0.01  0.08  0.13 -0.02
## C7  -0.03  0.02  0.03  0.04  0.03 -0.02 -0.01  0.09 -0.02  0.05  0.05 -0.04
## C8  -0.04  0.07 -0.18  0.13 -0.14  0.14 -0.10  0.03 -0.02  0.12  0.14 -0.03
## C9   0.05 -0.03  0.15 -0.05  0.12 -0.04  0.08  0.00  0.04 -0.03  0.01 -0.02
## C10  0.04 -0.02  0.11 -0.02  0.11 -0.10  0.06  0.01  0.07 -0.01 -0.05  0.03
## O1   0.04 -0.06  0.03 -0.05  0.10 -0.18  0.05 -0.03  0.07 -0.06 -0.04  0.04
## O2  -0.02  0.05 -0.06  0.09 -0.07  0.19 -0.05  0.04 -0.08  0.10  0.17 -0.08
## O3   0.06 -0.05  0.00  0.03  0.07 -0.11  0.03 -0.03  0.09  0.01  0.04  0.03
## O4   0.00  0.03 -0.02  0.05 -0.06  0.17 -0.03  0.03 -0.05  0.05  0.09 -0.04
## O5   0.17 -0.12  0.15 -0.13  0.20 -0.24  0.15 -0.12  0.22 -0.13 -0.12  0.12
## O6  -0.10  0.11 -0.09  0.09 -0.13  0.21 -0.10  0.09 -0.13  0.08  0.07 -0.08
## O7   0.07 -0.06  0.13 -0.07  0.13 -0.17  0.09 -0.01  0.13 -0.07 -0.16  0.13
## O8   0.00 -0.02 -0.07  0.00  0.02 -0.11  0.01 -0.02  0.05 -0.01  0.02 -0.02
## O9  -0.09  0.06 -0.09  0.11 -0.02 -0.04 -0.07  0.10 -0.04  0.13  0.11 -0.06
## O10  0.15 -0.14  0.12 -0.12  0.20 -0.27  0.15 -0.11  0.20 -0.11 -0.08  0.09
```

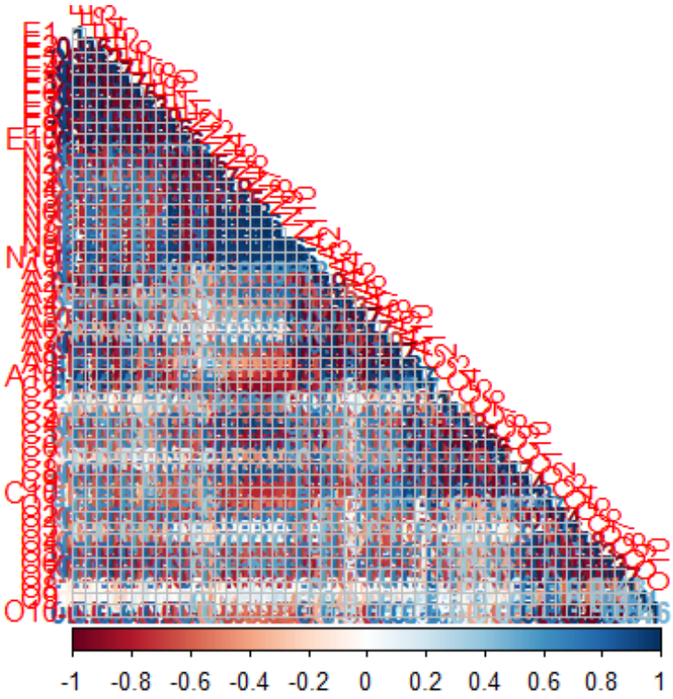
```
##        N3    N4    N5    N6    N7    N8    N9   N10    A1    A2    A3    A4
## E1  -0.13  0.14 -0.07 -0.11 -0.05 -0.06 -0.10 -0.20 -0.03  0.27  0.05  0.08
## E2   0.05 -0.07  0.04  0.04  0.04  0.05  0.04  0.19  0.13 -0.29 -0.04 -0.11
## E3  -0.20  0.20 -0.18 -0.22 -0.21 -0.23 -0.25 -0.36 -0.14  0.42 -0.12  0.21
## E4   0.19 -0.11  0.13  0.15  0.14  0.14  0.15  0.27  0.12 -0.25  0.01 -0.05
## E5  -0.09  0.12 -0.10 -0.12 -0.10 -0.12 -0.14 -0.24 -0.13  0.39 -0.04  0.20
## E6   0.08 -0.05  0.13  0.12  0.10  0.12  0.11  0.20  0.19 -0.30  0.01 -0.14
## E7  -0.14  0.13 -0.11 -0.14 -0.09 -0.11 -0.15 -0.24 -0.10  0.36 -0.02  0.14
## E8   0.12 -0.09  0.05  0.06  0.03  0.02  0.07  0.13 -0.01 -0.17 -0.05  0.00
## E9  -0.11  0.12 -0.06 -0.08 -0.02 -0.04 -0.07 -0.15  0.01  0.22  0.06  0.05
## E10  0.21 -0.12  0.15  0.18  0.17  0.16  0.21  0.25  0.10 -0.24  0.05 -0.06
## N1   0.55 -0.25  0.39  0.54  0.42  0.44  0.49  0.42  0.00 -0.05  0.11  0.06
## N2  -0.40  0.26 -0.26 -0.38 -0.29 -0.32 -0.34 -0.35  0.02  0.12 -0.06  0.02
## N3   1.00 -0.25  0.32  0.45  0.36  0.36  0.39  0.40 -0.03  0.01  0.08  0.14
## N4  -0.25  1.00 -0.13 -0.21 -0.23 -0.25 -0.20 -0.40  0.06  0.05 -0.07  0.01
## N5   0.32 -0.13  1.00  0.48  0.37  0.39  0.43  0.31  0.08 -0.07  0.13  0.01
## N6   0.45 -0.21  0.48  1.00  0.50  0.54  0.60  0.45  0.05 -0.08  0.16  0.05
## N7   0.36 -0.23  0.37  0.50  1.00  0.77  0.50  0.48  0.11 -0.07  0.21 -0.02
## N8   0.36 -0.25  0.39  0.54  0.77  1.00  0.53  0.54  0.12 -0.10  0.21 -0.02
## N9   0.39 -0.20  0.43  0.60  0.50  0.53  1.00  0.41  0.12 -0.15  0.31 -0.09
## N10  0.40 -0.40  0.31  0.45  0.48  0.54  0.41  1.00  0.09 -0.14  0.16 -0.02
## A1  -0.03  0.06  0.08  0.05  0.11  0.12  0.12  0.09  1.00 -0.26  0.21 -0.37
## A2   0.01  0.05 -0.07 -0.08 -0.07 -0.10 -0.15 -0.14 -0.26  1.00 -0.15  0.39
## A3   0.08 -0.07  0.13  0.16  0.21  0.21  0.31  0.16  0.21 -0.15  1.00 -0.30
## A4   0.14  0.01  0.01  0.05 -0.02 -0.02 -0.09 -0.02 -0.37  0.39 -0.30  1.00
## A5  -0.08  0.02  0.06  0.01  0.05  0.06  0.12  0.07  0.38 -0.42  0.23 -0.50
## A6   0.19 -0.01  0.11  0.17  0.06  0.06  0.00  0.04 -0.24  0.25 -0.27  0.49
## A7  -0.01 -0.02  0.11  0.09  0.13  0.15  0.19  0.17  0.38 -0.57  0.24 -0.43
## A8   0.07  0.03 -0.06 -0.03 -0.06 -0.08 -0.12 -0.09 -0.30  0.36 -0.20  0.45
## A9   0.14 -0.01  0.03  0.08  0.03  0.03 -0.04  0.01 -0.29  0.37 -0.24  0.63
## A10 -0.06  0.13 -0.10 -0.12 -0.12 -0.14 -0.18 -0.19 -0.16  0.33 -0.23  0.34
## C1  -0.04  0.10 -0.15 -0.14 -0.16 -0.17 -0.11 -0.18 -0.04  0.06 -0.12  0.05
## C2   0.06 -0.05  0.09  0.11  0.13  0.12  0.09  0.11 -0.01  0.07  0.15  0.02
## C3   0.12  0.02 -0.09 -0.06 -0.05 -0.07 -0.03 -0.05 -0.04  0.10 -0.08  0.11
## C4   0.22 -0.14  0.26  0.30  0.33  0.35  0.28  0.34  0.09 -0.05  0.27 -0.04
## C5  -0.06  0.15 -0.10 -0.10 -0.14 -0.13 -0.13 -0.17  0.00  0.06 -0.18  0.09
## C6   0.10 -0.05  0.17  0.19  0.19  0.19  0.15  0.16  0.05  0.00  0.17 -0.02
## C7   0.11  0.02  0.00  0.00 -0.03 -0.06  0.04 -0.05 -0.07  0.03 -0.06  0.07
## C8   0.10 -0.09  0.19  0.19  0.25  0.28  0.19  0.24  0.18 -0.11  0.23 -0.12
## C9   0.05  0.08 -0.07 -0.05 -0.11 -0.11 -0.02 -0.13 -0.07  0.08 -0.12  0.11
## C10  0.02  0.06 -0.09 -0.07 -0.09 -0.10 -0.04 -0.09 -0.05  0.09 -0.11  0.10
## O1  -0.04 -0.03 -0.11 -0.09 -0.08 -0.08 -0.04  0.00 -0.09  0.08  0.04  0.01
## O2   0.12  0.01  0.20  0.19  0.13  0.14  0.16  0.08  0.11 -0.07  0.05 -0.03
## O3   0.11 -0.05  0.02  0.04  0.09  0.07  0.05  0.07 -0.03  0.10  0.06  0.09
## O4   0.04  0.06  0.12  0.11  0.06  0.08  0.11  0.01  0.12 -0.13  0.06 -0.09
## O5  -0.07  0.07 -0.08 -0.10 -0.06 -0.08 -0.05 -0.11 -0.03  0.12  0.01  0.05
## O6   0.02  0.01  0.08  0.07  0.01  0.04  0.07  0.06  0.07 -0.12  0.04 -0.09
## O7  -0.09  0.06 -0.15 -0.15 -0.09 -0.11 -0.09 -0.10 -0.02  0.09 -0.05  0.05
## O8   0.02 -0.07 -0.03 -0.01  0.05  0.06  0.06  0.10 -0.04  0.00  0.15 -0.05
## O9   0.19 -0.09  0.05  0.09  0.09  0.07  0.10  0.17 -0.11  0.11 -0.02  0.16
## O10 -0.03  0.03 -0.08 -0.07 -0.02 -0.04 -0.04 -0.04 -0.04  0.15  0.03  0.07
```

```
##        A5    A6    A7    A8    A9   A10    C1    C2    C3    C4    C5    C6
## E1  -0.11  0.06 -0.23  0.15  0.13  0.31  0.05  0.04  0.01 -0.06  0.09 -0.01
## E2   0.21 -0.07  0.30 -0.15 -0.14 -0.25 -0.01 -0.05  0.02  0.04 -0.02 -0.01
## E3  -0.24  0.12 -0.40  0.26  0.21  0.39  0.16 -0.03  0.08 -0.21  0.17 -0.10
## E4   0.16  0.00  0.28 -0.11 -0.09 -0.24 -0.05  0.02  0.03  0.16 -0.07  0.06
## E5  -0.25  0.11 -0.36  0.25  0.23  0.40  0.11  0.01  0.08 -0.13  0.14 -0.05
## E6   0.24 -0.03  0.35 -0.17 -0.16 -0.26 -0.06 -0.02 -0.07  0.12 -0.02  0.06
## E7  -0.18  0.08 -0.36  0.21  0.17  0.35  0.07  0.02  0.03 -0.09  0.13 -0.04
## E8   0.07  0.02  0.16  0.01 -0.05 -0.14  0.01 -0.06  0.06  0.03 -0.02 -0.01
## E9  -0.07  0.01 -0.17  0.07  0.13  0.23  0.04  0.05  0.00 -0.04  0.05  0.01
## E10  0.14  0.01  0.25 -0.10 -0.08 -0.24 -0.06  0.02  0.02  0.14 -0.09  0.08
## N1   0.00  0.13  0.05 -0.01  0.06 -0.13 -0.08  0.09 -0.02  0.26 -0.10  0.13
## N2   0.00 -0.01 -0.06  0.07  0.00  0.17  0.08  0.03  0.04 -0.14  0.04 -0.02
## N3  -0.08  0.19 -0.01  0.07  0.14 -0.06 -0.04  0.06  0.12  0.22 -0.06  0.10
## N4   0.02 -0.01 -0.02  0.03 -0.01  0.13  0.10 -0.05  0.02 -0.14  0.15 -0.05
## N5   0.06  0.11  0.11 -0.06  0.03 -0.10 -0.15  0.09 -0.09  0.26 -0.10  0.17
## N6   0.01  0.17  0.09 -0.03  0.08 -0.12 -0.14  0.11 -0.06  0.30 -0.10  0.19
## N7   0.05  0.06  0.13 -0.06  0.03 -0.12 -0.16  0.13 -0.05  0.33 -0.14  0.19
## N8   0.06  0.06  0.15 -0.08  0.03 -0.14 -0.17  0.12 -0.07  0.35 -0.13  0.19
## N9   0.12  0.00  0.19 -0.12 -0.04 -0.18 -0.11  0.09 -0.03  0.28 -0.13  0.15
## N10  0.07  0.04  0.17 -0.09  0.01 -0.19 -0.18  0.11 -0.05  0.34 -0.17  0.16
## A1   0.38 -0.24  0.38 -0.30 -0.29 -0.16 -0.04 -0.01 -0.04  0.09  0.00  0.05
## A2  -0.42  0.25 -0.57  0.36  0.37  0.33  0.06  0.07  0.10 -0.05  0.06  0.00
## A3   0.23 -0.27  0.24 -0.20 -0.24 -0.23 -0.12  0.15 -0.08  0.27 -0.18  0.17
## A4  -0.50  0.49 -0.43  0.45  0.63  0.34  0.05  0.02  0.11 -0.04  0.09 -0.02
## A5   1.00 -0.33  0.57 -0.41 -0.45 -0.26 -0.03 -0.02 -0.07  0.05 -0.06  0.02
## A6  -0.33  1.00 -0.29  0.36  0.48  0.27  0.00  0.02  0.05 -0.01  0.09  0.03
## A7   0.57 -0.29  1.00 -0.39 -0.40 -0.31 -0.05 -0.01 -0.08  0.11 -0.07  0.05
## A8  -0.41  0.36 -0.39  1.00  0.43  0.34  0.09 -0.01  0.14 -0.07  0.11 -0.04
## A9  -0.45  0.48 -0.40  0.43  1.00  0.36  0.05  0.01  0.14 -0.05  0.11 -0.02
## A10 -0.26  0.27 -0.31  0.34  0.36  1.00  0.11 -0.03  0.14 -0.17  0.16 -0.08
## C1  -0.03  0.00 -0.05  0.09  0.05  0.11  1.00 -0.26  0.30 -0.35  0.39 -0.31
## C2  -0.02  0.02 -0.01 -0.01  0.01 -0.03 -0.26  1.00 -0.16  0.40 -0.36  0.51
## C3  -0.07  0.05 -0.08  0.14  0.14  0.14  0.30 -0.16  1.00 -0.20  0.20 -0.21
## C4   0.05 -0.01  0.11 -0.07 -0.05 -0.17 -0.35  0.40 -0.20  1.00 -0.36  0.46
## C5  -0.06  0.09 -0.07  0.11  0.11  0.16  0.39 -0.36  0.20 -0.36  1.00 -0.39
## C6   0.02  0.03  0.05 -0.04 -0.02 -0.08 -0.31  0.51 -0.21  0.46 -0.39  1.00
## C7  -0.02  0.05 -0.03  0.08  0.06  0.07  0.31 -0.27  0.27 -0.26  0.30 -0.31
## C8   0.14 -0.06  0.17 -0.15 -0.10 -0.17 -0.32  0.23 -0.18  0.39 -0.37  0.31
## C9  -0.07  0.08 -0.09  0.13  0.14  0.13  0.43 -0.27  0.23 -0.31  0.42 -0.32
## C10 -0.06  0.06 -0.07  0.11  0.12  0.20  0.33 -0.14  0.35 -0.24  0.27 -0.20
## O1  -0.02 -0.08 -0.05  0.02  0.02  0.05  0.12  0.08  0.15 -0.03 -0.05  0.00
## O2   0.07  0.07  0.09 -0.03 -0.05 -0.07 -0.07 -0.01 -0.15  0.11  0.03  0.05
## O3  -0.04  0.06 -0.06  0.05  0.13  0.09 -0.01  0.10  0.14  0.10 -0.08  0.09
## O4   0.13  0.00  0.15 -0.06 -0.09 -0.05 -0.01 -0.05 -0.11  0.04  0.05  0.00
## O5  -0.03  0.02 -0.08  0.08  0.11  0.21  0.19  0.01  0.22 -0.13  0.07 -0.03
## O6   0.10 -0.05  0.16 -0.08 -0.14 -0.14 -0.03 -0.03 -0.14  0.05  0.02  0.00
## O7  -0.03 -0.01 -0.06  0.09  0.10  0.17  0.21 -0.01  0.26 -0.16  0.09 -0.06
## O8   0.03 -0.11  0.03 -0.02 -0.02 -0.03  0.04  0.12  0.10  0.09 -0.10  0.07
## O9  -0.09  0.11 -0.08  0.13  0.17  0.06  0.02  0.06  0.16  0.05 -0.06  0.02
## O10 -0.07  0.03 -0.11  0.09  0.13  0.18  0.10  0.06  0.20 -0.02  0.01  0.04
```

```
##        C7    C8    C9   C10    O1    O2    O3    O4    O5    O6    O7    O8
## E1  -0.03 -0.04  0.05  0.04  0.04 -0.02  0.06  0.00  0.17 -0.10  0.07  0.00
## E2   0.02  0.07 -0.03 -0.02 -0.06  0.05 -0.05  0.03 -0.12  0.11 -0.06 -0.02
## E3   0.03 -0.18  0.15  0.11  0.03 -0.06  0.00 -0.02  0.15 -0.09  0.13 -0.07
## E4   0.04  0.13 -0.05 -0.02 -0.05  0.09  0.03  0.05 -0.13  0.09 -0.07  0.00
## E5   0.03 -0.14  0.12  0.11  0.10 -0.07  0.07 -0.06  0.20 -0.13  0.13  0.02
## E6  -0.02  0.14 -0.04 -0.10 -0.18  0.19 -0.11  0.17 -0.24  0.21 -0.17 -0.11
## E7  -0.01 -0.10  0.08  0.06  0.05 -0.05  0.03 -0.03  0.15 -0.10  0.09  0.01
## E8   0.09  0.03  0.00  0.01 -0.03  0.04 -0.03  0.03 -0.12  0.09 -0.01 -0.02
## E9  -0.02 -0.02  0.04  0.07  0.07 -0.08  0.09 -0.05  0.22 -0.13  0.13  0.05
## E10  0.05  0.12 -0.03 -0.01 -0.06  0.10  0.01  0.05 -0.13  0.08 -0.07 -0.01
## N1   0.05  0.14  0.01 -0.05 -0.04  0.17  0.04  0.09 -0.12  0.07 -0.16  0.02
## N2  -0.04 -0.03 -0.02  0.03  0.04 -0.08  0.03 -0.04  0.12 -0.08  0.13 -0.02
## N3   0.11  0.10  0.05  0.02 -0.04  0.12  0.11  0.04 -0.07  0.02 -0.09  0.02
## N4   0.02 -0.09  0.08  0.06 -0.03  0.01 -0.05  0.06  0.07  0.01  0.06 -0.07
## N5   0.00  0.19 -0.07 -0.09 -0.11  0.20  0.02  0.12 -0.08  0.08 -0.15 -0.03
## N6   0.00  0.19 -0.05 -0.07 -0.09  0.19  0.04  0.11 -0.10  0.07 -0.15 -0.01
## N7  -0.03  0.25 -0.11 -0.09 -0.08  0.13  0.09  0.06 -0.06  0.01 -0.09  0.05
## N8  -0.06  0.28 -0.11 -0.10 -0.08  0.14  0.07  0.08 -0.08  0.04 -0.11  0.06
## N9   0.04  0.19 -0.02 -0.04 -0.04  0.16  0.05  0.11 -0.05  0.07 -0.09  0.06
## N10 -0.05  0.24 -0.13 -0.09  0.00  0.08  0.07  0.01 -0.11  0.06 -0.10  0.10
## A1  -0.07  0.18 -0.07 -0.05 -0.09  0.11 -0.03  0.12 -0.03  0.07 -0.02 -0.04
## A2   0.03 -0.11  0.08  0.09  0.08 -0.07  0.10 -0.13  0.12 -0.12  0.09  0.00
## A3  -0.06  0.23 -0.12 -0.11  0.04  0.05  0.06  0.06  0.01  0.04 -0.05  0.15
## A4   0.07 -0.12  0.11  0.10  0.01 -0.03  0.09 -0.09  0.05 -0.09  0.05 -0.05
## A5  -0.02  0.14 -0.07 -0.06 -0.02  0.07 -0.04  0.13 -0.03  0.10 -0.03  0.03
## A6   0.05 -0.06  0.08  0.06 -0.08  0.07  0.06  0.00  0.02 -0.05 -0.01 -0.11
## A7  -0.03  0.17 -0.09 -0.07 -0.05  0.09 -0.06  0.15 -0.08  0.16 -0.06  0.03
## A8   0.08 -0.15  0.13  0.11  0.02 -0.03  0.05 -0.06  0.08 -0.08  0.09 -0.02
## A9   0.06 -0.10  0.14  0.12  0.02 -0.05  0.13 -0.09  0.11 -0.14  0.10 -0.02
## A10  0.07 -0.17  0.13  0.20  0.05 -0.07  0.09 -0.05  0.21 -0.14  0.17 -0.03
## C1   0.31 -0.32  0.43  0.33  0.12 -0.07 -0.01 -0.01  0.19 -0.03  0.21  0.04
## C2  -0.27  0.23 -0.27 -0.14  0.08 -0.01  0.10 -0.05  0.01 -0.03 -0.01  0.12
## C3   0.27 -0.18  0.23  0.35  0.15 -0.15  0.14 -0.11  0.22 -0.14  0.26  0.10
## C4  -0.26  0.39 -0.31 -0.24 -0.03  0.11  0.10  0.04 -0.13  0.05 -0.16  0.09
## C5   0.30 -0.37  0.42  0.27 -0.05  0.03 -0.08  0.05  0.07  0.02  0.09 -0.10
## C6  -0.31  0.31 -0.32 -0.20  0.00  0.05  0.09  0.00 -0.03  0.00 -0.06  0.07
## C7   1.00 -0.22  0.41  0.29  0.05  0.01 -0.01  0.02  0.09  0.01  0.11  0.01
## C8  -0.22  1.00 -0.31 -0.28 -0.07  0.10  0.03  0.06 -0.11  0.06 -0.13  0.03
## C9   0.41 -0.31  1.00  0.30 -0.01  0.04 -0.06  0.06  0.08  0.02  0.08 -0.05
## C10  0.29 -0.28  0.30  1.00  0.16 -0.13  0.06 -0.09  0.25 -0.09  0.27  0.11
## O1   0.05 -0.07 -0.01  0.16  1.00 -0.34  0.25 -0.25  0.31 -0.23  0.35  0.64
## O2   0.01  0.10  0.04 -0.13 -0.34  1.00 -0.24  0.56 -0.30  0.30 -0.39 -0.29
## O3  -0.01  0.03 -0.06  0.06  0.25 -0.24  1.00 -0.25  0.31 -0.57  0.18  0.22
## O4   0.02  0.06  0.06 -0.09 -0.25  0.56 -0.25  1.00 -0.22  0.31 -0.22 -0.23
## O5   0.09 -0.11  0.08  0.25  0.31 -0.30  0.31 -0.22  1.00 -0.37  0.40  0.25
## O6   0.01  0.06  0.02 -0.09 -0.23  0.30 -0.57  0.31 -0.37  1.00 -0.21 -0.16
## O7   0.11 -0.13  0.08  0.27  0.35 -0.39  0.18 -0.22  0.40 -0.21  1.00  0.28
## O8   0.01  0.03 -0.05  0.11  0.64 -0.29  0.22 -0.23  0.25 -0.16  0.28  1.00
## O9   0.10 -0.02  0.04  0.12  0.20 -0.19  0.23 -0.23  0.16 -0.16  0.14  0.20
## O10  0.04 -0.06  0.02  0.20  0.31 -0.33  0.45 -0.31  0.62 -0.47  0.34  0.27
```

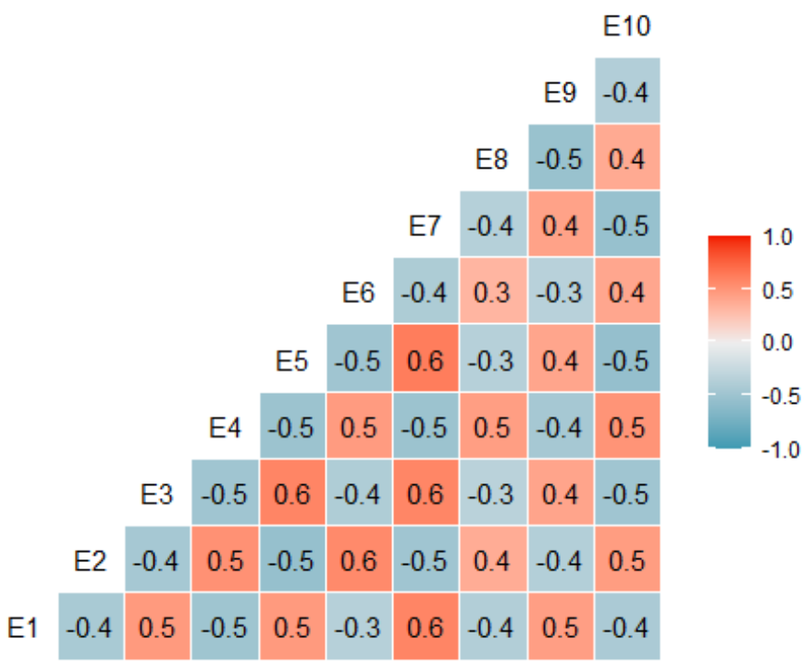
```
##        O9   O10
## E1  -0.09  0.15
## E2   0.06 -0.14
## E3  -0.09  0.12
## E4   0.11 -0.12
## E5  -0.02  0.20
## E6  -0.04 -0.27
## E7  -0.07  0.15
## E8   0.10 -0.11
## E9  -0.04  0.20
## E10  0.13 -0.11
## N1   0.11 -0.08
## N2  -0.06  0.09
## N3   0.19 -0.03
## N4  -0.09  0.03
## N5   0.05 -0.08
## N6   0.09 -0.07
## N7   0.09 -0.02
## N8   0.07 -0.04
## N9   0.10 -0.04
## N10  0.17 -0.04
## A1  -0.11 -0.04
## A2   0.11  0.15
## A3  -0.02  0.03
## A4   0.16  0.07
## A5  -0.09 -0.07
## A6   0.11  0.03
## A7  -0.08 -0.11
## A8   0.13  0.09
## A9   0.17  0.13
## A10  0.06  0.18
## C1   0.02  0.10
## C2   0.06  0.06
## C3   0.16  0.20
## C4   0.05 -0.02
## C5  -0.06  0.01
## C6   0.02  0.04
## C7   0.10  0.04
## C8  -0.02 -0.06
## C9   0.04  0.02
## C10  0.12  0.20
## O1   0.20  0.31
## O2  -0.19 -0.33
## O3   0.23  0.45
## O4  -0.23 -0.31
## O5   0.16  0.62
## O6  -0.16 -0.47
## O7   0.14  0.34
## O8   0.20  0.27
## O9   1.00  0.22
## O10  0.22  1.00
```

```
corrplot(cor(M, method="spearman"), method = "number", type = "lower")
```

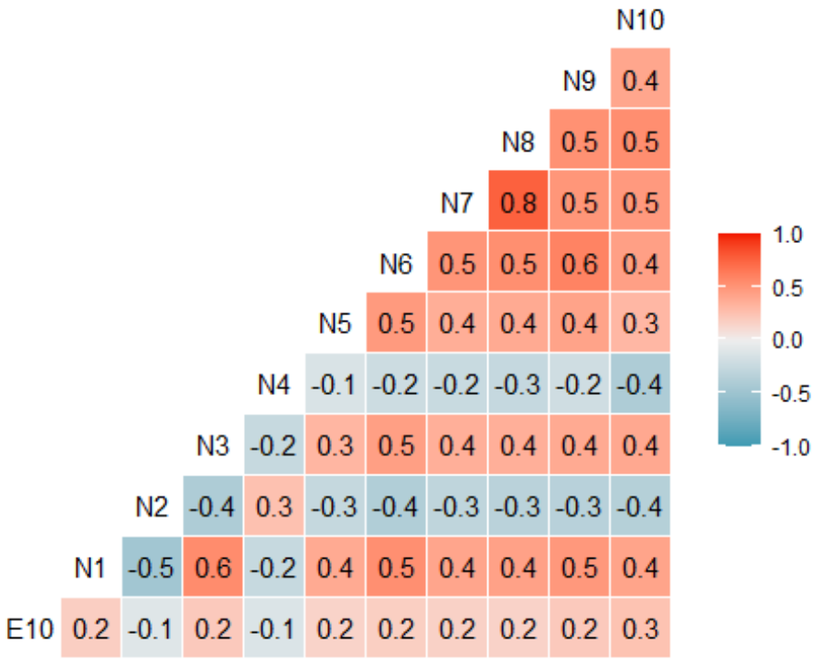


#GGplot to plot different correlation matrix plot # High correlation between N8 and N7

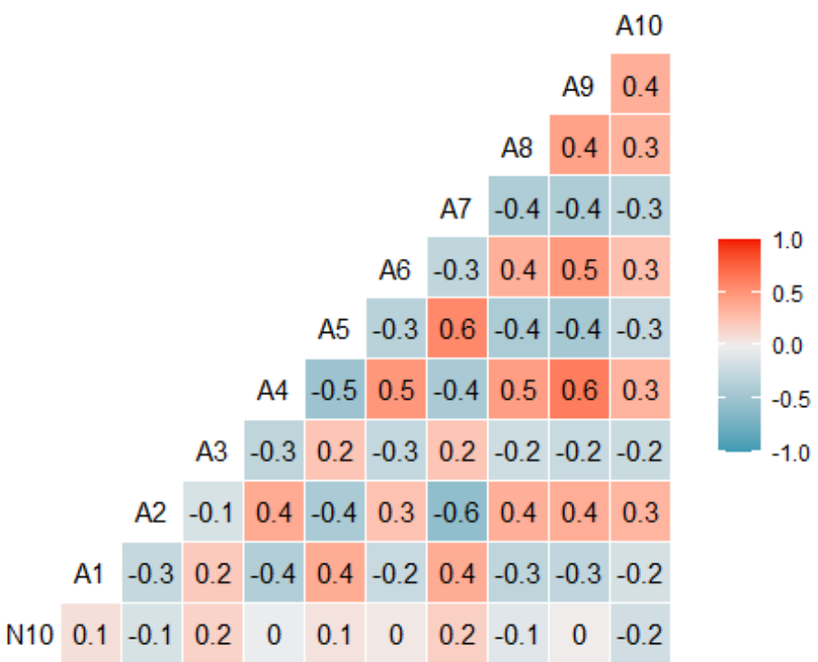
```
ggcorr(likeditems[,1:10], method = c("pairwise", "spearman"), label=TRUE)
```



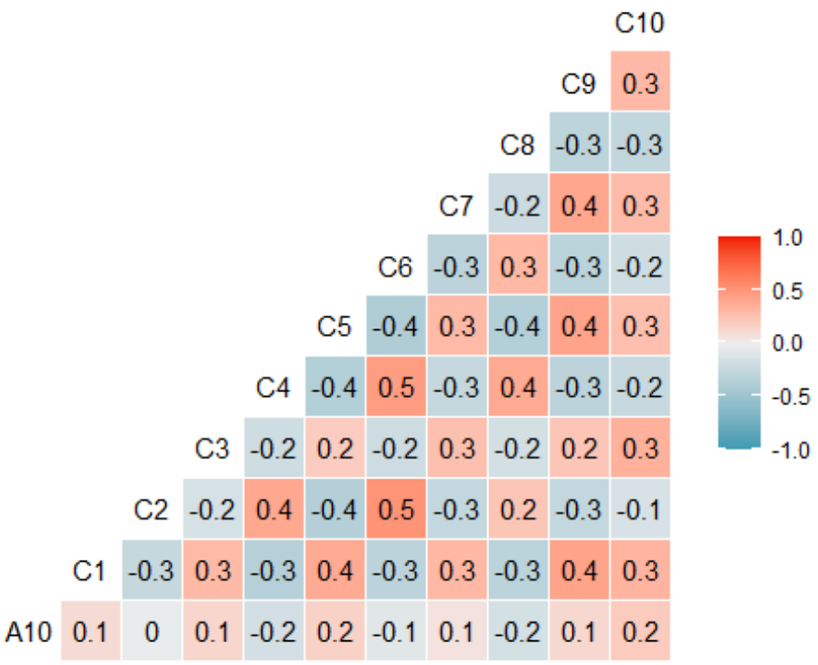

```
ggcorr(likeditems[,10:20], method = c("pairwise", "spearman"), label=TRUE)
```



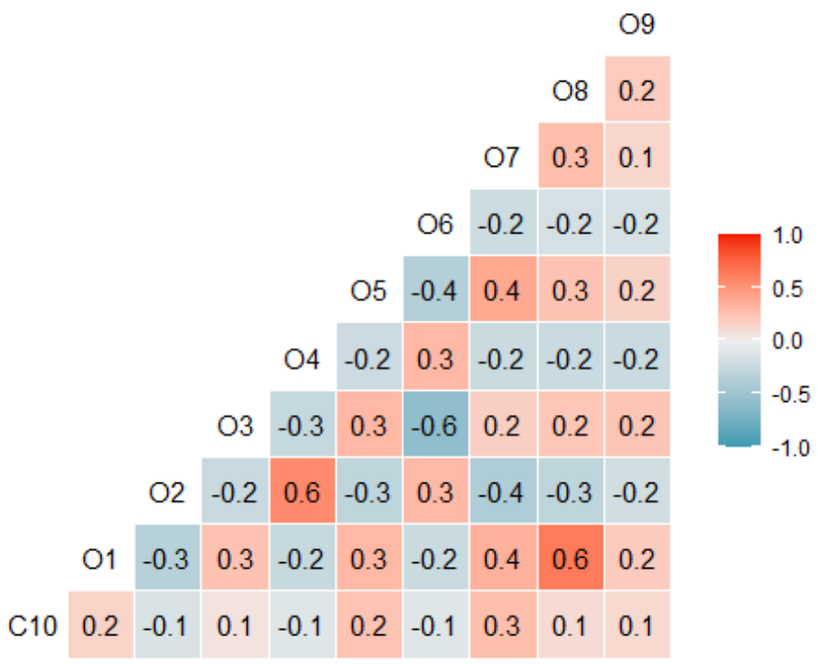

```
ggcorr(likeditems[,20:30], method = c("pairwise", "spearman"), label=TRUE)
```




```
ggcorr(likeditems[,30:40], method = c("pairwise", "spearman"), label=TRUE)
```




```
ggcorr(likeditems[,40:49], method = c("pairwise", "spearman"), label=TRUE)
```



#let's remove the variable N8 from the dataset

```
likeditems$N8 <- NULL
```

Run a correlation test to see how correlated the variables are.
Which correlations are significant

```
options("scipen"=100, "digits"=5)
```

if these P values,

so I ran a correlation test, took out the p values and around them off two decimal places

```
round(cor(likeditems), 2)
```

```
##        E1    E2    E3    E4    E5    E6    E7    E8    E9   E10    N1    N2
## E1   1.00 -0.42  0.47 -0.48  0.48 -0.35  0.59 -0.37  0.46 -0.41 -0.11  0.15
## E2  -0.42  1.00 -0.45  0.53 -0.54  0.57 -0.48  0.37 -0.36  0.46  0.06 -0.03
## E3   0.47 -0.45  1.00 -0.48  0.59 -0.39  0.58 -0.32  0.42 -0.47 -0.23  0.28
## E4  -0.48  0.53 -0.48  1.00 -0.51  0.47 -0.50  0.45 -0.45  0.51  0.15 -0.09
## E5   0.48 -0.54  0.59 -0.51  1.00 -0.48  0.63 -0.34  0.42 -0.54 -0.13  0.13
## E6  -0.35  0.57 -0.39  0.47 -0.48  1.00 -0.41  0.32 -0.33  0.41  0.11 -0.05
## E7   0.59 -0.48  0.58 -0.50  0.63 -0.41  1.00 -0.34  0.43 -0.53 -0.14  0.16
## E8  -0.37  0.37 -0.32  0.45 -0.34  0.32 -0.34  1.00 -0.51  0.38  0.09 -0.05
## E9   0.46 -0.36  0.42 -0.45  0.42 -0.33  0.43 -0.51  1.00 -0.37 -0.13  0.14
## E10 -0.41  0.46 -0.47  0.51 -0.54  0.41 -0.53  0.38 -0.37  1.00  0.18 -0.09
## N1  -0.11  0.06 -0.23  0.15 -0.13  0.11 -0.14  0.09 -0.13  0.18  1.00 -0.46
## N2   0.15 -0.03  0.28 -0.09  0.13 -0.05  0.16 -0.05  0.14 -0.09 -0.46  1.00
## N3  -0.12  0.06 -0.20  0.18 -0.09  0.09 -0.13  0.11 -0.11  0.20  0.55 -0.40
## N4   0.14 -0.07  0.20 -0.11  0.12 -0.05  0.13 -0.08  0.12 -0.11 -0.25  0.26
## N5  -0.07  0.04 -0.18  0.13 -0.10  0.14 -0.11  0.04 -0.06  0.15  0.39 -0.26
## N6  -0.10  0.04 -0.22  0.15 -0.12  0.13 -0.14  0.05 -0.08  0.18  0.54 -0.38
## N7  -0.05  0.04 -0.21  0.14 -0.10  0.11 -0.09  0.02 -0.03  0.16  0.42 -0.29
## N9  -0.09  0.05 -0.25  0.15 -0.14  0.12 -0.15  0.07 -0.07  0.20  0.49 -0.34
## N10 -0.19  0.19 -0.36  0.28 -0.24  0.20 -0.24  0.13 -0.15  0.25  0.42 -0.36
## A1  -0.02  0.12 -0.12  0.12 -0.10  0.19 -0.08 -0.01  0.02  0.09  0.00  0.02
## A2   0.27 -0.27  0.43 -0.25  0.38 -0.29  0.36 -0.17  0.22 -0.24 -0.04  0.12
## A3   0.05 -0.04 -0.12  0.02 -0.04  0.01 -0.02 -0.04  0.06  0.05  0.11 -0.06
## A4   0.09 -0.11  0.22 -0.06  0.19 -0.12  0.15 -0.01  0.04 -0.07  0.07  0.02
## A5  -0.11  0.21 -0.24  0.16 -0.24  0.23 -0.18  0.08 -0.07  0.15  0.00  0.01
## A6   0.06 -0.06  0.12 -0.01  0.11 -0.01  0.08  0.01  0.01  0.00  0.14 -0.01
## A7  -0.23  0.30 -0.40  0.28 -0.36  0.34 -0.35  0.17 -0.17  0.25  0.05 -0.05
## A8   0.15 -0.15  0.26 -0.11  0.24 -0.17  0.21  0.00  0.07 -0.11 -0.01  0.07
## A9   0.14 -0.14  0.22 -0.10  0.23 -0.15  0.18 -0.06  0.12 -0.09  0.06  0.00
## A10  0.32 -0.24  0.40 -0.24  0.39 -0.25  0.35 -0.14  0.23 -0.24 -0.13  0.17
## C1   0.06 -0.01  0.16 -0.05  0.11 -0.06  0.07  0.01  0.04 -0.05 -0.08  0.08
## C2   0.04 -0.05 -0.03  0.02  0.01 -0.02  0.02 -0.06  0.05  0.02  0.09  0.03
## C3   0.01  0.02  0.07  0.03  0.07 -0.05  0.03  0.06  0.00  0.01 -0.02  0.04
## C4  -0.06  0.04 -0.21  0.16 -0.13  0.12 -0.09  0.03 -0.04  0.13  0.26 -0.14
## C5   0.09 -0.02  0.17 -0.07  0.15 -0.02  0.13 -0.02  0.05 -0.08 -0.10  0.05
## C6  -0.01 -0.01 -0.10  0.06 -0.05  0.06 -0.04 -0.01  0.01  0.08  0.13 -0.02
## C7  -0.03  0.02  0.03  0.03  0.03 -0.02  0.00  0.08 -0.02  0.04  0.05 -0.04
## C8  -0.04  0.08 -0.18  0.13 -0.14  0.14 -0.10  0.03 -0.02  0.13  0.14 -0.04
## C9   0.05 -0.03  0.15 -0.05  0.13 -0.04  0.08  0.00  0.04 -0.03  0.01 -0.02
## C10  0.05 -0.02  0.11 -0.02  0.10 -0.08  0.07  0.00  0.06 -0.02 -0.05  0.03
## O1   0.04 -0.05  0.03 -0.04  0.09 -0.18  0.06 -0.02  0.07 -0.07 -0.05  0.04
## O2  -0.03  0.06 -0.07  0.10 -0.07  0.19 -0.06  0.05 -0.08  0.10  0.17 -0.08
## O3   0.07 -0.04  0.00  0.03  0.06 -0.09  0.04 -0.04  0.09 -0.01  0.03  0.03
## O4  -0.01  0.04 -0.02  0.06 -0.05  0.15 -0.04  0.04 -0.05  0.06  0.09 -0.04
## O5   0.19 -0.13  0.16 -0.14  0.20 -0.23  0.16 -0.13  0.22 -0.14 -0.13  0.13
## O6  -0.09  0.10 -0.08  0.09 -0.11  0.19 -0.09  0.10 -0.12  0.09  0.07 -0.07
## O7   0.08 -0.06  0.14 -0.07  0.12 -0.15  0.10 -0.02  0.12 -0.09 -0.17  0.14
## O8   0.01 -0.02 -0.07  0.01  0.01 -0.11  0.01 -0.01  0.05 -0.01  0.02 -0.02
```

```
## O9   -0.08  0.07 -0.09  0.11 -0.03 -0.01 -0.05  0.08 -0.04  0.11  0.11 -0.06
## O10  0.16 -0.14  0.12 -0.13  0.20 -0.26  0.16 -0.12  0.20 -0.13 -0.09  0.10
##         N3    N4    N5    N6    N7    N9   N10    A1    A2    A3    A4    A5
## E1   -0.12  0.14 -0.07 -0.10 -0.05 -0.09 -0.19 -0.02  0.27  0.05  0.09 -0.11
## E2    0.06 -0.07  0.04  0.04  0.04  0.05  0.19  0.12 -0.27 -0.04 -0.11  0.21
## E3   -0.20  0.20 -0.18 -0.22 -0.21 -0.25 -0.36 -0.12  0.43 -0.12  0.22 -0.24
## E4    0.18 -0.11  0.13  0.15  0.14  0.15  0.28  0.12 -0.25  0.02 -0.06  0.16
## E5   -0.09  0.12 -0.10 -0.12 -0.10 -0.14 -0.24 -0.10  0.38 -0.04  0.19 -0.24
## E6    0.09 -0.05  0.14  0.13  0.11  0.12  0.20  0.19 -0.29  0.01 -0.12  0.23
## E7   -0.13  0.13 -0.11 -0.14 -0.09 -0.15 -0.24 -0.08  0.36 -0.02  0.15 -0.18
## E8    0.11 -0.08  0.04  0.05  0.02  0.07  0.13 -0.01 -0.17 -0.04 -0.01  0.08
## E9   -0.11  0.12 -0.06 -0.08 -0.03 -0.07 -0.15  0.02  0.22  0.06  0.04 -0.07
## E10  0.20 -0.11  0.15  0.18  0.16  0.20  0.25  0.09 -0.24  0.05 -0.07  0.15
## N1    0.55 -0.25  0.39  0.54  0.42  0.49  0.42  0.00 -0.04  0.11  0.07  0.00
## N2   -0.40  0.26 -0.26 -0.38 -0.29 -0.34 -0.36  0.02  0.12 -0.06  0.02  0.01
## N3    1.00 -0.25  0.32  0.45  0.36  0.38  0.39 -0.02  0.02  0.08  0.14 -0.07
## N4   -0.25  1.00 -0.13 -0.21 -0.24 -0.20 -0.39  0.06  0.04 -0.06  0.01  0.02
## N5    0.32 -0.13  1.00  0.48  0.37  0.43  0.31  0.08 -0.07  0.13  0.01  0.06
## N6    0.45 -0.21  0.48  1.00  0.51  0.60  0.45  0.05 -0.08  0.16  0.06  0.01
## N7    0.36 -0.24  0.37  0.51  1.00  0.50  0.48  0.11 -0.07  0.22 -0.02  0.06
## N9    0.38 -0.20  0.43  0.60  0.50  1.00  0.41  0.11 -0.15  0.31 -0.09  0.12
## N10   0.39 -0.39  0.31  0.45  0.48  0.41  1.00  0.08 -0.14  0.16 -0.02  0.06
## A1   -0.02  0.06  0.08  0.05  0.11  0.11  0.08  1.00 -0.23  0.19 -0.33  0.34
## A2    0.02  0.04 -0.07 -0.08 -0.07 -0.15 -0.14 -0.23  1.00 -0.15  0.40 -0.42
## A3    0.08 -0.06  0.13  0.16  0.22  0.31  0.16  0.19 -0.15  1.00 -0.31  0.24
## A4    0.14  0.01  0.01  0.06 -0.02 -0.09 -0.02 -0.33  0.40 -0.31  1.00 -0.50
## A5   -0.07  0.02  0.06  0.01  0.06  0.12  0.06  0.34 -0.42  0.24 -0.50  1.00
## A6    0.18 -0.01  0.11  0.18  0.06 -0.01  0.05 -0.21  0.25 -0.27  0.51 -0.32
## A7   -0.01 -0.01  0.11  0.08  0.13  0.19  0.17  0.35 -0.57  0.24 -0.44  0.56
## A8    0.06  0.03 -0.06 -0.03 -0.06 -0.13 -0.08 -0.26  0.36 -0.20  0.46 -0.41
## A9    0.14  0.00  0.03  0.08  0.02 -0.05  0.01 -0.25  0.38 -0.24  0.65 -0.45
## A10  -0.07  0.13 -0.10 -0.12 -0.12 -0.19 -0.19 -0.13  0.32 -0.22  0.32 -0.25
## C1   -0.05  0.10 -0.15 -0.14 -0.16 -0.12 -0.18 -0.03  0.07 -0.12  0.04 -0.03
## C2    0.06 -0.05  0.09  0.11  0.13  0.09  0.11 -0.01  0.07  0.15  0.02 -0.02
## C3    0.10  0.02 -0.10 -0.07 -0.06 -0.04 -0.05 -0.02  0.09 -0.06  0.09 -0.05
## C4    0.21 -0.13  0.26  0.30  0.33  0.28  0.34  0.08 -0.05  0.27 -0.03  0.04
## C5   -0.06  0.15 -0.10 -0.10 -0.14 -0.13 -0.17  0.02  0.06 -0.18  0.09 -0.05
## C6    0.10 -0.05  0.17  0.20  0.19  0.15  0.16  0.05  0.00  0.17 -0.01  0.02
## C7    0.10  0.02 -0.01 -0.01 -0.04  0.03 -0.05 -0.07  0.02 -0.05  0.05 -0.01
## C8    0.10 -0.09  0.19  0.19  0.25  0.20  0.24  0.17 -0.11  0.23 -0.11  0.14
## C9    0.06  0.08 -0.07 -0.05 -0.11 -0.03 -0.13 -0.05  0.08 -0.12  0.10 -0.07
## C10   0.01  0.06 -0.08 -0.07 -0.09 -0.04 -0.09 -0.03  0.08 -0.10  0.08 -0.04
## O1   -0.05 -0.02 -0.12 -0.09 -0.09 -0.05  0.00 -0.10  0.08  0.04 -0.01 -0.01
## O2    0.14  0.01  0.21  0.20  0.14  0.17  0.09  0.12 -0.05  0.05 -0.01  0.06
## O3    0.08 -0.03  0.01  0.04  0.08  0.04  0.08 -0.02  0.08  0.07  0.07 -0.03
## O4    0.05  0.06  0.13  0.12  0.07  0.12  0.01  0.12 -0.11  0.05 -0.07  0.12
## O5   -0.09  0.08 -0.08 -0.11 -0.08 -0.07 -0.12 -0.02  0.11  0.02  0.03 -0.01
## O6    0.04  0.01  0.09  0.07  0.02  0.08  0.06  0.05 -0.10  0.04 -0.06  0.08
## O7   -0.11  0.07 -0.16 -0.15 -0.10 -0.11 -0.11 -0.01  0.08 -0.04  0.03 -0.02
## O8    0.02 -0.06 -0.03 -0.01  0.06  0.06  0.10 -0.05 -0.01  0.16 -0.07  0.04
## O9    0.18 -0.07  0.05  0.09  0.08  0.09  0.17 -0.11  0.09 -0.01  0.15 -0.08
```

```
## O10 -0.06  0.04 -0.09 -0.08 -0.03 -0.06 -0.05 -0.04  0.14  0.04  0.04 -0.05
##        A6    A7    A8    A9   A10    C1    C2    C3    C4    C5    C6    C7
## E1   0.06 -0.23  0.15  0.14  0.32  0.06  0.04  0.01 -0.06  0.09 -0.01 -0.03
## E2  -0.06  0.30 -0.15 -0.14 -0.24 -0.01 -0.05  0.02  0.04 -0.02 -0.01  0.02
## E3   0.12 -0.40  0.26  0.22  0.40  0.16 -0.03  0.07 -0.21  0.17 -0.10  0.03
## E4  -0.01  0.28 -0.11 -0.10 -0.24 -0.05  0.02  0.03  0.16 -0.07  0.06  0.03
## E5   0.11 -0.36  0.24  0.23  0.39  0.11  0.01  0.07 -0.13  0.15 -0.05  0.03
## E6  -0.01  0.34 -0.17 -0.15 -0.25 -0.06 -0.02 -0.05  0.12 -0.02  0.06 -0.02
## E7   0.08 -0.35  0.21  0.18  0.35  0.07  0.02  0.03 -0.09  0.13 -0.04  0.00
## E8   0.01  0.17  0.00 -0.06 -0.14  0.01 -0.06  0.06  0.03 -0.02 -0.01  0.08
## E9   0.01 -0.17  0.07  0.12  0.23  0.04  0.05  0.00 -0.04  0.05  0.01 -0.02
## E10  0.00  0.25 -0.11 -0.09 -0.24 -0.05  0.02  0.01  0.13 -0.08  0.08  0.04
## N1   0.14  0.05 -0.01  0.06 -0.13 -0.08  0.09 -0.02  0.26 -0.10  0.13  0.05
## N2  -0.01 -0.05  0.07  0.00  0.17  0.08  0.03  0.04 -0.14  0.05 -0.02 -0.04
## N3   0.18 -0.01  0.06  0.14 -0.07 -0.05  0.06  0.10  0.21 -0.06  0.10  0.10
## N4  -0.01 -0.01  0.03  0.00  0.13  0.10 -0.05  0.02 -0.13  0.15 -0.05  0.02
## N5   0.11  0.11 -0.06  0.03 -0.10 -0.15  0.09 -0.10  0.26 -0.10  0.17 -0.01
## N6   0.18  0.08 -0.03  0.08 -0.12 -0.14  0.11 -0.07  0.30 -0.10  0.20 -0.01
## N7   0.06  0.13 -0.06  0.02 -0.12 -0.16  0.13 -0.06  0.33 -0.14  0.19 -0.04
## N9  -0.01  0.19 -0.13 -0.05 -0.19 -0.12  0.09 -0.04  0.28 -0.13  0.15  0.03
## N10  0.05  0.17 -0.08  0.01 -0.19 -0.18  0.11 -0.05  0.34 -0.17  0.16 -0.05
## A1  -0.21  0.35 -0.26 -0.25 -0.13 -0.03 -0.01 -0.02  0.08  0.02  0.05 -0.07
## A2   0.25 -0.57  0.36  0.38  0.32  0.07  0.07  0.09 -0.05  0.06  0.00  0.02
## A3  -0.27  0.24 -0.20 -0.24 -0.22 -0.12  0.15 -0.06  0.27 -0.18  0.17 -0.05
## A4   0.51 -0.44  0.46  0.65  0.32  0.04  0.02  0.09 -0.03  0.09 -0.01  0.05
## A5  -0.32  0.56 -0.41 -0.45 -0.25 -0.03 -0.02 -0.05  0.04 -0.05  0.02 -0.01
## A6   1.00 -0.28  0.35  0.48  0.26  0.00  0.02  0.03  0.00  0.08  0.03  0.04
## A7  -0.28  1.00 -0.39 -0.40 -0.30 -0.05 -0.01 -0.06  0.10 -0.06  0.04 -0.02
## A8   0.35 -0.39  1.00  0.43  0.33  0.09  0.00  0.12 -0.06  0.11 -0.04  0.07
## A9   0.48 -0.40  0.43  1.00  0.35  0.05  0.01  0.11 -0.04  0.11 -0.01  0.04
## A10  0.26 -0.30  0.33  0.35  1.00  0.11 -0.03  0.12 -0.17  0.17 -0.08  0.05
## C1   0.00 -0.05  0.09  0.05  0.11  1.00 -0.26  0.30 -0.35  0.39 -0.31  0.31
## C2   0.02 -0.01  0.00  0.01 -0.03 -0.26  1.00 -0.16  0.40 -0.36  0.51 -0.26
## C3   0.03 -0.06  0.12  0.11  0.12  0.30 -0.16  1.00 -0.19  0.20 -0.21  0.25
## C4   0.00  0.10 -0.06 -0.04 -0.17 -0.35  0.40 -0.19  1.00 -0.36  0.46 -0.25
## C5   0.08 -0.06  0.11  0.11  0.17  0.39 -0.36  0.20 -0.36  1.00 -0.39  0.29
## C6   0.03  0.04 -0.04 -0.01 -0.08 -0.31  0.51 -0.21  0.46 -0.39  1.00 -0.30
## C7   0.04 -0.02  0.07  0.04  0.05  0.31 -0.26  0.25 -0.25  0.29 -0.30  1.00
## C8  -0.06  0.17 -0.14 -0.10 -0.16 -0.32  0.23 -0.17  0.39 -0.37  0.31 -0.21
## C9   0.07 -0.08  0.12  0.13  0.13  0.43 -0.26  0.23 -0.31  0.42 -0.32  0.40
## C10  0.04 -0.05  0.10  0.10  0.19  0.33 -0.14  0.34 -0.23  0.28 -0.20  0.28
## O1  -0.08 -0.04  0.02  0.00  0.05  0.13  0.07  0.15 -0.03 -0.03  0.00  0.06
## O2   0.08  0.08 -0.02 -0.03 -0.05 -0.07  0.00 -0.13  0.11  0.03  0.05  0.01
## O3   0.04 -0.04  0.04  0.10  0.08 -0.01  0.10  0.12  0.09 -0.07  0.09 -0.02
## O4   0.01  0.13 -0.05 -0.07 -0.04  0.00 -0.04 -0.09  0.04  0.05  0.00  0.03
## O5   0.00 -0.07  0.06  0.08  0.20  0.20  0.01  0.20 -0.13  0.09 -0.03  0.08
## O6  -0.02  0.13 -0.06 -0.10 -0.11 -0.02 -0.02 -0.10  0.04  0.03  0.01  0.03
## O7  -0.03 -0.04  0.07  0.07  0.16  0.22 -0.01  0.24 -0.15  0.11 -0.06  0.09
## O8  -0.11  0.04 -0.03 -0.04 -0.03  0.04  0.11  0.10  0.09 -0.10  0.07  0.02
## O9   0.10 -0.06  0.11  0.15  0.05  0.03  0.05  0.14  0.05 -0.04  0.02  0.10
## O10  0.01 -0.10  0.08  0.10  0.17  0.11  0.06  0.18 -0.02  0.02  0.03  0.03
```

```
##        C8    C9   C10    O1    O2    O3    O4    O5    O6    O7    O8    O9
## E1  -0.04  0.05  0.05  0.04 -0.03  0.07 -0.01  0.19 -0.09  0.08  0.01 -0.08
## E2   0.08 -0.03 -0.02 -0.05  0.06 -0.04  0.04 -0.13  0.10 -0.06 -0.02  0.07
## E3  -0.18  0.15  0.11  0.03 -0.07  0.00 -0.02  0.16 -0.08  0.14 -0.07 -0.09
## E4   0.13 -0.05 -0.02 -0.04  0.10  0.03  0.06 -0.14  0.09 -0.07  0.01  0.11
## E5  -0.14  0.13  0.10  0.09 -0.07  0.06 -0.05  0.20 -0.11  0.12  0.01 -0.03
## E6   0.14 -0.04 -0.08 -0.18  0.19 -0.09  0.15 -0.23  0.19 -0.15 -0.11 -0.01
## E7  -0.10  0.08  0.07  0.06 -0.06  0.04 -0.04  0.16 -0.09  0.10  0.01 -0.05
## E8   0.03  0.00  0.00 -0.02  0.05 -0.04  0.04 -0.13  0.10 -0.02 -0.01  0.08
## E9  -0.02  0.04  0.06  0.07 -0.08  0.09 -0.05  0.22 -0.12  0.12  0.05 -0.04
## E10  0.13 -0.03 -0.02 -0.07  0.10 -0.01  0.06 -0.14  0.09 -0.09 -0.01  0.11
## N1   0.14  0.01 -0.05 -0.05  0.17  0.03  0.09 -0.13  0.07 -0.17  0.02  0.11
## N2  -0.04 -0.02  0.03  0.04 -0.08  0.03 -0.04  0.13 -0.07  0.14 -0.02 -0.06
## N3   0.10  0.06  0.01 -0.05  0.14  0.08  0.05 -0.09  0.04 -0.11  0.02  0.18
## N4  -0.09  0.08  0.06 -0.02  0.01 -0.03  0.06  0.08  0.01  0.07 -0.06 -0.07
## N5   0.19 -0.07 -0.08 -0.12  0.21  0.01  0.13 -0.08  0.09 -0.16 -0.03  0.05
## N6   0.19 -0.05 -0.07 -0.09  0.20  0.04  0.12 -0.11  0.07 -0.15 -0.01  0.09
## N7   0.25 -0.11 -0.09 -0.09  0.14  0.08  0.07 -0.08  0.02 -0.10  0.06  0.08
## N9   0.20 -0.03 -0.04 -0.05  0.17  0.04  0.12 -0.07  0.08 -0.11  0.06  0.09
## N10  0.24 -0.13 -0.09  0.00  0.09  0.08  0.01 -0.12  0.06 -0.11  0.10  0.17
## A1   0.17 -0.05 -0.03 -0.10  0.12 -0.02  0.12 -0.02  0.05 -0.01 -0.05 -0.11
## A2  -0.11  0.08  0.08  0.08 -0.05  0.08 -0.11  0.11 -0.10  0.08 -0.01  0.09
## A3   0.23 -0.12 -0.10  0.04  0.05  0.07  0.05  0.02  0.04 -0.04  0.16 -0.01
## A4  -0.11  0.10  0.08 -0.01 -0.01  0.07 -0.07  0.03 -0.06  0.03 -0.07  0.15
## A5   0.14 -0.07 -0.04 -0.01  0.06 -0.03  0.12 -0.01  0.08 -0.02  0.04 -0.08
## A6  -0.06  0.07  0.04 -0.08  0.08  0.04  0.01  0.00 -0.02 -0.03 -0.11  0.10
## A7   0.17 -0.08 -0.05 -0.04  0.08 -0.04  0.13 -0.07  0.13 -0.04  0.04 -0.06
## A8  -0.14  0.12  0.10  0.02 -0.02  0.04 -0.05  0.06 -0.06  0.07 -0.03  0.11
## A9  -0.10  0.13  0.10  0.00 -0.03  0.10 -0.07  0.08 -0.10  0.07 -0.04  0.15
## A10 -0.16  0.13  0.19  0.05 -0.05  0.08 -0.04  0.20 -0.11  0.16 -0.03  0.05
## C1  -0.32  0.43  0.33  0.13 -0.07 -0.01  0.00  0.20 -0.02  0.22  0.04  0.03
## C2   0.23 -0.26 -0.14  0.07  0.00  0.10 -0.04  0.01 -0.02 -0.01  0.11  0.05
## C3  -0.17  0.23  0.34  0.15 -0.13  0.12 -0.09  0.20 -0.10  0.24  0.10  0.14
## C4   0.39 -0.31 -0.23 -0.03  0.11  0.09  0.04 -0.13  0.04 -0.15  0.09  0.05
## C5  -0.37  0.42  0.28 -0.03  0.03 -0.07  0.05  0.09  0.03  0.11 -0.10 -0.04
## C6   0.31 -0.32 -0.20  0.00  0.05  0.09  0.00 -0.03  0.01 -0.06  0.07  0.02
## C7  -0.21  0.40  0.28  0.06  0.01 -0.02  0.03  0.08  0.03  0.09  0.02  0.10
## C8   1.00 -0.31 -0.27 -0.07  0.09  0.03  0.06 -0.11  0.05 -0.13  0.04 -0.01
## C9  -0.31  1.00  0.31  0.00  0.04 -0.05  0.06  0.09  0.03  0.08 -0.05  0.05
## C10 -0.27  0.31  1.00  0.15 -0.11  0.05 -0.07  0.24 -0.06  0.26  0.10  0.11
## O1  -0.07  0.00  0.15  1.00 -0.33  0.24 -0.23  0.31 -0.21  0.34  0.63  0.20
## O2   0.09  0.04 -0.11 -0.33  1.00 -0.21  0.54 -0.28  0.28 -0.37 -0.28 -0.16
## O3   0.03 -0.05  0.05  0.24 -0.21  1.00 -0.23  0.30 -0.53  0.16  0.22  0.21
## O4   0.06  0.06 -0.07 -0.23  0.54 -0.23  1.00 -0.19  0.28 -0.19 -0.21 -0.19
## O5  -0.11  0.09  0.24  0.31 -0.28  0.30 -0.19  1.00 -0.33  0.39  0.25  0.14
## O6   0.05  0.03 -0.06 -0.21  0.28 -0.53  0.28 -0.33  1.00 -0.17 -0.14 -0.12
## O7  -0.13  0.08  0.26  0.34 -0.37  0.16 -0.19  0.39 -0.17  1.00  0.27  0.11
## O8   0.04 -0.05  0.10  0.63 -0.28  0.22 -0.21  0.25 -0.14  0.27  1.00  0.19
## O9  -0.01  0.05  0.11  0.20 -0.16  0.21 -0.19  0.14 -0.12  0.11  0.19  1.00
## O10 -0.06  0.02  0.19  0.30 -0.31  0.43 -0.28  0.62 -0.43  0.33  0.27  0.19
##       O10
```

```
## E1   0.16
## E2  -0.14
## E3   0.12
## E4  -0.13
## E5   0.20
## E6  -0.26
## E7   0.16
## E8  -0.12
## E9   0.20
## E10 -0.13
## N1  -0.09
## N2   0.10
## N3  -0.06
## N4   0.04
## N5  -0.09
## N6  -0.08
## N7  -0.03
## N9  -0.06
## N10 -0.05
## A1  -0.04
## A2   0.14
## A3   0.04
## A4   0.04
## A5  -0.05
## A6   0.01
## A7  -0.10
## A8   0.08
## A9   0.10
## A10  0.17
## C1   0.11
## C2   0.06
## C3   0.18
## C4  -0.02
## C5   0.02
## C6   0.03
## C7   0.03
## C8  -0.06
## C9   0.02
## C10  0.19
## O1   0.30
## O2  -0.31
## O3   0.43
## O4  -0.28
## O5   0.62
## O6  -0.43
## O7   0.33
## O8   0.27
## O9   0.19
## O10  1.00
```

```r
MCorTest = corr.test(likeditems, adjust = "none")
MCorTest
```

```
## Call:corr.test(x = likeditems, adjust = "none")
## Correlation matrix
##        E1    E2    E3    E4    E5    E6    E7    E8    E9   E10    N1    N2
## E1   1.00 -0.42  0.47 -0.48  0.48 -0.35  0.59 -0.37  0.46 -0.41 -0.11  0.15
## E2  -0.42  1.00 -0.45  0.53 -0.54  0.57 -0.48  0.37 -0.36  0.46  0.06 -0.03
## E3   0.47 -0.45  1.00 -0.48  0.59 -0.39  0.58 -0.32  0.42 -0.47 -0.23  0.28
## E4  -0.48  0.53 -0.48  1.00 -0.51  0.47 -0.50  0.45 -0.45  0.51  0.15 -0.09
## E5   0.48 -0.54  0.59 -0.51  1.00 -0.48  0.63 -0.34  0.42 -0.54 -0.13  0.13
## E6  -0.35  0.57 -0.39  0.47 -0.48  1.00 -0.41  0.32 -0.33  0.41  0.11 -0.05
## E7   0.59 -0.48  0.58 -0.50  0.63 -0.41  1.00 -0.34  0.43 -0.53 -0.14  0.16
## E8  -0.37  0.37 -0.32  0.45 -0.34  0.32 -0.34  1.00 -0.51  0.38  0.09 -0.05
## E9   0.46 -0.36  0.42 -0.45  0.42 -0.33  0.43 -0.51  1.00 -0.37 -0.13  0.14
## E10 -0.41  0.46 -0.47  0.51 -0.54  0.41 -0.53  0.38 -0.37  1.00  0.18 -0.09
## N1  -0.11  0.06 -0.23  0.15 -0.13  0.11 -0.14  0.09 -0.13  0.18  1.00 -0.46
## N2   0.15 -0.03  0.28 -0.09  0.13 -0.05  0.16 -0.05  0.14 -0.09 -0.46  1.00
## N3  -0.12  0.06 -0.20  0.18 -0.09  0.09 -0.13  0.11 -0.11  0.20  0.55 -0.40
## N4   0.14 -0.07  0.20 -0.11  0.12 -0.05  0.13 -0.08  0.12 -0.11 -0.25  0.26
## N5  -0.07  0.04 -0.18  0.13 -0.10  0.14 -0.11  0.04 -0.06  0.15  0.39 -0.26
## N6  -0.10  0.04 -0.22  0.15 -0.12  0.13 -0.14  0.05 -0.08  0.18  0.54 -0.38
## N7  -0.05  0.04 -0.21  0.14 -0.10  0.11 -0.09  0.02 -0.03  0.16  0.42 -0.29
## N9  -0.09  0.05 -0.25  0.15 -0.14  0.12 -0.15  0.07 -0.07  0.20  0.49 -0.34
## N10 -0.19  0.19 -0.36  0.28 -0.24  0.20 -0.24  0.13 -0.15  0.25  0.42 -0.36
## A1  -0.02  0.12 -0.12  0.12 -0.10  0.19 -0.08 -0.01  0.02  0.09  0.00  0.02
## A2   0.27 -0.27  0.43 -0.25  0.38 -0.29  0.36 -0.17  0.22 -0.24 -0.04  0.12
## A3   0.05 -0.04 -0.12  0.02 -0.04  0.01 -0.02 -0.04  0.06  0.05  0.11 -0.06
## A4   0.09 -0.11  0.22 -0.06  0.19 -0.12  0.15 -0.01  0.04 -0.07  0.07  0.02
## A5  -0.11  0.21 -0.24  0.16 -0.24  0.23 -0.18  0.08 -0.07  0.15  0.00  0.01
## A6   0.06 -0.06  0.12 -0.01  0.11 -0.01  0.08  0.01  0.01  0.00  0.14 -0.01
## A7  -0.23  0.30 -0.40  0.28 -0.36  0.34 -0.35  0.17 -0.17  0.25  0.05 -0.05
## A8   0.15 -0.15  0.26 -0.11  0.24 -0.17  0.21  0.00  0.07 -0.11 -0.01  0.07
## A9   0.14 -0.14  0.22 -0.10  0.23 -0.15  0.18 -0.06  0.12 -0.09  0.06  0.00
## A10  0.32 -0.24  0.40 -0.24  0.39 -0.25  0.35 -0.14  0.23 -0.24 -0.13  0.17
## C1   0.06 -0.01  0.16 -0.05  0.11 -0.06  0.07  0.01  0.04 -0.05 -0.08  0.08
## C2   0.04 -0.05 -0.03  0.02  0.01 -0.02  0.02 -0.06  0.05  0.02  0.09  0.03
## C3   0.01  0.02  0.07  0.03  0.07 -0.05  0.03  0.06  0.00  0.01 -0.02  0.04
## C4  -0.06  0.04 -0.21  0.16 -0.13  0.12 -0.09  0.03 -0.04  0.13  0.26 -0.14
## C5   0.09 -0.02  0.17 -0.07  0.15 -0.02  0.13 -0.02  0.05 -0.08 -0.10  0.05
## C6  -0.01 -0.01 -0.10  0.06 -0.05  0.06 -0.04 -0.01  0.01  0.08  0.13 -0.02
## C7  -0.03  0.02  0.03  0.03  0.03 -0.02  0.00  0.08 -0.02  0.04  0.05 -0.04
## C8  -0.04  0.08 -0.18  0.13 -0.14  0.14 -0.10  0.03 -0.02  0.13  0.14 -0.04
## C9   0.05 -0.03  0.15 -0.05  0.13 -0.04  0.08  0.00  0.04 -0.03  0.01 -0.02
## C10  0.05 -0.02  0.11 -0.02  0.10 -0.08  0.07  0.00  0.06 -0.02 -0.05  0.03
## O1   0.04 -0.05  0.03 -0.04  0.09 -0.18  0.06 -0.02  0.07 -0.07 -0.05  0.04
## O2  -0.03  0.06 -0.07  0.10 -0.07  0.19 -0.06  0.05 -0.08  0.10  0.17 -0.08
## O3   0.07 -0.04  0.00  0.03  0.06 -0.09  0.04 -0.04  0.09 -0.01  0.03  0.03
## O4  -0.01  0.04 -0.02  0.06 -0.05  0.15 -0.04  0.04 -0.05  0.06  0.09 -0.04
## O5   0.19 -0.13  0.16 -0.14  0.20 -0.23  0.16 -0.13  0.22 -0.14 -0.13  0.13
## O6  -0.09  0.10 -0.08  0.09 -0.11  0.19 -0.09  0.10 -0.12  0.09  0.07 -0.07
```

```
##        O7   0.08 -0.06  0.14 -0.07  0.12 -0.15  0.10 -0.02  0.12 -0.09 -0.17  0.14
##        O8   0.01 -0.02 -0.07  0.01  0.01 -0.11  0.01 -0.01  0.05 -0.01  0.02 -0.02
##        O9  -0.08  0.07 -0.09  0.11 -0.03 -0.01 -0.05  0.08 -0.04  0.11  0.11 -0.06
##        O10  0.16 -0.14  0.12 -0.13  0.20 -0.26  0.16 -0.12  0.20 -0.13 -0.09  0.10
##              N3    N4    N5    N6    N7    N9   N10    A1    A2    A3    A4    A5
##        E1  -0.12  0.14 -0.07 -0.10 -0.05 -0.09 -0.19 -0.02  0.27  0.05  0.09 -0.11
##        E2   0.06 -0.07  0.04  0.04  0.04  0.05  0.19  0.12 -0.27 -0.04 -0.11  0.21
##        E3  -0.20  0.20 -0.18 -0.22 -0.21 -0.25 -0.36 -0.12  0.43 -0.12  0.22 -0.24
##        E4   0.18 -0.11  0.13  0.15  0.14  0.15  0.28  0.12 -0.25  0.02 -0.06  0.16
##        E5  -0.09  0.12 -0.10 -0.12 -0.10 -0.14 -0.24 -0.10  0.38 -0.04  0.19 -0.24
##        E6   0.09 -0.05  0.14  0.13  0.11  0.12  0.20  0.19 -0.29  0.01 -0.12  0.23
##        E7  -0.13  0.13 -0.11 -0.14 -0.09 -0.15 -0.24 -0.08  0.36 -0.02  0.15 -0.18
##        E8   0.11 -0.08  0.04  0.05  0.02  0.07  0.13 -0.01 -0.17 -0.04 -0.01  0.08
##        E9  -0.11  0.12 -0.06 -0.08 -0.03 -0.07 -0.15  0.02  0.22  0.06  0.04 -0.07
##        E10  0.20 -0.11  0.15  0.18  0.16  0.20  0.25  0.09 -0.24  0.05 -0.07  0.15
##        N1   0.55 -0.25  0.39  0.54  0.42  0.49  0.42  0.00 -0.04  0.11  0.07  0.00
##        N2  -0.40  0.26 -0.26 -0.38 -0.29 -0.34 -0.36  0.02  0.12 -0.06  0.02  0.01
##        N3   1.00 -0.25  0.32  0.45  0.36  0.38  0.39 -0.02  0.02  0.08  0.14 -0.07
##        N4  -0.25  1.00 -0.13 -0.21 -0.24 -0.20 -0.39  0.06  0.04 -0.06  0.01  0.02
##        N5   0.32 -0.13  1.00  0.48  0.37  0.43  0.31  0.08 -0.07  0.13  0.01  0.06
##        N6   0.45 -0.21  0.48  1.00  0.51  0.60  0.45  0.05 -0.08  0.16  0.06  0.01
##        N7   0.36 -0.24  0.37  0.51  1.00  0.50  0.48  0.11 -0.07  0.22 -0.02  0.06
##        N9   0.38 -0.20  0.43  0.60  0.50  1.00  0.41  0.11 -0.15  0.31 -0.09  0.12
##        N10  0.39 -0.39  0.31  0.45  0.48  0.41  1.00  0.08 -0.14  0.16 -0.02  0.06
##        A1  -0.02  0.06  0.08  0.05  0.11  0.11  0.08  1.00 -0.23  0.19 -0.33  0.34
##        A2   0.02  0.04 -0.07 -0.08 -0.07 -0.15 -0.14 -0.23  1.00 -0.15  0.40 -0.42
##        A3   0.08 -0.06  0.13  0.16  0.22  0.31  0.16  0.19 -0.15  1.00 -0.31  0.24
##        A4   0.14  0.01  0.01  0.06 -0.02 -0.09 -0.02 -0.33  0.40 -0.31  1.00 -0.50
##        A5  -0.07  0.02  0.06  0.01  0.06  0.12  0.06  0.34 -0.42  0.24 -0.50  1.00
##        A6   0.18 -0.01  0.11  0.18  0.06 -0.01  0.05 -0.21  0.25 -0.27  0.51 -0.32
##        A7  -0.01 -0.01  0.11  0.08  0.13  0.19  0.17  0.35 -0.57  0.24 -0.44  0.56
##        A8   0.06  0.03 -0.06 -0.03 -0.06 -0.13 -0.08 -0.26  0.36 -0.20  0.46 -0.41
##        A9   0.14  0.00  0.03  0.08  0.02 -0.05  0.01 -0.25  0.38 -0.24  0.65 -0.45
##        A10 -0.07  0.13 -0.10 -0.12 -0.12 -0.19 -0.19 -0.13  0.32 -0.22  0.32 -0.25
##        C1  -0.05  0.10 -0.15 -0.14 -0.16 -0.12 -0.18 -0.03  0.07 -0.12  0.04 -0.03
##        C2   0.06 -0.05  0.09  0.11  0.13  0.09  0.11 -0.01  0.07  0.15  0.02 -0.02
##        C3   0.10  0.02 -0.10 -0.07 -0.06 -0.04 -0.05 -0.02  0.09 -0.06  0.09 -0.05
##        C4   0.21 -0.13  0.26  0.30  0.33  0.28  0.34  0.08 -0.05  0.27 -0.03  0.04
##        C5  -0.06  0.15 -0.10 -0.10 -0.14 -0.13 -0.17  0.02  0.06 -0.18  0.09 -0.05
##        C6   0.10 -0.05  0.17  0.20  0.19  0.15  0.16  0.05  0.00  0.17 -0.01  0.02
##        C7   0.10  0.02 -0.01 -0.01 -0.04  0.03 -0.05 -0.07  0.02 -0.05  0.05 -0.01
##        C8   0.10 -0.09  0.19  0.19  0.25  0.20  0.24  0.17 -0.11  0.23 -0.11  0.14
##        C9   0.06  0.08 -0.07 -0.05 -0.11 -0.03 -0.13 -0.05  0.08 -0.12  0.10 -0.07
##        C10  0.01  0.06 -0.08 -0.07 -0.09 -0.04 -0.09 -0.03  0.08 -0.10  0.08 -0.04
##        O1  -0.05 -0.02 -0.12 -0.09 -0.09 -0.05  0.00 -0.10  0.08  0.04 -0.01 -0.01
##        O2   0.14  0.01  0.21  0.20  0.14  0.17  0.09  0.12 -0.05  0.05 -0.01  0.06
##        O3   0.08 -0.03  0.01  0.04  0.08  0.04  0.08 -0.02  0.08  0.07  0.07 -0.03
##        O4   0.05  0.06  0.13  0.12  0.07  0.12  0.01  0.12 -0.11  0.05 -0.07  0.12
##        O5  -0.09  0.08 -0.08 -0.11 -0.08 -0.07 -0.12 -0.02  0.11  0.02  0.03 -0.01
##        O6   0.04  0.01  0.09  0.07  0.02  0.08  0.06  0.05 -0.10  0.04 -0.06  0.08
##        O7  -0.11  0.07 -0.16 -0.15 -0.10 -0.11 -0.11 -0.01  0.08 -0.04  0.03 -0.02
```

```
## O8   0.02 -0.06 -0.03 -0.01  0.06  0.06  0.10 -0.05 -0.01  0.16 -0.07  0.04
## O9   0.18 -0.07  0.05  0.09  0.08  0.09  0.17 -0.11  0.09 -0.01  0.15 -0.08
## O10 -0.06  0.04 -0.09 -0.08 -0.03 -0.06 -0.05 -0.04  0.14  0.04  0.04 -0.05
##        A6    A7    A8    A9   A10    C1    C2    C3    C4    C5    C6    C7
## E1   0.06 -0.23  0.15  0.14  0.32  0.06  0.04  0.01 -0.06  0.09 -0.01 -0.03
## E2  -0.06  0.30 -0.15 -0.14 -0.24 -0.01 -0.05  0.02  0.04 -0.02 -0.01  0.02
## E3   0.12 -0.40  0.26  0.22  0.40  0.16 -0.03  0.07 -0.21  0.17 -0.10  0.03
## E4  -0.01  0.28 -0.11 -0.10 -0.24 -0.05  0.02  0.03  0.16 -0.07  0.06  0.03
## E5   0.11 -0.36  0.24  0.23  0.39  0.11  0.01  0.07 -0.13  0.15 -0.05  0.03
## E6  -0.01  0.34 -0.17 -0.15 -0.25 -0.06 -0.02 -0.05  0.12 -0.02  0.06 -0.02
## E7   0.08 -0.35  0.21  0.18  0.35  0.07  0.02  0.03 -0.09  0.13 -0.04  0.00
## E8   0.01  0.17  0.00 -0.06 -0.14  0.01 -0.06  0.06  0.03 -0.02 -0.01  0.08
## E9   0.01 -0.17  0.07  0.12  0.23  0.04  0.05  0.00 -0.04  0.05  0.01 -0.02
## E10  0.00  0.25 -0.11 -0.09 -0.24 -0.05  0.02  0.01  0.13 -0.08  0.08  0.04
## N1   0.14  0.05 -0.01  0.06 -0.13 -0.08  0.09 -0.02  0.26 -0.10  0.13  0.05
## N2  -0.01 -0.05  0.07  0.00  0.17  0.08  0.03  0.04 -0.14  0.05 -0.02 -0.04
## N3   0.18 -0.01  0.06  0.14 -0.07 -0.05  0.06  0.10  0.21 -0.06  0.10  0.10
## N4  -0.01 -0.01  0.03  0.00  0.13  0.10 -0.05  0.02 -0.13  0.15 -0.05  0.02
## N5   0.11  0.11 -0.06  0.03 -0.10 -0.15  0.09 -0.10  0.26 -0.10  0.17 -0.01
## N6   0.18  0.08 -0.03  0.08 -0.12 -0.14  0.11 -0.07  0.30 -0.10  0.20 -0.01
## N7   0.06  0.13 -0.06  0.02 -0.12 -0.16  0.13 -0.06  0.33 -0.14  0.19 -0.04
## N9  -0.01  0.19 -0.13 -0.05 -0.19 -0.12  0.09 -0.04  0.28 -0.13  0.15  0.03
## N10  0.05  0.17 -0.08  0.01 -0.19 -0.18  0.11 -0.05  0.34 -0.17  0.16 -0.05
## A1  -0.21  0.35 -0.26 -0.25 -0.13 -0.03 -0.01 -0.02  0.08  0.02  0.05 -0.07
## A2   0.25 -0.57  0.36  0.38  0.32  0.07  0.07  0.09 -0.05  0.06  0.00  0.02
## A3  -0.27  0.24 -0.20 -0.24 -0.22 -0.12  0.15 -0.06  0.27 -0.18  0.17 -0.05
## A4   0.51 -0.44  0.46  0.65  0.32  0.04  0.02  0.09 -0.03  0.09 -0.01  0.05
## A5  -0.32  0.56 -0.41 -0.45 -0.25 -0.03 -0.02 -0.05  0.04 -0.05  0.02 -0.01
## A6   1.00 -0.28  0.35  0.48  0.26  0.00  0.02  0.03  0.00  0.08  0.03  0.04
## A7  -0.28  1.00 -0.39 -0.40 -0.30 -0.05 -0.01 -0.06  0.10 -0.06  0.04 -0.02
## A8   0.35 -0.39  1.00  0.43  0.33  0.09  0.00  0.12 -0.06  0.11 -0.04  0.07
## A9   0.48 -0.40  0.43  1.00  0.35  0.05  0.01  0.11 -0.04  0.11 -0.01  0.04
## A10  0.26 -0.30  0.33  0.35  1.00  0.11 -0.03  0.12 -0.17  0.17 -0.08  0.05
## C1   0.00 -0.05  0.09  0.05  0.11  1.00 -0.26  0.30 -0.35  0.39 -0.31  0.31
## C2   0.02 -0.01  0.00  0.01 -0.03 -0.26  1.00 -0.16  0.40 -0.36  0.51 -0.26
## C3   0.03 -0.06  0.12  0.11  0.12  0.30 -0.16  1.00 -0.19  0.20 -0.21  0.25
## C4   0.00  0.10 -0.06 -0.04 -0.17 -0.35  0.40 -0.19  1.00 -0.36  0.46 -0.25
## C5   0.08 -0.06  0.11  0.11  0.17  0.39 -0.36  0.20 -0.36  1.00 -0.39  0.29
## C6   0.03  0.04 -0.04 -0.01 -0.08 -0.31  0.51 -0.21  0.46 -0.39  1.00 -0.30
## C7   0.04 -0.02  0.07  0.04  0.05  0.31 -0.26  0.25 -0.25  0.29 -0.30  1.00
## C8  -0.06  0.17 -0.14 -0.10 -0.16 -0.32  0.23 -0.17  0.39 -0.37  0.31 -0.21
## C9   0.07 -0.08  0.12  0.13  0.13  0.43 -0.26  0.23 -0.31  0.42 -0.32  0.40
## C10  0.04 -0.05  0.10  0.10  0.19  0.33 -0.14  0.34 -0.23  0.28 -0.20  0.28
## O1  -0.08 -0.04  0.02  0.00  0.05  0.13  0.07  0.15 -0.03 -0.03  0.00  0.06
## O2   0.08  0.08 -0.02 -0.03 -0.05 -0.07  0.00 -0.13  0.11  0.03  0.05  0.01
## O3   0.04 -0.04  0.04  0.10  0.08 -0.01  0.10  0.12  0.09 -0.07  0.09 -0.02
## O4   0.01  0.13 -0.05 -0.07 -0.04  0.00 -0.04 -0.09  0.04  0.05  0.00  0.03
## O5   0.00 -0.07  0.06  0.08  0.20  0.20  0.01  0.20 -0.13  0.09 -0.03  0.08
## O6  -0.02  0.13 -0.06 -0.10 -0.11 -0.02 -0.02 -0.10  0.04  0.03  0.01  0.03
## O7  -0.03 -0.04  0.07  0.07  0.16  0.22 -0.01  0.24 -0.15  0.11 -0.06  0.09
## O8  -0.11  0.04 -0.03 -0.04 -0.03  0.04  0.11  0.10  0.09 -0.10  0.07  0.02
```

```
## O9   0.10 -0.06  0.11  0.15  0.05  0.03  0.05  0.14  0.05 -0.04  0.02  0.10
## O10  0.01 -0.10  0.08  0.10  0.17  0.11  0.06  0.18 -0.02  0.02  0.03  0.03
##        C8    C9   C10    O1    O2    O3    O4    O5    O6    O7    O8    O9
## E1  -0.04  0.05  0.05  0.04 -0.03  0.07 -0.01  0.19 -0.09  0.08  0.01 -0.08
## E2   0.08 -0.03 -0.02 -0.05  0.06 -0.04  0.04 -0.13  0.10 -0.06 -0.02  0.07
## E3  -0.18  0.15  0.11  0.03 -0.07  0.00 -0.02  0.16 -0.08  0.14 -0.07 -0.09
## E4   0.13 -0.05 -0.02 -0.04  0.10  0.03  0.06 -0.14  0.09 -0.07  0.01  0.11
## E5  -0.14  0.13  0.10  0.09 -0.07  0.06 -0.05  0.20 -0.11  0.12  0.01 -0.03
## E6   0.14 -0.04 -0.08 -0.18  0.19 -0.09  0.15 -0.23  0.19 -0.15 -0.11 -0.01
## E7  -0.10  0.08  0.07  0.06 -0.06  0.04 -0.04  0.16 -0.09  0.10  0.01 -0.05
## E8   0.03  0.00  0.00 -0.02  0.05 -0.04  0.04 -0.13  0.10 -0.02 -0.01  0.08
## E9  -0.02  0.04  0.06  0.07 -0.08  0.09 -0.05  0.22 -0.12  0.12  0.05 -0.04
## E10  0.13 -0.03 -0.02 -0.07  0.10 -0.01  0.06 -0.14  0.09 -0.09 -0.01  0.11
## N1   0.14  0.01 -0.05 -0.05  0.17  0.03  0.09 -0.13  0.07 -0.17  0.02  0.11
## N2  -0.04 -0.02  0.03  0.04 -0.08  0.03 -0.04  0.13 -0.07  0.14 -0.02 -0.06
## N3   0.10  0.06  0.01 -0.05  0.14  0.08  0.05 -0.09  0.04 -0.11  0.02  0.18
## N4  -0.09  0.08  0.06 -0.02  0.01 -0.03  0.06  0.08  0.01  0.07 -0.06 -0.07
## N5   0.19 -0.07 -0.08 -0.12  0.21  0.01  0.13 -0.08  0.09 -0.16 -0.03  0.05
## N6   0.19 -0.05 -0.07 -0.09  0.20  0.04  0.12 -0.11  0.07 -0.15 -0.01  0.09
## N7   0.25 -0.11 -0.09 -0.09  0.14  0.08  0.07 -0.08  0.02 -0.10  0.06  0.08
## N9   0.20 -0.03 -0.04 -0.05  0.17  0.04  0.12 -0.07  0.08 -0.11  0.06  0.09
## N10  0.24 -0.13 -0.09  0.00  0.09  0.08  0.01 -0.12  0.06 -0.11  0.10  0.17
## A1   0.17 -0.05 -0.03 -0.10  0.12 -0.02  0.12 -0.02  0.05 -0.01 -0.05 -0.11
## A2  -0.11  0.08  0.08  0.08 -0.05  0.08 -0.11  0.11 -0.10  0.08 -0.01  0.09
## A3   0.23 -0.12 -0.10  0.04  0.05  0.07  0.05  0.02  0.04 -0.04  0.16 -0.01
## A4  -0.11  0.10  0.08 -0.01 -0.01  0.07 -0.07  0.03 -0.06  0.03 -0.07  0.15
## A5   0.14 -0.07 -0.04 -0.01  0.06 -0.03  0.12 -0.01  0.08 -0.02  0.04 -0.08
## A6  -0.06  0.07  0.04 -0.08  0.08  0.04  0.01  0.00 -0.02 -0.03 -0.11  0.10
## A7   0.17 -0.08 -0.05 -0.04  0.08 -0.04  0.13 -0.07  0.13 -0.04  0.04 -0.06
## A8  -0.14  0.12  0.10  0.02 -0.02  0.04 -0.05  0.06 -0.06  0.07 -0.03  0.11
## A9  -0.10  0.13  0.10  0.00 -0.03  0.10 -0.07  0.08 -0.10  0.07 -0.04  0.15
## A10 -0.16  0.13  0.19  0.05 -0.05  0.08 -0.04  0.20 -0.11  0.16 -0.03  0.05
## C1  -0.32  0.43  0.33  0.13 -0.07 -0.01  0.00  0.20 -0.02  0.22  0.04  0.03
## C2   0.23 -0.26 -0.14  0.07  0.00  0.10 -0.04  0.01 -0.02 -0.01  0.11  0.05
## C3  -0.17  0.23  0.34  0.15 -0.13  0.12 -0.09  0.20 -0.10  0.24  0.10  0.14
## C4   0.39 -0.31 -0.23 -0.03  0.11  0.09  0.04 -0.13  0.04 -0.15  0.09  0.05
## C5  -0.37  0.42  0.28 -0.03  0.03 -0.07  0.05  0.09  0.03  0.11 -0.10 -0.04
## C6   0.31 -0.32 -0.20  0.00  0.05  0.09  0.00 -0.03  0.01 -0.06  0.07  0.02
## C7  -0.21  0.40  0.28  0.06  0.01 -0.02  0.03  0.08  0.03  0.09  0.02  0.10
## C8   1.00 -0.31 -0.27 -0.07  0.09  0.03  0.06 -0.11  0.05 -0.13  0.04 -0.01
## C9  -0.31  1.00  0.31  0.00  0.04 -0.05  0.06  0.09  0.03  0.08 -0.05  0.05
## C10 -0.27  0.31  1.00  0.15 -0.11  0.05 -0.07  0.24 -0.06  0.26  0.10  0.11
## O1  -0.07  0.00  0.15  1.00 -0.33  0.24 -0.23  0.31 -0.21  0.34  0.63  0.20
## O2   0.09  0.04 -0.11 -0.33  1.00 -0.21  0.54 -0.28  0.28 -0.37 -0.28 -0.16
## O3   0.03 -0.05  0.05  0.24 -0.21  1.00 -0.23  0.30 -0.53  0.16  0.22  0.21
## O4   0.06  0.06 -0.07 -0.23  0.54 -0.23  1.00 -0.19  0.28 -0.19 -0.21 -0.19
## O5  -0.11  0.09  0.24  0.31 -0.28  0.30 -0.19  1.00 -0.33  0.39  0.25  0.14
## O6   0.05  0.03 -0.06 -0.21  0.28 -0.53  0.28 -0.33  1.00 -0.17 -0.14 -0.12
## O7  -0.13  0.08  0.26  0.34 -0.37  0.16 -0.19  0.39 -0.17  1.00  0.27  0.11
## O8   0.04 -0.05  0.10  0.63 -0.28  0.22 -0.21  0.25 -0.14  0.27  1.00  0.19
## O9  -0.01  0.05  0.11  0.20 -0.16  0.21 -0.19  0.14 -0.12  0.11  0.19  1.00
```

```
## O10 -0.06  0.02  0.19  0.30 -0.31  0.43 -0.28  0.62 -0.43  0.33  0.27  0.19
##       O10
## E1   0.16
## E2  -0.14
## E3   0.12
## E4  -0.13
## E5   0.20
## E6  -0.26
## E7   0.16
## E8  -0.12
## E9   0.20
## E10 -0.13
## N1  -0.09
## N2   0.10
## N3  -0.06
## N4   0.04
## N5  -0.09
## N6  -0.08
## N7  -0.03
## N9  -0.06
## N10 -0.05
## A1  -0.04
## A2   0.14
## A3   0.04
## A4   0.04
## A5  -0.05
## A6   0.01
## A7  -0.10
## A8   0.08
## A9   0.10
## A10  0.17
## C1   0.11
## C2   0.06
## C3   0.18
## C4  -0.02
## C5   0.02
## C6   0.03
## C7   0.03
## C8  -0.06
## C9   0.02
## C10  0.19
## O1   0.30
## O2  -0.31
## O3   0.43
## O4  -0.28
## O5   0.62
## O6  -0.43
## O7   0.33
## O8   0.27
## O9   0.19
## O10  1.00
```

```
## Sample Size
## [1] 19719
## Probability values (Entries above the diagonal are adjusted for multiple
tests.)
##       E1   E2   E3   E4   E5   E6   E7   E8   E9  E10   N1   N2   N3   N4
N5
## E1  0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00
0.00
## E2  0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00
0.00
## E3  0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00
0.00
## E4  0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00
0.00
## E5  0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00
0.00
## E6  0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00
0.00
## E7  0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00
0.00
## E8  0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00
0.00
## E9  0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00
0.00
## E10 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00
0.00
## N1  0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00
0.00
## N2  0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00
0.00
## N3  0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00
0.00
## N4  0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00
0.00
## N5  0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00
0.00
## N6  0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00
0.00
## N7  0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00
0.00
## N9  0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00
0.00
## N10 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00
0.00
## A1  0.03 0.00 0.00 0.00 0.00 0.00 0.00 0.09 0.01 0.00 0.92 0.00 0.01 0.00
0.00
## A2  0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.03 0.00
0.00
## A3  0.00 0.00 0.00 0.00 0.00 0.11 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00
0.00
## A4  0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.19 0.00 0.00 0.00 0.01 0.00 0.39
```

```
0.04
## A5  0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.58 0.41 0.00 0.01
0.00
## A6  0.00 0.00 0.00 0.42 0.00 0.04 0.00 0.08 0.40 0.50 0.00 0.08 0.00 0.17
0.00
## A7  0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.35 0.06
0.00
## A8  0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.65 0.00 0.00 0.09 0.00 0.00 0.00
0.00
## A9  0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.95 0.00 0.57
0.00
## A10 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00
0.00
## C1  0.00 0.11 0.00 0.00 0.00 0.00 0.00 0.20 0.00 0.00 0.00 0.00 0.00 0.00
0.00
## C2  0.00 0.00 0.00 0.01 0.21 0.03 0.00 0.00 0.00 0.02 0.00 0.00 0.00 0.00
0.00
## C3  0.09 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.97 0.06 0.00 0.00 0.00 0.00
0.00
## C4  0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00
0.00
## C5  0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.01 0.00 0.00 0.00 0.00 0.00 0.00
0.00
## C6  0.14 0.34 0.00 0.00 0.00 0.00 0.00 0.32 0.07 0.00 0.00 0.03 0.00 0.00
0.00
## C7  0.00 0.00 0.00 0.00 0.00 0.01 0.79 0.00 0.00 0.00 0.00 0.00 0.00 0.00
0.09
## C8  0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00
0.00
## C9  0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.97 0.00 0.00 0.32 0.01 0.00 0.00
0.00
## C10 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.67 0.00 0.01 0.00 0.00 0.07 0.00
0.00
## O1  0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00
0.00
## O2  0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.10
0.00
## O3  0.00 0.00 0.79 0.00 0.00 0.00 0.00 0.00 0.00 0.25 0.00 0.00 0.00 0.00
0.04
## O4  0.48 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00
0.00
## O5  0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00
0.00
## O6  0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.27
0.00
## O7  0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.01 0.00 0.00 0.00 0.00 0.00 0.00
0.00
## O8  0.47 0.00 0.00 0.41 0.04 0.00 0.09 0.09 0.00 0.28 0.00 0.01 0.03 0.00
0.00
## O9  0.00 0.00 0.00 0.00 0.00 0.04 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00
0.00
```

```
## O10 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00
0.00
##       N6   N7  N9  N10   A1   A2   A3   A4   A5   A6   A7   A8   A9 A10
C1
## E1  0.00 0.00 0.0 0.00 0.03 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00   0
0.00
## E2  0.00 0.00 0.0 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00   0
0.11
## E3  0.00 0.00 0.0 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00   0
0.00
## E4  0.00 0.00 0.0 0.00 0.00 0.00 0.00 0.00 0.00 0.42 0.00 0.00 0.00   0
0.00
## E5  0.00 0.00 0.0 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00   0
0.00
## E6  0.00 0.00 0.0 0.00 0.00 0.00 0.11 0.00 0.00 0.04 0.00 0.00 0.00   0
0.00
## E7  0.00 0.00 0.0 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00   0
0.00
## E8  0.00 0.00 0.0 0.00 0.09 0.00 0.00 0.19 0.00 0.08 0.00 0.65 0.00   0
0.20
## E9  0.00 0.00 0.0 0.00 0.01 0.00 0.00 0.00 0.00 0.40 0.00 0.00 0.00   0
0.00
## E10 0.00 0.00 0.0 0.00 0.00 0.00 0.00 0.00 0.00 0.50 0.00 0.00 0.00   0
0.00
## N1  0.00 0.00 0.0 0.00 0.92 0.00 0.00 0.00 0.58 0.00 0.00 0.09 0.00   0
0.00
## N2  0.00 0.00 0.0 0.00 0.00 0.00 0.00 0.01 0.41 0.08 0.00 0.00 0.95   0
0.00
## N3  0.00 0.00 0.0 0.00 0.01 0.03 0.00 0.00 0.00 0.00 0.35 0.00 0.00   0
0.00
## N4  0.00 0.00 0.0 0.00 0.00 0.00 0.00 0.39 0.01 0.17 0.06 0.00 0.57   0
0.00
## N5  0.00 0.00 0.0 0.00 0.00 0.00 0.00 0.04 0.00 0.00 0.00 0.00 0.00   0
0.00
## N6  0.00 0.00 0.0 0.00 0.00 0.00 0.00 0.00 0.06 0.00 0.00 0.00 0.00   0
0.00
## N7  0.00 0.00 0.0 0.00 0.00 0.00 0.00 0.02 0.00 0.00 0.00 0.00 0.00   0
0.00
## N9  0.00 0.00 0.0 0.00 0.00 0.00 0.00 0.00 0.00 0.20 0.00 0.00 0.00   0
0.00
## N10 0.00 0.00 0.0 0.00 0.00 0.00 0.00 0.03 0.00 0.00 0.00 0.00 0.10   0
0.00
## A1  0.00 0.00 0.0 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00   0
0.00
## A2  0.00 0.00 0.0 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00   0
0.00
## A3  0.00 0.00 0.0 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00   0
0.00
## A4  0.00 0.02 0.0 0.03 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00   0
0.00
## A5  0.06 0.00 0.0 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00   0
```

```
0.00
## A6  0.00 0.00 0.2 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00   0
0.69
## A7  0.00 0.00 0.0 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00   0
0.00
## A8  0.00 0.00 0.0 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00   0
0.00
## A9  0.00 0.00 0.0 0.10 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00   0
0.00
## A10 0.00 0.00 0.0 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00   0
0.00
## C1  0.00 0.00 0.0 0.00 0.00 0.00 0.00 0.00 0.00 0.69 0.00 0.00 0.00   0
0.00
## C2  0.00 0.00 0.0 0.00 0.21 0.00 0.00 0.00 0.03 0.00 0.14 0.73 0.12   0
0.00
## C3  0.00 0.00 0.0 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00   0
0.00
## C4  0.00 0.00 0.0 0.00 0.00 0.00 0.00 0.00 0.00 0.74 0.00 0.00 0.00   0
0.00
## C5  0.00 0.00 0.0 0.00 0.03 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00   0
0.00
## C6  0.00 0.00 0.0 0.00 0.00 0.95 0.00 0.14 0.00 0.00 0.00 0.00 0.10   0
0.00
## C7  0.17 0.00 0.0 0.00 0.00 0.01 0.00 0.00 0.15 0.00 0.01 0.00 0.00   0
0.00
## C8  0.00 0.00 0.0 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00   0
0.00
## C9  0.00 0.00 0.0 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00   0
0.00
## C10 0.00 0.00 0.0 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00   0
0.00
## O1  0.00 0.00 0.0 0.53 0.00 0.00 0.00 0.43 0.07 0.00 0.00 0.02 0.92   0
0.00
## O2  0.00 0.00 0.0 0.00 0.00 0.00 0.00 0.12 0.00 0.00 0.00 0.00 0.00   0
0.00
## O3  0.00 0.00 0.0 0.00 0.02 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00   0
0.10
## O4  0.00 0.00 0.0 0.05 0.00 0.00 0.00 0.00 0.00 0.13 0.00 0.00 0.00   0
0.68
## O5  0.00 0.00 0.0 0.00 0.00 0.00 0.00 0.00 0.05 0.89 0.00 0.00 0.00   0
0.00
## O6  0.00 0.00 0.0 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00   0
0.01
## O7  0.00 0.00 0.0 0.00 0.11 0.00 0.00 0.00 0.02 0.00 0.00 0.00 0.00   0
0.00
## O8  0.24 0.00 0.0 0.00 0.00 0.31 0.00 0.00 0.00 0.00 0.00 0.00 0.00   0
0.00
## O9  0.00 0.00 0.0 0.00 0.00 0.00 0.04 0.00 0.00 0.00 0.00 0.00 0.00   0
0.00
## O10 0.00 0.00 0.0 0.00 0.00 0.00 0.00 0.00 0.00 0.33 0.00 0.00 0.00   0
0.00
```

```
##       C2   C3   C4   C5   C6   C7   C8   C9  C10   O1   O2   O3   O4   O5
O6
## E1  0.00 0.09 0.00 0.00 0.14 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.48 0.00
0.00
## E2  0.00 0.00 0.00 0.00 0.34 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00
0.00
## E3  0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.79 0.00 0.00
0.00
## E4  0.01 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00
0.00
## E5  0.21 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00
0.00
## E6  0.03 0.00 0.00 0.00 0.00 0.01 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00
0.00
## E7  0.00 0.00 0.00 0.00 0.00 0.79 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00
0.00
## E8  0.00 0.00 0.00 0.01 0.32 0.00 0.00 0.97 0.67 0.00 0.00 0.00 0.00 0.00
0.00
## E9  0.00 0.97 0.00 0.00 0.07 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00
0.00
## E10 0.02 0.06 0.00 0.00 0.00 0.00 0.00 0.00 0.01 0.00 0.00 0.25 0.00 0.00
0.00
## N1  0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.32 0.00 0.00 0.00 0.00 0.00 0.00
0.00
## N2  0.00 0.00 0.00 0.00 0.03 0.00 0.00 0.01 0.00 0.00 0.00 0.00 0.00 0.00
0.00
## N3  0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.07 0.00 0.00 0.00 0.00 0.00
0.00
## N4  0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.10 0.00 0.00 0.00
0.27
## N5  0.00 0.00 0.00 0.00 0.00 0.09 0.00 0.00 0.00 0.00 0.00 0.04 0.00 0.00
0.00
## N6  0.00 0.00 0.00 0.00 0.00 0.17 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00
0.00
## N7  0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00
0.00
## N9  0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00
0.00
## N10 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.53 0.00 0.00 0.05 0.00
0.00
## A1  0.21 0.00 0.00 0.03 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.02 0.00 0.00
0.00
## A2  0.00 0.00 0.00 0.00 0.95 0.01 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00
0.00
## A3  0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00
0.00
## A4  0.00 0.00 0.00 0.00 0.14 0.00 0.00 0.00 0.00 0.43 0.12 0.00 0.00 0.00
0.00
## A5  0.03 0.00 0.00 0.00 0.00 0.15 0.00 0.00 0.00 0.07 0.00 0.00 0.00 0.05
0.00
## A6  0.00 0.00 0.74 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.13 0.89
```

```
0.00
## A7  0.14 0.00 0.00 0.00 0.00 0.01 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00
0.00
## A8  0.73 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.02 0.00 0.00 0.00 0.00
0.00
## A9  0.12 0.00 0.00 0.00 0.10 0.00 0.00 0.00 0.00 0.92 0.00 0.00 0.00 0.00
0.00
## A10 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00
0.00
## C1  0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.10 0.68 0.00
0.01
## C2  0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.65 0.00 0.00 0.32
0.00
## C3  0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00
0.00
## C4  0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00
0.00
## C5  0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00
0.00
## C6  0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.84 0.00 0.00 0.91 0.00
0.29
## C7  0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.05 0.03 0.00 0.00
0.00
## C8  0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00
0.00
## C9  0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.49 0.00 0.00 0.00 0.00
0.00
## C10 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00
0.00
## O1  0.00 0.00 0.00 0.00 0.84 0.00 0.00 0.49 0.00 0.00 0.00 0.00 0.00 0.00
0.00
## O2  0.65 0.00 0.00 0.00 0.00 0.05 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00
0.00
## O3  0.00 0.00 0.00 0.00 0.00 0.03 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00
0.00
## O4  0.00 0.00 0.00 0.00 0.91 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00
0.00
## O5  0.32 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00
0.00
## O6  0.00 0.00 0.00 0.00 0.29 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00
0.00
## O7  0.21 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00
0.00
## O8  0.00 0.00 0.00 0.00 0.00 0.02 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00
0.00
## O9  0.00 0.00 0.00 0.00 0.01 0.00 0.14 0.00 0.00 0.00 0.00 0.00 0.00 0.00
0.00
## O10 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00
0.00
##       O7   O8   O9  O10
## E1  0.00 0.47 0.00 0.00
```

```
## E2  0.00 0.00 0.00 0.00
## E3  0.00 0.00 0.00 0.00
## E4  0.00 0.41 0.00 0.00
## E5  0.00 0.04 0.00 0.00
## E6  0.00 0.00 0.04 0.00
## E7  0.00 0.09 0.00 0.00
## E8  0.01 0.09 0.00 0.00
## E9  0.00 0.00 0.00 0.00
## E10 0.00 0.28 0.00 0.00
## N1  0.00 0.00 0.00 0.00
## N2  0.00 0.01 0.00 0.00
## N3  0.00 0.03 0.00 0.00
## N4  0.00 0.00 0.00 0.00
## N5  0.00 0.00 0.00 0.00
## N6  0.00 0.24 0.00 0.00
## N7  0.00 0.00 0.00 0.00
## N9  0.00 0.00 0.00 0.00
## N10 0.00 0.00 0.00 0.00
## A1  0.11 0.00 0.00 0.00
## A2  0.00 0.31 0.00 0.00
## A3  0.00 0.00 0.04 0.00
## A4  0.00 0.00 0.00 0.00
## A5  0.02 0.00 0.00 0.00
## A6  0.00 0.00 0.00 0.33
## A7  0.00 0.00 0.00 0.00
## A8  0.00 0.00 0.00 0.00
## A9  0.00 0.00 0.00 0.00
## A10 0.00 0.00 0.00 0.00
## C1  0.00 0.00 0.00 0.00
## C2  0.21 0.00 0.00 0.00
## C3  0.00 0.00 0.00 0.00
## C4  0.00 0.00 0.00 0.00
## C5  0.00 0.00 0.00 0.00
## C6  0.00 0.00 0.01 0.00
## C7  0.00 0.02 0.00 0.00
## C8  0.00 0.00 0.14 0.00
## C9  0.00 0.00 0.00 0.00
## C10 0.00 0.00 0.00 0.00
## O1  0.00 0.00 0.00 0.00
## O2  0.00 0.00 0.00 0.00
## O3  0.00 0.00 0.00 0.00
## O4  0.00 0.00 0.00 0.00
## O5  0.00 0.00 0.00 0.00
## O6  0.00 0.00 0.00 0.00
## O7  0.00 0.00 0.00 0.00
## O8  0.00 0.00 0.00 0.00
## O9  0.00 0.00 0.00 0.00
## O10 0.00 0.00 0.00 0.00
##
##  To see confidence intervals of the correlations, print with the
short=FALSE option
```

```r
#ls(MCorTest)
M = MCorTest$p
round(M,2)
```

```
##       E1   E2   E3   E4   E5   E6   E7   E8   E9  E10   N1   N2   N3   N4
N5
## E1  0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00
0.00
## E2  0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00
0.00
## E3  0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00
0.00
## E4  0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00
0.00
## E5  0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00
0.00
## E6  0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00
0.00
## E7  0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00
0.00
## E8  0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00
0.00
## E9  0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00
0.00
## E10 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00
0.00
## N1  0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00
0.00
## N2  0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00
0.00
## N3  0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00
0.00
## N4  0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00
0.00
## N5  0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00
0.00
## N6  0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00
0.00
## N7  0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00
0.00
## N9  0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00
0.00
## N10 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00
0.00
## A1  0.03 0.00 0.00 0.00 0.00 0.00 0.00 0.09 0.01 0.00 0.92 0.00 0.01 0.00
0.00
## A2  0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.03 0.00
0.00
## A3  0.00 0.00 0.00 0.00 0.00 0.11 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00
0.00
## A4  0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.19 0.00 0.00 0.00 0.01 0.00 0.39
```

```
0.04
## A5  0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.58 0.41 0.00 0.01
0.00
## A6  0.00 0.00 0.00 0.42 0.00 0.04 0.00 0.08 0.40 0.50 0.00 0.08 0.00 0.17
0.00
## A7  0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.35 0.06
0.00
## A8  0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.65 0.00 0.00 0.09 0.00 0.00 0.00
0.00
## A9  0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.95 0.00 0.57
0.00
## A10 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00
0.00
## C1  0.00 0.11 0.00 0.00 0.00 0.00 0.00 0.20 0.00 0.00 0.00 0.00 0.00 0.00
0.00
## C2  0.00 0.00 0.00 0.01 0.21 0.03 0.00 0.00 0.00 0.02 0.00 0.00 0.00 0.00
0.00
## C3  0.09 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.97 0.06 0.00 0.00 0.00 0.00
0.00
## C4  0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00
0.00
## C5  0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.01 0.00 0.00 0.00 0.00 0.00 0.00
0.00
## C6  0.14 0.34 0.00 0.00 0.00 0.00 0.00 0.32 0.07 0.00 0.00 0.03 0.00 0.00
0.00
## C7  0.00 0.00 0.00 0.00 0.00 0.01 0.79 0.00 0.00 0.00 0.00 0.00 0.00 0.00
0.09
## C8  0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00
0.00
## C9  0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.97 0.00 0.00 0.32 0.01 0.00 0.00
0.00
## C10 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.67 0.00 0.01 0.00 0.00 0.07 0.00
0.00
## O1  0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00
0.00
## O2  0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.10
0.00
## O3  0.00 0.00 0.79 0.00 0.00 0.00 0.00 0.00 0.00 0.25 0.00 0.00 0.00 0.00
0.04
## O4  0.48 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00
0.00
## O5  0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00
0.00
## O6  0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.27
0.00
## O7  0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.01 0.00 0.00 0.00 0.00 0.00 0.00
0.00
## O8  0.47 0.00 0.00 0.41 0.04 0.00 0.09 0.09 0.00 0.28 0.00 0.01 0.03 0.00
0.00
## O9  0.00 0.00 0.00 0.00 0.00 0.04 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00
0.00
```

```
## O10 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00
0.00
##       N6   N7  N9  N10   A1   A2   A3   A4   A5   A6   A7   A8   A9 A10
C1
## E1  0.00 0.00 0.0 0.00 0.03 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00   0
0.00
## E2  0.00 0.00 0.0 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00   0
0.11
## E3  0.00 0.00 0.0 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00   0
0.00
## E4  0.00 0.00 0.0 0.00 0.00 0.00 0.00 0.00 0.00 0.42 0.00 0.00 0.00   0
0.00
## E5  0.00 0.00 0.0 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00   0
0.00
## E6  0.00 0.00 0.0 0.00 0.00 0.00 0.11 0.00 0.00 0.04 0.00 0.00 0.00   0
0.00
## E7  0.00 0.00 0.0 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00   0
0.00
## E8  0.00 0.00 0.0 0.00 0.09 0.00 0.00 0.19 0.00 0.08 0.00 0.65 0.00   0
0.20
## E9  0.00 0.00 0.0 0.00 0.01 0.00 0.00 0.00 0.00 0.40 0.00 0.00 0.00   0
0.00
## E10 0.00 0.00 0.0 0.00 0.00 0.00 0.00 0.00 0.00 0.50 0.00 0.00 0.00   0
0.00
## N1  0.00 0.00 0.0 0.00 0.92 0.00 0.00 0.00 0.58 0.00 0.00 0.09 0.00   0
0.00
## N2  0.00 0.00 0.0 0.00 0.00 0.00 0.00 0.01 0.41 0.08 0.00 0.00 0.95   0
0.00
## N3  0.00 0.00 0.0 0.00 0.01 0.03 0.00 0.00 0.00 0.00 0.35 0.00 0.00   0
0.00
## N4  0.00 0.00 0.0 0.00 0.00 0.00 0.00 0.39 0.01 0.17 0.06 0.00 0.57   0
0.00
## N5  0.00 0.00 0.0 0.00 0.00 0.00 0.00 0.04 0.00 0.00 0.00 0.00 0.00   0
0.00
## N6  0.00 0.00 0.0 0.00 0.00 0.00 0.00 0.00 0.06 0.00 0.00 0.00 0.00   0
0.00
## N7  0.00 0.00 0.0 0.00 0.00 0.00 0.00 0.02 0.00 0.00 0.00 0.00 0.00   0
0.00
## N9  0.00 0.00 0.0 0.00 0.00 0.00 0.00 0.00 0.00 0.20 0.00 0.00 0.00   0
0.00
## N10 0.00 0.00 0.0 0.00 0.00 0.00 0.00 0.03 0.00 0.00 0.00 0.00 0.10   0
0.00
## A1  0.00 0.00 0.0 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00   0
0.00
## A2  0.00 0.00 0.0 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00   0
0.00
## A3  0.00 0.00 0.0 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00   0
0.00
## A4  0.00 0.02 0.0 0.03 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00   0
0.00
## A5  0.06 0.00 0.0 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00   0
```

```
0.00
## A6  0.00 0.00 0.2 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00   0
0.69
## A7  0.00 0.00 0.0 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00   0
0.00
## A8  0.00 0.00 0.0 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00   0
0.00
## A9  0.00 0.00 0.0 0.10 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00   0
0.00
## A10 0.00 0.00 0.0 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00   0
0.00
## C1  0.00 0.00 0.0 0.00 0.00 0.00 0.00 0.00 0.00 0.69 0.00 0.00 0.00   0
0.00
## C2  0.00 0.00 0.0 0.00 0.21 0.00 0.00 0.00 0.03 0.00 0.14 0.73 0.12   0
0.00
## C3  0.00 0.00 0.0 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00   0
0.00
## C4  0.00 0.00 0.0 0.00 0.00 0.00 0.00 0.00 0.00 0.74 0.00 0.00 0.00   0
0.00
## C5  0.00 0.00 0.0 0.00 0.03 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00   0
0.00
## C6  0.00 0.00 0.0 0.00 0.00 0.95 0.00 0.14 0.00 0.00 0.00 0.00 0.10   0
0.00
## C7  0.17 0.00 0.0 0.00 0.00 0.01 0.00 0.00 0.15 0.00 0.01 0.00 0.00   0
0.00
## C8  0.00 0.00 0.0 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00   0
0.00
## C9  0.00 0.00 0.0 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00   0
0.00
## C10 0.00 0.00 0.0 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00   0
0.00
## O1  0.00 0.00 0.0 0.53 0.00 0.00 0.00 0.43 0.07 0.00 0.00 0.02 0.92   0
0.00
## O2  0.00 0.00 0.0 0.00 0.00 0.00 0.00 0.12 0.00 0.00 0.00 0.00 0.00   0
0.00
## O3  0.00 0.00 0.0 0.00 0.02 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00   0
0.10
## O4  0.00 0.00 0.0 0.05 0.00 0.00 0.00 0.00 0.00 0.13 0.00 0.00 0.00   0
0.68
## O5  0.00 0.00 0.0 0.00 0.00 0.00 0.00 0.00 0.05 0.89 0.00 0.00 0.00   0
0.00
## O6  0.00 0.00 0.0 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00   0
0.01
## O7  0.00 0.00 0.0 0.00 0.11 0.00 0.00 0.00 0.02 0.00 0.00 0.00 0.00   0
0.00
## O8  0.24 0.00 0.0 0.00 0.00 0.31 0.00 0.00 0.00 0.00 0.00 0.00 0.00   0
0.00
## O9  0.00 0.00 0.0 0.00 0.00 0.00 0.04 0.00 0.00 0.00 0.00 0.00 0.00   0
0.00
## O10 0.00 0.00 0.0 0.00 0.00 0.00 0.00 0.00 0.00 0.33 0.00 0.00 0.00   0
0.00
```

```
##       C2   C3   C4   C5   C6   C7   C8   C9  C10   O1   O2   O3   O4   O5
O6
## E1  0.00 0.09 0.00 0.00 0.14 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.48 0.00
0.00
## E2  0.00 0.00 0.00 0.00 0.34 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00
0.00
## E3  0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.79 0.00 0.00
0.00
## E4  0.01 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00
0.00
## E5  0.21 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00
0.00
## E6  0.03 0.00 0.00 0.00 0.00 0.01 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00
0.00
## E7  0.00 0.00 0.00 0.00 0.00 0.79 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00
0.00
## E8  0.00 0.00 0.00 0.01 0.32 0.00 0.00 0.97 0.67 0.00 0.00 0.00 0.00 0.00
0.00
## E9  0.00 0.97 0.00 0.00 0.07 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00
0.00
## E10 0.02 0.06 0.00 0.00 0.00 0.00 0.00 0.00 0.01 0.00 0.00 0.25 0.00 0.00
0.00
## N1  0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.32 0.00 0.00 0.00 0.00 0.00 0.00
0.00
## N2  0.00 0.00 0.00 0.00 0.03 0.00 0.00 0.01 0.00 0.00 0.00 0.00 0.00 0.00
0.00
## N3  0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.07 0.00 0.00 0.00 0.00 0.00
0.00
## N4  0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.10 0.00 0.00 0.00
0.27
## N5  0.00 0.00 0.00 0.00 0.00 0.09 0.00 0.00 0.00 0.00 0.00 0.04 0.00 0.00
0.00
## N6  0.00 0.00 0.00 0.00 0.00 0.17 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00
0.00
## N7  0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00
0.00
## N9  0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00
0.00
## N10 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.53 0.00 0.00 0.05 0.00
0.00
## A1  0.21 0.00 0.00 0.03 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.02 0.00 0.00
0.00
## A2  0.00 0.00 0.00 0.00 0.95 0.01 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00
0.00
## A3  0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00
0.00
## A4  0.00 0.00 0.00 0.00 0.14 0.00 0.00 0.00 0.00 0.43 0.12 0.00 0.00 0.00
0.00
## A5  0.03 0.00 0.00 0.00 0.00 0.15 0.00 0.00 0.00 0.07 0.00 0.00 0.00 0.05
0.00
## A6  0.00 0.00 0.74 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.13 0.89
```

```
0.00
## A7  0.14 0.00 0.00 0.00 0.00 0.01 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00
0.00
## A8  0.73 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.02 0.00 0.00 0.00 0.00
0.00
## A9  0.12 0.00 0.00 0.00 0.10 0.00 0.00 0.00 0.00 0.92 0.00 0.00 0.00 0.00
0.00
## A10 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00
0.00
## C1  0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.10 0.68 0.00
0.01
## C2  0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.65 0.00 0.00 0.32
0.00
## C3  0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00
0.00
## C4  0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00
0.00
## C5  0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00
0.00
## C6  0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.84 0.00 0.00 0.91 0.00
0.29
## C7  0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.05 0.03 0.00 0.00
0.00
## C8  0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00
0.00
## C9  0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.49 0.00 0.00 0.00 0.00
0.00
## C10 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00
0.00
## O1  0.00 0.00 0.00 0.00 0.84 0.00 0.00 0.49 0.00 0.00 0.00 0.00 0.00 0.00
0.00
## O2  0.65 0.00 0.00 0.00 0.00 0.05 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00
0.00
## O3  0.00 0.00 0.00 0.00 0.00 0.03 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00
0.00
## O4  0.00 0.00 0.00 0.00 0.91 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00
0.00
## O5  0.32 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00
0.00
## O6  0.00 0.00 0.00 0.00 0.29 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00
0.00
## O7  0.21 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00
0.00
## O8  0.00 0.00 0.00 0.00 0.00 0.02 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00
0.00
## O9  0.00 0.00 0.00 0.00 0.01 0.00 0.14 0.00 0.00 0.00 0.00 0.00 0.00 0.00
0.00
## O10 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00
0.00
##       O7   O8   O9  O10
## E1  0.00 0.47 0.00 0.00
```

```
## E2  0.00 0.00 0.00 0.00
## E3  0.00 0.00 0.00 0.00
## E4  0.00 0.41 0.00 0.00
## E5  0.00 0.04 0.00 0.00
## E6  0.00 0.00 0.04 0.00
## E7  0.00 0.09 0.00 0.00
## E8  0.01 0.09 0.00 0.00
## E9  0.00 0.00 0.00 0.00
## E10 0.00 0.28 0.00 0.00
## N1  0.00 0.00 0.00 0.00
## N2  0.00 0.01 0.00 0.00
## N3  0.00 0.03 0.00 0.00
## N4  0.00 0.00 0.00 0.00
## N5  0.00 0.00 0.00 0.00
## N6  0.00 0.24 0.00 0.00
## N7  0.00 0.00 0.00 0.00
## N9  0.00 0.00 0.00 0.00
## N10 0.00 0.00 0.00 0.00
## A1  0.11 0.00 0.00 0.00
## A2  0.00 0.31 0.00 0.00
## A3  0.00 0.00 0.04 0.00
## A4  0.00 0.00 0.00 0.00
## A5  0.02 0.00 0.00 0.00
## A6  0.00 0.00 0.00 0.33
## A7  0.00 0.00 0.00 0.00
## A8  0.00 0.00 0.00 0.00
## A9  0.00 0.00 0.00 0.00
## A10 0.00 0.00 0.00 0.00
## C1  0.00 0.00 0.00 0.00
## C2  0.21 0.00 0.00 0.00
## C3  0.00 0.00 0.00 0.00
## C4  0.00 0.00 0.00 0.00
## C5  0.00 0.00 0.00 0.00
## C6  0.00 0.00 0.01 0.00
## C7  0.00 0.02 0.00 0.00
## C8  0.00 0.00 0.14 0.00
## C9  0.00 0.00 0.00 0.00
## C10 0.00 0.00 0.00 0.00
## O1  0.00 0.00 0.00 0.00
## O2  0.00 0.00 0.00 0.00
## O3  0.00 0.00 0.00 0.00
## O4  0.00 0.00 0.00 0.00
## O5  0.00 0.00 0.00 0.00
## O6  0.00 0.00 0.00 0.00
## O7  0.00 0.00 0.00 0.00
## O8  0.00 0.00 0.00 0.00
## O9  0.00 0.00 0.00 0.00
## O10 0.00 0.00 0.00 0.00

# Now, for each element, see if it is < .01 (or whatever significance) #and
set the entry to  true = significant or else false
```

```r
# if these P values are less than point 01 set to true,
# if it's not set it to false
# and then we'll see a certain amount of here that are.
MTest = ifelse(M < .01, T, F)
MTest
```

```
##        E1    E2    E3    E4    E5    E6    E7    E8    E9   E10    N1    N2
## E1   TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE
## E2   TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE
## E3   TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE
## E4   TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE
## E5   TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE
## E6   TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE
## E7   TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE
## E8   TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE
## E9   TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE
## E10  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE
## N1   TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE
## N2   TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE
## N3   TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE
## N4   TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE
## N5   TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE
## N6   TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE
## N7   TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE
## N9   TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE
## N10  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE
## A1  FALSE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE FALSE FALSE  TRUE FALSE  TRUE
## A2   TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE
## A3   TRUE  TRUE  TRUE  TRUE  TRUE FALSE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE
## A4   TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE FALSE  TRUE  TRUE  TRUE  TRUE
## A5   TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE FALSE FALSE
## A6   TRUE  TRUE  TRUE FALSE  TRUE FALSE  TRUE FALSE FALSE FALSE  TRUE FALSE
## A7   TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE
## A8   TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE FALSE  TRUE  TRUE FALSE  TRUE
## A9   TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE FALSE
## A10  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE
## C1   TRUE FALSE  TRUE  TRUE  TRUE  TRUE  TRUE FALSE  TRUE  TRUE  TRUE  TRUE
## C2   TRUE  TRUE  TRUE  TRUE FALSE FALSE  TRUE  TRUE  TRUE FALSE  TRUE  TRUE
## C3  FALSE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE FALSE FALSE  TRUE  TRUE
## C4   TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE
## C5   TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE
## C6  FALSE FALSE  TRUE  TRUE  TRUE  TRUE  TRUE FALSE FALSE  TRUE  TRUE FALSE
## C7   TRUE  TRUE  TRUE  TRUE  TRUE FALSE FALSE  TRUE  TRUE  TRUE  TRUE  TRUE
## C8   TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE
## C9   TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE FALSE  TRUE  TRUE FALSE FALSE
## C10  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE FALSE  TRUE  TRUE  TRUE  TRUE
## O1   TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE
## O2   TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE
## O3   TRUE  TRUE FALSE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE FALSE  TRUE  TRUE
## O4  FALSE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE
## O5   TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE
```

```
##        N3    N4    N5    N6    N7    N9   N10    A1    A2    A3    A4    A5
## E1   TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE FALSE  TRUE  TRUE  TRUE  TRUE
## E2   TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE
## E3   TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE
## E4   TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE
## E5   TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE
## E6   TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE FALSE  TRUE  TRUE
## E7   TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE
## E8   TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE FALSE  TRUE  TRUE FALSE  TRUE
## E9   TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE FALSE  TRUE  TRUE  TRUE  TRUE
## E10  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE
## N1   TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE FALSE  TRUE  TRUE  TRUE FALSE
## N2   TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE FALSE
## N3   TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE FALSE FALSE  TRUE  TRUE  TRUE
## N4   TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE FALSE  TRUE
## N5   TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE FALSE  TRUE
## N6   TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE FALSE
## N7   TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE FALSE  TRUE
## N9   TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE
## N10  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE FALSE  TRUE
## A1  FALSE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE
## A2  FALSE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE
## A3   TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE
## A4   TRUE FALSE FALSE  TRUE FALSE  TRUE FALSE  TRUE  TRUE  TRUE  TRUE  TRUE
## A5   TRUE  TRUE  TRUE FALSE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE
## A6   TRUE FALSE  TRUE  TRUE  TRUE FALSE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE
## A7  FALSE FALSE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE
## A8   TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE
## A9   TRUE FALSE  TRUE  TRUE  TRUE  TRUE FALSE  TRUE  TRUE  TRUE  TRUE  TRUE
## A10  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE
## C1   TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE
## C2   TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE FALSE  TRUE  TRUE  TRUE FALSE
## C3   TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE
## C4   TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE
## C5   TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE FALSE  TRUE  TRUE  TRUE  TRUE
## C6   TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE FALSE  TRUE FALSE  TRUE
## C7   TRUE  TRUE FALSE FALSE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE FALSE
## C8   TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE
## C9   TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE
## C10 FALSE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE
## O1   TRUE  TRUE  TRUE  TRUE  TRUE  TRUE FALSE  TRUE  TRUE  TRUE FALSE FALSE
## O2   TRUE FALSE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE FALSE  TRUE
## O3   TRUE  TRUE FALSE  TRUE  TRUE  TRUE  TRUE FALSE  TRUE  TRUE  TRUE  TRUE
## O4   TRUE  TRUE  TRUE  TRUE  TRUE  TRUE FALSE  TRUE  TRUE  TRUE  TRUE  TRUE
## O5   TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE FALSE
## O6   TRUE FALSE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE
```

```
##        A6    A7    A8    A9   A10    C1    C2    C3    C4    C5    C6    C7
## E1   TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE FALSE  TRUE  TRUE FALSE  TRUE
## E2   TRUE  TRUE  TRUE  TRUE  TRUE FALSE  TRUE  TRUE  TRUE  TRUE FALSE  TRUE
## E3   TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE
## E4  FALSE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE
## E5   TRUE  TRUE  TRUE  TRUE  TRUE  TRUE FALSE  TRUE  TRUE  TRUE  TRUE  TRUE
## E6  FALSE  TRUE  TRUE  TRUE  TRUE  TRUE FALSE  TRUE  TRUE  TRUE  TRUE FALSE
## E7   TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE FALSE
## E8  FALSE  TRUE FALSE  TRUE  TRUE FALSE  TRUE  TRUE  TRUE  TRUE FALSE  TRUE
## E9  FALSE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE FALSE  TRUE  TRUE FALSE  TRUE
## E10 FALSE  TRUE  TRUE  TRUE  TRUE  TRUE FALSE FALSE  TRUE  TRUE  TRUE  TRUE
## N1   TRUE  TRUE FALSE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE
## N2  FALSE  TRUE  TRUE FALSE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE FALSE  TRUE
## N3   TRUE FALSE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE
## N4  FALSE FALSE  TRUE FALSE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE
## N5   TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE FALSE
## N6   TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE FALSE
## N7   TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE
## N9  FALSE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE
## N10  TRUE  TRUE  TRUE FALSE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE
## A1   TRUE  TRUE  TRUE  TRUE  TRUE  TRUE FALSE  TRUE  TRUE FALSE  TRUE  TRUE
## A2   TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE FALSE  TRUE
## A3   TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE
## A4   TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE FALSE  TRUE
## A5   TRUE  TRUE  TRUE  TRUE  TRUE  TRUE FALSE  TRUE  TRUE  TRUE  TRUE FALSE
## A6   TRUE  TRUE  TRUE  TRUE  TRUE FALSE  TRUE  TRUE FALSE  TRUE  TRUE  TRUE
## A7   TRUE  TRUE  TRUE  TRUE  TRUE  TRUE FALSE  TRUE  TRUE  TRUE  TRUE FALSE
## A8   TRUE  TRUE  TRUE  TRUE  TRUE  TRUE FALSE  TRUE  TRUE  TRUE  TRUE  TRUE
## A9   TRUE  TRUE  TRUE  TRUE  TRUE  TRUE FALSE  TRUE  TRUE  TRUE FALSE  TRUE
## A10  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE
## C1  FALSE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE
## C2   TRUE FALSE FALSE FALSE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE
## C3   TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE
## C4  FALSE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE
## C5   TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE
## C6   TRUE  TRUE  TRUE FALSE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE
## C7   TRUE FALSE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE
## C8   TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE
## C9   TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE
## C10  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE
## O1   TRUE  TRUE FALSE FALSE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE FALSE  TRUE
## O2   TRUE  TRUE  TRUE  TRUE  TRUE  TRUE FALSE  TRUE  TRUE  TRUE  TRUE FALSE
## O3   TRUE  TRUE  TRUE  TRUE  TRUE FALSE  TRUE  TRUE  TRUE  TRUE  TRUE FALSE
## O4  FALSE  TRUE  TRUE  TRUE  TRUE FALSE  TRUE  TRUE  TRUE  TRUE FALSE  TRUE
## O5  FALSE  TRUE  TRUE  TRUE  TRUE  TRUE FALSE  TRUE  TRUE  TRUE  TRUE  TRUE
## O6   TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE FALSE  TRUE
## O7   TRUE  TRUE  TRUE  TRUE  TRUE  TRUE FALSE  TRUE  TRUE  TRUE  TRUE  TRUE
```

```
##       C8    C9   C10    O1    O2    O3    O4    O5    O6    O7    O8    O9
## E1  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE FALSE  TRUE  TRUE  TRUE FALSE  TRUE
## E2  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE
## E3  TRUE  TRUE  TRUE  TRUE  TRUE FALSE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE
## E4  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE FALSE  TRUE
## E5  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE FALSE  TRUE
## E6  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE FALSE
## E7  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE FALSE  TRUE
## E8  TRUE FALSE FALSE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE FALSE  TRUE
## E9  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE
## E10 TRUE  TRUE  TRUE  TRUE  TRUE FALSE  TRUE  TRUE  TRUE  TRUE FALSE  TRUE
## N1  TRUE FALSE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE
## N2  TRUE FALSE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE
## N3  TRUE  TRUE FALSE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE FALSE  TRUE
## N4  TRUE  TRUE  TRUE  TRUE FALSE  TRUE  TRUE  TRUE FALSE  TRUE  TRUE  TRUE
## N5  TRUE  TRUE  TRUE  TRUE  TRUE FALSE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE
## N6  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE FALSE  TRUE
## N7  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE
## N9  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE
## N10 TRUE  TRUE  TRUE FALSE  TRUE  TRUE FALSE  TRUE  TRUE  TRUE  TRUE  TRUE
## A1  TRUE  TRUE  TRUE  TRUE  TRUE FALSE  TRUE  TRUE  TRUE FALSE  TRUE  TRUE
## A2  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE FALSE  TRUE
## A3  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE FALSE
## A4  TRUE  TRUE  TRUE FALSE FALSE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE
## A5  TRUE  TRUE  TRUE FALSE  TRUE  TRUE  TRUE FALSE  TRUE FALSE  TRUE  TRUE
## A6  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE FALSE FALSE  TRUE  TRUE  TRUE  TRUE
## A7  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE
## A8  TRUE  TRUE  TRUE FALSE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE
## A9  TRUE  TRUE  TRUE FALSE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE
## A10 TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE
## C1  TRUE  TRUE  TRUE  TRUE  TRUE FALSE FALSE  TRUE  TRUE  TRUE  TRUE  TRUE
## C2  TRUE  TRUE  TRUE  TRUE FALSE  TRUE  TRUE FALSE  TRUE FALSE  TRUE  TRUE
## C3  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE
## C4  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE
## C5  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE
## C6  TRUE  TRUE  TRUE FALSE  TRUE  TRUE FALSE  TRUE FALSE  TRUE  TRUE FALSE
## C7  TRUE  TRUE  TRUE  TRUE FALSE FALSE  TRUE  TRUE  TRUE  TRUE FALSE  TRUE
## C8  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE FALSE
## C9  TRUE  TRUE  TRUE FALSE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE
## C10 TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE
## O1  TRUE FALSE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE
## O2  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE
## O3  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE
## O4  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE
## O5  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE
## O6  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE
## O7  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE
## O8  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE
```

```
## O9   FALSE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE
## O10   TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE
##        O10
## E1    TRUE
## E2    TRUE
## E3    TRUE
## E4    TRUE
## E5    TRUE
## E6    TRUE
## E7    TRUE
## E8    TRUE
## E9    TRUE
## E10   TRUE
## N1    TRUE
## N2    TRUE
## N3    TRUE
## N4    TRUE
## N5    TRUE
## N6    TRUE
## N7    TRUE
## N9    TRUE
## N10   TRUE
## A1    TRUE
## A2    TRUE
## A3    TRUE
## A4    TRUE
## A5    TRUE
## A6   FALSE
## A7    TRUE
## A8    TRUE
## A9    TRUE
## A10   TRUE
## C1    TRUE
## C2    TRUE
## C3    TRUE
## C4    TRUE
## C5    TRUE
## C6    TRUE
## C7    TRUE
## C8    TRUE
## C9    TRUE
## C10   TRUE
## O1    TRUE
## O2    TRUE
## O3    TRUE
## O4    TRUE
## O5    TRUE
## O6    TRUE
## O7    TRUE
## O8    TRUE
```

```
## O9   TRUE
## O10  TRUE

# Now lets see how many significant correlations there are for each variable.
We can do
# this by summing the columns of the matrix
# if we sum these counts up and subtract from once we take off
# diagonal If you recall, will see that

colSums(MTest) - 1  # We have to subtract 1 for the diagonal elements (self-
correlation)

##  E1  E2  E3  E4  E5  E6  E7  E8  E9 E10  N1  N2  N3  N4  N5  N6  N7  N9 N10
A1
##  43  46  47  46  46  43  46  39  44  43  44  43  43  42  45  45  47  47  44
39
##  A2  A3  A4  A5  A6  A7  A8  A9 A10  C1  C2  C3  C4  C5  C6  C7  C8  C9 C10
O1
##  45  46  40  40  35  44  44  42  48  43  37  45  47  47  36  39  47  44  46
41
##  O2  O3  O4  O5  O6  O7  O8  O9 O10
##  44  42  43  45  46  45  38  44  47
```

PCA_Plot functions

```
PCA_Plot = function(pcaData)
{
  library(ggplot2)

  theta = seq(0,2*pi,length.out = 100)
  circle = data.frame(x = cos(theta), y = sin(theta))
  p = ggplot(circle,aes(x,y)) + geom_path()

  loadings = data.frame(pcaData$rotation, .names =
row.names(pcaData$rotation))
  p + geom_text(data=loadings, mapping=aes(x = PC1, y = PC2, label = .names,
colour = .names, fontface="bold")) +
    coord_fixed(ratio=1) + labs(x = "PC1", y = "PC2")
}

PCA_Plot_Secondary = function(pcaData)
{
  library(ggplot2)

  theta = seq(0,2*pi,length.out = 100)
  circle = data.frame(x = cos(theta), y = sin(theta))
  p = ggplot(circle,aes(x,y)) + geom_path()

  loadings = data.frame(pcaData$rotation, .names =
row.names(pcaData$rotation))
  p + geom_text(data=loadings, mapping=aes(x = PC3, y = PC4, label = .names,
colour = .names, fontface="bold")) +
    coord_fixed(ratio=1) + labs(x = "PC3", y = "PC4")
}
```

```r
PCA_Plot_Psyc = function(pcaData)
{
  library(ggplot2)

  theta = seq(0,2*pi,length.out = 100)
  circle = data.frame(x = cos(theta), y = sin(theta))
  p = ggplot(circle,aes(x,y)) + geom_path()

  loadings = as.data.frame(unclass(pcaData$loadings))
  s = rep(0, ncol(loadings))
  for (i in 1:ncol(loadings))
  {
    s[i] = 0
    for (j in 1:nrow(loadings))
      s[i] = s[i] + loadings[j, i]^2
    s[i] = sqrt(s[i])
  }

  for (i in 1:ncol(loadings))
    loadings[, i] = loadings[, i] / s[i]

  loadings$.names = row.names(loadings)

  p + geom_text(data=loadings, mapping=aes(x = PC1, y = PC2, label = .names,
colour = .names, fontface="bold")) +
    coord_fixed(ratio=1) + labs(x = "PC1", y = "PC2")
}

PCA_Plot_Psyc_Secondary = function(pcaData)
{
  library(ggplot2)

  theta = seq(0,2*pi,length.out = 100)
  circle = data.frame(x = cos(theta), y = sin(theta))
  p = ggplot(circle,aes(x,y)) + geom_path()

  loadings = as.data.frame(unclass(pcaData$loadings))
  s = rep(0, ncol(loadings))
  for (i in 1:ncol(loadings))
  {
    s[i] = 0
    for (j in 1:nrow(loadings))
      s[i] = s[i] + loadings[j, i]^2
    s[i] = sqrt(s[i])
  }

  for (i in 1:ncol(loadings))
    loadings[, i] = loadings[, i] / s[i]

  loadings$.names = row.names(loadings)
```

```
  print(loadings)
  p + geom_text(data=loadings, mapping=aes(x = PC3, y = PC4, label = .names,
colour = .names, fontface="bold")) +
    coord_fixed(ratio=1) + labs(x = "PC3", y = "PC4")
}
```

PCA/FA

Test KMO Sampling Adequancy

```
library(psych)
KMO(likeditems)
```

```
## Kaiser-Meyer-Olkin factor adequacy
## Call: KMO(r = likeditems)
## Overall MSA =  0.91
## MSA for each item =
##   E1   E2   E3   E4   E5   E6   E7   E8   E9  E10   N1   N2   N3   N4   N5
N6
## 0.94 0.93 0.96 0.95 0.95 0.94 0.94 0.90 0.92 0.95 0.92 0.90 0.91 0.89 0.95
0.91
##   N7   N9  N10   A1   A2   A3   A4   A5   A6   A7   A8   A9  A10   C1   C2
C3
## 0.93 0.91 0.93 0.90 0.94 0.90 0.89 0.92 0.90 0.91 0.95 0.90 0.96 0.92 0.86
0.90
##   C4   C5   C6   C7   C8   C9  C10   O1   O2   O3   O4   O5   O6   O7   O8
O9
## 0.93 0.91 0.88 0.89 0.94 0.89 0.91 0.77 0.84 0.80 0.81 0.86 0.83 0.91 0.75
0.90
##  O10
## 0.85
```

```
# Overall MSA = 0.91
# These are similar to intercorrelations
```

Test Bartlett's test of Sphericity

```
library(REdaS)
bart_spher(likeditems)
```

```
##  Bartlett's Test of Sphericity
##
## Call: bart_spher(x = likeditems)
##
##      X2 = 355580.866
##      df = 1176
## p-value < 2.22e-16
```

```
# p-value < 2.22e-16 (very small number)
#This is showing that the alternative is true that there are a lot of
#differences or enough shared variance that we should be able to test this.
```

#Test for Reliability Analysis using Cronbach's Alpha # This shows how reliable is this data to each other

```
library(psych)
alpha(likeditems, check.keys = TRUE)
```

```
## Warning in alpha(likeditems, check.keys = TRUE): Some items were negatively
correlated with total scale and were automatically reversed.
##  This is indicated by a negative sign for the variable name.

##
## Reliability analysis
## Call: alpha(x = likeditems, check.keys = TRUE)
##
##   raw_alpha std.alpha G6(smc) average_r S/N    ase mean   sd median_r
##       0.88      0.87    0.91      0.12   7 0.0013  2.1 0.45    0.092
##
##  lower alpha upper     95% confidence boundaries
## 0.87 0.88 0.88
##
##  Reliability if an item is dropped:
##      raw_alpha std.alpha G6(smc) average_r S/N alpha se var.r med.r
## E1-       0.87      0.87    0.91      0.12 6.8   0.0013 0.020 0.092
## E2        0.87      0.87    0.91      0.12 6.8   0.0013 0.020 0.092
## E3-       0.87      0.87    0.91      0.12 6.6   0.0013 0.020 0.089
## E4        0.87      0.87    0.91      0.12 6.7   0.0013 0.020 0.090
## E5-       0.87      0.87    0.91      0.12 6.6   0.0013 0.020 0.089
## E6        0.87      0.87    0.91      0.12 6.7   0.0013 0.020 0.089
## E7-       0.87      0.87    0.91      0.12 6.7   0.0013 0.020 0.090
## E8        0.87      0.87    0.91      0.13 6.9   0.0013 0.020 0.093
## E9-       0.87      0.87    0.91      0.12 6.8   0.0013 0.020 0.092
## E10       0.87      0.87    0.91      0.12 6.7   0.0013 0.020 0.090
## N1        0.87      0.87    0.91      0.12 6.8   0.0013 0.020 0.092
## N2-       0.87      0.87    0.91      0.13 6.9   0.0013 0.021 0.093
## N3        0.87      0.87    0.91      0.13 6.9   0.0013 0.020 0.092
## N4-       0.87      0.87    0.91      0.13 7.0   0.0013 0.021 0.093
## N5        0.87      0.87    0.91      0.12 6.8   0.0013 0.021 0.090
## N6        0.87      0.87    0.91      0.12 6.8   0.0013 0.020 0.090
## N7        0.87      0.87    0.91      0.12 6.8   0.0013 0.020 0.090
## N9        0.87      0.87    0.91      0.12 6.8   0.0013 0.020 0.090
## N10       0.87      0.87    0.91      0.12 6.7   0.0013 0.020 0.090
## A1        0.87      0.87    0.91      0.13 6.9   0.0013 0.021 0.092
## A2-       0.87      0.87    0.91      0.12 6.7   0.0013 0.020 0.091
## A3        0.87      0.87    0.91      0.13 6.9   0.0013 0.021 0.092
## A4-       0.87      0.87    0.91      0.12 6.9   0.0013 0.020 0.093
## A5        0.87      0.87    0.91      0.12 6.8   0.0013 0.020 0.093
## A6-       0.88      0.88    0.91      0.13 7.0   0.0013 0.020 0.094
## A7        0.87      0.87    0.91      0.12 6.7   0.0013 0.020 0.090
## A8-       0.87      0.87    0.91      0.12 6.8   0.0013 0.021 0.092
## A9-       0.87      0.87    0.91      0.12 6.8   0.0013 0.020 0.091
## A10-      0.87      0.87    0.91      0.12 6.7   0.0013 0.021 0.089
## C1-       0.87      0.87    0.91      0.12 6.8   0.0013 0.021 0.092
## C2        0.88      0.88    0.91      0.13 7.0   0.0012 0.020 0.093
## C3-       0.87      0.87    0.91      0.13 6.9   0.0013 0.021 0.092
## C4        0.87      0.87    0.91      0.12 6.8   0.0013 0.021 0.090
## C5-       0.87      0.87    0.91      0.13 6.9   0.0013 0.021 0.092
## C6        0.87      0.87    0.91      0.13 6.9   0.0013 0.021 0.093
```

```
## C7-       0.88      0.88    0.92      0.13 7.0   0.0013 0.021 0.095
## C8        0.87      0.87    0.91      0.12 6.8   0.0013 0.021 0.089
## C9-       0.87      0.87    0.91      0.13 6.9   0.0013 0.021 0.093
## C10-      0.87      0.87    0.91      0.13 6.9   0.0013 0.021 0.092
## O1-       0.87      0.87    0.91      0.13 6.9   0.0013 0.021 0.093
## O2        0.87      0.87    0.91      0.13 6.9   0.0013 0.021 0.092
## O3-       0.88      0.88    0.91      0.13 7.0   0.0013 0.020 0.095
## O4        0.87      0.87    0.91      0.13 6.9   0.0013 0.021 0.093
## O5-       0.87      0.87    0.91      0.12 6.8   0.0013 0.021 0.090
## O6        0.87      0.87    0.91      0.13 6.9   0.0013 0.021 0.093
## O7-       0.87      0.87    0.91      0.12 6.8   0.0013 0.021 0.090
## O8-       0.88      0.88    0.91      0.13 7.1   0.0012 0.020 0.094
## O9-       0.88      0.88    0.92      0.13 7.1   0.0012 0.020 0.093
## O10-      0.87      0.87    0.91      0.12 6.8   0.0013 0.021 0.091
##
##  Item statistics
##           n raw.r std.r r.cor r.drop mean   sd
## E1-   19719 0.459  0.45 0.436  0.414 2.37 1.23
## E2    19719 0.448  0.43 0.424  0.398 2.76 1.31
## E3-   19719 0.637  0.62 0.626  0.602 1.58 1.24
## E4    19719 0.513  0.49 0.488  0.471 3.15 1.22
## E5-   19719 0.594  0.58 0.585  0.555 1.57 1.28
## E6    19719 0.528  0.52 0.515  0.486 2.45 1.24
## E7-   19719 0.558  0.54 0.541  0.511 2.13 1.43
## E8    19719 0.336  0.32 0.299  0.284 3.38 1.27
## E9-   19719 0.427  0.41 0.399  0.373 1.91 1.40
## E10   19719 0.507  0.49 0.477  0.461 3.59 1.30
## N1    19719 0.416  0.40 0.387  0.365 3.26 1.31
## N2-   19719 0.343  0.34 0.315  0.295 1.77 1.18
## N3    19719 0.315  0.30 0.277  0.267 3.84 1.14
## N4-   19719 0.278  0.27 0.235  0.226 2.24 1.22
## N5    19719 0.405  0.39 0.371  0.355 2.95 1.27
## N6    19719 0.452  0.43 0.426  0.402 2.98 1.32
## N7    19719 0.430  0.41 0.398  0.380 3.15 1.30
## N9    19719 0.477  0.46 0.454  0.430 3.14 1.30
## N10   19719 0.503  0.48 0.473  0.457 2.83 1.31
## A1    19719 0.299  0.30 0.270  0.241 2.31 1.37
## A2-   19719 0.476  0.48 0.475  0.437 1.07 1.08
## A3    19719 0.310  0.31 0.284  0.259 2.16 1.22
## A4-   19719 0.349  0.37 0.359  0.306 0.97 1.05
## A5    19719 0.381  0.39 0.377  0.336 2.17 1.14
## A6-   19719 0.189  0.20 0.179  0.139 1.10 1.13
## A7    19719 0.505  0.51 0.506  0.466 2.16 1.13
## A8-   19719 0.385  0.40 0.380  0.344 1.23 1.04
## A9-   19719 0.365  0.38 0.374  0.321 1.06 1.09
## A10-  19719 0.510  0.52 0.504  0.473 1.32 1.05
## C1-   19719 0.376  0.38 0.362  0.332 1.68 1.10
## C2    19719 0.215  0.20 0.172  0.155 2.98 1.37
## C3-   19719 0.286  0.31 0.278  0.244 1.02 1.00
## C4    19719 0.464  0.45 0.440  0.418 2.65 1.24
## C5-   19719 0.362  0.36 0.337  0.312 2.30 1.25
```

```
## C6   19719 0.332  0.32 0.297  0.274 2.92 1.40
## C7-  19719 0.214  0.22 0.188  0.163 1.35 1.15
## C8   19719 0.427  0.43 0.406  0.384 2.48 1.13
## C9-  19719 0.321  0.32 0.299  0.269 1.78 1.25
## C10- 19719 0.335  0.35 0.327  0.293 1.36 1.01
## O1-  19719 0.282  0.30 0.284  0.234 1.31 1.12
## O2   19719 0.342  0.36 0.340  0.296 2.15 1.14
## O3-  19719 0.172  0.20 0.175  0.127 0.87 1.01
## O4   19719 0.267  0.28 0.260  0.220 2.08 1.11
## O5-  19719 0.413  0.44 0.429  0.377 1.13 0.94
## O6   19719 0.301  0.32 0.302  0.256 1.79 1.07
## O7-  19719 0.367  0.39 0.370  0.330 0.93 0.92
## O8-  19719 0.126  0.14 0.118  0.070 1.79 1.26
## O9-  19719 0.087  0.12 0.076  0.043 0.87 0.98
## O10- 19719 0.382  0.41 0.402  0.343 1.00 0.98
##
## Non missing response frequency for each item
##     0    1    2    3    4    5 miss
## E1  0 0.24 0.23 0.28 0.18 0.07    0
## E2  0 0.21 0.24 0.24 0.18 0.13    0
## E3  0 0.08 0.17 0.24 0.28 0.23    0
## E4  0 0.10 0.21 0.28 0.25 0.16    0
## E5  0 0.09 0.16 0.21 0.28 0.25    0
## E6  0 0.26 0.32 0.19 0.15 0.08    0
## E7  0 0.23 0.21 0.18 0.19 0.18    0
## E8  0 0.09 0.19 0.23 0.26 0.24    0
## E9  0 0.17 0.20 0.19 0.23 0.21    0
## E10 0 0.08 0.16 0.19 0.25 0.33    0
## N1  0 0.11 0.20 0.22 0.25 0.22    0
## N2  0 0.08 0.20 0.28 0.28 0.16    0
## N3  0 0.04 0.11 0.16 0.35 0.34    0
## N4  0 0.17 0.27 0.27 0.18 0.10    0
## N5  0 0.15 0.25 0.23 0.24 0.13    0
## N6  0 0.16 0.24 0.22 0.22 0.16    0
## N7  0 0.12 0.22 0.22 0.25 0.19    0
## N9  0 0.13 0.22 0.21 0.27 0.17    0
## N10 0 0.19 0.25 0.23 0.20 0.13    0
## A1  0 0.39 0.25 0.13 0.14 0.10    0
## A2  0 0.03 0.08 0.17 0.34 0.37    0
## A3  0 0.40 0.26 0.17 0.13 0.05    0
## A4  0 0.03 0.07 0.14 0.36 0.40    0
## A5  0 0.34 0.35 0.16 0.10 0.05    0
## A6  0 0.04 0.09 0.18 0.31 0.38    0
## A7  0 0.34 0.35 0.17 0.10 0.05    0
## A8  0 0.03 0.09 0.22 0.39 0.26    0
## A9  0 0.04 0.08 0.14 0.37 0.37    0
## A10 0 0.03 0.09 0.29 0.34 0.25    0
## C1  0 0.06 0.17 0.29 0.34 0.14    0
## C2  0 0.19 0.21 0.19 0.24 0.16    0
## C3  0 0.02 0.07 0.17 0.37 0.36    0
## C4  0 0.21 0.29 0.24 0.18 0.09    0
```

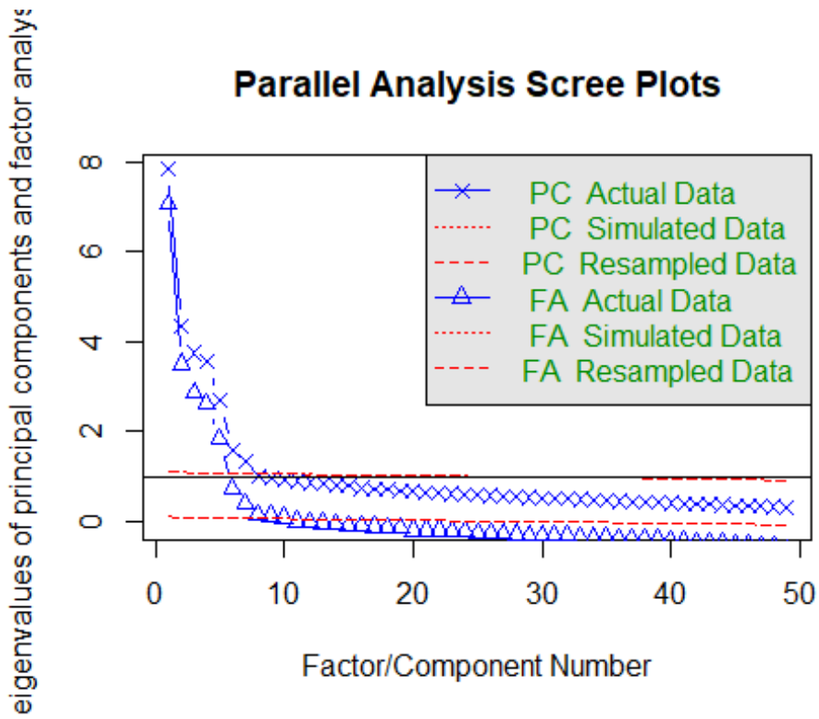
```
## C5  0 0.21 0.26 0.26 0.18 0.10    0
## C6  0 0.21 0.23 0.17 0.22 0.17    0
## C7  0 0.06 0.11 0.23 0.33 0.27    0
## C8  0 0.24 0.26 0.32 0.13 0.05    0
## C9  0 0.11 0.19 0.25 0.28 0.18    0
## C10 0 0.03 0.09 0.31 0.35 0.22    0
## O1  0 0.05 0.10 0.24 0.33 0.28    0
## O2  0 0.36 0.31 0.19 0.09 0.04    0
## O3  0 0.02 0.06 0.15 0.31 0.46    0
## O4  0 0.39 0.29 0.21 0.07 0.04    0
## O5  0 0.02 0.05 0.25 0.40 0.28    0
## O6  0 0.53 0.27 0.11 0.06 0.04    0
## O7  0 0.01 0.05 0.17 0.40 0.38    0
## O8  0 0.12 0.18 0.25 0.27 0.18    0
## O9  0 0.02 0.05 0.14 0.34 0.44    0
## O10 0 0.02 0.06 0.20 0.34 0.38    0
```

```
#raw_alpha 0.88
```

#Parallel Analysis (Horn's parallel analysis)

#Created a Psychologist John L. Horn in 1965
#Closest to Heuristic Determination of Number of Components or Factors
#Compares actual eigenvalues with ones from a Monto-Carlo simulated dataset of #the same size
#Dependent upon sample size, correlation coefficient, and how items fall on #components

```
library(psych)
comp <- fa.parallel(likeditems)
```




```
## Parallel analysis suggests that the number of factors =  10  and the number
of components =  7
```

#Create PCA # we want to center to zero because some of the items might be scalled differently # we also want to standardize the original data set. # On this data set What this means is when we go later on using the principal function # to get the scores that those scores are going to be standardized # because we're standardizing the original data set to create the principal component analysis.

```
p = prcomp(likeditems, center = T, scale = T)
p
```

```
## Standard deviations (1, .., p=49):
##  [1] 2.79971 2.08666 1.93594 1.88371 1.63984 1.25626 1.15086 1.00257
0.98170
## [10] 0.95752 0.94676 0.92483 0.90711 0.89643 0.88390 0.85605 0.84880
0.83972
## [19] 0.81483 0.81350 0.79710 0.78872 0.77848 0.76522 0.75968 0.75213
0.74286
## [28] 0.73162 0.72390 0.70963 0.70885 0.69915 0.69799 0.68716 0.66921
0.66799
## [37] 0.65960 0.64937 0.64482 0.63508 0.63011 0.61614 0.60971 0.60295
0.58963
## [46] 0.58605 0.57028 0.56833 0.55842
##
## Rotation (n x k) = (49 x 49):
##             PC1         PC2        PC3        PC4        PC5        PC6
## E1  -0.19379700  0.11012911 -0.1496348  0.0727995 -0.1530694 -0.1148301
## E2   0.19097622 -0.15395226  0.1371379 -0.0738426  0.1418126 -0.1522552
## E3  -0.25737632  0.05240990 -0.0593525  0.1176691 -0.0598530 -0.0781762
## E4   0.21376920 -0.07625682  0.1615556 -0.0972150  0.1368399 -0.1571890
## E5  -0.24305425  0.12728227 -0.0833450  0.0661625 -0.1361967  0.0003342
## E6   0.20771312 -0.10954670  0.1025985  0.0323790  0.0811233 -0.2249125
## E7  -0.23124014  0.11679781 -0.1209617  0.0887490 -0.1295128 -0.0330026
## E8   0.14191385 -0.09489290  0.1857333 -0.0611614  0.1467045 -0.0500254
## E9  -0.17371874  0.09822523 -0.1736440  0.0194331 -0.1618414 -0.0918264
## E10  0.20870410 -0.05626493  0.1542526 -0.0858760  0.1080734 -0.1367627
## N1   0.14483840  0.24205454  0.1307504 -0.0229955 -0.1820973  0.0919865
## N2  -0.12291509 -0.15089849 -0.1066700  0.0198209  0.1756998 -0.3233098
## N3   0.11351855  0.22905178  0.1830284 -0.0500990 -0.1438564  0.0436424
## N4  -0.09665298 -0.12855919 -0.0538092  0.0723846  0.0201787 -0.3081709
## N5   0.13414755  0.20259999  0.0424025  0.0257067 -0.1515619 -0.1102527
## N6   0.15380338  0.26444446  0.0904496 -0.0069045 -0.1887958 -0.0375121
## N7   0.14436515  0.23929609  0.0106065 -0.0457193 -0.1737772 -0.0563331
## N9   0.16632348  0.20314144  0.0271546 -0.0532837 -0.2597108 -0.0244298
## N10  0.18467789  0.19718731  0.0652605 -0.0991527 -0.0773470  0.0753881
## A1   0.09589769 -0.08922623 -0.1418607  0.0059751 -0.1748763 -0.2914457
## A2  -0.18792836  0.17238625  0.0802329  0.0410101  0.1026281 -0.0125958
## A3   0.09630359  0.05658600 -0.2071023 -0.0775776 -0.1865316 -0.0409558
## A4  -0.12348496  0.19763166  0.2554484  0.0488021  0.1983849 -0.0820960
## A5   0.14203933 -0.17536108 -0.1759170 -0.0578599 -0.1890275 -0.1413589
## A6  -0.06372732  0.18652268  0.2334634  0.0732112  0.1307771 -0.1756338
## A7   0.19607886 -0.16752115 -0.1155389 -0.0684441 -0.1488927 -0.1485480
## A8  -0.14023614  0.13809251  0.1923718  0.0367447  0.1378964 -0.0820583
## A9  -0.13040618  0.20673633  0.2285579  0.0225725  0.1334930 -0.1234921
## A10 -0.19463514  0.07824733  0.0778092  0.0273286  0.0246519 -0.2208891
```

```
## C1  -0.10913955 -0.15654925  0.1836502 -0.0777726 -0.1979424 -0.0537399
## C2   0.04608811  0.18724781 -0.1813620 -0.0448102  0.1746988 -0.1480882
## C3  -0.07502358 -0.06268113  0.1743510 -0.1693322 -0.1148677 -0.0990995
## C4   0.14505949  0.23040414 -0.1464507 -0.0217936  0.0875557 -0.1157939
## C5  -0.10853359 -0.14620632  0.2108116  0.0412236 -0.2133499 -0.0824820
## C6   0.08839220  0.19851061 -0.1862721 -0.0207249  0.1699738 -0.1891262
## C7  -0.04397838 -0.09246611  0.2242453 -0.0574033 -0.2228148  0.0133902
## C8   0.13550284  0.13439969 -0.1779655  0.0046409  0.0735458 -0.1372341
## C9  -0.09062363 -0.09944273  0.2401143  0.0038407 -0.2406589 -0.0408902
## C10 -0.09586748 -0.08034802  0.1697625 -0.1427241 -0.1657214 -0.1209988
## O1  -0.07224315  0.00167873 -0.0435417 -0.3290181  0.0088645  0.1379941
## O2   0.09893704  0.04449648  0.0525099  0.2901271 -0.1201795 -0.2313439
## O3  -0.04187178  0.10292059 -0.0344236 -0.2934375  0.0405913 -0.1652558
## O4   0.07413956 -0.01875752  0.0235510  0.2540452 -0.1520380 -0.2364997
## O5  -0.13564347 -0.00041156 -0.0411750 -0.2939998 -0.0732274 -0.2057576
## O6   0.09267802 -0.05051172  0.0448472  0.2570343 -0.0666395  0.0573617
## O7  -0.11326552 -0.06001989  0.0020126 -0.2649504 -0.0216221 -0.0916282
## O8  -0.01620016  0.03696297 -0.0767265 -0.3250733 -0.0159230  0.1300825
## O9  -0.00012042  0.09089754  0.1192038 -0.2205712  0.0470464 -0.0080847
## O10 -0.12360493  0.05189567 -0.0602565 -0.3282784 -0.0183039 -0.1693289
##            PC7        PC8        PC9       PC10       PC11       PC12
## E1   0.0033332 -0.0757972  0.0882124 -0.1296798  0.0156032 -0.0063147
## E2  -0.0038561 -0.1348243  0.0644716 -0.0708832  0.0685203  0.1781347
## E3   0.0642269 -0.0136116  0.1137590 -0.0110358 -0.0037145 -0.0696370
## E4   0.0378346  0.0335417  0.0901317 -0.0584801 -0.0250064 -0.0028135
## E5   0.0538131  0.0147784  0.0824415 -0.0459575 -0.0691991 -0.1455068
## E6   0.0018361 -0.1665185  0.0588664 -0.0881915  0.0819315  0.1584215
## E7   0.0557747 -0.0325710  0.1395977 -0.1106914 -0.0241689 -0.1115638
## E8   0.1242742  0.1610548  0.1244160 -0.0817387 -0.2314221 -0.4991524
## E9  -0.0446049 -0.1966137 -0.0133696  0.0059951  0.2282386  0.3613012
## E10  0.0268765  0.0646829  0.0365566  0.0504957  0.0919420  0.0585153
## N1  -0.0039431  0.0627588 -0.0706140  0.0796265 -0.0248498  0.0075469
## N2   0.0960993  0.0234481  0.1447617 -0.1189971  0.1367457 -0.0555515
## N3   0.0002266  0.0736258  0.1170070  0.0868530 -0.0263673  0.0563626
## N4   0.0652986  0.1359119 -0.3262988  0.1362007  0.4271523 -0.2708727
## N5  -0.0500837 -0.0321178 -0.2305633  0.0301160  0.1103794 -0.2098875
## N6  -0.0410550 -0.0546191 -0.1602689  0.0575339  0.0346915 -0.1300564
## N7  -0.0589955 -0.1494033  0.0894168 -0.0677745 -0.0077674 -0.0691760
## N9   0.0244033  0.0285325 -0.0660789  0.0469471  0.0805730 -0.1980332
## N10 -0.0300572 -0.2260539  0.1654200 -0.1532397 -0.1017733  0.1280423
## A1  -0.0988083 -0.2449730  0.2153374 -0.0284056 -0.0217739  0.0232270
## A2   0.1028439  0.1230755  0.2358014  0.0094470  0.0654980  0.0768149
## A3   0.1553999  0.2492134  0.2429250 -0.0308469  0.1434452 -0.1069962
## A4   0.0116773 -0.0797119 -0.0761432 -0.0661132  0.0532332  0.0389799
## A5  -0.0200168 -0.0868257 -0.0352350 -0.0637340 -0.0149302 -0.0565437
## A6  -0.0664440 -0.1594062 -0.2156880 -0.0678205  0.0088848  0.0026232
## A7  -0.0178895 -0.1607721 -0.1202982 -0.0559860 -0.0083772 -0.0540551
## A8   0.1075624  0.0267057  0.0920365 -0.0943167 -0.0565041 -0.1322366
## A9  -0.0297004 -0.1641321 -0.0679997 -0.0852841  0.0454680  0.0601011
## A10  0.0070031 -0.1748208 -0.0016960 -0.1019978 -0.1598431 -0.1525068
## C1   0.1200972  0.0597841  0.0151660  0.0971791 -0.0433726  0.1449579
```

```
## C2   0.2547895  0.0940354 -0.0321978  0.3556212 -0.0675735  0.1962241
## C3   0.0913964  0.0138897  0.3871484  0.1214183 -0.1198321  0.0133553
## C4   0.1321552  0.0700711  0.0968764  0.0600999  0.0369755  0.0547717
## C5  -0.0778822 -0.1033151 -0.0731641 -0.0529587  0.0465227  0.0198291
## C6   0.1801117  0.0548680 -0.0797218  0.3245539 -0.0784762  0.0960591
## C7   0.1024973  0.2153036  0.0860459 -0.0193533  0.2274233 -0.0306583
## C8   0.0409654 -0.0751541  0.2251596 -0.1924412  0.0961404 -0.0927923
## C9   0.0676368  0.1319315  0.0059433  0.0893333  0.1471149  0.1663891
## C10  0.1469554 -0.0831969  0.0428947  0.3227427 -0.1329216  0.1049118
## O1   0.3485708  0.0056122 -0.2252158 -0.3238060 -0.0150740  0.1000390
## O2   0.0774878  0.3073548 -0.0664328 -0.2056263 -0.1549999  0.2051240
## O3  -0.3371972  0.2805100  0.0465347 -0.1829754  0.0214992  0.0966653
## O4   0.1695798  0.2487464 -0.1699027 -0.2621599 -0.3092268  0.1615693
## O5  -0.0838286  0.0404850 -0.1791386  0.0850173 -0.1833220 -0.0237399
## O6   0.4613443 -0.2554348  0.0093295  0.0795811  0.0629831 -0.0680259
## O7   0.1750581 -0.2900777 -0.0426034  0.1254753 -0.1990020 -0.1672072
## O8   0.3790378 -0.0323766 -0.1954780 -0.3466706  0.0406238  0.0905939
## O9   0.0748793  0.0096807  0.1283708 -0.0592759  0.4772657 -0.0301832
## O10 -0.1831094  0.1222616 -0.0799492  0.0568604 -0.1356218 -0.0153075
##           PC13       PC14       PC15       PC16       PC17       PC18
## E1  -0.0478556  0.0652073  0.0807466 -0.1234832  0.0328338  0.0085226
## E2   0.0644875  0.0624034  0.0916814  0.0869494  0.1300543 -0.0342663
## E3   0.0260765  0.0901236  0.0694642  0.0244725  0.1737920 -0.0071474
## E4   0.0424573  0.0779528  0.0577496  0.0665639  0.0092297  0.0030700
## E5  -0.1167871  0.1145877  0.0771191  0.0098573 -0.0015433 -0.0462136
## E6   0.0573684  0.1585430  0.1479220 -0.0174533  0.1538595 -0.0230460
## E7  -0.1051582  0.1712340  0.1313170 -0.0230217  0.0821354 -0.0392793
## E8  -0.0787789  0.1287951  0.1684813 -0.0245527  0.0278728 -0.0743324
## E9   0.0535473 -0.1681591 -0.0646498 -0.0376669  0.0243378  0.0203254
## E10  0.1247729 -0.1292331 -0.0041141  0.0366222  0.0115954  0.1131609
## N1  -0.0660303  0.2083936 -0.0835946 -0.0048411  0.0330262 -0.1751661
## N2   0.1072303 -0.1622982  0.1451230 -0.1032519  0.2351480  0.1805386
## N3  -0.1323064  0.1760950 -0.2033226 -0.0383151 -0.0591492 -0.1942435
## N4   0.1068391  0.2497517 -0.3265356  0.0766329 -0.1785587  0.0120882
## N5   0.0470534 -0.0284098  0.0014158  0.1384588  0.4393833  0.0648931
## N6   0.1164275  0.0173019  0.0281325  0.0176274  0.0772833  0.0932463
## N7   0.1829614 -0.0581806  0.1222165 -0.0014337  0.0044344  0.1747776
## N9   0.1567287 -0.0836664  0.0524779  0.0075277  0.0319554  0.1987737
## N10 -0.0465761 -0.0663902  0.1337809  0.0618766 -0.0779831  0.0425944
## A1   0.0588377  0.3205148 -0.1160119  0.2777900 -0.1727175 -0.1391487
## A2   0.1971560  0.0928778  0.0400360  0.3691302  0.2362746 -0.0287437
## A3   0.2535009 -0.1849756  0.1302557 -0.1132940 -0.3514771  0.1790639
## A4   0.0647901 -0.0487900 -0.0657176 -0.1328019 -0.0943496 -0.0266426
## A5  -0.2802497  0.0400988  0.0471135 -0.1637980  0.1082260 -0.0339401
## A6  -0.0643122 -0.0340120 -0.0226095 -0.2353957  0.0221963 -0.0740483
## A7  -0.2144162 -0.0453243  0.0220917 -0.2895637 -0.1645660  0.0032384
## A8   0.0434258 -0.0397368  0.0844581 -0.0934394 -0.3155934  0.0416886
## A9   0.0783311 -0.0833801 -0.0616661 -0.1386760 -0.2036139 -0.0051288
## A10 -0.2801343  0.0073149  0.0301602  0.0036839  0.0297419  0.1499533
## C1   0.1800693  0.1072677  0.1547040 -0.0069972 -0.0166054 -0.1802648
## C2  -0.1392917  0.1146845  0.1768316 -0.1345428  0.0372429 -0.0028718
```

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## C3  -0.0075957  0.0239587 -0.5463231 -0.1393907  0.0458454  0.1461128
## C4   0.0278382  0.1012589  0.0507071 -0.0644300 -0.1425122 -0.0312931
## C5   0.1141532  0.2259085  0.2475870  0.0530620 -0.1807577  0.0319830
## C6  -0.0748453  0.1166695  0.1254652 -0.0864522  0.0227654 -0.0706126
## C7  -0.0795636 -0.2254100  0.0475393 -0.2942370  0.2830922 -0.2378608
## C8   0.0953672 -0.1662024 -0.2718080 -0.1225557  0.1201837 -0.4558813
## C9   0.0273365  0.0769598  0.2507487 -0.1582228 -0.0767986 -0.2157767
## C10 -0.1435820 -0.0628220 -0.1001244  0.0025427  0.1005656  0.4079150
## O1   0.0335912  0.1858828 -0.0735834  0.0177686  0.0961898  0.0305083
## O2  -0.1022186 -0.0801762 -0.0673950  0.1681812 -0.0051277  0.0684480
## O3  -0.0385338  0.2154686 -0.0014107 -0.1478955  0.0379095  0.1316135
## O4  -0.0605673 -0.1651013 -0.1425873  0.1338970 -0.0698271  0.0065193
## O5   0.0438129 -0.3036165  0.0728517  0.2239259 -0.0241892 -0.2614709
## O6  -0.0437763 -0.1553983  0.0233100  0.1257378 -0.0836730 -0.1267948
## O7   0.1813072 -0.0958345 -0.0479260  0.0480404 -0.0055043 -0.1124460
## O8   0.0767258  0.1451399 -0.0590266 -0.0327115  0.0071540  0.0730758
## O9  -0.5695014 -0.1426168  0.0708172  0.3779535 -0.1461121  0.0290914
## O10 -0.0022222 -0.1951143  0.0786915  0.1710976 -0.1003908 -0.2036984
##            PC19       PC20       PC21       PC22        PC23       PC24
## E1   0.33287390 -0.0161512 -0.1063110 -0.0320740 -0.11931771  0.0430851
## E2   0.34002818 -0.0374518 -0.1184818  0.0593764  0.07691511  0.0078430
## E3  -0.01088677  0.1203330 -0.0785946 -0.0253754 -0.02258820  0.0701399
## E4  -0.03665414 -0.0857930  0.0233348  0.0542464  0.05268671  0.0581546
## E5  -0.06922503  0.0302761  0.1158294  0.0407155  0.06024222  0.0546902
## E6   0.34809896  0.0175244 -0.0653954  0.1093018  0.13520395  0.0351923
## E7   0.18907268  0.0016632  0.0357040  0.1381939  0.05012797  0.0762171
## E8   0.03045699 -0.0133607  0.0104065  0.0318022 -0.05537299  0.1561640
## E9   0.07662182 -0.0208391 -0.1895801 -0.0328875  0.05640085 -0.0940243
## E10 -0.03859842 -0.0682189 -0.2345784 -0.3019059 -0.22551897 -0.0256085
## N1   0.15301925  0.0080054 -0.1620338 -0.1371810 -0.09911544  0.0244225
## N2  -0.18270161  0.2392661  0.0931039 -0.1479656 -0.08140642 -0.0100365
## N3   0.08593208  0.0369823 -0.2191637 -0.2199642  0.05237574  0.0587682
## N4   0.11510854 -0.1038400 -0.0991827  0.2370964 -0.10511139 -0.0182261
## N5   0.00754695  0.0556790  0.3026826 -0.1556177  0.26930232 -0.2479989
## N6  -0.03187352  0.1055510 -0.0043912  0.0193242 -0.06480005  0.0139658
## N7  -0.10820472  0.0229942 -0.0868216  0.3048441 -0.18688241 -0.1235130
## N9  -0.02387805  0.0955328 -0.1061511 -0.0141698 -0.10885869  0.0920514
## N10 -0.05186440 -0.0441080  0.0844447  0.1982340 -0.02853546 -0.0278600
## A1  -0.42104113 -0.1632283  0.0801449 -0.3145734  0.16502717 -0.0231625
## A2   0.01356820 -0.0785639 -0.0862950 -0.0801971  0.00756064  0.1270200
## A3   0.15394849 -0.0471314 -0.0172761 -0.2567560  0.19188943  0.2883418
## A4  -0.05416749  0.0190726  0.0823389  0.0321238  0.05910423  0.1935450
## A5   0.07887437  0.1072726 -0.0588262 -0.1187701 -0.01583656  0.0497564
## A6  -0.02264058  0.1019253  0.1422093 -0.2134806  0.04444429  0.2127316
## A7  -0.01193814  0.0858312  0.0594847 -0.0432189 -0.00216528 -0.0378617
## A8   0.12719099 -0.0378447 -0.0775703 -0.1402003  0.08233592 -0.7177355
## A9  -0.08468175  0.0215434  0.0877719 -0.0179445  0.06272720  0.2561701
## A10 -0.02388870 -0.3028388 -0.2763328 -0.1651088 -0.20821324 -0.0583366
## C1  -0.03984994  0.3653264  0.1057336 -0.0563311 -0.39466543 -0.1570228
## C2  -0.10961628  0.0744554 -0.0459866  0.0167678  0.07432627 -0.0021315
## C3   0.17304870  0.3012094  0.2214447  0.0453354  0.13209538 -0.0830287
```

```
## C4   0.03588338 -0.1484353  0.2177608  0.2417981  0.07277919 -0.0813772
## C5  -0.00033442 -0.0477849  0.1839566  0.1361552  0.11931051  0.0018025
## C6  -0.06892431  0.0270975  0.0186414  0.0035067  0.01434444 -0.0736075
## C7  -0.19492709 -0.3476785 -0.1165119  0.0956067  0.33185785 -0.1061574
## C8  -0.06997845 -0.1396389  0.1234472  0.1519881 -0.39060572 -0.0198600
## C9  -0.15013784 -0.0296852  0.0178587  0.0400288 -0.15115609  0.0485782
## C10  0.00406409 -0.4065367  0.1797990  0.0968515 -0.20637615  0.1179317
## O1  -0.05087416 -0.0184473  0.0179878 -0.0984621 -0.00991912  0.0081562
## O2  -0.03087288 -0.0078648  0.0771341  0.0221019  0.00088059 -0.0318901
## O3  -0.07796369  0.0440997 -0.0777780  0.1241754  0.07095917  0.0214232
## O4  -0.07858999  0.1352143 -0.1796303  0.1960645  0.07527364  0.0502565
## O5   0.22059698 -0.0307159  0.1060655 -0.0980802  0.00915746  0.0324028
## O6   0.14785872 -0.0204741  0.1189425 -0.0467855  0.05684849  0.0640739
## O7  -0.18727505  0.1873599 -0.4416999  0.2551288  0.27142579  0.0476053
## O8   0.00182810 -0.1112469  0.1052499 -0.0786423 -0.03780546 -0.0369665
## O9  -0.08405396  0.2718955 -0.0097688  0.0976957 -0.02648055  0.0116848
## O10  0.17392871 -0.1082120  0.1661868  0.0058586 -0.00653378  0.0066086
##           PC25       PC26      PC27       PC28       PC29        PC30
## E1   0.0251944  0.2217125  0.072362 -0.5223212 -0.2393420  0.00026607
## E2  -0.0439080 -0.0444703 -0.196391  0.0621783 -0.0104444  0.04445977
## E3  -0.0169281  0.0283557 -0.019467  0.1872654  0.1032634  0.12091612
## E4   0.0067134 -0.0903621  0.097525  0.2146233 -0.0136181  0.04168540
## E5  -0.0234512 -0.0761716 -0.052811  0.1966482  0.0689581  0.08573119
## E6  -0.1278216  0.0288478 -0.231842  0.0754124  0.0274006  0.04747478
## E7   0.0143245  0.1149289 -0.036991 -0.0941415  0.0072737  0.06698751
## E8  -0.0151125  0.1152663 -0.013197 -0.1675209 -0.0654048  0.14380261
## E9  -0.0370919  0.0023199  0.099431  0.0667240  0.0126005  0.20231449
## E10  0.0907914  0.0270654  0.294055 -0.3746233  0.0649779 -0.01113140
## N1   0.0550208  0.0533402  0.019010  0.1375363 -0.0217105  0.10213786
## N2   0.2042841  0.0179109  0.133573  0.1528544  0.0757305  0.40326053
## N3   0.0429463  0.0165692  0.299741  0.1738243  0.0259434  0.30183082
## N4   0.1422746 -0.0311509 -0.016805  0.0707361 -0.0767777 -0.03868704
## N5  -0.3980116 -0.1174474  0.182211 -0.1430878 -0.1093089 -0.06822426
## N6   0.0757362  0.0273453 -0.150629  0.0790618  0.1470416  0.06406175
## N7   0.3451578 -0.0411071 -0.069049 -0.0019784 -0.0613549 -0.16433075
## N9   0.0056335 -0.0152512 -0.281876 -0.0223281  0.1120286  0.14183237
## N10  0.1279756 -0.0517529  0.070755  0.0280264 -0.0886837  0.02109828
## A1   0.0489142  0.1569351 -0.255175 -0.1175594 -0.1084070  0.04734856
## A2   0.0701850 -0.0012579  0.064928  0.1049582  0.1048245 -0.40695927
## A3  -0.1918148 -0.0506889  0.011344  0.1427121 -0.0826732 -0.17952270
## A4  -0.0871937 -0.0475744 -0.046501  0.0118071 -0.1543744  0.05421496
## A5   0.0458128  0.0306335  0.101972  0.1617746  0.2062248 -0.42529286
## A6   0.2569285  0.3196326  0.051688  0.0809124  0.0863351 -0.25797389
## A7  -0.0384365 -0.0477242  0.016204  0.0888322 -0.0526041  0.01697919
## A8  -0.0887554  0.2456468 -0.114867  0.1230722  0.1876925 -0.07779788
## A9  -0.1679657 -0.1114709 -0.131885 -0.1030004 -0.1134654 -0.01562036
## A10 -0.0708374 -0.5746493  0.013647  0.0710247 -0.1173537 -0.05956047
## C1  -0.1163148  0.0105666  0.025792  0.1756625 -0.5358655 -0.13638031
## C2   0.0878207 -0.1231964 -0.128959 -0.0961971  0.0144107 -0.20436227
## C3   0.1639412 -0.2629826 -0.088031 -0.1891782  0.1123709 -0.06215474
## C4  -0.0287753 -0.0519300  0.314072  0.0283647 -0.0796170  0.11879885
```

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## C5   0.1446561 -0.0989529  0.436241 -0.0922318  0.2252362 -0.05908115
## C6   0.0387362  0.0067963 -0.033454 -0.1046485  0.0043457  0.08595580
## C7   0.2571236  0.0334196 -0.105732 -0.0008061 -0.2536588 -0.02802180
## C8  -0.2376169  0.0476713  0.061274  0.0315844  0.1879319 -0.10867256
## C9  -0.2462268 -0.1816574 -0.142238 -0.2222542  0.4471671  0.06500515
## C10 -0.2183552  0.4065265  0.022067  0.1529542  0.0209688  0.03050562
## O1   0.0226782 -0.0089598 -0.033480 -0.0137489  0.0339496  0.03038417
## O2   0.0734264  0.0263178 -0.018651 -0.0404048 -0.0061564  0.00754493
## O3  -0.1356332  0.0381311  0.101723  0.0861155 -0.0881451 -0.05574531
## O4  -0.1083650  0.0621261  0.014762 -0.0224187  0.0238495 -0.01019227
## O5   0.1239657 -0.0572637 -0.079077  0.0080121  0.0266853  0.07943195
## O6   0.1241910 -0.0876370  0.100284  0.0690803 -0.0679803  0.01393869
## O7  -0.1928038  0.1302075  0.200195 -0.0432365  0.0341334 -0.04693505
## O8   0.0672891 -0.0100864 -0.046599 -0.0457256  0.0560832  0.02363500
## O9  -0.0787740  0.1032199 -0.025626 -0.0715936 -0.0127813 -0.02274182
## O10  0.1556291 -0.0353591 -0.026012  0.0150435  0.0501422  0.04836331
##           PC31       PC32       PC33       PC34        PC35       PC36
## E1   0.0289283  0.0961404  0.1419607  0.0866097 -0.16162045 -0.0699391
## E2   0.0032784  0.0700722 -0.0182051  0.0490121  0.02514757  0.0166031
## E3  -0.1013466 -0.0822536 -0.0705632  0.0181933  0.18406018 -0.0083215
## E4  -0.0523513  0.1100620  0.1218083  0.0633376  0.31806206 -0.0909715
## E5  -0.0293723  0.0157583 -0.0828957 -0.0960964  0.15668528 -0.0111241
## E6   0.1881705 -0.0798093 -0.0550193 -0.1337239 -0.06619080  0.1314702
## E7  -0.0022837  0.0463350  0.0313848 -0.0115377  0.13767310  0.0859665
## E8  -0.2305417 -0.0653681 -0.1482782 -0.0484696  0.26447727 -0.1796802
## E9  -0.2137085 -0.1085463 -0.1755290  0.0208401  0.46014902 -0.2253654
## E10 -0.0963162 -0.0801687 -0.0825871  0.0418808  0.17801118  0.0265744
## N1  -0.0296065  0.1389899  0.0362760  0.1828358 -0.14249675  0.1258749
## N2   0.0016531  0.1530538  0.1501499  0.0180141 -0.30166696  0.0526919
## N3  -0.0322846  0.1650274  0.0141642 -0.2953320 -0.08964231  0.0813800
## N4  -0.0913514  0.0391891  0.1266188 -0.1166665 -0.01143534 -0.1921836
## N5  -0.0791609  0.0957064  0.0867192 -0.1807431  0.04316731 -0.0201047
## N6   0.1659471 -0.1016791 -0.0885138  0.2882541 -0.01287428 -0.1565441
## N7  -0.1667453  0.0743152 -0.0196102 -0.4352346  0.06864261  0.3565767
## N9   0.0409478 -0.0379036 -0.0356515  0.3128543 -0.03142212 -0.0294835
## N10 -0.0858478 -0.0044502  0.2110791 -0.0483558 -0.11755561 -0.5649801
## A1  -0.0031177 -0.0145745  0.0474903  0.0507210  0.00062068  0.0415936
## A2  -0.2219601 -0.1036352  0.0160845  0.0700963 -0.19185298 -0.0549942
## A3   0.1937944  0.0233128 -0.0288943 -0.1553979  0.03985274 -0.0171857
## A4  -0.2241155  0.0868015 -0.0875433  0.0938233 -0.08606444  0.1339344
## A5  -0.3933704 -0.1217456 -0.0276947  0.1594454 -0.08515058  0.1012443
## A6   0.3336384 -0.1835202  0.2390290 -0.1402088  0.23126030 -0.0763986
## A7  -0.1759831  0.0623371 -0.0274695  0.0045364 -0.06669131 -0.0188163
## A8  -0.0788629  0.0541483 -0.0072337  0.0626409 -0.05069434 -0.0454579
## A9  -0.3207723  0.0528629 -0.1658099  0.0706444 -0.10566345  0.0914970
## A10  0.2678444 -0.1099628  0.0459812  0.0224017 -0.01120433  0.0283168
## C1   0.0690991 -0.0767089 -0.0312824  0.0509861  0.08884243 -0.0041469
## C2   0.0306615  0.5635029  0.0643324  0.1196165  0.17303333 -0.0978604
## C3   0.0440089 -0.0939414 -0.0152378  0.0345225  0.05573555 -0.0347123
## C4  -0.0198096 -0.3473013  0.3343377  0.3484637  0.09143374  0.3337070
## C5   0.2121406  0.2034753 -0.4171268  0.1591331 -0.03033331  0.0319833
```
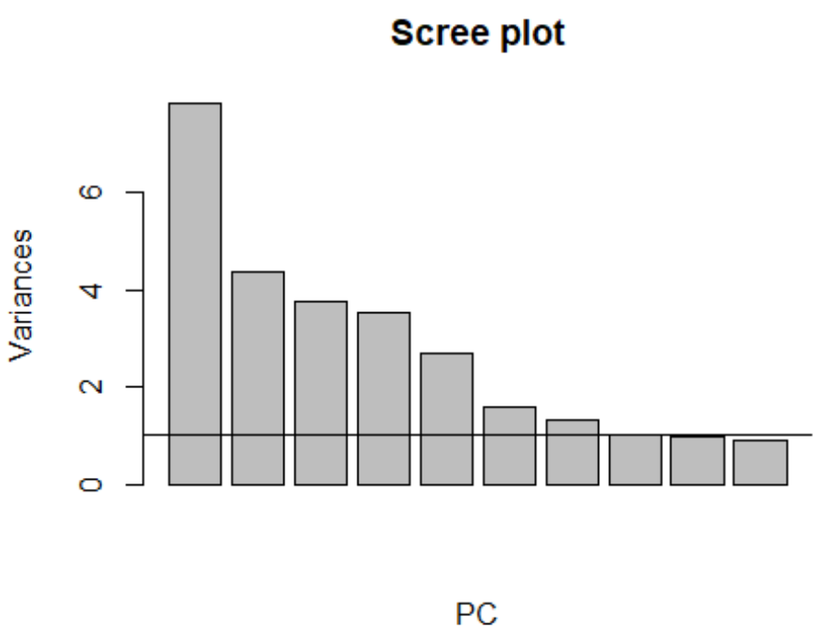

```
## C6   0.0572847 -0.4204827 -0.4346260 -0.2338160 -0.20155729 -0.0688165
## C7   0.0459602 -0.0443826 -0.0938952  0.1047703 -0.03071006  0.0225680
## C8   0.1959744  0.1824399 -0.2058665  0.0319093  0.00117393 -0.0478191
## C9  -0.0935835 -0.1195437  0.3566204 -0.1973977 -0.05155897 -0.0554038
## C10 -0.0233616  0.0784716 -0.0264039 -0.0362111 -0.05170378  0.0334964
## O1   0.0134728 -0.0150704 -0.0224624  0.1006712  0.01648857 -0.0374670
## O2   0.0338514  0.0841758 -0.0667731 -0.0672677 -0.02781388 -0.0416053
## O3   0.0112330 -0.0647067 -0.0680918 -0.0324106 -0.22114415 -0.2712250
## O4   0.0018821 -0.0535381  0.0271751  0.0422326  0.03242923  0.0625936
## O5  -0.0219836  0.0552547  0.0201968 -0.0227852  0.00549500  0.0745827
## O6  -0.0638334 -0.0613993 -0.0127348 -0.0329347 -0.22763107 -0.2210800
## O7   0.1157910  0.0038674  0.1124046 -0.0120758 -0.08728034  0.0114508
## O8  -0.0078964  0.0021858 -0.0291938 -0.1666845  0.02225432  0.0985947
## O9   0.1242071 -0.0119733 -0.0641712  0.0098957  0.03770608  0.1122985
## O10 -0.0695809 -0.0191694  0.0244740  0.0102363 -0.03969902 -0.0225643
##           PC37       PC38        PC39         PC40       PC41        PC42
## E1  -0.1444691 -0.1294472 -0.07133854  0.180466442  0.0102107  0.15235520
## E2   0.1990487 -0.0469094 -0.07880957  0.110660381 -0.2014348 -0.55249358
## E3  -0.0369149 -0.0435657  0.22425386 -0.282854655 -0.0228867  0.06618277
## E4  -0.5071603 -0.4279485 -0.23113695  0.172274076 -0.1417739  0.22109892
## E5  -0.0904610 -0.0515087  0.01147442 -0.314535310  0.0597570 -0.14433856
## E6  -0.0203180  0.1428868  0.15364999 -0.235879328  0.2873958  0.36734215
## E7  -0.1028008 -0.2043227 -0.08251224 -0.128139767  0.0013899 -0.25768921
## E8   0.2414194  0.3028845  0.01071599  0.186657199 -0.0310803  0.08755002
## E9   0.0901373  0.2274078 -0.07891783  0.200132171 -0.1021284  0.11011010
## E10 -0.1344598 -0.0584594  0.15709909 -0.463522549  0.0838749 -0.15731545
## N1   0.0879758  0.0655069  0.09012745 -0.191574088 -0.6528053  0.18846385
## N2   0.1362476 -0.0148389  0.01651985  0.098966014 -0.0999181 -0.00457579
## N3   0.0496316 -0.0528051 -0.04019623  0.200937085  0.4305699 -0.11309376
## N4   0.1266777 -0.0982692  0.04192081 -0.070843228  0.0422985  0.00068913
## N5   0.0414859 -0.0280083  0.06275611  0.007935377 -0.0584615 -0.03014605
## N6  -0.0263935 -0.0589160 -0.04801067  0.131129408  0.1520679 -0.07494856
## N7  -0.0923884  0.1107203  0.04161574  0.087305128 -0.1141836 -0.00751935
## N9  -0.1021145  0.0544504 -0.10508641  0.029007600  0.1871832 -0.03197753
## N10  0.3168869 -0.2567017  0.15247165 -0.216595088  0.0539712  0.04940640
## A1  -0.0104190  0.0507824  0.06634024  0.031886699 -0.0211554 -0.04587577
## A2   0.0511945  0.0841414 -0.02403004  0.152805861  0.0908335  0.22143485
## A3   0.1396909 -0.0841531  0.03189897 -0.015703807 -0.1256827  0.01044742
## A4  -0.0491560 -0.0653986  0.01595431 -0.117801218  0.0274247  0.04290626
## A5   0.0899931 -0.1505503 -0.10058562  0.011777428  0.0863005 -0.12608189
## A6   0.0343891  0.0889896  0.00219796  0.039142565 -0.0741025 -0.04406663
## A7  -0.0636190  0.1054870  0.00058848 -0.062837085  0.0329893  0.26853088
## A8  -0.0352956 -0.0273370  0.01164613  0.010917452  0.0158255  0.00144473
## A9   0.0708754 -0.0708785 -0.05376717  0.016464015  0.0187193 -0.06976594
## A10  0.0627785  0.0511436 -0.01599338  0.067821300 -0.0153262  0.00512976
## C1   0.0423808 -0.0129658 -0.04244616  0.005251056  0.0971087 -0.07405741
## C2   0.0273638  0.1523377  0.11554372 -0.000086055  0.1093585 -0.03397883
## C3   0.0031582  0.0026603  0.01941890 -0.003284319 -0.0789311  0.05171537
## C4   0.0994583  0.1572056 -0.01291929 -0.013523436  0.0875161 -0.02946610
## C5   0.0934586  0.0038132  0.07239712  0.078800023 -0.0303175  0.04228084
## C6   0.0071796 -0.3030932 -0.05950518  0.076801080 -0.1547021  0.03535540
```

```
## C7   0.0274599 -0.0653063  0.04208201 -0.031717433  0.0448591 -0.00018455
## C8   0.0063895  0.0078835  0.01129081  0.008445439  0.0010343 -0.01089059
## C9  -0.0299734  0.0326904 -0.04065407  0.057830324 -0.0921634  0.00408200
## C10  0.0161941  0.0055768  0.04577751  0.015908079 -0.0073514 -0.01439399
## O1   0.0210850 -0.0456520  0.04691832 -0.025898234  0.0227331  0.07798204
## O2   0.1202112  0.1450586 -0.62306121 -0.276845503  0.0056747  0.06189190
## O3  -0.3642352  0.3306376  0.07364960 -0.029054120 -0.0656744 -0.18615385
## O4  -0.0212666 -0.1195721  0.49036015  0.217833940 -0.0314622 -0.07302743
## O5  -0.0600215 -0.0481535  0.07464643  0.013354843  0.0780498  0.14806834
## O6  -0.4301388  0.3216696  0.05554285 -0.002484530 -0.0656184 -0.19877695
## O7   0.0463524  0.0485676 -0.26737348 -0.146945047 -0.0592220  0.00556116
## O8   0.0024454  0.0458898 -0.05359359  0.028935625  0.0267060 -0.05044327
## O9   0.0147011 -0.0095652  0.01497715  0.031113050 -0.0442850  0.05268906
## O10 -0.0166321  0.0915171  0.00854012 -0.070303317 -0.0037764 -0.12248765
##           PC43        PC44       PC45        PC46       PC47       PC48
## E1  -0.1833953 -0.00876835  0.0373579  0.07618897 -0.0652677 -0.0325934
## E2  -0.3365257 -0.19180334 -0.0664974 -0.00196103 -0.0394161  0.0623879
## E3  -0.4528640  0.40246943 -0.3666734  0.15109232 -0.1670969 -0.0376133
## E4   0.0620790  0.02822626 -0.0362734  0.05895011 -0.0540944 -0.0500425
## E5   0.0097836 -0.47292038  0.3085801 -0.03521666 -0.1338392  0.0469119
## E6   0.2500935  0.06127394  0.1065768  0.02585194  0.0061593 -0.0961443
## E7   0.3038190 -0.04358494 -0.0054480 -0.02654229  0.1699795  0.0703347
## E8   0.0343925  0.04468484  0.0621476 -0.03837396  0.0290225  0.0224303
## E9   0.1529577 -0.02474276  0.0725847 -0.04822996  0.0988981  0.0037808
## E10  0.0348810 -0.10224036  0.1081556  0.03489512 -0.0210711  0.0509798
## N1   0.1678135 -0.01541733  0.0467724 -0.00099434 -0.0487142  0.0309837
## N2   0.1484457 -0.02333981  0.0978599  0.00020919 -0.0011565 -0.0137718
## N3  -0.0559212  0.00912854 -0.0584347  0.00644997 -0.0013235 -0.0695698
## N4   0.0268826 -0.00111044  0.0048525 -0.03654529 -0.0185101 -0.0082676
## N5   0.0032562 -0.00368131 -0.0514168  0.01748748  0.0240874 -0.0476288
## N6  -0.1576921  0.20904200  0.5310971  0.32407719 -0.0016787  0.1660520
## N7  -0.1173060  0.03190649  0.0777642 -0.05841275  0.0301582 -0.1343687
## N9   0.1531903 -0.22713835 -0.5122758 -0.23350370  0.0350725 -0.0794092
## N10  0.0575762  0.03469979 -0.0787869 -0.08342666  0.0015032  0.0529709
## A1   0.0006942  0.05479557  0.0043948 -0.02800087  0.0678729  0.0157748
## A2  -0.0390163 -0.31984543 -0.0221667  0.12328709 -0.0058446  0.1224000
## A3  -0.0520575  0.07268048  0.0735869  0.00456126  0.0732881 -0.0296225
## A4  -0.1392992  0.07311255  0.0029044 -0.08049255  0.6730046  0.2322999
## A5   0.1460390  0.24028193  0.0522943 -0.13894599  0.0728258 -0.0343453
## A6  -0.0055835 -0.10784490 -0.1221002 -0.04930186 -0.0237736 -0.0319794
## A7  -0.3110979 -0.44091992 -0.0944401  0.27322603 -0.0141691  0.1368931
## A8   0.0073955  0.01099535 -0.0068885 -0.04441041 -0.0063029 -0.0242888
## A9   0.1658525  0.06013078  0.0445490  0.06021956 -0.5406347 -0.2149580
## A10  0.0417844  0.04341876 -0.0177622  0.00533428  0.0501291  0.0043092
## C1   0.0892930 -0.00572982 -0.0177166  0.01950512  0.0084794  0.0049534
## C2   0.0279133  0.05964661 -0.0056204  0.01328876 -0.0104011  0.0028680
## C3   0.0031438 -0.00322386  0.0058889 -0.00105357  0.0182673  0.0171323
## C4  -0.0921195 -0.00086986  0.0064498 -0.06380160 -0.0958998  0.0116169
## C5  -0.0073112 -0.00982128 -0.1086533 -0.05460835  0.0050020 -0.0038719
## C6  -0.0103949 -0.06752558 -0.0836643 -0.03663149  0.0367595 -0.0106186
## C7  -0.0049607  0.00195171 -0.0067979  0.03069488 -0.0585481  0.0020537
```

```
## C8  -0.0140633 -0.00888075 -0.0309384 -0.03147228  0.0057776 -0.0211740
## C9  -0.0525341  0.02630575  0.0496323 -0.01481388  0.0606381  0.0026229
## C10 -0.0150879 -0.00074673  0.0291968 -0.01411586 -0.0068498 -0.0178809
## O1  -0.2333983 -0.08091074  0.1844722 -0.22783698  0.1342352 -0.5472346
## O2  -0.1070466  0.10636645 -0.0076676 -0.02831946 -0.0156292 -0.0246849
## O3  -0.0110398  0.07825582  0.0100716 -0.15281608 -0.0578214  0.0810920
## O4   0.0926215 -0.09777416 -0.0148341  0.07856210  0.0220779  0.0252384
## O5  -0.1323455  0.06607009  0.1041055 -0.47397601 -0.1772384  0.2988560
## O6   0.0207606  0.10708247  0.0248477 -0.05635307  0.0015436 -0.0685427
## O7   0.0157539 -0.00113453  0.0085259  0.05458067  0.0042240  0.0218860
## O8   0.1908510  0.12191319 -0.1903447  0.24918395 -0.1263597  0.4904428
## O9  -0.0327695  0.02985400 -0.0008676  0.01449470 -0.0110781  0.0115438
## O10  0.1481002  0.00995842 -0.1258067  0.52678343  0.2196352 -0.3562414
##            PC49
## E1   0.29615243
## E2   0.05294309
## E3  -0.01103261
## E4   0.06723288
## E5   0.46698334
## E6   0.06404074
## E7  -0.61980339
## E8   0.02017150
## E9   0.01793120
## E10 -0.05837815
## N1   0.00963651
## N2   0.00155298
## N3  -0.01880631
## N4  -0.00206700
## N5   0.00508486
## N6  -0.11188572
## N7  -0.00499226
## N9   0.10713074
## N10  0.00397105
## A1   0.00802223
## A2  -0.13747021
## A3  -0.02410293
## A4   0.14378777
## A5   0.18467385
## A6   0.00391184
## A7  -0.33048769
## A8  -0.00508646
## A9  -0.11440905
## A10 -0.03377543
## C1  -0.00988325
## C2   0.00765779
## C3  -0.00014173
## C4   0.01394212
## C5   0.02910390
## C6   0.00310071
## C7   0.00019351
## C8  -0.00425769
```

```
## C9  -0.00855663
## C10 -0.00393125
## O1  -0.14252532
## O2  -0.02476072
## O3  -0.04725766
## O4   0.02456866
## O5  -0.11692353
## O6  -0.01325674
## O7   0.02518264
## O8   0.14362541
## O9   0.01412246
## O10  0.10799850
```

```
# Check the scree plot
plot(p, main="Scree plot", xlab="PC")
#when we use the abline() one zero that's creating a horizontal line at #one, and so, if we looked at this , we can look at nine or 10 components and so.
abline(1,0)
```



Check the PCA summary function
for the cummulative proportional variances of the different pcs.

```
summary(p)
```

```
## Importance of components:
##                           PC1    PC2    PC3    PC4    PC5    PC6   PC7    PC8
## Standard deviation     2.80 2.0867 1.9359 1.8837 1.6398 1.2563 1.151 1.0026
## Proportion of Variance 0.16 0.0889 0.0765 0.0724 0.0549 0.0322 0.027 0.0205
## Cumulative Proportion  0.16 0.2488 0.3253 0.3977 0.4526 0.4848 0.512 0.5324
##                           PC9   PC10   PC11   PC12   PC13   PC14   PC15
PC16
## Standard deviation     0.9817 0.9575 0.9468 0.9248 0.9071 0.8964 0.8839
```

```
0.856
## Proportion of Variance 0.0197 0.0187 0.0183 0.0175 0.0168 0.0164 0.0159
0.015
## Cumulative Proportion  0.5520 0.5707 0.5890 0.6065 0.6233 0.6397 0.6556
0.671
##                           PC17   PC18   PC19   PC20  PC21   PC22   PC23
PC24
## Standard deviation     0.8488 0.8397 0.8148 0.8135 0.797 0.7887 0.7785
0.765
## Proportion of Variance 0.0147 0.0144 0.0135 0.0135 0.013 0.0127 0.0124
0.012
## Cumulative Proportion  0.6853 0.6997 0.7132 0.7267 0.740 0.7524 0.7648
0.777
##                           PC25   PC26   PC27   PC28   PC29   PC30   PC31
PC32
## Standard deviation     0.7597 0.7521 0.7429 0.7316 0.7239 0.7096 0.7088
0.69915
## Proportion of Variance 0.0118 0.0115 0.0113 0.0109 0.0107 0.0103 0.0102
0.00998
## Cumulative Proportion  0.7885 0.8000 0.8113 0.8222 0.8329 0.8432 0.8534
0.86342
##                           PC33    PC34    PC35    PC36    PC37    PC38
PC39
## Standard deviation     0.69799 0.68716 0.66921 0.66799 0.65960 0.64937
0.64482
## Proportion of Variance 0.00994 0.00964 0.00914 0.00911 0.00888 0.00861
0.00849
## Cumulative Proportion  0.87336 0.88300 0.89214 0.90125 0.91012 0.91873
0.92722
##                           PC40   PC41    PC42    PC43    PC44   PC45
PC46
## Standard deviation     0.63508 0.6301 0.61614 0.60971 0.60295 0.5896
0.58605
## Proportion of Variance 0.00823 0.0081 0.00775 0.00759 0.00742 0.0071
0.00701
## Cumulative Proportion  0.93545 0.9435 0.95130 0.95888 0.96630 0.9734
0.98041
##                           PC47    PC48    PC49
## Standard deviation     0.57028 0.56833 0.55842
## Proportion of Variance 0.00664 0.00659 0.00636
## Cumulative Proportion  0.98704 0.99364 1.00000
```

The Psych package has a wonderful PCA function that allows many more options including build-in factor rotation, specifiying a number of factors to include and automatic "score" generation

#Best Way to Conduct PCA Analysis # Since there are cross loading at 0.43, #increased the cutoff point to 0.436

```
p2 = psych::principal(likeditems, rotate="varimax", nfactors=4, scores=TRUE)
print(p2$loadings, cutoff=.436, sort=T)
```

```
##
## Loadings:
##     RC1    RC2    RC3    RC4
## E1   0.631
## E2  -0.670
## E3   0.704
## E4  -0.654
## E5   0.736
## E6  -0.595
## E7   0.721
## E8  -0.505
## E9   0.554
## E10 -0.613
## A2   0.603
## A7  -0.619
## A10  0.508
## N1          0.681
## N3          0.675
## N5          0.516
## N6          0.689
## N7          0.576
## N9          0.558
## N10         0.612
## C1                  0.528
## C4                 -0.548
## C5                  0.564
## C6                 -0.535
## C8                 -0.530
## C9                  0.565
## O1                         0.656
## O2                        -0.602
## O3                         0.578
## O4                        -0.520
## O5                         0.639
## O6                        -0.547
## O7                         0.554
## O8                         0.618
## O10                        0.702
## N2         -0.484
## N4
## A1
## A3                 -0.487
## A4   0.441
## A5  -0.485
## A6
## A8
## A9   0.461
## C2                 -0.474
## C3
## C7                  0.486
## C10                 0.443
```

```
## O9
##
##                  RC1   RC2   RC3   RC4
## SS loadings    6.457 4.786 4.390 3.856
## Proportion Var 0.132 0.098 0.090 0.079
## Cumulative Var 0.132 0.229 0.319 0.398
```

#Removing all the irrelevant variables

```
likeditemsWithReducedVars <- likeditems
likeditemsWithReducedVars$N4 <- NULL
likeditemsWithReducedVars$A1 <- NULL
likeditemsWithReducedVars$A6 <- NULL
likeditemsWithReducedVars$A8 <- NULL
likeditemsWithReducedVars$C3 <- NULL
likeditemsWithReducedVars$O9 <- NULL
```

#Running PCA again after removing the irrelevant variables

```
p3 = psych::principal(likeditemsWithReducedVars, rotate="varimax", nfactors=4,
scores=TRUE)
print(p3$loadings, cutoff=.4, sort=T)
```

```
##
## Loadings:
##     RC1    RC2    RC4    RC3
## E1   0.652
## E2  -0.690
## E3   0.717
## E4  -0.675
## E5   0.759
## E6  -0.608
## E7   0.742
## E8  -0.528
## E9   0.578
## E10 -0.631
## A2   0.594
## A7  -0.602
## A10  0.503
## N1          0.739
## N2         -0.548
## N3          0.714
## N5          0.567
## N6          0.748
## N7          0.631
## N9          0.649
## N10         0.616
## C1                  0.592
## C2                 -0.543
## C4                 -0.592
## C5                  0.638
## C6                 -0.600
## C7                  0.547
```

```
## C8                -0.564
## C9                 0.638
## O1                        0.657
## O2                       -0.610
## O3                        0.590
## O4                       -0.526
## O5                        0.649
## O6                       -0.567
## O7                        0.559
## O8                        0.618
## O10                       0.712
## A3                -0.429
## A4   0.404
## A5  -0.458
## A9   0.435
## C10                0.484
##
##                  RC1   RC2   RC4   RC3
## SS loadings    6.176 4.353 3.983 3.651
## Proportion Var 0.144 0.101 0.093 0.085
## Cumulative Var 0.144 0.245 0.337 0.422
```

PCAS Other useful available information

```
ls(p3)
```

```
##  [1] "Call"         "chi"          "communality"  "complexity"   "criteria"
##  [6] "dof"          "EPVAL"        "factors"      "fit"          "fit.off"
## [11] "fn"           "loadings"     "n.obs"        "null.dof"
"null.model"
## [16] "objective"    "PVAL"         "r.scores"     "R2"           "residual"
## [21] "rms"          "rot.mat"      "rotation"     "scores"
"STATISTIC"
## [26] "Structure"    "uniquenesses" "Vaccounted"   "values"       "weights"
```

Show the eigen values

```
p3$values
```

```
##  [1] 7.52349 4.13785 3.37155 3.12970 2.43648 1.38099 1.29398 0.96474
0.90315
## [10] 0.87651 0.85259 0.79426 0.73834 0.72613 0.70082 0.69236 0.65734
0.63255
## [19] 0.61455 0.59979 0.57174 0.55366 0.54698 0.53033 0.51417 0.50053
0.49197
## [28] 0.47836 0.46020 0.45452 0.43902 0.42559 0.41799 0.40531 0.40028
0.38277
## [37] 0.37229 0.36800 0.35088 0.34512 0.32764 0.32354 0.31195
```

#This tells me automatically that there are 7 components with eigen values greater than 1

```
table(p3$values > 1)
```

```
##
## FALSE  TRUE
##    36     7
```

#Shows the shared variances amongst the variables

```
p3$communality
```

```
##      E1      E2      E3      E4      E5      E6      E7      E8      E9
E10
## 0.45060 0.48817 0.60080 0.50995 0.59692 0.43756 0.57366 0.32507 0.38346
0.46550
##      N1      N2      N3      N5      N6      N7      N9     N10      A2
A3
## 0.56172 0.32004 0.51703 0.37114 0.59279 0.46389 0.48087 0.48485 0.39642
0.21540
##      A4      A5      A7      A9     A10      C1      C2      C4      C5
C6
## 0.37139 0.31487 0.42370 0.39616 0.33133 0.38760 0.33759 0.49651 0.42401
0.40332
##      C7      C8      C9     C10      O1      O2      O3      O4      O5
O6
## 0.31472 0.36603 0.41334 0.30863 0.43403 0.41456 0.38157 0.28352 0.46965
0.33999
##      O7      O8     O10
## 0.36961 0.40377 0.54082
```

Shows the rotation matrix used to take the data from being correlated to making it uncorrelated

```
p3$rot.mat
```

```
##           [,1]     [,2]     [,3]     [,4]
## [1,]  0.789472  0.43741 -0.27618 -0.33034
## [2,] -0.534325  0.60163  0.12080 -0.58133
## [3,]  0.288889 -0.26927  0.84117 -0.36941
## [4,]  0.088163  0.61172  0.44895  0.64534
```

#Calculating scores # Using the score function that the principal component analysis has so in that regard, if we do p3$scores, # because we use the principal function out of sight and create a temporary variable called scores, # were we now have all scores for each of the four components for each

```
scores <- p3$scores
```

#what we want to do here is we ultimately want to see #are these components really interdependent on each other or #are they collinear dependent on each other, #so the way that we can check that is by doing the correlation of the scores, and because I used.

```
cor(scores)
```

```
##                          RC1                       RC2
RC4
## RC1 1.00000000000000000000  0.00000000000000017216
0.00000000000000043266
## RC2 0.00000000000000172162  1.00000000000000000000
0.00000000000000635754
```

```
## RC4 0.00000000000000043266  0.00000000000000063575
1.00000000000000000000
## RC3 0.00000000000000375905 -0.00000000000000030725 -
0.00000000000000705696
##                            RC3
## RC1  0.00000000000000037591
## RC2 -0.00000000000000030725
## RC4 -0.00000000000000070570
## RC3  1.00000000000000000000
```

by doing this we feel confident that these components
are not sharing information
And then end up using them in a linear regression we'd be confident that we no longer have any multicollinearity
like we would, if we tried to put those individual variables that we use as inputs for the principal component analysis
separately in as as a linear regression.
The minimum score for component 1 is 3.5 standard deviation below the mean
The maximum score for component 1 is 2.7 standard deviation above the mean

```
scores_1 <- scores[,1]
min_score <- min(scores_1)
min_score
```

```
## [1] -3.5208
```

```
max_score <- max(scores_1)
max_score
```

```
## [1] 2.7341
```

five number summary for your scores from component 1

```
summary(scores_1)
```

```
##    Min. 1st Qu.  Median    Mean 3rd Qu.    Max.
## -3.5208 -0.6859  0.0377  0.0000  0.7374  2.7341
```

Calculate the scores for component 2
Use scores_2 to show the five number summary for the scores from component 2

```
scores_2 <- scores[,2]
summary(scores_2)
```

```
##    Min. 1st Qu.  Median    Mean 3rd Qu.    Max.
##  -4.404  -0.704   0.018   0.000   0.722   2.839
```

The minimum score for component 2 is 4.4 standard deviation below the mean
The maximum score for component 2 is 2.8 standard deviation above the mean

#Calculate the scores for component 3 #Use scores_3 to show the five number summary for the scores from component 3

```
scores_3 <- scores[,3]
summary(scores_3)
```

```
##    Min. 1st Qu.  Median    Mean 3rd Qu.    Max.
## -4.0972 -0.6779  0.0208  0.0000  0.6902  3.0389
```

The minimum score for component 3 is 4.1 standard deviation below the mean
The maximum score for component 3 is 3.0 standard deviation above the mean

#Calculate the scores for component 3 #Use scores_4 to show the five number summary for the scores from component 4

```
scores_4 <- scores[,4]
summary(scores_4)

##    Min. 1st Qu.  Median    Mean 3rd Qu.    Max.
## -4.3223 -0.6552  0.0648  0.0000  0.7505  2.2881
```

The minimum score for component 4 is 4.3 standard deviation below the mean
The maximum score for component 4 is 2.3 standard deviation above the mean

#Summary of the overall scores

```
summary(scores)

##       RC1                RC2                RC4                RC3
##  Min.   :-3.5208   Min.   :-4.404   Min.   :-4.0972   Min.   :-4.3223
##  1st Qu.:-0.6859   1st Qu.:-0.704   1st Qu.:-0.6779   1st Qu.:-0.6552
##  Median : 0.0377   Median : 0.018   Median : 0.0208   Median : 0.0648
##  Mean   : 0.0000   Mean   : 0.000   Mean   : 0.0000   Mean   : 0.0000
##  3rd Qu.: 0.7374   3rd Qu.: 0.722   3rd Qu.: 0.6902   3rd Qu.: 0.7505
##  Max.   : 2.7341   Max.   : 2.839   Max.   : 3.0389   Max.   : 2.2881
```

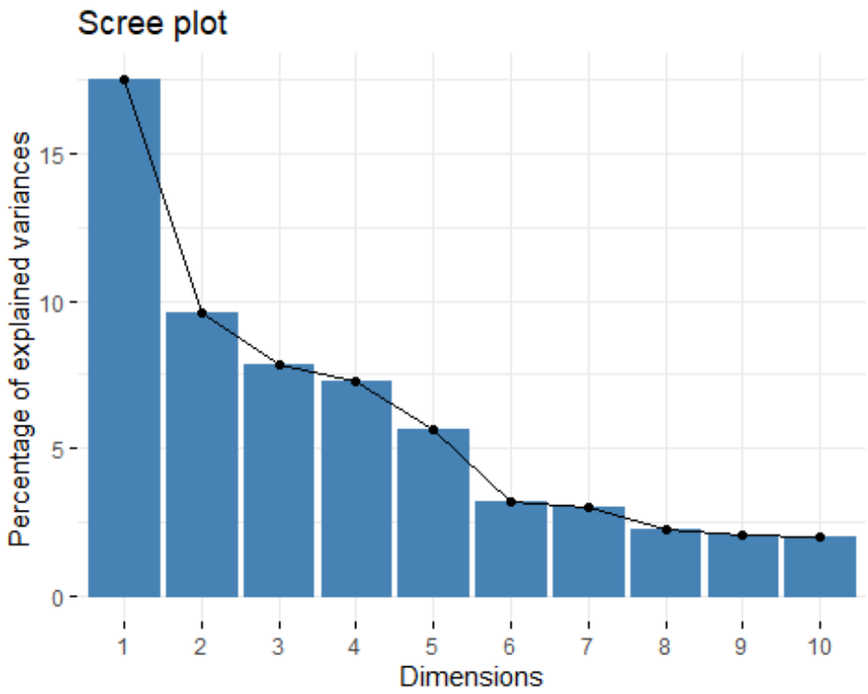
Conducting factor analysis

```
fit = factanal(likeditems, 4)
print(fit$loadings, cuttoff=0.4, sort=T)

##
## Loadings:
##     Factor1 Factor2 Factor3 Factor4
## E1   0.664
## E2  -0.681          -0.108
## E3   0.657  -0.279   0.255
## E4  -0.701   0.133
## E5   0.723           0.224
## E6  -0.576          -0.136  -0.223
## E7   0.735           0.156
## E8  -0.557
## E9   0.604                   0.119
## E10 -0.657   0.166
## N1  -0.157   0.632   0.137
## N3  -0.182   0.544   0.238
## N5           0.539          -0.126
## N6  -0.116   0.703   0.102
## N7           0.652
## N9  -0.113   0.656
## N10 -0.273   0.610
```

```
## C4            0.555  -0.134
## A2   0.370           0.500
## A4                   0.768
## A5  -0.171          -0.615
## A6            0.116  0.604
## A7  -0.347          -0.572
## A8   0.140           0.577
## A9   0.118           0.710
## O1                          0.579
## O2            0.176        -0.528
## O3            0.152         0.522
## O5   0.188                 0.622
## O7           -0.189         0.506
## O8            0.114 -0.121  0.533
## O10  0.188                 0.683
## N2   0.157 -0.442
## N4   0.147 -0.333
## A1                  -0.399
## A3            0.321 -0.406
## A10  0.338 -0.174   0.397  0.112
## C1           -0.336  0.147  0.177
## C2   0.115   0.320
## C3           -0.156  0.184  0.296
## C5           -0.336  0.209
## C6            0.397 -0.119
## C7  -0.114 -0.152   0.166
## C8            0.392 -0.233
## C9           -0.234  0.242
## C10          -0.199  0.172  0.273
## O4                         -0.447
## O6  -0.114                 -0.497
## O9  -0.140   0.148  0.193  0.339
##
##                Factor1 Factor2 Factor3 Factor4
## SS loadings      5.147   4.565   3.880   3.214
## Proportion Var   0.105   0.093   0.079   0.066
## Cumulative Var   0.105   0.198   0.277   0.343
```

#Using Factorextra

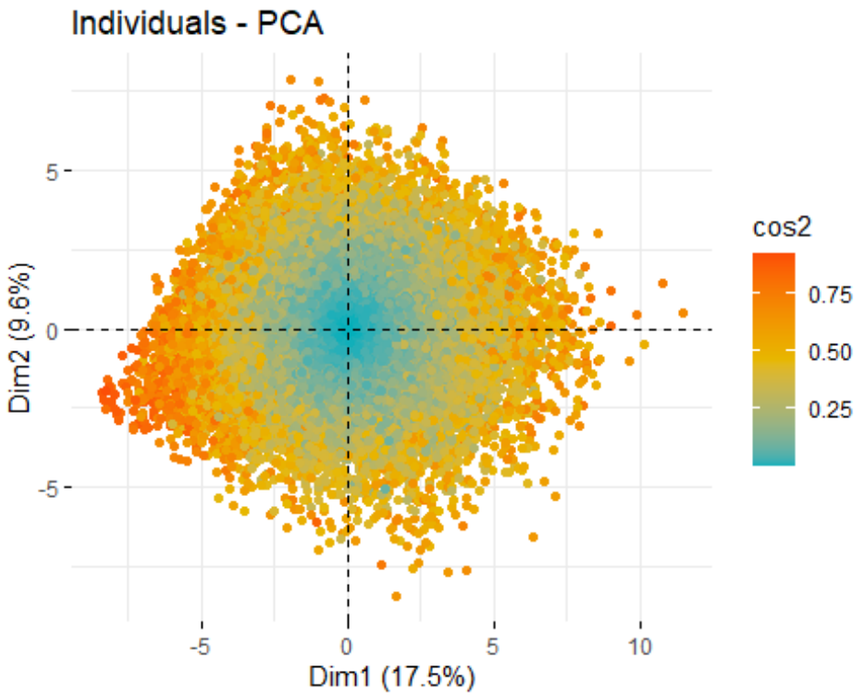
```
library(factoextra)

p3 <- prcomp(likeditemsWithReducedVars, scale = TRUE)
fviz_eig(p3)
```



#PCA Individuals

```
pI<-fviz_pca_ind(p3,
                 col.ind = "cos2", # Color by the quality of representation
                 gradient.cols = c("#00AFBB", "#E7B800", "#FC4E07"),
                 repel = TRUE     # Avoid text overlapping
)
pI
```

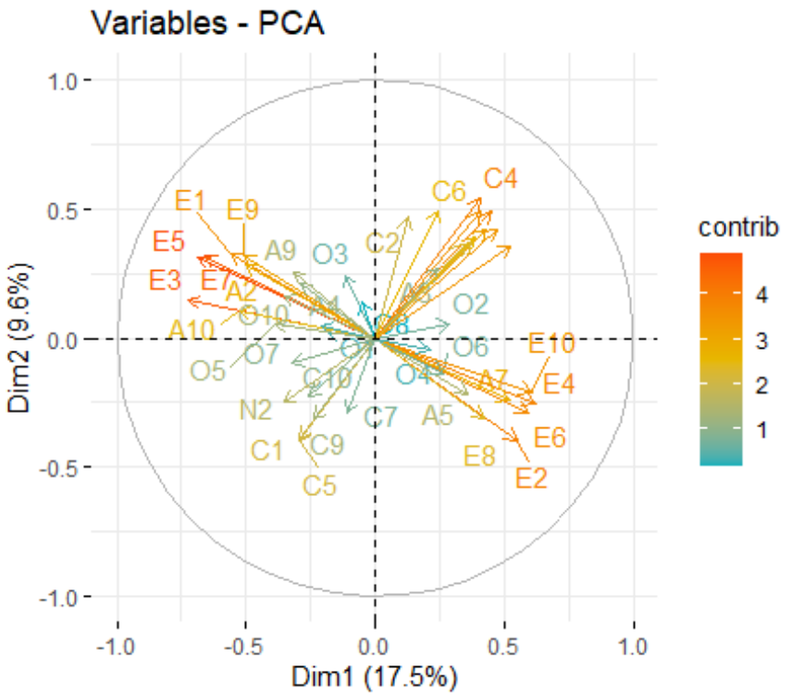
```
## Warning: ggrepel: 19719 unlabeled data points (too many overlaps). Consider
## increasing max.overlaps
```



#PCA Variables

```
pca_var<-fviz_pca_var(p3,
                      col.var = "contrib", # Color by contributions to the PC
                      gradient.cols = c("#00AFBB", "#E7B800", "#FC4E07"),
                      repel = TRUE     # Avoid text overlapping
)

pca_var
```

```
## Warning: ggrepel: 8 unlabeled data points (too many overlaps). Consider
## increasing max.overlaps
```

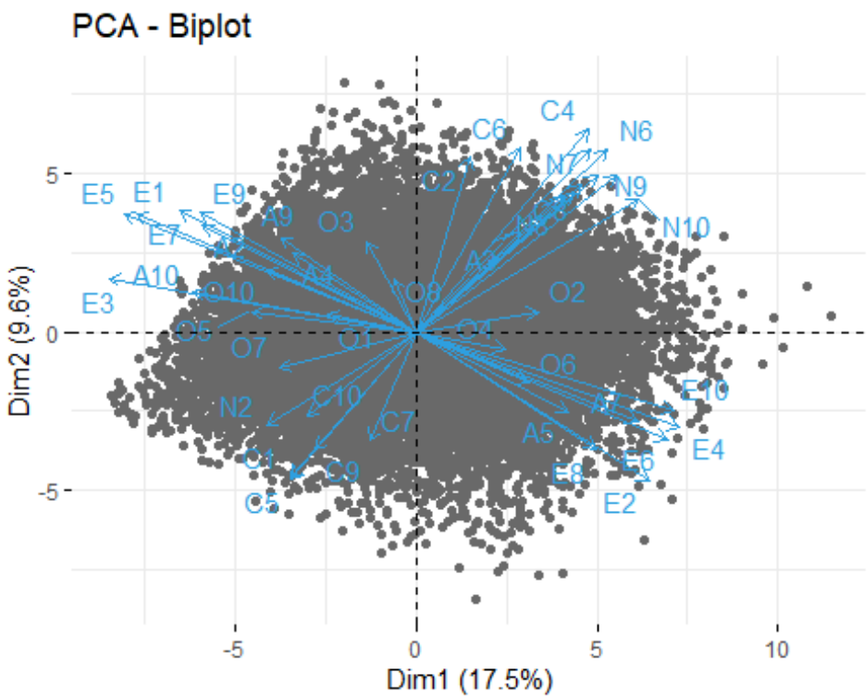


#Biplot

```
bi_plot<-fviz_pca_biplot(p3, repel = TRUE,
                         col.var = "#2E9FDF", # Variables color
                         col.ind = "#696969"  # Individuals color
)
bi_plot
```

```
## Warning: ggrepel: 19719 unlabeled data points (too many overlaps). Consider
## increasing max.overlaps
```

```
## Warning: ggrepel: 2 unlabeled data points (too many overlaps). Consider
## increasing max.overlaps
```



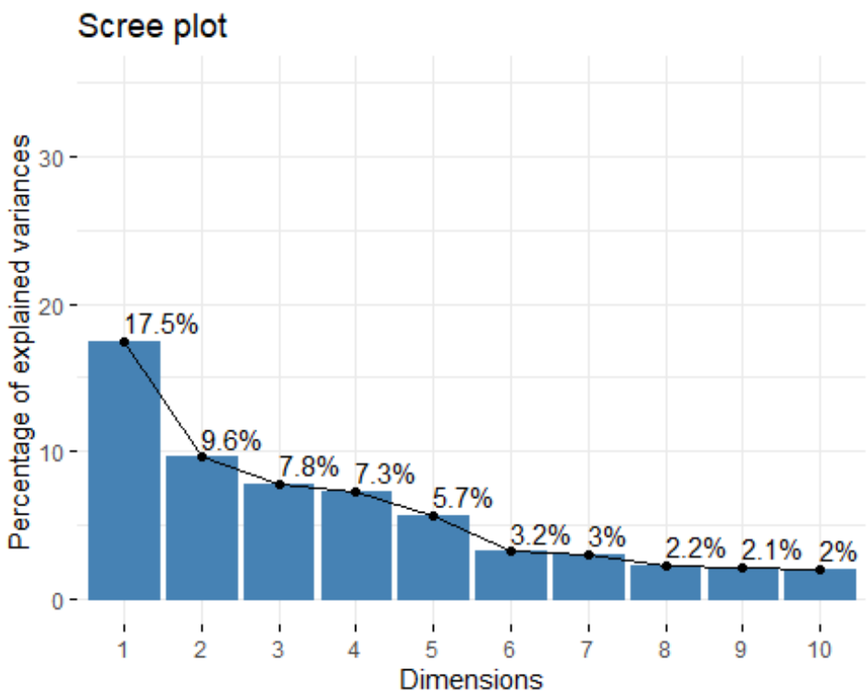
#IF graph is set to true, it will provide the individual and variable maps

```
p4 <- PCA(likeditemsWithReducedVars, graph = FALSE)
#Shows all the objects or functions available in PCA
print(p4)
```

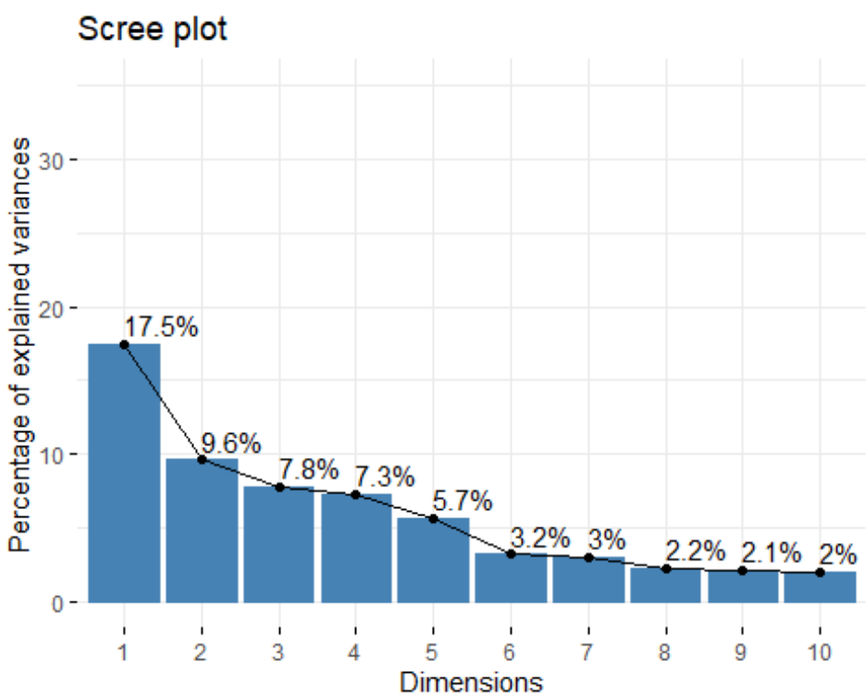
```
## **Results for the Principal Component Analysis (PCA)**
## The analysis was performed on 19719 individuals, described by 43 variables
## *The results are available in the following objects:
##
##    name               description
## 1  "$eig"             "eigenvalues"
## 2  "$var"             "results for the variables"
## 3  "$var$coord"       "coord. for the variables"
## 4  "$var$cor"         "correlations variables - dimensions"
## 5  "$var$cos2"        "cos2 for the variables"
## 6  "$var$contrib"     "contributions of the variables"
## 7  "$ind"             "results for the individuals"
## 8  "$ind$coord"       "coord. for the individuals"
## 9  "$ind$cos2"        "cos2 for the individuals"
## 10 "$ind$contrib"     "contributions of the individuals"
## 11 "$call"            "summary statistics"
## 12 "$call$centre"     "mean of the variables"
## 13 "$call$ecart.type" "standard error of the variables"
## 14 "$call$row.w"      "weights for the individuals"
## 15 "$call$col.w"      "weights for the variables"
```

#Options for providing screeplot

```
fviz_eig(p4, addlabels = TRUE, ylim = c(0, 35))
```




```
fviz_screeplot(p4, addlabels = TRUE, ylim = c(0, 35))
```



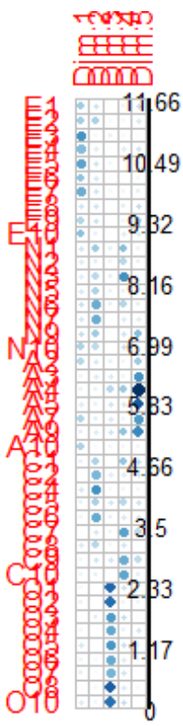
#Which variables contibute the most to the PCs? #there are ll variables

```
variables <- get_pca_var(p4)
head(variables$contrib, 11)
```

```
##       Dim.1   Dim.2    Dim.3     Dim.4   Dim.5
## E1  4.1342 2.53563 0.195461 0.8964160 2.62910
## E2  3.9895 3.84026 0.381687 0.5191059 1.94919
```

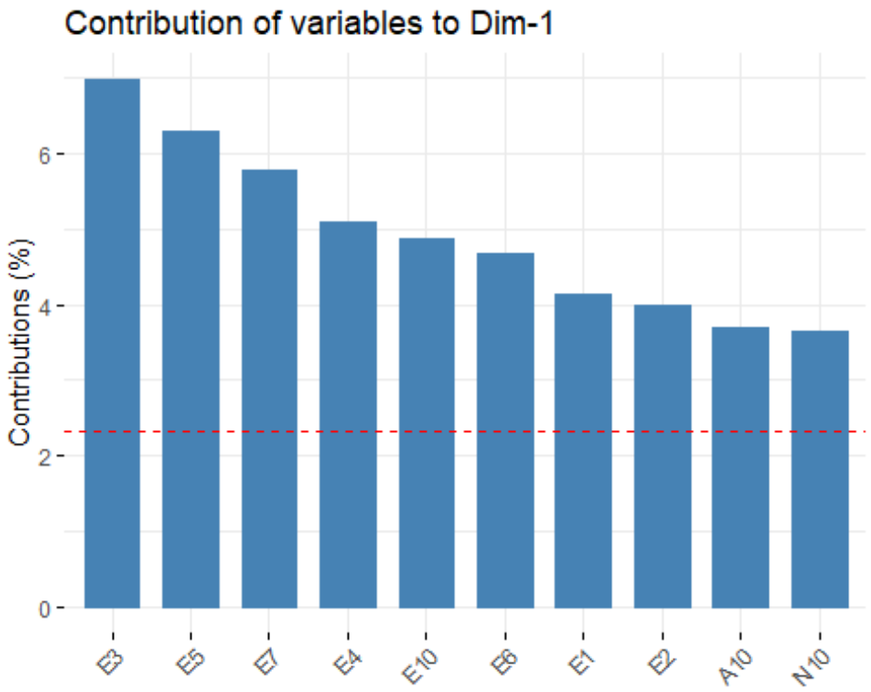
```
## E3  6.9743 0.49955 1.158004 0.5234490 0.13456
## E4  5.0974 1.58878 0.297135 1.6196212 2.53795
## E5  6.2911 2.40533 0.637193 0.0830185 1.21823
## E6  4.6650 2.02714 0.078493 0.0019838 0.60740
## E7  5.7722 2.40492 0.574952 0.6549411 1.45992
## E8  2.3801 2.38313 0.017592 1.4953827 2.92309
## E9  3.4392 2.46201 0.017523 0.7107344 3.30967
## E10 4.8734 1.07612 0.159015 1.5642642 1.62758
## N1  2.4186 4.27515 1.400432 4.9729099 0.89350
```

```
library("corrplot")
corrplot(variables$contrib, is.corr=FALSE)
```

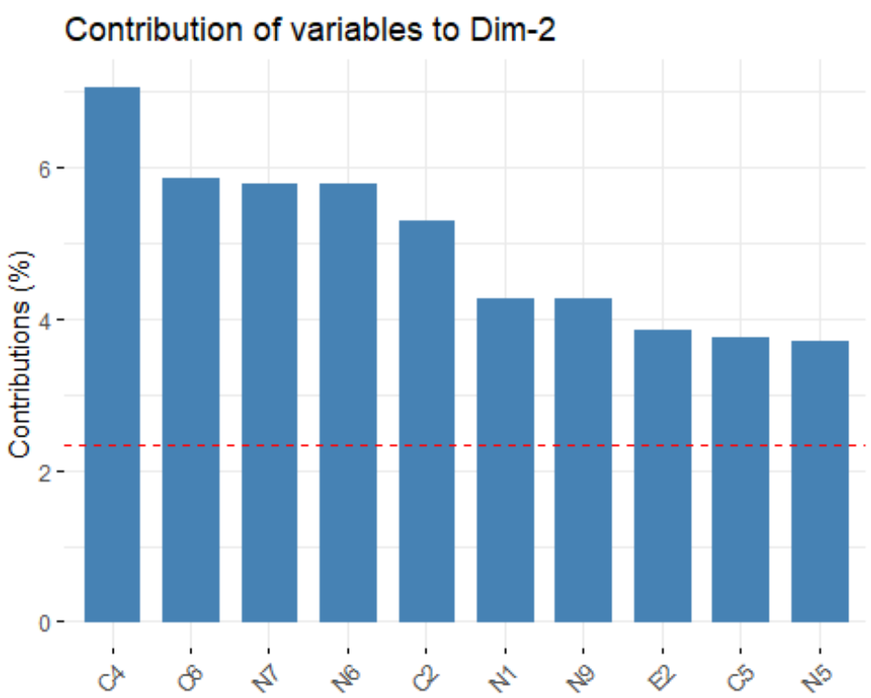


Contributions of variables to PC1

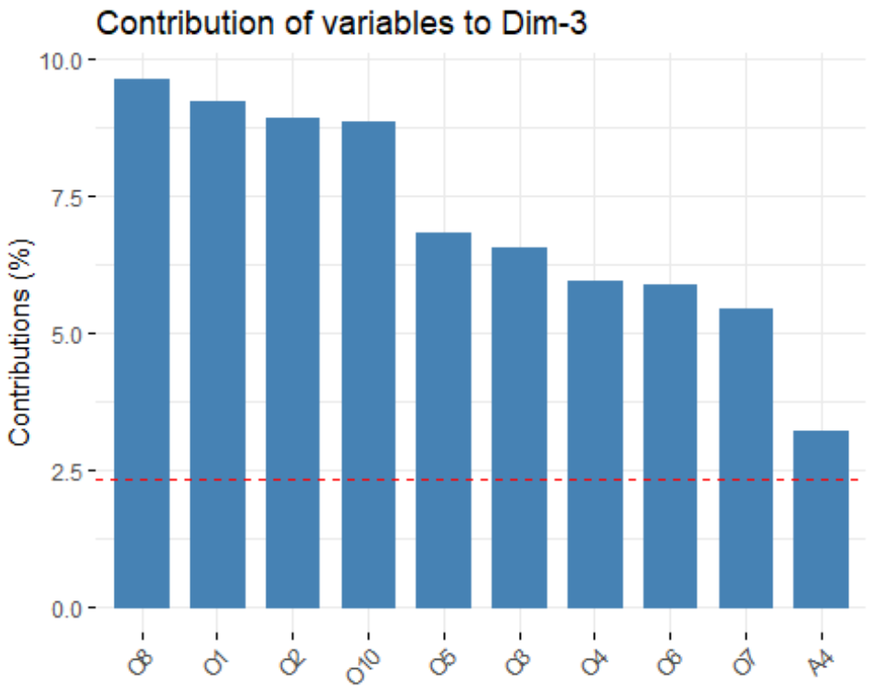
```
fviz_contrib(p4, choice = "var", axes = 1, top = 10)
```



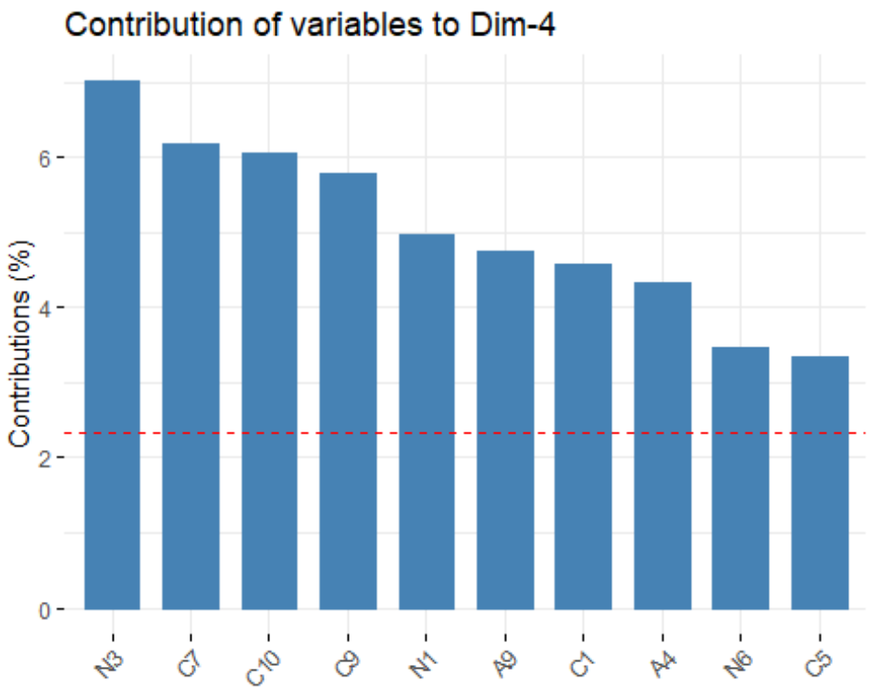

```r
# Contributions of variables to PC2
fviz_contrib(p4, choice = "var", axes = 2, top = 10)
```




```r
# Contributions of variables to PC3
fviz_contrib(p4, choice = "var", axes = 3, top = 10)
```



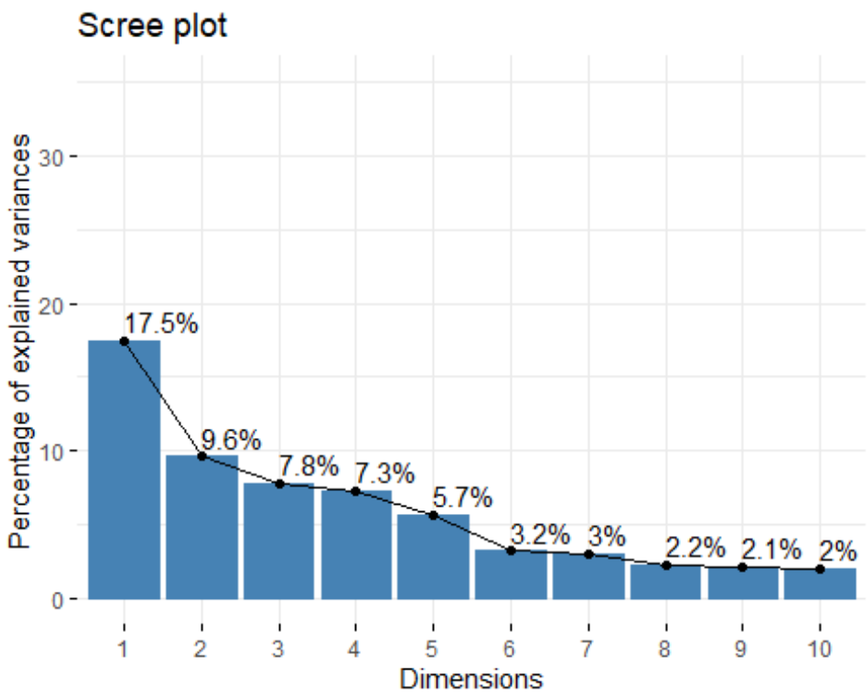

```r
# Contributions of variables to PC4
fviz_contrib(p4, choice = "var", axes = 4, top = 10)
```



#Scree plot visualization with the number of #components kept in teh result

```r
library(ade4)
p5 <- dudi.pca(likeditemsWithReducedVars,
               scannf = FALSE,   # Hide scree plot
               nf = 3            # Number of components kept in the results
```

```
)
fviz_screeplot(p5, addlabels = TRUE, ylim = c(0, 35))
```



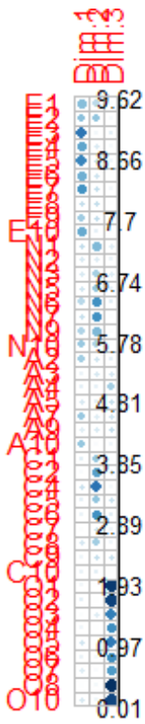

```
variables2 <- get_pca_var(p5)
```

#Which variables contibute the most to the PCs? #there are ll variables

```
head(variables2$contrib, 11)
```

```
##       Dim.1   Dim.2    Dim.3
## E1   4.1342 2.53563 0.195461
## E2   3.9895 3.84026 0.381687
## E3   6.9743 0.49955 1.158004
## E4   5.0974 1.58878 0.297135
## E5   6.2911 2.40533 0.637193
## E6   4.6650 2.02714 0.078493
## E7   5.7722 2.40492 0.574952
## E8   2.3801 2.38313 0.017592
## E9   3.4392 2.46201 0.017523
## E10 4.8734 1.07612 0.159015
## N1   2.4186 4.27515 1.400432
```

```
library("corrplot")
corrplot(variables2$contrib, is.corr=FALSE)
```


9.62
8.66
7.7
6.74
5.78
4.81
3.85
2.89
1.93
0.97
0.01