R Notebook

This is an R Markdown Notebook. When you execute code within the notebook, the results appear beneath the code.

Try executing this chunk by clicking the *Run* button within the chunk or by placing your cursor inside it and pressing *Ctrl+Shift+Enter*.

```
#install necessary publishing packages
Sys.unsetenv("http_proxy")
Sys.unsetenv("https_proxy")


#install.packages('tinytex')
#tinytex::install_tinytex(force = TRUE)


#tinytex:::is_tinytex()
#tinytex::tlmgr_path()
```

```
library(readr)
cerealDRO <- read_csv("D:/Prasanna/Personal/Learning/Other Reads/GL/Course Material/Advanced Statistics/
```

```
## Parsed with column specification:
## cols(
##   .default = col_double(),
##   Cereals = col_character()
## )
```

```
## See spec(...) for full column specifications.
```

```
View(cerealDRO)
summary(cerealDRO)
```

```
##    Cereals             Filling         Natural          Fibre
##  Length:235         Min.   :1.000   Min.   :1.000   Min.   :1.000
##  Class :character   1st Qu.:3.000   1st Qu.:3.000   1st Qu.:3.000
##  Mode  :character   Median :4.000   Median :4.000   Median :4.000
##                     Mean   :3.881   Mean   :3.783   Mean   :3.528
##                     3rd Qu.:4.500   3rd Qu.:4.000   3rd Qu.:4.000
##                     Max.   :5.000   Max.   :5.000   Max.   :5.000
##      Sweet            Easy            Salt         Satisfying
##  Min.   :1.000   Min.   :1.000   Min.   :1.000   Min.   :2.000
##  1st Qu.:2.000   1st Qu.:4.000   1st Qu.:1.000   1st Qu.:3.000
##  Median :2.000   Median :5.000   Median :2.000   Median :4.000
##  Mean   :2.506   Mean   :4.532   Mean   :1.991   Mean   :4.004
##  3rd Qu.:3.000   3rd Qu.:5.000   3rd Qu.:3.000   3rd Qu.:5.000
##  Max.   :5.000   Max.   :6.000   Max.   :4.000   Max.   :6.000
##      Energy            Fun             Kids           Soggy
##  Min.   :1.000   Min.   :1.000   Min.   :1.000   Min.   :1.000
##  1st Qu.:3.000   1st Qu.:2.000   1st Qu.:3.000   1st Qu.:1.000
```

```
##  Median :4.000   Median :2.000   Median :4.000   Median :2.000
##  Mean   :3.643   Mean   :2.617   Mean   :3.843   Mean   :2.255
##  3rd Qu.:4.000   3rd Qu.:3.000   3rd Qu.:5.000   3rd Qu.:3.000
##  Max.   :5.000   Max.   :5.000   Max.   :6.000   Max.   :5.000
##    Economical        Health          Family        Calories
##  Min.   :1.000   Min.   :1.000   Min.   :1.000   Min.   :1.000
##  1st Qu.:3.000   1st Qu.:3.000   1st Qu.:3.000   1st Qu.:2.000
##  Median :3.000   Median :4.000   Median :4.000   Median :3.000
##  Mean   :3.217   Mean   :3.809   Mean   :3.877   Mean   :2.702
##  3rd Qu.:4.000   3rd Qu.:4.000   3rd Qu.:5.000   3rd Qu.:3.000
##  Max.   :5.000   Max.   :5.000   Max.   :6.000   Max.   :5.000
##      Plain           Crisp           Regular         Sugar
##  Min.   :1.000   Min.   :1.000   Min.   :1.000   Min.   :1.000
##  1st Qu.:1.000   1st Qu.:2.000   1st Qu.:2.000   1st Qu.:1.000
##  Median :2.000   Median :3.000   Median :3.000   Median :2.000
##  Mean   :2.268   Mean   :3.204   Mean   :3.072   Mean   :2.145
##  3rd Qu.:3.000   3rd Qu.:4.000   3rd Qu.:4.000   3rd Qu.:3.000
##  Max.   :5.000   Max.   :6.000   Max.   :5.000   Max.   :5.000
##      Fruit          Process         Quality         Treat
##  Min.   :1.000   Min.   :1.000   Min.   :1.000   Min.   :1.00
##  1st Qu.:1.000   1st Qu.:2.000   1st Qu.:3.000   1st Qu.:2.00
##  Median :1.000   Median :3.000   Median :4.000   Median :3.00
##  Mean   :1.694   Mean   :2.936   Mean   :3.694   Mean   :2.63
##  3rd Qu.:3.000   3rd Qu.:4.000   3rd Qu.:4.000   3rd Qu.:3.00
##  Max.   :5.000   Max.   :6.000   Max.   :5.000   Max.   :6.00
##      Boring       Nutritious
##  Min.   :1.00   Min.   :1.000
##  1st Qu.:1.00   1st Qu.:3.000
##  Median :2.00   Median :4.000
##  Mean   :1.83   Mean   :3.664
##  3rd Qu.:2.00   3rd Qu.:4.000
##  Max.   :5.00   Max.   :5.000
```

```
head(cerealDRO)
```

```
## # A tibble: 6 x 26
##   Cereals Filling Natural Fibre Sweet  Easy  Salt Satisfying Energy   Fun
##   <chr>     <dbl>   <dbl> <dbl> <dbl> <dbl> <dbl>      <dbl>  <dbl> <dbl>
## 1 Weetab~       5       5     5     1     2     1          5      4     1
## 2 Specia~       1       2     2     1     5     2          5      1     1
## 3 Specia~       5       4     5     5     5     3          5      5     5
## 4 CMuesli       5       5     5     3     5     2          5      5     5
## 5 CornFl~       4       5     3     2     5     2          5      4     5
## 6 RiceBu~       4       4     4     2     5     2          5      4     5
## # ... with 16 more variables: Kids <dbl>, Soggy <dbl>, Economical <dbl>,
## #   Health <dbl>, Family <dbl>, Calories <dbl>, Plain <dbl>, Crisp <dbl>,
## #   Regular <dbl>, Sugar <dbl>, Fruit <dbl>, Process <dbl>, Quality <dbl>,
## #   Treat <dbl>, Boring <dbl>, Nutritious <dbl>
```

```
tail(cerealDRO)
```

```
## # A tibble: 6 x 26
##   Cereals Filling Natural Fibre Sweet  Easy  Salt Satisfying Energy   Fun
```

```
##   <chr>     <dbl>   <dbl> <dbl> <dbl> <dbl> <dbl>      <dbl>  <dbl> <dbl>
## 1 PMuesli       4       4     4     3     4     2          4      3     2
## 2 Weetab~       3       4     4     1     4     2          3      3     2
## 3 PMuesli       5       4     4     3     4     3          4      4     4
## 4 Weetab~       4       4     4     1     4     1          4      4     3
## 5 Specia~       3       3     3     3     4     2          3      3     2
## 6 Weetab~       4       4     4     1     4     1          4      3     2
## # ... with 16 more variables: Kids <dbl>, Soggy <dbl>, Economical <dbl>,
## #   Health <dbl>, Family <dbl>, Calories <dbl>, Plain <dbl>, Crisp <dbl>,
## #   Regular <dbl>, Sugar <dbl>, Fruit <dbl>, Process <dbl>, Quality <dbl>,
## #   Treat <dbl>, Boring <dbl>, Nutritious <dbl>
```

```
# Some data transformations as likert scale exceeds  5 point scale and has a value of 6
cerealDRO[cerealDRO==6]<- 5
cerealDRO
```

```
## # A tibble: 235 x 26
##    Cereals Filling Natural Fibre Sweet  Easy  Salt Satisfying Energy   Fun
##    <chr>     <dbl>   <dbl> <dbl> <dbl> <dbl> <dbl>      <dbl>  <dbl> <dbl>
##  1 Weetab~       5       5     5     1     2     1          5      4     1
##  2 Specia~       1       2     2     1     5     2          5      1     1
##  3 Specia~       5       4     5     5     5     3          5      5     5
##  4 CMuesli       5       5     5     3     5     2          5      5     5
##  5 CornFl~       4       5     3     2     5     2          5      4     5
##  6 RiceBu~       4       4     4     2     5     2          5      4     5
##  7 Specia~       4       4     3     2     5     1          5      5     5
##  8 Specia~       4       3     3     2     5     1          5      4     4
##  9 RiceBu~       4       3     3     2     5     1          5      4     4
## 10 CornFl~       4       3     3     2     5     1          5      4     4
## # ... with 225 more rows, and 16 more variables: Kids <dbl>, Soggy <dbl>,
## #   Economical <dbl>, Health <dbl>, Family <dbl>, Calories <dbl>,
## #   Plain <dbl>, Crisp <dbl>, Regular <dbl>, Sugar <dbl>, Fruit <dbl>,
## #   Process <dbl>, Quality <dbl>, Treat <dbl>, Boring <dbl>,
## #   Nutritious <dbl>
```

```
cerealDR<-cerealDRO[-1]


attach(cerealDR)
```

```
# perform certain tests on the data to find if
# ** Sample is adequate - using KMO test of sample adequecy
# ** Dimensionality reduction possible - barlett test of Sphericity

library(psych)
```

```
## Warning: package 'psych' was built under R version 3.6.1
```

```
cerealKMO <- KMO(cerealDR)
cerealKMO
```

```
## Kaiser-Meyer-Olkin factor adequacy
```

```
## Call: KMO(r = cerealDR)
## Overall MSA =  0.85
## MSA for each item =
##    Filling    Natural      Fibre      Sweet       Easy       Salt
##       0.89       0.90       0.88       0.78       0.83       0.82
## Satisfying     Energy        Fun       Kids      Soggy Economical
##       0.91       0.91       0.85       0.67       0.63       0.73
##     Health     Family   Calories      Plain      Crisp    Regular
##       0.92       0.73       0.86       0.82       0.83       0.87
##      Sugar      Fruit    Process    Quality      Treat     Boring
##       0.78       0.77       0.80       0.91       0.88       0.87
## Nutritious
##       0.92
```

```
cerealCor <- round(cor(cerealDR),2)
cerealBartlett <- cortest.bartlett(cerealCor, n = nrow(cerealDR0))
cerealBartlett
```

```
## $chisq
## [1] 2878.65
##
## $p.value
## [1] 0
##
## $df
## [1] 300
```

```
library(corrplot)
```

```
## Warning: package 'corrplot' was built under R version 3.6.1
```

```
## corrplot 0.84 loaded
```

```
# Find out of pca can be applied based  on the cor between variables and corrplot

# decide number of fctors by using scree plot
names(cerealDR)
```

```
##  [1] "Filling"    "Natural"    "Fibre"      "Sweet"      "Easy"
##  [6] "Salt"       "Satisfying" "Energy"     "Fun"        "Kids"
## [11] "Soggy"      "Economical" "Health"     "Family"     "Calories"
## [16] "Plain"      "Crisp"      "Regular"    "Sugar"      "Fruit"
## [21] "Process"    "Quality"    "Treat"      "Boring"     "Nutritious"
```

```
cor(cerealDR)
```

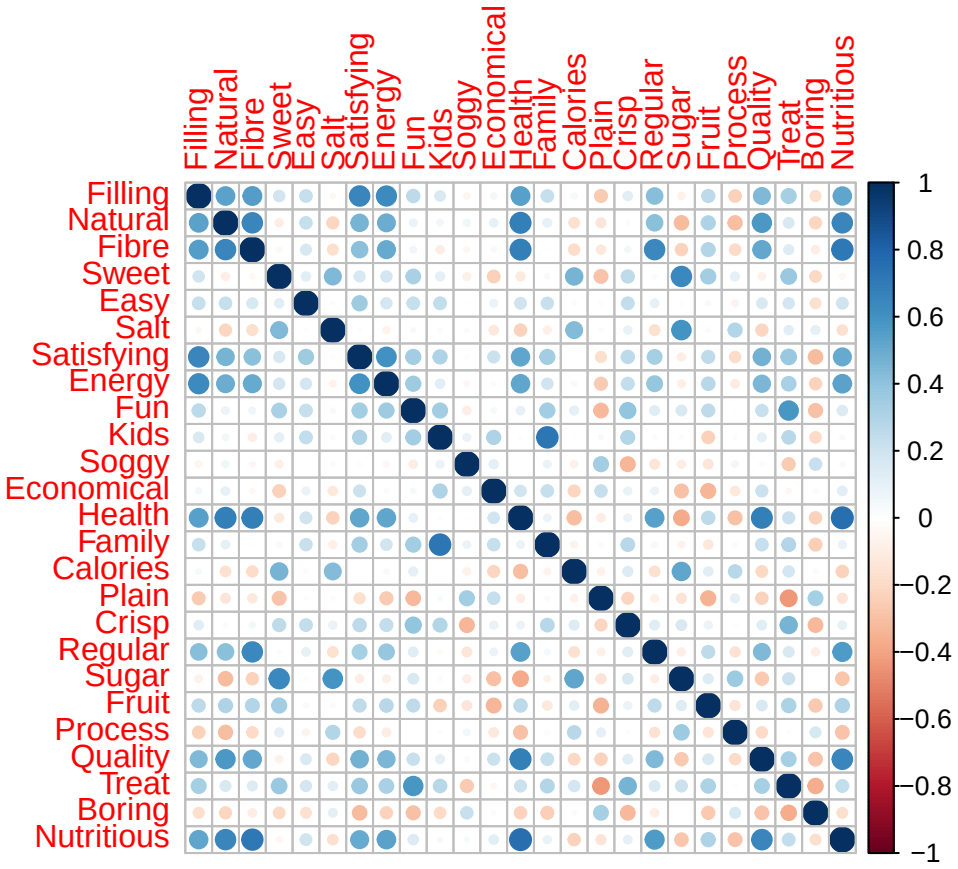
```
##                Filling     Natural        Fibre       Sweet         Easy
## Filling     1.00000000  0.53968982  0.552003065  0.19040004  0.237430844
## Natural     0.53968982  1.00000000  0.652289828 -0.09094192  0.231200127
## Fibre       0.55200307  0.65228983  1.000000000 -0.03739830  0.175859374
## Sweet       0.19040004 -0.09094192 -0.037398300  1.00000000  0.124736166
```

```
## Easy        0.23743084  0.23120013  0.175859374  0.12473617  1.000000000
## Salt       -0.03626646 -0.21687200 -0.174887993  0.44399118  0.013718595
## Satisfying  0.65415162  0.46649207  0.414854460  0.17953203  0.351409453
## Energy      0.63675882  0.49354159  0.503730689  0.18496133  0.181689577
## Fun         0.26521397  0.08190321  0.062730827  0.32722313  0.239504083
## Kids        0.16032166  0.05971495 -0.093404569  0.11908175  0.242728223
## Soggy      -0.05988555  0.06839973 -0.041667404 -0.08375192 -0.007683385
## Economical  0.05194244  0.10316137 -0.033965332 -0.23981376  0.089328985
## Health      0.54706871  0.68809770  0.683983690 -0.11562213  0.204213278
## Family      0.23367398  0.10674234 -0.008412267  0.03853504  0.225122821
## Calories    0.04721422 -0.16167366 -0.186542023  0.46731243 -0.022805607
## Plain      -0.25064803 -0.13851302 -0.122845902 -0.28955897  0.019140316
## Crisp       0.12687526  0.02080611  0.050527459  0.25981733  0.240631080
## Regular     0.42049880  0.41763842  0.648375681 -0.02518025  0.106329931
## Sugar      -0.07851945 -0.31680448 -0.225567250  0.64838267 -0.015639984
## Fruit       0.26116604  0.30015027  0.293141065  0.34650542  0.035884483
## Process    -0.23419509 -0.30805266 -0.194892706  0.11450985 -0.066393291
## Quality     0.44321697  0.57909956  0.513193764 -0.07754712  0.164648484
## Treat       0.33983991  0.16989309  0.142593245  0.37467405  0.184731541
## Boring     -0.17785084 -0.21758679 -0.099258673 -0.20033406 -0.169705127
## Nutritious  0.52621459  0.65072607  0.713064954 -0.04716005  0.204448721
##                   Salt   Satisfying      Energy          Fun         Kids
## Filling    -0.03626646  0.654151625  0.63675882  0.265213973  0.160321662
## Natural    -0.21687200  0.466492067  0.49354159  0.081903207  0.059714946
## Fibre      -0.17488799  0.414854460  0.50373069  0.062730827 -0.093404569
## Sweet       0.44399118  0.179532033  0.18496133  0.327223134  0.119081748
## Easy        0.01371860  0.351409453  0.18168958  0.239504083  0.242728223
## Salt        1.00000000 -0.012745988 -0.06713581  0.033474536  0.024483803
## Satisfying -0.01274599  1.000000000  0.60343285  0.348331252  0.302769921
## Energy     -0.06713581  0.603432845  1.00000000  0.350327368  0.129792406
## Fun         0.03347454  0.348331252  0.35032737  1.000000000  0.344943414
## Kids        0.02448380  0.302769921  0.12979241  0.344943414  1.000000000
## Soggy       0.02359707 -0.013261427 -0.04592438 -0.098754958  0.088859520
## Economical -0.12590486  0.212175296  0.02641362  0.040700477  0.303934597
## Health     -0.22837678  0.522089653  0.52424330  0.100955593 -0.013620606
## Family     -0.08943424  0.345222020  0.19090292  0.347184634  0.724116120
## Calories    0.43809745  0.005358204  0.03362541  0.113449859  0.009721636
## Plain       0.02137203 -0.179957988 -0.25577344 -0.322275476  0.030241379
## Crisp       0.09550574  0.264086144  0.24855721  0.398694869  0.293709966
## Regular    -0.16453021  0.331811073  0.38571918  0.136731512 -0.025734500
## Sugar       0.59177089 -0.091413804 -0.08606954  0.165290744 -0.022348181
## Fruit       0.02557426  0.254831721  0.27438372  0.251421273 -0.234295492
## Process     0.29832766 -0.187033511 -0.10393584 -0.009329038  0.013964254
## Quality    -0.21785225  0.471768623  0.45703627  0.224503157  0.111778573
## Treat       0.12062176  0.370353239  0.32363505  0.584648136  0.275914643
## Boring      0.11223148 -0.319654672 -0.22338882 -0.298063613 -0.195340193
## Nutritious -0.16009606  0.501680164  0.53577674  0.155230301  0.033247503
##                   Soggy  Economical       Health       Family     Calories
## Filling    -0.059885555  0.05194244  0.547068708  0.233673983  0.047214217
## Natural     0.068399728  0.10316137  0.688097695  0.106742337 -0.161673661
## Fibre      -0.041667404 -0.03396533  0.683983690 -0.008412267 -0.186542023
## Sweet      -0.083751919 -0.23981376 -0.115622126  0.038535041  0.467312428
## Easy       -0.007683385  0.08932898  0.204213278  0.225122821 -0.022805607
## Salt        0.023597066 -0.12590486 -0.228376777 -0.089434239  0.438097454
```

```
## Satisfying -0.013261427  0.21217530  0.522089653  0.345222020  0.005358204
## Energy     -0.045924383  0.02641362  0.524243298  0.190902922  0.033625413
## Fun        -0.098754958  0.04070048  0.100955593  0.347184634  0.113449859
## Kids        0.088859520  0.30393460 -0.013620606  0.724116120  0.009721636
## Soggy       1.000000000  0.11715122  0.006146656  0.082666210 -0.079664961
## Economical  0.117151217  1.00000000  0.192658638  0.231987240 -0.210471442
## Health      0.006146656  0.19265864  1.000000000  0.081719400 -0.307176155
## Family      0.082666210  0.23198724  0.081719400  1.000000000 -0.066136936
## Calories   -0.079664961 -0.21047144 -0.307176155 -0.066136936  1.000000000
## Plain       0.346129827  0.23120114 -0.099609317 -0.028206729 -0.076190855
## Crisp      -0.337141180  0.09084745  0.082185293  0.279076456  0.143389460
## Regular    -0.137300090  0.08029354  0.543222577  0.044234462 -0.164908655
## Sugar      -0.094456381 -0.29255416 -0.376892968 -0.061661312  0.525826174
## Fruit      -0.137035700 -0.33848391  0.266341061 -0.125689029  0.125937859
## Process     0.059960688 -0.12910943 -0.292763907 -0.027407092  0.271275078
## Quality    -0.029808614  0.21549364  0.686304848  0.236893992 -0.201350145
## Treat      -0.256086894 -0.04241349  0.215207088  0.290905323  0.189949931
## Boring      0.226885825 -0.02137835 -0.228589063 -0.249748195 -0.027015687
## Nutritious  0.032786390  0.12902808  0.757614796  0.091035941 -0.226340067
##                   Plain       Crisp     Regular        Sugar       Fruit
## Filling    -0.25064803  0.12687526  0.42049880 -0.078519448  0.26116604
## Natural    -0.13851302  0.02080611  0.41763842 -0.316804483  0.30015027
## Fibre      -0.12284590  0.05052746  0.64837568 -0.225567250  0.29314106
## Sweet      -0.28955897  0.25981733 -0.02518025  0.648382667  0.34650542
## Easy        0.01914032  0.24063108  0.10632993 -0.015639984  0.03588448
## Salt        0.02137203  0.09550574 -0.16453021  0.591770895  0.02557426
## Satisfying -0.17995799  0.26408614  0.33181107 -0.091413804  0.25483172
## Energy     -0.25577344  0.24855721  0.38571918 -0.086069535  0.27438372
## Fun        -0.32227548  0.39869487  0.13673151  0.165290744  0.25142127
## Kids        0.03024138  0.29370997 -0.02573450 -0.022348181 -0.23429549
## Soggy       0.34612983 -0.33714118 -0.13730009 -0.094456381 -0.13703570
## Economical  0.23120114  0.09084745  0.08029354 -0.292554157 -0.33848391
## Health     -0.09960932  0.08218529  0.54322258 -0.376892968  0.26634106
## Family     -0.02820673  0.27907646  0.04423446 -0.061661312 -0.12568903
## Calories   -0.07619086  0.14338946 -0.16490865  0.525826174  0.12593786
## Plain       1.00000000 -0.21020347 -0.08026008 -0.146856923 -0.34308629
## Crisp      -0.21020347  1.00000000  0.13442586  0.163766199  0.08983357
## Regular    -0.08026008  0.13442586  1.00000000 -0.090571672  0.25474509
## Sugar      -0.14685692  0.16376620 -0.09057167  1.000000000  0.14533048
## Fruit      -0.34308629  0.08983357  0.25474509  0.145330476  1.00000000
## Process     0.11507418  0.01001031 -0.15015168  0.365692112 -0.14246201
## Quality    -0.22690816  0.13014529  0.44147633 -0.263389434  0.16460384
## Treat      -0.43243767  0.46023136  0.16807989  0.212715048  0.31404638
## Boring      0.33052554 -0.32640996 -0.09469787 -0.000921067 -0.26006170
## Nutritious -0.14491592  0.10308733  0.56777612 -0.274637388  0.30605745
##                 Process     Quality       Treat       Boring  Nutritious
## Filling    -0.234195089  0.44321697  0.33983991 -0.177850835  0.52621459
## Natural    -0.308052665  0.57909956  0.16989309 -0.217586787  0.65072607
## Fibre      -0.194892706  0.51319376  0.14259324 -0.099258673  0.71306495
## Sweet       0.114509852 -0.07754712  0.37467405 -0.200334059 -0.04716005
## Easy       -0.066393291  0.16464848  0.18473154 -0.169705127  0.20444872
## Salt        0.298327658 -0.21785225  0.12062176  0.112231476 -0.16009606
## Satisfying -0.187033511  0.47176862  0.37035324 -0.319654672  0.50168016
## Energy     -0.103935835  0.45703627  0.32363505 -0.223388817  0.53577674
```

```
## Fun         -0.009329038  0.22450316  0.58464814 -0.298063613  0.15523030
## Kids         0.013964254  0.11177857  0.27591464 -0.195340193  0.03324750
## Soggy        0.059960688 -0.02980861 -0.25608689  0.226885825  0.03278639
## Economical -0.129109427  0.21549364 -0.04241349 -0.021378353  0.12902808
## Health     -0.292763907  0.68630485  0.21520709 -0.228589063  0.75761480
## Family     -0.027407092  0.23689399  0.29090532 -0.249748195  0.09103594
## Calories    0.271275078 -0.20135015  0.18994993 -0.027015687 -0.22634007
## Plain       0.115074182 -0.22690816 -0.43243767  0.330525544 -0.14491592
## Crisp       0.010010306  0.13014529  0.46023136 -0.326409963  0.10308733
## Regular    -0.150151681  0.44147633  0.16807989 -0.094697872  0.56777612
## Sugar       0.365692112 -0.26338943  0.21271505 -0.000921067 -0.27463739
## Fruit      -0.142462009  0.16460384  0.31404638 -0.260061699  0.30605745
## Process     1.000000000 -0.19001149  0.01515335  0.172489361 -0.28600488
## Quality    -0.190011494  1.00000000  0.33178455 -0.284256014  0.65983453
## Treat       0.015153345  0.33178455  1.00000000 -0.362789133  0.24507215
## Boring      0.172489361 -0.28425601 -0.36278913  1.000000000 -0.17027548
## Nutritious -0.286004881  0.65983453  0.24507215 -0.170275481  1.00000000
```

```
corrplot(cor(cerealDR[,1:25]))
```




```
# determine the eigen vectors , eigen values for factanal


ev_cereal <- eigen(cor(cerealDR))
ev_cereal$values
```

```
##  [1] 6.5104814 3.7921753 2.4942279 1.6821942 1.0856935 0.9450867 0.8532528
##  [8] 0.7910547 0.7326378 0.6977062 0.6481540 0.5507242 0.5314532 0.4874731
## [15] 0.4168149 0.3869282 0.3640988 0.3608730 0.3061363 0.2755866 0.2628312
## [22] 0.2428432 0.2183801 0.1986326 0.1645601
```

```
ev_cereal$vectors
```

```
##              [,1]        [,2]         [,3]         [,4]         [,5]
##  [1,] -0.29285459 -0.05139409  0.045409527 -0.175648940  0.106614756
##  [2,] -0.29384807  0.13150198  0.083040197 -0.100833688  0.138611833
##  [3,] -0.28676859  0.12325577  0.209966110 -0.138184774 -0.155324216
##  [4,] -0.03486923 -0.39831897  0.116796675 -0.143001498  0.154591053
##  [5,] -0.13603565 -0.07291661 -0.170910671 -0.121281672 -0.007026231
##  [6,]  0.08725627 -0.27991620  0.085980305 -0.373389879 -0.126813529
##  [7,] -0.29196256 -0.08223422 -0.107925154 -0.152312576  0.100997940
##  [8,] -0.28531936 -0.06952512  0.045003598 -0.131068073  0.028696506
##  [9,] -0.16114260 -0.27028143 -0.161871944  0.112617668  0.078372162
## [10,] -0.08552043 -0.12885811 -0.497711494 -0.083795548  0.082365615
## [11,]  0.04325508  0.14197831 -0.113098093 -0.445775202  0.479082529
## [12,] -0.06284624  0.14661039 -0.365664977 -0.083323195 -0.236908886
## [13,] -0.31835812  0.16118563  0.079395593 -0.067819269 -0.074382717
## [14,] -0.12427041 -0.09916419 -0.459987956 -0.018756915  0.137393730
## [15,]  0.06717069 -0.32372681  0.110174550 -0.216081155  0.008979861
## [16,]  0.12908891  0.20761248 -0.157870081 -0.373618430 -0.143241202
## [17,] -0.12114750 -0.25169679 -0.170565346  0.185222116 -0.401702990
## [18,] -0.24298554  0.07468047  0.141557209 -0.069080151 -0.380912863
## [19,]  0.09965488 -0.38370090  0.142313814 -0.201216417 -0.095145307
## [20,] -0.15440271 -0.14759467  0.341705163  0.110951866  0.282132033
## [21,]  0.13360770 -0.15469780 -0.003885401 -0.263300887 -0.338965585
## [22,] -0.29457315  0.07984503 -0.023597039  0.009659106 -0.087750860
## [23,] -0.19025098 -0.30172672 -0.059524060  0.150368084 -0.059429586
## [24,]  0.16227646  0.15225240  0.083992978 -0.333826657 -0.157534280
## [25,] -0.31615368  0.11601325  0.101720598 -0.113944917 -0.067841201
##               [,6]         [,7]        [,8]         [,9]        [,10]
##  [1,]  0.009038229  0.232001835 -0.40564065 -0.001396871  0.056356574
##  [2,]  0.056985629  0.012786365  0.05494239 -0.209887304 -0.076729074
##  [3,] -0.010400046 -0.147993546 -0.11939952  0.017489690 -0.177213252
##  [4,]  0.113867163  0.070455816  0.08503921  0.178174996 -0.129890292
##  [5,]  0.667213308 -0.478178111 -0.05484785 -0.162995363  0.248070462
##  [6,]  0.108633229  0.210054344  0.21956446  0.029372130 -0.030735229
##  [7,]  0.124262735  0.182044735 -0.10959549 -0.079050274  0.126774346
##  [8,] -0.128165682  0.111673347 -0.29720319 -0.103775264  0.231035177
##  [9,] -0.174510455 -0.229952078  0.07084376  0.353433117  0.389537622
## [10,] -0.103296954 -0.025064069 -0.13874980  0.050557913 -0.298248970
## [11,] -0.172960659 -0.173112172  0.31068692  0.103462609  0.074472606
## [12,]  0.076357089  0.457954109  0.34927259  0.161852635  0.223018780
## [13,]  0.008823887  0.023322155  0.19281379 -0.074569352  0.016116395
## [14,] -0.199416918 -0.119621435 -0.17177050  0.001844428 -0.368886062
## [15,]  0.043547250  0.279803207 -0.10075852 -0.258828064 -0.024494864
## [16,]  0.232025764 -0.119899560  0.09664799  0.094374742 -0.173444809
## [17,]  0.186209692 -0.032004580  0.02633833  0.061079255  0.002872429
## [18,] -0.075781365 -0.141713807 -0.04687467  0.358736951 -0.344961429
## [19,] -0.006543944 -0.005160841  0.11359068  0.113234835 -0.189833307
## [20,]  0.051179676 -0.184820448  0.18880719  0.178366853 -0.069937477
```

```
## [21,] -0.409388675 -0.364238642  0.04623460 -0.480055999  0.130693249
## [22,] -0.225255220  0.042404947  0.30707676 -0.205996744  0.045922577
## [23,] -0.190089601 -0.072889118  0.15493389  0.064487856  0.197801478
## [24,] -0.153027200 -0.061898163 -0.36126905  0.418454372  0.358578334
## [25,] -0.036577878 -0.033731016  0.16742866  0.066327818 -0.030076890
##             [,11]       [,12]       [,13]        [,14]        [,15]
##  [1,] -0.05274779 -0.10904935 -0.07981082  0.107921139 -0.110511682
##  [2,] -0.05393988  0.28142389 -0.11016453 -0.082539898  0.271528464
##  [3,] -0.04105435  0.03474143  0.01423228 -0.138980054 -0.019417744
##  [4,] -0.04978617 -0.22731081  0.08215589 -0.214245056  0.132180965
##  [5,] -0.22964067 -0.11373408 -0.18825845 -0.086219624  0.056329980
##  [6,] -0.35237234  0.15812470  0.28193888  0.305657728 -0.206209981
##  [7,]  0.12374771 -0.23178654  0.10795805  0.348172994  0.030770878
##  [8,]  0.28330069 -0.11704402  0.34711084 -0.159813549 -0.107341422
##  [9,]  0.16677061 -0.04922232 -0.16261506 -0.062665541 -0.311895622
## [10,] -0.11592676  0.10768219 -0.02288115  0.037780033  0.132445514
## [11,]  0.12136198  0.02962409  0.17063283 -0.348240239  0.033681191
## [12,]  0.09787957 -0.26093674 -0.20459812  0.005331482  0.355604331
## [13,] -0.04151516  0.03970035  0.09936475  0.095855733 -0.073244886
## [14,] -0.08378184  0.05909883 -0.01238341  0.141353460  0.090141676
## [15,]  0.31049900  0.34254251 -0.51960153 -0.232945713  0.010584958
## [16,]  0.45760275  0.17898596 -0.05528350  0.261421299 -0.378469127
## [17,]  0.26096107  0.35814023  0.46467864 -0.246859672  0.226728845
## [18,]  0.10322994 -0.26230042 -0.24306934 -0.104406287 -0.037700979
## [19,] -0.14794283 -0.21838844 -0.03673022 -0.140807670  0.009967933
## [20,]  0.30171517  0.06723503 -0.04969529  0.462158730  0.426944399
## [21,]  0.13218019 -0.23819214  0.02042100  0.172508960  0.226725534
## [22,] -0.22482742  0.06357529 -0.15906582 -0.108669207 -0.102236370
## [23,] -0.12404091  0.29969902 -0.17857493  0.190914125 -0.181140271
## [24,] -0.22668556  0.29863269 -0.06020401  0.063226193  0.329862621
## [25,] -0.10530462  0.15551916  0.07998859 -0.054759944 -0.010442231
##              [,16]        [,17]       [,18]       [,19]       [,20]
##  [1,]  0.0549156765  0.278004369 -0.18752287 -0.26833338  0.02234677
##  [2,] -0.3789771728  0.166998143  0.22277481 -0.43702867  0.01641254
##  [3,] -0.2134089769  0.196930812 -0.02526099  0.08115654  0.33927240
##  [4,]  0.2935698461  0.305706645  0.38065148  0.16940641  0.11953529
##  [5,]  0.0286110539 -0.091127738 -0.03185584  0.05670740 -0.19129165
##  [6,] -0.3792975263 -0.218119663 -0.07159137  0.01006288 -0.12096714
##  [7,]  0.1703554099 -0.136965724 -0.31276496  0.07833149  0.41239861
##  [8,] -0.0443221306 -0.157287631  0.31439929  0.06066031 -0.51904924
##  [9,] -0.3442405764 -0.171811904  0.18182374 -0.13526566  0.32355996
## [10,] -0.1887294537  0.089323733  0.20312995  0.35579135  0.06470506
## [11,]  0.0177569125  0.066105774 -0.41923787 -0.01484279 -0.07585444
## [12,] -0.1323076977  0.101837893  0.05183278 -0.02052020 -0.11712867
## [13,]  0.1238501475  0.108736364  0.08113743  0.00696172 -0.01580855
## [14,]  0.1440253711 -0.242530192 -0.03114240 -0.21886778 -0.14337074
## [15,] -0.0009608895 -0.200780992 -0.12146555  0.20315861  0.02120677
## [16,]  0.2047159907  0.142681146  0.28313103 -0.13478606  0.02653506
## [17,]  0.1057367068 -0.006965651 -0.21022232 -0.17405483  0.12575884
## [18,] -0.0987462677 -0.117210123 -0.28316081  0.04828242 -0.26977868
## [19,]  0.1180967899 -0.051180071  0.04527764 -0.39533193  0.01630266
## [20,]  0.0063100759 -0.166446044  0.04920102  0.01064424 -0.12741578
## [21,] -0.0714214070  0.137202946  0.01621678  0.04306877  0.07819036
## [22,]  0.4245776412 -0.362041746  0.16040925 -0.15970197  0.08859079
```

```
## [23,]  0.1627435939  0.511864797 -0.20380697  0.07567808 -0.31613690
## [24,]  0.2177198432 -0.089731166  0.10051784 -0.03077240  0.04517495
## [25,]  0.0431070287 -0.124845876  0.07173264  0.46109341  0.08817621
##             [,21]        [,22]         [,23]        [,24]         [,25]
##  [1,]  0.41627245  0.124199390  0.4133347821 -0.230175946 -0.0166428976
##  [2,] -0.33454436  0.051300742  0.0279861994  0.041962022  0.3153238019
##  [3,]  0.18317110 -0.276737402 -0.5033314993 -0.189387642 -0.3442383572
##  [4,]  0.10050868  0.227140773 -0.2133757141 -0.002960624  0.3306523009
##  [5,]  0.05437654 -0.004595285 -0.0062111685 -0.022078835 -0.0457984778
##  [6,]  0.12014933  0.158558136 -0.1307568246 -0.089564428  0.0677680369
##  [7,] -0.46461245 -0.037011569 -0.1501048736  0.079057100  0.0966579328
##  [8,] -0.14140263 -0.111960414 -0.1145541744 -0.055245417 -0.1162050638
##  [9,]  0.10479285  0.045881247  0.0365785242  0.102029851  0.0644997278
## [10,] -0.22055131  0.245319111  0.2481025826 -0.082649032 -0.3938654500
## [11,]  0.01168852  0.068732414 -0.0005031334 -0.041053358 -0.0647323760
## [12,]  0.15980192 -0.178303380 -0.0900288161 -0.067245671 -0.0602348619
## [13,]  0.19168086  0.226203386  0.0373840589  0.767312044 -0.2697536602
## [14,]  0.30858129 -0.266562208 -0.2718887740  0.186007508  0.2483536524
## [15,]  0.09371501  0.004658622 -0.0571477120  0.160238810 -0.0347055397
## [16,] -0.04734456 -0.040896841  0.0273790324 -0.124913778  0.0319100995
## [17,]  0.07621909  0.108183588  0.0976974182 -0.062029794 -0.0009366069
## [18,] -0.17763245  0.304503661  0.0047256839  0.021922065  0.1879897244
## [19,] -0.25212362 -0.421362540  0.2675135313  0.136316786 -0.3375407581
## [20,]  0.14422123  0.024315949  0.0442349035 -0.159736110 -0.2174892455
## [21,]  0.10190094  0.058846979  0.0911817408 -0.010438451  0.1175643915
## [22,] -0.01903325  0.260649595 -0.0602238842 -0.379800169 -0.1355389183
## [23,] -0.21071476 -0.151129847 -0.1492079883 -0.052485333  0.0057567216
## [24,] -0.07720142  0.049527031 -0.0656175775  0.085900118 -0.0092214579
## [25,]  0.08228211 -0.461216699  0.4525233284 -0.023638885  0.3320569301
```

```
# Determine the factors , and choose appropriate as per scree plot , elbow and Kaizen rules
library(nFactors)
```

```
## Warning: package 'nFactors' was built under R version 3.6.1
```

```
## Loading required package: MASS
```

```
## Loading required package: boot
```

```
##
## Attaching package: 'boot'
```

```
## The following object is masked from 'package:psych':
##
##     logit
```

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

```
##
## Attaching package: 'lattice'
```

```
## The following object is masked from 'package:boot':
##
##     melanoma

##
## Attaching package: 'nFactors'

## The following object is masked from 'package:lattice':
##
##     parallel
```

```
library(lattice)
library(latticeExtra)
```

```
## Warning: package 'latticeExtra' was built under R version 3.6.1

## Loading required package: RColorBrewer
```

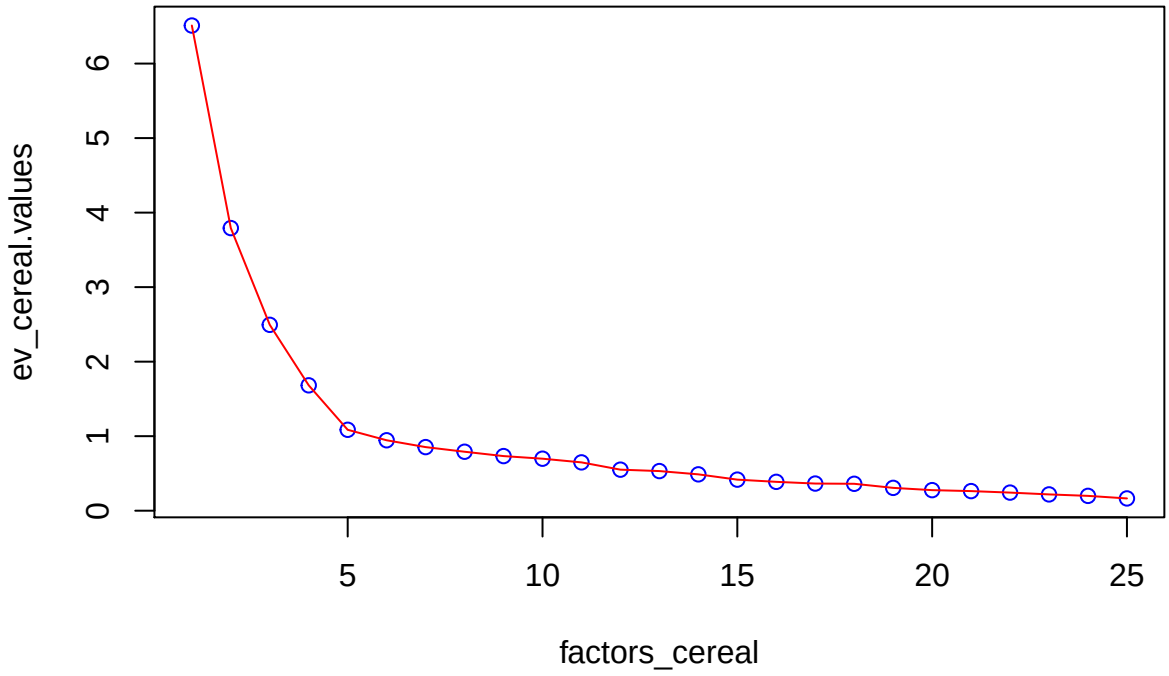
```
?parallel
```

```
## starting httpd help server ...

##  done
```

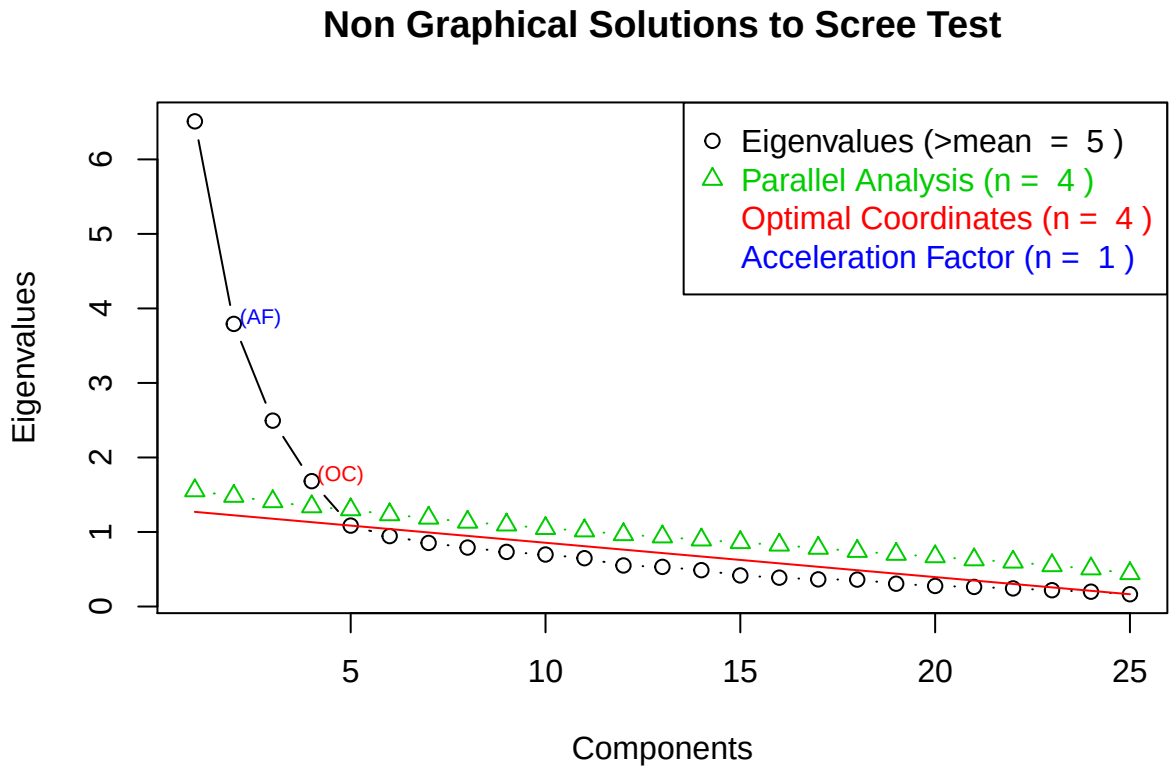
```
factors_cereal <- c(1:25)
scree_cereal <- data.frame(factors_cereal , ev_cereal$values)
scree_cereal
```

```
##    factors_cereal ev_cereal.values
## 1               1        6.5104814
## 2               2        3.7921753
## 3               3        2.4942279
## 4               4        1.6821942
## 5               5        1.0856935
## 6               6        0.9450867
## 7               7        0.8532528
## 8               8        0.7910547
## 9               9        0.7326378
## 10             10        0.6977062
## 11             11        0.6481540
## 12             12        0.5507242
## 13             13        0.5314532
## 14             14        0.4874731
## 15             15        0.4168149
## 16             16        0.3869282
## 17             17        0.3640988
## 18             18        0.3608730
## 19             19        0.3061363
## 20             20        0.2755866
## 21             21        0.2628312
## 22             22        0.2428432
## 23             23        0.2183801
## 24             24        0.1986326
## 25             25        0.1645601
```

```
plot( scree_cereal , col ="Blue")
lines(scree_cereal, col ="Red")
```




```
#parallel_cereal <- fa.parallel(cerealDR , fm="ml",fa="fa")

parallel_cereal  <- parallel(nrow(cerealDR), ncol(cerealDR),  rep =  100 , cent = 0.05 )

ns_cereal <- nScree(x = ev_cereal$values,aparallel = parallel_cereal$eigen$qevpea )
plotnScree(ns_cereal)
```

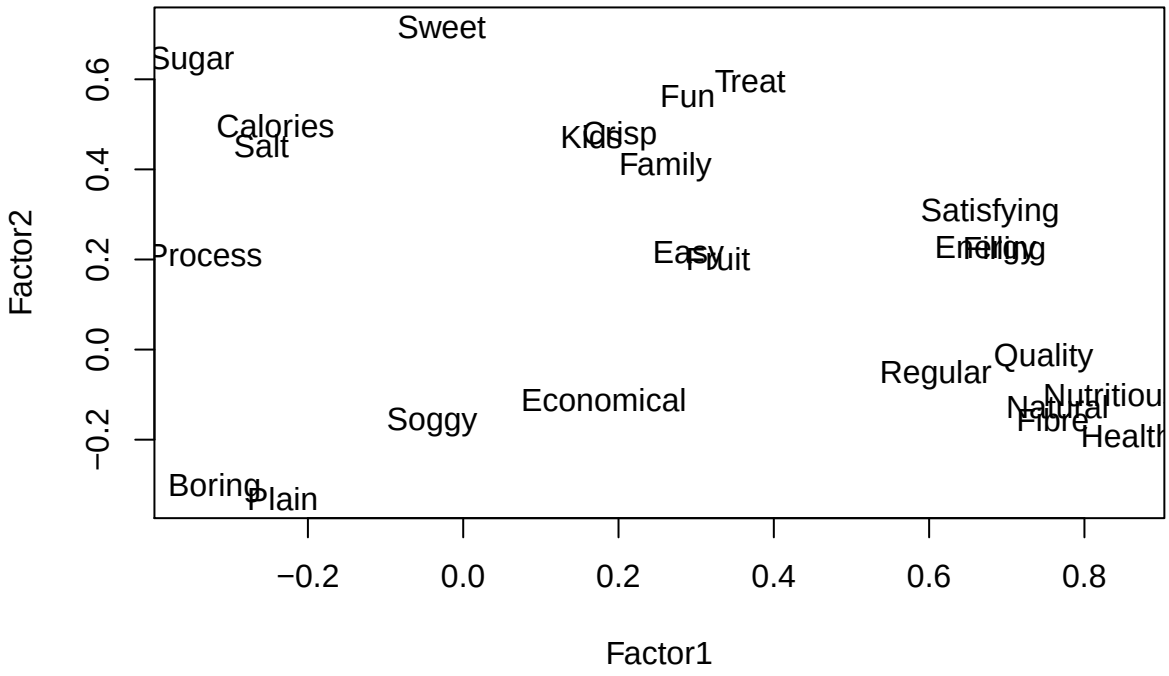



```
# Performing  Factor analysis  using factanal  function

set.seed(100)
library(nFactors)

punrotate_cereal <- factanal( x = cerealDR, factors = 4 , rotation = "none")

print(punrotate_cereal , digits = 3 , cutoff = 0.4 , sort = TRUE)
```

```
##
## Call:
## factanal(x = cerealDR, factors = 4, rotation = "none")
##
## Uniquenesses:
##    Filling    Natural      Fibre      Sweet       Easy       Salt
##      0.444      0.388      0.312      0.353      0.846      0.511
## Satisfying     Energy        Fun       Kids      Soggy Economical
##      0.432      0.486      0.528      0.230      0.773      0.724
##     Health     Family   Calories      Plain      Crisp    Regular
##      0.224      0.348      0.591      0.551      0.680      0.588
##      Sugar      Fruit    Process    Quality      Treat     Boring
##      0.261      0.564      0.795      0.436      0.419      0.669
## Nutritious
##      0.268
##
## Loadings:
```

```
##            Factor1 Factor2 Factor3 Factor4
## Filling     0.697
## Natural     0.765
## Fibre       0.759
## Satisfying  0.679
## Energy      0.673
## Health      0.855
## Regular     0.609
## Quality     0.748
## Nutritious  0.834
## Sweet               0.718
## Fun                 0.562
## Sugar               0.642   0.403
## Treat               0.598
## Kids                0.473  -0.710
## Family              0.404  -0.648
## Easy
## Salt                0.452
## Soggy                              0.409
## Economical                 -0.464
## Calories            0.498
## Plain                              0.469
## Crisp               0.476
## Fruit                       0.491
## Process
## Boring
##
##                Factor1 Factor2 Factor3 Factor4
## SS loadings      6.016   3.318   2.112   1.132
## Proportion Var   0.241   0.133   0.084   0.045
## Cumulative Var   0.241   0.373   0.458   0.503
##
## Test of the hypothesis that 4 factors are sufficient.
## The chi square statistic is 398.19 on 206 degrees of freedom.
## The p-value is 2.3e-14
```

```r
# plot the results of factor analysis to determine grouping of factors and name
# current weightage of factors without rotation doesnt not help in identifying the names for the columns
ucr_load <- punrotate_cereal$loadings[,1:2]
plot(ucr_load  ,  type = "n" )
text(ucr_load  , labels = row.names(ucr_load))
```




```
# compute the factor scores using loadings without rotation
library(psych)

factorScores_punrotate_cereal <- factor.scores( cerealDR , f = punrotate_cereal$loadings)
factorScores_punrotate_cereal
```

```
## $scores
##            Factor1      Factor2      Factor3      Factor4
##   [1,]  1.42809657 -1.587370800 -0.859953716  1.412239931
##   [2,] -1.79324007 -0.325642052 -2.274802818  0.370559869
##   [3,]  1.59420267  1.593635359  0.075365107  0.528159175
##   [4,]  1.95481570  0.775600090  0.081872352 -0.544110179
##   [5,]  1.10558546  0.460079555 -0.723729548 -1.491704446
##   [6,]  0.86210348  1.058107480 -0.981304956 -1.167232535
##   [7,]  1.10575584  0.940723184 -1.105566967 -1.546581425
##   [8,]  0.24433843  0.052305376 -1.519203265 -0.953699377
##   [9,]  0.24433843  0.052305376 -1.519203265 -0.953699377
##  [10,]  0.24433843  0.052305376 -1.519203265 -0.953699377
##  [11,]  0.41421287 -1.549709709 -0.369508431  1.338763040
##  [12,] -0.07540467 -0.218235771  0.741912098  0.728383832
##  [13,] -0.62660691  1.804215748  0.992206953  1.251880515
##  [14,] -0.56618131  1.849693723  0.499153399  1.131988974
##  [15,]  0.38378856  2.355209505  0.045396744  0.852734778
##  [16,]  0.15222405 -0.663839412  1.140564428 -0.319778541
##  [17,] -1.43932428  0.956064247 -1.808482982 -1.746891554
##  [18,]  0.07681061  0.670565917 -0.619195923  1.362086767
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##  [19,]  1.09199592 -0.752748593 -0.562698343  1.449441150
##  [20,] -0.90606043  0.957769192  3.129386645  1.143560790
##  [21,] -0.06355161  0.272601685  1.150260581  1.071899345
##  [22,] -1.01468509 -1.402119409  1.658441879  1.597279104
##  [23,]  1.25228549 -0.638209020  1.936880761 -1.823602498
##  [24,]  1.04277858  0.698031570 -0.207168172 -1.488642758
##  [25,]  1.06774710  0.193236981  0.921636689 -0.417346082
##  [26,] -0.08200937 -0.462880739 -0.254538124  1.908778867
##  [27,]  0.56481033 -1.058706106  0.822724649 -1.289176634
##  [28,] -1.00115879 -1.420670286  0.079622131 -1.363786659
##  [29,] -0.23958107 -1.307890685  0.788788360 -1.626548009
##  [30,] -0.39378685  0.160952350 -1.209773279 -0.639395750
##  [31,] -0.34185986  1.367278223 -0.472769530 -0.684391220
##  [32,]  1.20301917 -1.364511126  1.479709043  0.925897965
##  [33,]  0.62634525  1.674344798 -0.675081543 -0.892429665
##  [34,]  1.29434182  0.088214636 -0.797031430 -0.669361095
##  [35,]  1.06005941 -0.849925500 -0.359005128 -0.266294588
##  [36,] -1.25665923 -0.133671117 -1.868596871 -0.422454166
##  [37,] -0.19341053  1.972628070  0.347195971 -0.328264707
##  [38,] -0.26413880  1.918196879  0.868017475  0.014055808
##  [39,] -0.69963013  1.530126113  1.440009791 -0.282860693
##  [40,] -0.22373392  0.483119959 -1.101513865  1.906092398
##  [41,]  1.62944349  2.192931719  0.981103917  0.895766710
##  [42,]  0.96175598  0.466835557  0.814070878 -0.051232869
##  [43,]  0.36124305 -0.628953915  0.279485409  0.953676215
##  [44,]  1.55966862  0.481689466 -0.504134811  0.295712459
##  [45,]  2.08142585  0.456348818 -0.798863514 -1.078114890
##  [46,]  1.39858125 -0.939307181  0.057971936  0.689386256
##  [47,] -0.09309362 -1.124479595  1.131103264 -0.812776967
##  [48,] -0.04062065 -0.817874472  1.305691863 -0.333957278
##  [49,] -0.61852812 -0.410015815  1.199120352  0.111378491
##  [50,] -0.20860422 -1.447356664  1.924918207 -1.964719604
##  [51,] -0.20894514 -1.334755312  2.039760842 -1.055477744
##  [52,] -1.09903530 -0.538039142 -2.026661321 -0.676096003
##  [53,] -2.75212986  0.756338221 -1.327235391 -3.421786365
##  [54,]  0.80091156 -1.017814030 -0.574155827  0.303932130
##  [55,] -0.72440830  0.997313967  0.328052930  0.311934969
##  [56,]  0.84887593 -0.304322409 -1.154399788  0.834274115
##  [57,]  0.27917220 -0.052380387  1.346219450 -1.567392118
##  [58,]  1.92304089  1.054921440 -0.107245783 -0.506340155
##  [59,] -0.70311819 -0.496136141 -1.138174217 -0.863295583
##  [60,]  0.83021483  0.883959163  0.312727646 -0.809904968
##  [61,]  0.06976135 -0.300432753 -0.499533754  0.309301977
##  [62,]  0.04316195  0.473773377  0.008654375 -0.073345066
##  [63,]  0.86455561 -1.403717670  1.604732462 -1.076597785
##  [64,]  1.17453214  1.510861150  1.801196518 -0.240011051
##  [65,]  0.12081899 -0.809500446 -1.295441666 -0.040819864
##  [66,] -0.99251057 -1.126614031 -0.661687942  0.148809493
##  [67,]  1.71276677 -0.616670040 -1.394652777  0.687338361
##  [68,]  1.14483009  0.856078717 -1.324403460 -1.856318130
##  [69,] -0.61203679  1.783448197 -0.217998063 -0.603257829
##  [70,] -0.75712329 -0.138341436 -1.864708103 -1.701764831
##  [71,]  1.04908155 -0.465147620 -1.232228335 -0.165785257
##  [72,]  0.78592578  0.143103690 -1.164662892 -0.059958064
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##  [73,] -0.81303752 -0.037044951 -1.076100850  1.895874057
##  [74,]  0.95662363 -0.783692563  2.561469691  0.789074001
##  [75,] -0.33514623 -1.396028903  1.670128585 -0.642691541
##  [76,] -2.56856291 -1.600056424  0.807028194 -2.217400811
##  [77,]  0.06448813  0.086296097  1.391390851  1.306143319
##  [78,] -1.17169673 -0.096114786  1.205080229  0.248260749
##  [79,]  1.62269176 -0.315587309 -0.814382356  1.675517775
##  [80,] -2.36919776  0.442204124 -0.496634497 -0.443495466
##  [81,]  0.62453473 -0.862097582  0.349709175 -1.243383223
##  [82,] -1.08261388 -2.082488548  1.140163816 -1.827157550
##  [83,] -0.73478082 -0.600954843  0.573554430  0.074997160
##  [84,] -1.63644438  0.451102003  1.397677298  1.039992023
##  [85,] -3.24041101  1.294349551  1.582662422  2.079717578
##  [86,]  1.18144754 -1.478313323  0.422936969 -0.156927777
##  [87,]  0.48802704  2.259379044 -0.418590519 -0.304748659
##  [88,]  0.45432678  0.292755752  0.974455802  1.622052226
##  [89,]  0.13663784 -1.104808488 -0.092767591  0.645652987
##  [90,]  0.11999002 -0.648812555  0.153422355 -2.104128034
##  [91,] -1.64650292  1.724251797  0.249737983 -0.898800131
##  [92,]  0.23948910 -0.826416081 -0.491032448  1.873936496
##  [93,]  0.36171028 -0.998056101  1.029929801  0.245589881
##  [94,]  0.55608617 -0.200875920 -0.626114922 -0.300582724
##  [95,]  0.09277070 -0.220416987  0.179054642  0.512774691
##  [96,] -0.88838513 -0.618675740 -1.043560897 -1.944912559
##  [97,]  0.34731872 -0.003460689  0.126880661 -0.436238143
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##  [99,] -0.10940986 -1.738559845 -0.118617390 -0.510869483
## [100,]  0.39928952  2.078315985  0.816149853 -0.392325119
## [101,]  0.35534865  2.307210646  0.516591712 -0.501153618
## [102,]  0.19069255 -1.502455196 -0.246454175 -0.314418736
## [103,]  0.19069255 -1.502455196 -0.246454175 -0.314418736
## [104,]  0.47033732  0.581645022  1.243562715 -0.145784454
## [105,]  0.18433504 -1.200241066  0.400828710  1.152197055
## [106,] -1.00360073 -0.683294120 -0.349488093  0.493150977
## [107,] -1.17039722 -0.701366827 -0.378405598  0.896310703
## [108,] -0.59120418  1.468316518 -0.151588548 -0.542137737
## [109,] -1.07077787 -1.591474802 -0.362689050  1.383613121
## [110,] -0.14647122 -1.461941558 -0.136294151  0.682250542
## [111,] -0.32876731 -0.770095783  1.407720480 -0.618342690
## [112,]  0.09651664 -1.224497685 -0.358824415  0.166629682
## [113,] -0.31866403  0.060330064  1.407550246 -0.774576293
## [114,] -0.80429046  2.368806068 -0.172163951  0.289479351
## [115,]  0.17407206  0.188142419  2.208109371 -0.160172991
## [116,] -0.25434618 -0.996250309  1.268301355  0.343968769
## [117,] -0.09417001 -0.409501839  1.546132899  1.376160171
## [118,] -0.67528217  0.274140779  0.757555573  0.018624638
## [119,] -0.31140554 -0.938248573 -0.604448358  0.851238814
## [120,] -0.61722128 -0.214637415 -1.540169559  0.479661084
## [121,] -0.68837487  1.282939723  1.833553979 -0.787165205
## [122,]  0.78894229  0.258007616  0.342497730 -0.549660006
## [123,] -0.12760404 -0.009132309 -1.360455589  0.005413976
## [124,]  0.43423894 -0.265538305 -1.348462313  0.366662709
## [125,]  0.87537362 -0.455807721 -0.148588475 -0.624225292
## [126,] -2.02588673  1.745325876  0.277642402  0.221884403
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## [127,]  0.93299825  0.797477421  2.747004036 -1.193764831
## [128,] -0.01693343 -1.090855470 -0.227473596  0.442890695
## [129,] -0.88453062 -0.374764588 -1.564748495 -0.930770376
## [130,] -1.63089258 -0.724685204 -1.232728985 -1.189071289
## [131,]  0.36401108  0.098563735 -0.637600230  1.007863027
## [132,]  0.53507051  0.953839170  0.604185238  0.351184557
## [133,]  0.41214365 -0.684099067 -1.098219152  0.026374604
## [134,]  0.47601217 -0.559614232 -0.148641617 -0.791357420
## [135,]  0.23917236  0.347380797 -0.588333053  0.680178341
## [136,] -2.08547757  1.499557298 -0.508665911  0.279110690
## [137,] -0.19930654  1.257676894 -0.338151707  2.109608911
## [138,] -0.80644846  1.186388058 -0.554977019  1.303165968
## [139,] -0.23305635  0.058948884 -1.129254596  0.738243657
## [140,] -1.24270414 -0.365176577 -0.623513816 -0.187961530
## [141,] -0.35526139  0.190400475 -0.603106204 -1.065678908
## [142,] -0.03071588  0.681498939  0.690942130 -0.309027938
## [143,] -1.49750029 -1.574128996 -0.525433165 -1.594254784
## [144,] -0.48467381 -0.028842652 -0.136275040 -0.201347589
## [145,]  1.05948690  0.160459126 -0.780731310 -0.579468777
## [146,]  0.07216940 -0.322971587 -1.629749681 -1.366729769
## [147,]  0.77710137 -0.834310477 -1.074325209  0.493269594
## [148,]  0.02591670 -0.293772028 -0.288341197 -0.522945373
## [149,]  0.85755368 -0.292428438  0.008520697  1.601005438
## [150,]  0.02565295  1.389963580 -0.207062379 -0.070295767
## [151,] -0.10322941  1.310901020 -0.813676603 -0.311927925
## [152,]  0.22021760 -2.085491731  1.821842912 -0.246586406
## [153,]  0.12575344  1.709049717  0.914280397  0.821209415
## [154,]  1.69246951 -0.200737096 -0.922908347  1.968261124
## [155,]  0.64195998  1.042657761 -0.844325888 -0.005400520
## [156,] -0.78955635  0.186155879 -0.057570008  0.171654936
## [157,]  0.08655737 -0.184779558 -0.874624899  0.331081234
## [158,] -1.07651352  0.766458128 -0.534461489  0.136083179
## [159,]  1.02825289 -0.258280308  0.743910962  2.772726109
## [160,]  0.08376808 -0.171748706  2.620170119  1.690902511
## [161,]  0.35269277  0.174199300  0.620236167 -0.702197648
## [162,]  0.22345518  0.310114414  0.932407794 -1.172763822
## [163,]  1.54464049  0.108307571 -0.420662752  0.518698980
## [164,]  2.17777249  0.818865515 -0.221365925 -1.700462742
## [165,]  0.67084135  2.062652706 -0.411052509  0.283486977
## [166,] -0.47382074  0.281027018 -0.066611376  0.312113919
## [167,] -0.84636121  0.701354679 -0.193115236 -0.052610380
## [168,] -0.65609957 -0.983811300  1.100604003 -0.341538704
## [169,]  0.19503757 -0.585985672  0.602351568  0.791773261
## [170,]  1.38001731 -0.065155261 -0.839914054  1.671827195
## [171,]  0.31668618  0.474775575 -0.651907408  2.356342201
## [172,] -0.92809095 -0.084093770 -0.014060420  1.118747593
## [173,] -1.19144935 -0.030639502  0.150095180  1.255746754
## [174,] -1.69167999  0.783060131  0.072139375 -0.291954910
## [175,] -1.41865830 -1.482994549  0.709939743  0.046982388
## [176,] -1.19842998 -0.868036556  0.274585813  0.059329004
## [177,] -0.39242405 -1.011952404 -0.589549684  0.366571779
## [178,]  1.18821243  0.262640833  0.596229954 -0.348318368
## [179,]  1.20087595  0.173332506  0.432083548 -0.413303530
## [180,]  1.01136162  0.190638494 -0.575130649 -0.656653232
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## [181,]  0.34958998 -0.425871753  0.308913629  0.837523815
## [182,] -3.17887522 -0.104030726  1.465392802  1.427666420
## [183,] -0.05325359 -0.230638261 -0.467961258 -0.023493094
## [184,]  0.60027158  1.064740513 -0.196260120  1.053223076
## [185,]  0.95876699  0.797289382 -0.450057810 -1.435628161
## [186,]  0.87499506  0.890030637  0.384437673 -0.830705571
## [187,] -0.29185863  1.136817907 -0.318170513  0.804158639
## [188,] -0.16724029 -0.786778101  1.408999662 -0.042971558
## [189,]  0.87712702 -0.728753467 -1.235849824 -0.790857602
## [190,]  0.96330202  0.708202517 -0.492100310 -1.320669203
## [191,] -0.33531278 -0.413048868 -1.489833555  1.327335038
## [192,]  0.09892961  0.576734467 -0.590430331  2.148127733
## [193,] -0.61923395  0.298329101 -0.721682243  0.737961526
## [194,] -0.53433123 -1.062049328 -1.587792263  0.569206956
## [195,] -1.46441278  0.726040167 -1.132326137 -0.726167332
## [196,]  0.35328722 -0.551803380  1.246463080 -1.610208327
## [197,]  0.50746434 -0.289377614 -1.399110025  0.609304571
## [198,]  0.23366028 -0.971897379 -0.079772954 -0.498442149
## [199,]  0.23366028 -0.971897379 -0.079772954 -0.498442149
## [200,]  0.53299972 -1.199920462 -0.739568516  0.384432862
## [201,]  0.47234096  0.707064379 -0.117158307 -0.302264085
## [202,]  0.95169481 -1.308772412  0.113324876  0.370680537
## [203,] -1.97899678  2.556232683 -0.321904823 -0.015096458
## [204,]  0.43573543 -0.581352616 -1.410077950  1.163495544
## [205,] -1.67766784 -0.323422575 -0.615022768  0.754117207
## [206,]  1.22852686 -0.481550748 -0.449947258  1.579355771
## [207,]  1.27114652  1.350266995  0.398843488  0.703381048
## [208,] -0.05233344 -1.090178047 -1.042713060 -0.949201377
## [209,]  1.57074906 -0.573648581  1.399729371 -1.229169223
## [210,]  0.67076287 -0.653388713  1.673857084 -1.430520956
## [211,] -0.24510565  1.026423891 -0.628071119 -1.025464221
## [212,]  0.49696414  0.876882634  1.587098628 -0.793528998
## [213,] -0.32964882  0.293903977 -0.230492428 -0.780003648
## [214,]  0.41971379 -0.552510282 -0.978762800  1.566227973
## [215,] -1.15947939  0.672997640 -1.385037276  0.105972505
## [216,] -0.02749964 -1.077659808 -0.650605525 -0.082695155
## [217,] -0.84570312  1.807070765  0.418203867 -0.392367620
## [218,] -1.80908603  0.104176984 -0.018904865  0.803253843
## [219,] -1.80908603  0.104176984 -0.018904865  0.803253843
## [220,]  1.89075457  1.448905324 -0.138828487 -0.169848685
## [221,]  1.75393270  0.752147694 -0.077033758 -0.080836666
## [222,]  1.75393270  0.752147694 -0.077033758 -0.080836666
## [223,] -0.43155956 -0.220175730  1.313290588  0.024019508
## [224,] -1.93026578 -0.121446473  0.067980348  0.438165643
## [225,] -0.17267895 -1.458523731 -0.447423135  0.489728685
## [226,] -0.17267895 -1.458523731 -0.447423135  0.489728685
## [227,] -0.42253034 -0.781017927  0.320997812 -0.189790246
## [228,] -1.36292576 -0.342835476 -0.008116012 -0.220486211
## [229,] -2.27529082  0.814551176  0.531173198 -0.605841873
## [230,]  0.13223003 -0.520056153  0.925237618  0.411227783
## [231,]  0.01118654 -1.145328615 -0.676833837  0.633011168
## [232,]  0.56168580  1.180288027  0.937148345 -0.631199650
## [233,]  0.32030424 -0.881454048 -0.397396948 -0.333957516
## [234,] -0.76995526 -0.690088393  0.352362777 -0.071166968
```

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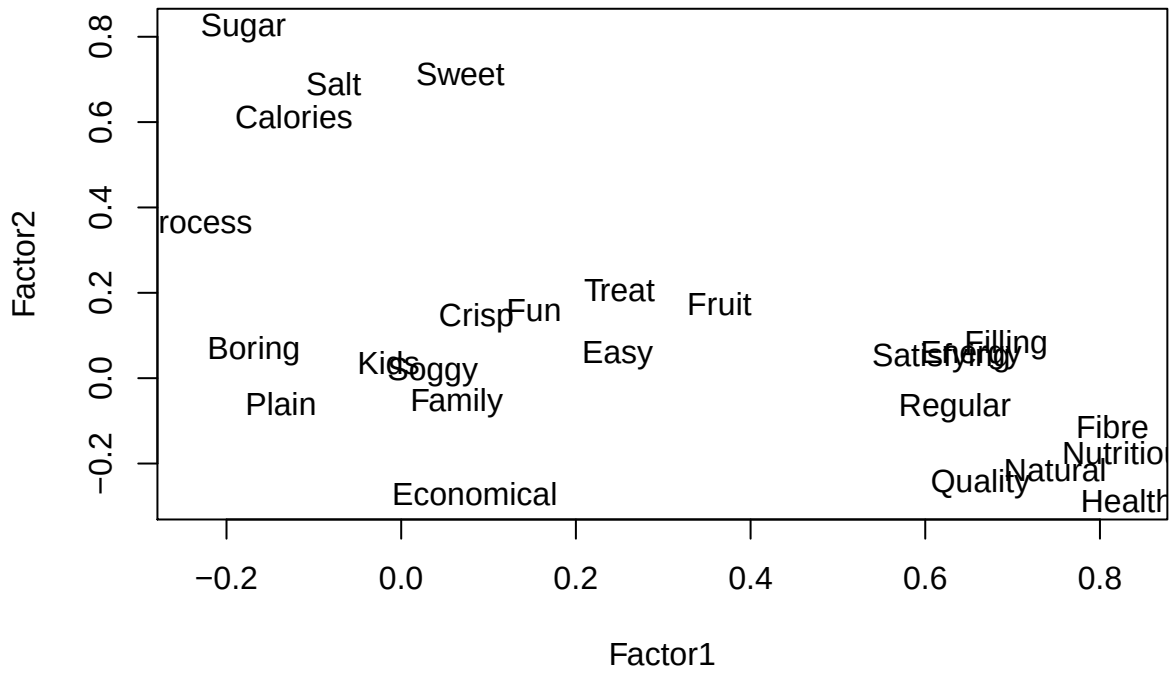
## [235,]  0.31338830 -1.222639304 -0.704220952  0.035824892
##
## $weights
##                 Factor1      Factor2     Factor3     Factor4
## Filling     0.092319949  0.055202956  0.02997842  0.10457947
## Natural     0.116057098 -0.036975605  0.02378575  0.08055350
## Fibre       0.143028875 -0.056228599  0.12533980  0.18340463
## Sweet      -0.004599539  0.228591637  0.15291270  0.09681019
## Easy        0.020167786  0.027829867 -0.02525053  0.03833452
## Salt       -0.029867162  0.099538720  0.08233443  0.28227671
## Satisfying  0.092302029  0.078755995 -0.03061508  0.07881874
## Energy      0.081369826  0.051206148  0.03164880  0.03608062
## Fun         0.032181183  0.119763569 -0.02915500 -0.18030657
## Kids        0.042310824  0.231670595 -0.47563360  0.20842688
## Soggy      -0.003029909 -0.023447343 -0.03595520  0.20297649
## Economical  0.014712388 -0.017433571 -0.09851023  0.06601036
## Health      0.224825137 -0.096064718  0.05620708  0.08946418
## Family      0.044078527  0.130881751 -0.28677772  0.02594768
## Calories   -0.024058042  0.094937214  0.07313701  0.09975319
## Plain      -0.024781888 -0.067822532 -0.07069604  0.32701795
## Crisp       0.017431521  0.078748626 -0.02141019 -0.11848091
## Regular     0.060912513 -0.010858206  0.04634340  0.05635648
## Sugar      -0.078647833  0.276407152  0.23730176  0.30076623
## Fruit       0.034209866  0.040018285  0.13385805 -0.14634899
## Process    -0.024626270  0.029828680  0.01322163  0.10296435
## Quality     0.100928336 -0.004872182 -0.01389387 -0.05249647
## Treat       0.051934758  0.160599926  0.01552934 -0.26857729
## Boring     -0.028112193 -0.051705510  0.01297790  0.20716685
## Nutritious  0.182952657 -0.041885609  0.06926885  0.15075724
##
## $r.scores
##               Factor1      Factor2       Factor3       Factor4
## Factor1  1.000000e+00 1.290634e-15 -2.428613e-16 -1.637579e-15
## Factor2  1.249001e-15 1.000000e+00  1.955901e-15  2.407796e-15
## Factor3 -2.532696e-16 1.879573e-15  1.000000e+00 -1.318390e-16
## Factor4 -1.686151e-15 2.419072e-15 -1.405126e-16  1.000000e+00
##
## $missing
##   [1] 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
##  [36] 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
##  [71] 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
## [106] 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
## [141] 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
## [176] 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
## [211] 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
##
## $R2
## [1] 0.9710279 0.9453244 0.9260466 0.8262652
```

```
# rotate the factors and compute the factor scores to group and name the factors appropriately
protate_cereal <- factanal( x = cerealDR, factors = 4 , rotation = "varimax")

print(protate_cereal, digits = 3 , cutoff = 0.4 , sort = TRUE)
```

```
##
## Call:
## factanal(x = cerealDR, factors = 4, rotation = "varimax")
##
## Uniquenesses:
##    Filling    Natural      Fibre      Sweet       Easy       Salt
##      0.444      0.388      0.312      0.353      0.846      0.511
## Satisfying     Energy        Fun       Kids      Soggy Economical
##      0.432      0.486      0.528      0.230      0.773      0.724
##     Health     Family   Calories      Plain      Crisp    Regular
##      0.224      0.348      0.591      0.551      0.680      0.588
##      Sugar      Fruit    Process    Quality      Treat     Boring
##      0.261      0.564      0.795      0.436      0.419      0.669
## Nutritious
##      0.268
##
## Loadings:
##             Factor1 Factor2 Factor3 Factor4
## Filling      0.693
## Natural      0.749
## Fibre        0.814
## Satisfying   0.618
## Energy       0.652
## Health       0.831
## Regular      0.634
## Quality      0.663
## Nutritious   0.834
## Sweet                0.715
## Salt                 0.691
## Calories             0.613
## Sugar                0.821
## Fun                          0.534
## Plain                       -0.647
## Treat                        0.632
## Boring                      -0.509
## Kids                                 0.876
## Family                               0.793
## Easy
## Soggy                       -0.455
## Economical
## Crisp                        0.441
## Fruit                        0.438
## Process
##
##                Factor1 Factor2 Factor3 Factor4
## SS loadings      5.202   2.629   2.400   2.347
## Proportion Var   0.208   0.105   0.096   0.094
## Cumulative Var   0.208   0.313   0.409   0.503
##
## Test of the hypothesis that 4 factors are sufficient.
## The chi square statistic is 398.19 on 206 degrees of freedom.
## The p-value is 2.3e-14
```

```r
# Plot to name the factors
cr_load <- protate_cereal$loadings[,1:2]
plot(cr_load  ,  type = "n" )
text(cr_load  , labels = row.names(cr_load))
```




```r
factorScores_protate_cereal <-  factor.scores(cerealDR, protate_cereal$loadings)
factorScores_protate_cereal
```

```
## $scores
##             Factor1      Factor2      Factor3      Factor4
##   [1,]  1.542033783 -1.174834975 -1.816593232  0.484800476
##   [2,] -2.135678381 -0.617665792 -1.267986992  1.443388710
##   [3,]  1.585876602  1.019213365  0.749753953  1.117969747
##   [4,]  1.646080038 -0.169402225  1.271851914  0.608058370
##   [5,]  0.395532252 -1.002334740  1.546028145  0.794754865
##   [6,]  0.174669185 -0.475516836  1.493580253  1.304146272
##   [7,]  0.264141255 -0.860013233  1.768617427  1.335832153
##   [8,] -0.442706009 -1.168311649  0.570664077  1.180406697
##   [9,] -0.442706009 -1.168311649  0.570664077  1.180406697
##  [10,] -0.442706009 -1.168311649  0.570664077  1.180406697
##  [11,]  0.713315985 -0.711282555 -1.863251030 -0.124693534
##  [12,]  0.336979188  0.551454407 -0.581289438 -0.615414442
##  [13,] -0.026168060  2.486287929 -0.030488007  0.127546829
##  [14,] -0.134896759  2.224482140  0.012112461  0.553006919
##  [15,]  0.527199554  2.005254118  0.617860583  1.320146884
```

```
##  [16,]  0.371658119 -0.153590465  0.157650281 -1.296312869
##  [17,] -2.324955471 -0.624512899  1.267609610  1.380465722
##  [18,]  0.269129693  0.842497476 -0.852272418  1.088871621
##  [19,]  1.292520335 -0.349744213 -1.432130244  0.576773558
##  [20,]  0.274036635  2.860134351 -0.046718378 -2.140423365
##  [21,]  0.535176573  1.245550168 -0.527700880 -0.658893536
##  [22,] -0.005553968  0.782883618 -1.926999912 -1.992733900
##  [23,]  1.171644973 -0.788223574  1.767376391 -1.983657025
##  [24,]  0.465932544 -0.586044312  1.748199857  0.465690171
##  [25,]  1.102895305  0.077907007  0.834072816 -0.531875278
##  [26,]  0.409684026  0.510575950 -1.846840313  0.299770898
##  [27,]  0.409598739 -1.150831519  0.766684886 -1.303353960
##  [28,] -1.238821930 -1.383586643  0.169991223 -1.187007974
##  [29,] -0.427943920 -1.305543950  0.733253512 -1.615729222
##  [30,] -0.865559512 -0.640304355  0.293822232  0.898797874
##  [31,] -0.677313176  0.506961345  1.100328841  0.867025820
##  [32,]  1.803560702 -0.152540410 -0.925679308 -1.490969369
##  [33,]  0.094158955  0.289997105  1.596061632  1.344443269
##  [34,]  0.794048412 -0.944071351  0.715613218  0.855873866
##  [35,]  0.837327225 -1.156315061 -0.064443774  0.059685789
##  [36,] -1.763511366 -0.821417020 -0.338674940  1.169522638
##  [37,] -0.245464383  1.437966541  1.307694821  0.564717286
##  [38,] -0.076128532  1.816925918  1.083540138  0.147735926
##  [39,] -0.398490978  1.762311632  1.135581117 -0.655991453
##  [40,]  0.024611256  0.834937420 -1.541685974  1.433687879
##  [41,]  1.939198010  2.018187725  0.936396285  0.720131860
##  [42,]  1.070723143  0.428341213  0.637125573 -0.269059391
##  [43,]  0.695621927  0.055111473 -0.967878550 -0.299956590
##  [44,]  1.373818557 -0.130616654  0.249026182  1.019674715
##  [45,]  1.392514452 -1.080868708  1.403532748  1.124199538
##  [46,]  1.530607295 -0.651645072 -0.734603434 -0.099496013
##  [47,]  0.019608960 -0.662586474  0.264229266 -1.644353770
##  [48,]  0.238182549 -0.147369342  0.078839355 -1.549923579
##  [49,] -0.211305248  0.455092308 -0.213009154 -1.305317192
##  [50,] -0.191957869 -1.069060939  1.150184886 -2.683491359
##  [51,]  0.089706434 -0.494537635  0.494280287 -2.569622473
##  [52,] -1.717359082 -1.341070169 -0.338131499  1.095309229
##  [53,] -3.874172976 -1.039266702  2.327762333  0.329655825
##  [54,]  0.707756978 -1.028205546 -0.706993275  0.203637666
##  [55,] -0.527863001  1.184993562  0.169452852  0.112966011
##  [56,]  0.725215369 -0.536444854 -0.863554475  1.132438918
##  [57,]  0.171547416 -0.269714887  1.547277397 -1.361419739
##  [58,]  1.568496474 -0.030090806  1.344131651  0.900583681
##  [59,] -1.173211999 -1.104679917  0.082578342  0.421524343
##  [60,]  0.590742151  0.161991490  1.345917549  0.194096708
##  [61,]  0.030380979 -0.302225990 -0.482411179  0.339623426
##  [62,]  0.005674706  0.292229107  0.314952687  0.217148140
##  [63,]  0.962400424 -1.016502902  0.624125776 -2.025606835
##  [64,]  1.437918896  1.462295913  1.556239947 -0.579946976
##  [65,] -0.212624428 -1.201380170 -0.597987632  0.709655483
##  [66,] -1.009722750 -0.771375828 -1.035544439 -0.165525293
##  [67,]  1.428331503 -1.152365032 -0.766552154  1.332540468
##  [68,]  0.158563836 -1.178513207  1.943360774  1.432753034
##  [69,] -0.850844372  1.022183291  1.239203863  0.813817315
```

```
##  [70,] -1.661150697 -1.571932692  0.800298950  1.046251137
##  [71,]  0.613717269 -1.222801434 -0.109805407  0.989371702
##  [72,]  0.398127445 -0.645168507  0.075438754  1.190694651
##  [73,] -0.497930794  0.620966781 -1.923003447  1.040796209
##  [74,]  1.801996577  0.736428178 -0.368286447 -2.188130371
##  [75,] -0.005525948 -0.470146282  0.034005211 -2.245301134
##  [76,] -2.728174379 -1.209667229  0.567724103 -2.344635571
##  [77,]  0.788579704  1.303848524 -0.741785447 -0.884002282
##  [78,] -0.692057423  0.884781573 -0.278058560 -1.247743789
##  [79,]  1.765130518 -0.175632809 -1.322339340  1.143760627
##  [80,] -2.455356987  0.466855718 -0.008381127  0.071931300
##  [81,]  0.347019216 -1.215847745  0.756972645 -0.793623683
##  [82,] -1.144163088 -1.583111663  0.380338796 -2.487424430
##  [83,] -0.486409657  0.051849361 -0.422097356 -0.904538525
##  [84,] -0.865980669  1.860133941 -0.698838456 -1.103690396
##  [85,] -2.033049478  3.447244720 -1.410949755 -0.999041672
##  [86,]  1.205994671 -1.228085057 -0.307983476 -0.852795811
##  [87,]  0.179509858  1.139470276  1.441027911  1.484545751
##  [88,]  1.120866018  1.320056091 -0.884240638 -0.303259076
##  [89,]  0.320088094 -0.541738518 -1.081053289 -0.316436526
##  [90,] -0.419014189 -1.446460644  1.419681374 -0.776486990
##  [91,] -1.763707296  1.303942295  1.313475500  0.134462081
##  [92,]  0.646613791  0.050476818 -1.981655426  0.381384185
##  [93,]  0.706010625 -0.215928272 -0.447988063 -1.225663400
##  [94,]  0.271081005 -0.707535510  0.142364532  0.487435905
##  [95,]  0.284036180  0.151121344 -0.475842561 -0.149158116
##  [96,] -1.619334069 -1.630276029  0.871751987  0.060809025
##  [97,]  0.231155730 -0.245389940  0.448176116 -0.111953852
##  [98,]  0.455088048  0.017541205  0.339192656 -0.679681912
##  [99,] -0.217705071 -1.503908862 -0.530633611 -0.847885118
## [100,]  0.402741716  1.542794067  1.626508735  0.333022445
## [101,]  0.245448508  1.528632180  1.768350468  0.665951114
## [102,]  0.073007010 -1.373361519 -0.527094150 -0.532967111
## [103,]  0.073007010 -1.373361519 -0.527094150 -0.532967111
## [104,]  0.699537841  0.778243596  0.747349191 -0.688245860
## [105,]  0.639079191 -0.153446292 -1.438988434 -0.678324439
## [106,] -0.856080845 -0.147703741 -1.029753015 -0.156086532
## [107,] -0.903594236  0.064963321 -1.405877813 -0.105420818
## [108,] -0.786527443  0.853685987  1.043557230  0.621249800
## [109,] -0.640895471 -0.344489716 -2.235849971 -0.443667268
## [110,]  0.069685399 -0.725009151 -1.363483084 -0.503178291
## [111,] -0.082450581 -0.134643906  0.290922401 -1.719185030
## [112,]  0.082643566 -0.968885218 -0.813087532 -0.241972304
## [113,] -0.144780558  0.373611784  0.848574153 -1.343773544
## [114,] -0.784722041  1.940023740  0.787458575  1.171320732
## [115,]  0.688139266  0.998226618  0.669988108 -1.745916647
## [116,]  0.227745168  0.093946946 -0.613843638 -1.531865398
## [117,]  0.718984641  1.096339020 -1.059950233 -1.272207078
## [118,] -0.428303035  0.710353291  0.122291647 -0.634346877
## [119,] -0.175150106 -0.440343354 -1.350659669  0.135601474
## [120,] -0.831169770 -0.451760630 -0.913430044  1.140150455
## [121,] -0.418482316  1.514650188  1.490360736 -1.187802922
## [122,]  0.654501833 -0.129952989  0.808665106 -0.096067722
## [123,] -0.472536125 -0.579938568 -0.286516619  1.107033877
```

```
## [124,]  0.159054382 -0.720150440 -0.589360034  1.149176225
## [125,]  0.608335123 -0.912053354  0.428066633 -0.024928362
## [126,] -1.792028702  1.972839950  0.342652125  0.236268105
## [127,]  1.218668748  0.975875789  2.081258280 -1.925730644
## [128,]  0.085625538 -0.652574441 -0.967360267 -0.263016695
## [129,] -1.475418010 -1.197070073  0.082790604  0.787987882
## [130,] -2.137902317 -1.235382763  0.013030154  0.146710171
## [131,]  0.448746530  0.185286822 -0.803782549  0.826298839
## [132,]  0.718959495  0.981824225  0.434059367  0.123251423
## [133,]  0.122553831 -1.064666221 -0.489228362  0.675837888
## [134,]  0.196356670 -0.967106280  0.424552884 -0.184393391
## [135,]  0.246069426  0.254590970 -0.427736236  0.823608028
## [136,] -2.028852176  1.490482546  0.012027358  0.772404387
## [137,]  0.278657594  1.816842692 -1.160277155  1.208908641
## [138,] -0.562659653  1.428018809 -0.714168576  1.094648995
## [139,] -0.305453826 -0.044645518 -0.823758403  1.050779094
## [140,] -1.350598692 -0.317715951 -0.415915498  0.060996415
## [141,] -0.791809257 -0.565911107  0.773507814  0.341086515
## [142,]  0.043192344  0.647534815  0.722666411 -0.308009588
## [143,] -1.915021704 -1.750777671  0.060092418 -0.895531051
## [144,] -0.538513205 -0.058293112  0.019683142 -0.032716285
## [145,]  0.604516779 -0.783129035  0.633293708  0.844862430
## [146,] -0.734133167 -1.641426929  0.653677079  0.986420681
## [147,]  0.601786262 -1.023712919 -0.862311000  0.737383853
## [148,] -0.188907347 -0.598113635  0.223455743  0.015093479
## [149,]  1.253241940  0.363538810 -1.261564947  0.299802890
## [150,] -0.096712048  0.849380368  0.742618957  0.835577649
## [151,] -0.439934196  0.436740118  0.758106917  1.236719982
## [152,]  0.680950226 -0.835436738 -0.496525930 -2.523787283
## [153,]  0.529597454  1.985946761  0.414304852  0.225503660
## [154,]  1.879529371 -0.017601863 -1.504787861  1.353969391
## [155,]  0.334636778  0.196554969  0.524561064  1.336556490
## [156,] -0.701454957  0.387068121 -0.221180266  0.007174508
## [157,] -0.050184927 -0.381684536 -0.505670699  0.715761618
## [158,] -1.120552574  0.638586524 -0.041276800  0.620783806
## [159,]  1.931785977  1.245199570 -2.019691861 -0.062865506
## [160,]  1.245261954  1.853465872 -0.956105443 -1.964893579
## [161,]  0.284750505 -0.030368647  0.846939323 -0.482908585
## [162,]  0.110528331  0.008027284  1.327583557 -0.784922538
## [163,]  1.456973866 -0.244744309 -0.112095119  0.805240724
## [164,]  1.445736775 -0.894147954  2.220831664  0.729425462
## [165,]  0.522080086  1.244971006  0.904026450  1.521219603
## [166,] -0.376211980  0.439643687 -0.220187018  0.148425403
## [167,] -0.869618708  0.595520758  0.189409022  0.318637063
## [168,] -0.379999973 -0.206106595 -0.169496844 -1.584525194
## [169,]  0.579974822  0.192383377 -0.790740123 -0.610327020
## [170,]  1.525168711  0.048890267 -1.246255048  1.235909895
## [171,]  0.767909677  1.114447321 -1.712334361  1.240671897
## [172,] -0.542579214  0.712080087 -1.148097893 -0.025286603
## [173,] -0.705777146  0.955927044 -1.257083442 -0.166559691
## [174,] -1.649958208  0.866499958  0.294071260 -0.075788840
## [175,] -1.060051391 -0.353377418 -0.975774666 -1.586620702
## [176,] -0.988031770 -0.162267429 -0.701133532 -0.880064458
## [177,] -0.379792999 -0.701936243 -1.011382027 -0.011712777
```

```
## [178,]  1.145821010 -0.014922337  0.779907220 -0.190423459
## [179,]  1.099180407 -0.186286857  0.758789422 -0.104887794
## [180,]  0.591309825 -0.695516262  0.738879425  0.664703768
## [181,]  0.653160568  0.158089923 -0.766066459 -0.248967271
## [182,] -2.143724866  2.072808170 -1.614983116 -1.673743416
## [183,] -0.170721190 -0.370338291 -0.197629126  0.264983339
## [184,]  0.762953321  1.028609278 -0.209618301  0.978631982
## [185,]  0.336349440 -0.577560141  1.694078948  0.708431081
## [186,]  0.644803075  0.176987974  1.388594443  0.142634790
## [187,] -0.164478712  1.126710206 -0.183256546  0.891811589
## [188,]  0.229221452  0.094389740 -0.148301683 -1.597081842
## [189,]  0.287181452 -1.672665627  0.222085006  0.723608131
## [190,]  0.364801572 -0.604389831  1.548315988  0.721236288
## [191,] -0.312963952 -0.226558344 -1.632108260  1.204746391
## [192,]  0.521194310  1.166901278 -1.526315817  1.158675265
## [193,] -0.562942942  0.403186882 -0.707006985  0.747355414
## [194,] -0.713758708 -1.049171194 -1.414944580  0.803902738
## [195,] -1.876211556  0.019232469  0.442469905  0.874529173
## [196,]  0.218383349 -0.706785290  1.321185886 -1.510950368
## [197,]  0.282344105 -0.659598153 -0.791601600  1.236365387
## [198,]  0.086919499 -1.024298809 -0.064275474 -0.439449148
## [199,]  0.086919499 -1.024298809 -0.064275474 -0.439449148
## [200,]  0.445931124 -1.124603032 -0.953644413  0.213597331
## [201,]  0.296503145  0.181924369  0.688805376  0.482361094
## [202,]  1.055550448 -0.931789507 -0.752792844 -0.468763618
## [203,] -1.999596412  2.150826464  0.853071202  1.096555343
## [204,]  0.378834080 -0.582649380 -1.407877376  1.185227264
## [205,] -1.486188424  0.283905306 -1.247039168  0.147147431
## [206,]  1.475520538 -0.078406315 -1.347205533  0.663110399
## [207,]  1.430010287  1.158004508  0.473053658  0.695105633
## [208,] -0.552145154 -1.686633247  0.001047928  0.172811066
## [209,]  1.489604079 -0.772351357  1.289078652 -1.337629949
## [210,]  0.677219605 -0.579335415  1.269576941 -1.821797424
## [211,] -0.713290762  0.006020205  1.191946568  0.793798717
## [212,]  0.622209348  0.817884634  1.492533448 -0.938472694
## [213,] -0.593635114 -0.193264883  0.670020161  0.133788502
## [214,]  0.589384967 -0.169038265 -1.642660652  0.904539316
## [215,] -1.425419932  0.198424233 -0.239361235  1.264274000
## [216,] -0.183249847 -1.086085157 -0.615670091  0.004668552
## [217,] -0.841135438  1.484531920  1.148210401  0.282549749
## [218,] -1.451599301  0.909456806 -0.984065393 -0.163040889
## [219,] -1.451599301  0.909456806 -0.984065393 -0.163040889
## [220,]  1.611899558  0.406526583  1.263018720  1.167776128
## [221,]  1.550123363  0.019212202  0.813176416  0.768093351
## [222,]  1.550123363  0.019212202  0.813176416  0.768093351
## [223,] -0.039773854  0.550953439  0.016533334 -1.286322319
## [224,] -1.635739497  0.641010533 -0.815296544 -0.431322405
## [225,] -0.090294580 -0.949001063 -1.268866499 -0.279915737
## [226,] -0.090294580 -0.949001063 -1.268866499 -0.279915737
## [227,] -0.332985892 -0.395572803 -0.281086683 -0.762373695
## [228,] -1.310074983 -0.012676000 -0.290447188 -0.472192892
## [229,] -2.157339557  1.086774404  0.524388282 -0.615999689
## [230,]  0.497489095  0.213387987 -0.402946494 -0.926131964
## [231,]  0.049036361 -0.806215638 -1.225913889  0.124325679
```

```
## [232,]  0.547060306  0.804883192  1.412311264 -0.208556330
## [233,]  0.126818671 -1.043755595 -0.190512690 -0.084877544
## [234,] -0.614966848 -0.172520261 -0.398162211 -0.794856434
## [235,]  0.155340294 -1.239984554 -0.723754411  0.068970392
##
## $weights
##                Factor1      Factor2      Factor3       Factor4
## Filling     0.120591482  0.080346361 -0.030864160  0.0381506348
## Natural     0.137185214 -0.005242536 -0.055169420 -0.0003770006
## Fibre       0.218248191  0.069957697 -0.123858463 -0.0714070560
## Sweet       0.055439612  0.278316222  0.067025213 -0.0019873752
## Easy        0.021836499  0.022043606 -0.016964181  0.0451423208
## Salt        0.070071243  0.252324635 -0.167993906  0.0214347468
## Satisfying  0.096662949  0.057354624 -0.009012448  0.0956940234
## Energy      0.091802447  0.047593801  0.020431123  0.0208874546
## Fun        -0.032637876 -0.024362051  0.209170401  0.0576924243
## Kids       -0.034776590  0.042284660 -0.127272756  0.5531137298
## Soggy       0.045626141  0.067119460 -0.183492223  0.0528680389
## Economical  0.006888436 -0.027833558 -0.077373458  0.0881657988
## Health      0.250504889 -0.055381332 -0.063804925 -0.0323571995
## Family     -0.031580620 -0.034012364  0.003292687  0.3159472630
## Calories    0.021857693  0.154477254 -0.023250702 -0.0031638857
## Plain       0.052803912  0.086166437 -0.317739788  0.0773383782
## Crisp      -0.025466048 -0.016049916  0.136269082  0.0390633356
## Regular     0.084550726  0.025291686 -0.029691261 -0.0219529755
## Sugar       0.064994414  0.467840233 -0.073400682 -0.0295368860
## Fruit       0.024172374  0.008175189  0.170916477 -0.1106535218
## Process     0.008700011  0.083379158 -0.070641676  0.0159578293
## Quality     0.074874137 -0.060502651  0.058848719  0.0207197389
## Treat      -0.028877998 -0.023518727  0.314070803  0.0289299209
## Boring      0.037433852  0.077329450 -0.197821634 -0.0059789061
## Nutritious  0.230724934  0.029127732 -0.091867414 -0.0151642666
##
## $r.scores
##               Factor1       Factor2       Factor3       Factor4
## Factor1  1.000000e+00 -1.769418e-16  3.400058e-15  1.346145e-15
## Factor2 -2.081668e-16  1.000000e+00 -1.502271e-15 -1.576430e-15
## Factor3  3.379241e-15 -1.495548e-15  1.000000e+00 -9.847808e-16
## Factor4  1.363493e-15 -1.561251e-15 -1.027390e-15  1.000000e+00
##
## $missing
##   [1] 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
##  [36] 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
##  [71] 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
## [106] 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
## [141] 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
## [176] 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
## [211] 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
##
## $R2
## [1] 0.9564660 0.9147540 0.8680029 0.9294413
```

```
#Naming the dimensions
Dimension1 <- colnames(cerealDR[,c(1,2,3,7,8,13,18,22,25)])
```

```
Dimension1
```

```
## [1] "Filling"    "Natural"    "Fibre"      "Satisfying" "Energy"
## [6] "Health"     "Regular"    "Quality"    "Nutritious"
```

```
Dimension2 <- colnames(cerealDR[,c(4,6,19,21)])
Dimension2
```

```
## [1] "Sweet"   "Salt"    "Sugar"   "Process"
```

```
Dimension3 <- colnames(cerealDR[,c(10,12,14)])
Dimension3
```

```
## [1] "Kids"       "Economical" "Family"
```

```
Dimension4 <- colnames(cerealDR[,c(5,9,11,16,17,20,23,24)])
Dimension4
```

```
## [1] "Easy"   "Fun"    "Soggy"  "Plain"  "Crisp"  "Fruit"  "Treat"  "Boring"
```

```
remove(newcerealDR)
```

```
## Warning in remove(newcerealDR): object 'newcerealDR' not found
```

```
newcerealDR <- cerealDR

aggDim1 <- apply(newcerealDR[,Dimension1],1, mean)
aggDim2 <- apply(newcerealDR[,Dimension2],1, mean)
aggDim3 <-  apply(newcerealDR[,Dimension3],1, mean)
aggDim4 <-  apply(newcerealDR[,Dimension4],1, mean)
```

```
newcerealDR[,26] <- round(aggDim1 , digits = 3)
newcerealDR[,27] <- round(aggDim2 , digits = 3)
newcerealDR[,28] <- round(aggDim3, digits = 2)
newcerealDR[,29] <- round(aggDim4 , digits = 2)

colnames(newcerealDR)[26:29] <- c("Health", "Taste", "Family", "Experience")
print(newcerealDR)
```

```
## # A tibble: 235 x 29
##    Filling Natural Fibre Sweet  Easy  Salt Satisfying Energy   Fun  Kids
##      <dbl>   <dbl> <dbl> <dbl> <dbl> <dbl>      <dbl>  <dbl> <dbl> <dbl>
##  1       5       5     5     1     2     1          5      4     1     4
##  2       1       2     2     1     5     2          5      1     1     5
##  3       5       4     5     5     5     3          5      5     5     5
##  4       5       5     5     3     5     2          5      5     5     5
##  5       4       5     3     2     5     2          5      4     5     5
##  6       4       4     4     2     5     2          5      4     5     5
##  7       4       4     3     2     5     1          5      5     5     5
##  8       4       3     3     2     5     1          5      4     4     5
```

```
##  9       4       3     3     2     5     1          5      4     4     5
## 10       4       3     3     2     5     1          5      4     4     5
## # ... with 225 more rows, and 19 more variables: Soggy <dbl>,
## #   Economical <dbl>, Health <dbl>, Family <dbl>, Calories <dbl>,
## #   Plain <dbl>, Crisp <dbl>, Regular <dbl>, Sugar <dbl>, Fruit <dbl>,
## #   Process <dbl>, Quality <dbl>, Treat <dbl>, Boring <dbl>,
## #   Nutritious <dbl>, Health <dbl>, Taste <dbl>, Family <dbl>,
## #   Experience <dbl>
```

Dimension 1 ==> Signifies Health related parameters Dimension 2 ==> Signifies Taste related parameters Dimension 3 ==> Signifies Family related parameters Dimension 4 ==> Signifies Experience related parameters Next step is to add these 4 new Dimensions as columns to the dataset

```
aggregate(x= newcerealDR[,27:29], by = list(cerealDRO$Cereals) ,  FUN = mean , sort = TRUE)
```

```
##        Group.1    Taste   Family Experience
## 1      AllBran 2.233333 2.976667   2.299333
## 2      CMuesli 2.711538 3.512308   2.759231
## 3   CornFlakes 2.583333 4.123704   2.597037
## 4    JustRight 2.687500 3.166875   2.665000
## 5     Komplete 2.464286 2.642857   2.722143
## 6   NutriGrain 3.031250 3.972083   2.724167
## 7      PMuesli 2.763889 3.203333   2.895000
## 8  RiceBubbles 2.130952 4.190476   2.720000
## 9     SpecialK 2.347826 3.709565   2.558261
## 10     Sustain 2.125000 3.278333   2.918333
## 11    Vitabrit 1.830000 3.933200   2.540800
## 12    Weetabix 2.000000 3.803333   2.374815
```

```
## Re-computing the whole exercise using principal  function than using factanal function

# Please  note input of first argument to principal function i.e. "x" can be either a
# correlation matrrix of the dataframe of original data or the data frame with original data of input v
# If original data frame of input variables is given , correlation is computed.
# However , if cor(x) is used in  the principal function , pCAresult$scores will yield a result of NULL

#factors without rotation

library(psych)
unrotate_cereal <- principal( cerealDR ,  nfactors = 4 , rotate =  "none")
unrotate_cereal
```

```
## Principal Components Analysis
## Call: principal(r = cerealDR, nfactors = 4, rotate = "none")
## Standardized loadings (pattern matrix) based upon correlation matrix
##              PC1   PC2   PC3   PC4   h2   u2 com
## Filling     0.75  0.10 -0.07  0.23 0.63 0.37 1.2
## Natural     0.75 -0.26 -0.13  0.13 0.66 0.34 1.4
## Fibre       0.73 -0.24 -0.33  0.18 0.74 0.26 1.8
## Sweet       0.09  0.78 -0.18  0.19 0.68 0.32 1.3
## Easy        0.35  0.14  0.27  0.16 0.24 0.76 2.7
## Salt       -0.22  0.55 -0.14  0.48 0.60 0.40 2.5
## Satisfying  0.74  0.16  0.17  0.20 0.65 0.35 1.4
```

```
## Energy      0.73  0.14 -0.07  0.17 0.58 0.42 1.2
## Fun         0.41  0.53  0.26 -0.15 0.53 0.47 2.6
## Kids        0.22  0.25  0.79  0.11 0.74 0.26 1.4
## Soggy      -0.11 -0.28  0.18  0.58 0.45 0.55 1.7
## Economical  0.16 -0.29  0.58  0.11 0.45 0.55 1.7
## Health      0.81 -0.31 -0.13  0.09 0.78 0.22 1.4
## Family      0.32  0.19  0.73  0.02 0.67 0.33 1.5
## Calories   -0.17  0.63 -0.17  0.28 0.54 0.46 1.7
## Plain      -0.33 -0.40  0.25  0.48 0.57 0.43 3.3
## Crisp       0.31  0.49  0.27 -0.24 0.47 0.53 2.9
## Regular     0.62 -0.15 -0.22  0.09 0.46 0.54 1.4
## Sugar      -0.25  0.75 -0.22  0.26 0.74 0.26 1.7
## Fruit       0.39  0.29 -0.54 -0.14 0.55 0.45 2.6
## Process    -0.34  0.30  0.01  0.34 0.32 0.68 3.0
## Quality     0.75 -0.16  0.04 -0.01 0.59 0.41 1.1
## Treat       0.49  0.59  0.09 -0.20 0.63 0.37 2.2
## Boring     -0.41 -0.30 -0.13  0.43 0.46 0.54 3.0
## Nutritious  0.81 -0.23 -0.16  0.15 0.75 0.25 1.3
##
##                        PC1  PC2  PC3  PC4
## SS loadings           6.51 3.79 2.49 1.68
## Proportion Var        0.26 0.15 0.10 0.07
## Cumulative Var        0.26 0.41 0.51 0.58
## Proportion Explained  0.45 0.26 0.17 0.12
## Cumulative Proportion 0.45 0.71 0.88 1.00
##
## Mean item complexity =  1.9
## Test of the hypothesis that 4 components are sufficient.
##
## The root mean square of the residuals (RMSR) is  0.06
##  with the empirical chi square  428.91  with prob <  9e-18
##
## Fit based upon off diagonal values = 0.96
```

```
print(unrotate_cereal$loadings,  sort = TRUE)
```

```
##
## Loadings:
##            PC1    PC2    PC3    PC4
## Filling     0.747  0.100          0.228
## Natural     0.750 -0.256 -0.131  0.131
## Fibre       0.732 -0.240 -0.332  0.179
## Satisfying  0.745  0.160  0.170  0.198
## Energy      0.728  0.135          0.170
## Health      0.812 -0.314 -0.125
## Regular     0.620 -0.145 -0.224
## Quality     0.752 -0.155
## Nutritious  0.807 -0.226 -0.161  0.148
## Sweet               0.776 -0.184  0.185
## Salt       -0.223  0.545 -0.136  0.484
## Fun         0.411  0.526  0.256 -0.146
## Calories   -0.171  0.630 -0.174  0.280
## Sugar      -0.254  0.747 -0.225  0.261
## Treat       0.485  0.588        -0.195
```

```
## Kids        0.218  0.251  0.786  0.109
## Economical  0.160 -0.286  0.577  0.108
## Family      0.317  0.193  0.726
## Fruit       0.394  0.287 -0.540 -0.144
## Soggy      -0.110 -0.276  0.179  0.578
## Easy        0.347  0.142  0.270  0.157
## Plain      -0.329 -0.404  0.249  0.485
## Crisp       0.309  0.490  0.269 -0.240
## Process    -0.341  0.301         0.341
## Boring     -0.414 -0.296 -0.133  0.433
##
##                  PC1   PC2   PC3   PC4
## SS loadings    6.51 3.792 2.494 1.682
## Proportion Var 0.26 0.152 0.100 0.067
## Cumulative Var 0.26 0.412 0.512 0.579
```

```
factor.scores(cerealDR, unrotate_cereal$loadings)
```

```
## $scores
##                PC1          PC2          PC3          PC4
##   [1,]  0.96209119 -2.338502319  0.324581717  1.072995402
##   [2,] -1.84293973 -0.443295563  2.594085050 -0.203341763
##   [3,]  1.74526247  1.053766874  0.528690482  0.475915537
##   [4,]  2.05523869  0.227041812 -0.375300355 -0.062641403
##   [5,]  1.19654810  0.464342116  1.043671867 -1.061647938
##   [6,]  1.08552822  0.853718019  1.468299266 -0.928293574
##   [7,]  1.28319066  0.688392835  1.577060734 -1.207858040
##   [8,]  0.40497911 -0.179360526  1.369323059 -1.128603864
##   [9,]  0.40497911 -0.179360526  1.369323059 -1.128603864
##  [10,]  0.40497911 -0.179360526  1.369323059 -1.128603864
##  [11,]  0.13365951 -1.757851712  0.089546367  1.427612178
##  [12,] -0.11306489 -0.231186280 -0.502722747  0.615105982
##  [13,] -0.41333084  1.961445282 -0.791748645  1.117509876
##  [14,] -0.35465771  1.841680265 -0.453156455  0.775925581
##  [15,]  0.62739540  2.208511080  0.789515499  1.363730642
##  [16,]  0.05670838 -0.397952171 -1.180041635 -0.396697997
##  [17,] -1.07696887  0.838642402  2.244583196 -1.772869379
##  [18,]  0.13239233  0.250827803  1.042101380  0.380346662
##  [19,]  0.83624946 -1.179272609  0.349882098  1.428620747
##  [20,] -0.62387004  1.714908290 -2.330860426  1.915606247
##  [21,]  0.08919468  0.199318915 -0.770537594  1.023490548
##  [22,] -1.16573641 -0.987715471 -1.405525495  1.299619219
##  [23,]  1.26100023 -0.008889205 -2.026444432 -1.111391044
##  [24,]  1.30694325  0.709792472 -0.072066508 -1.138153284
##  [25,]  1.22409782  0.062424359 -0.934110217 -0.205968298
##  [26,] -0.25805575 -0.821809991  0.207671993  2.034059271
##  [27,]  0.41929651 -0.535529358 -0.890404951 -0.810427046
##  [28,] -1.01671958 -0.947109202 -0.132116108 -1.094195616
##  [29,] -0.31967271 -0.717480526 -0.960623542 -1.312065975
##  [30,] -0.26902349 -0.009624716  1.075764214 -0.995404689
##  [31,] -0.06676070  1.357843789  0.620946109 -0.472016677
##  [32,]  1.00896099 -1.154104924 -1.285800026  1.021780489
##  [33,]  1.03857890  1.514393709  1.171442825 -0.382952582
##  [34,]  1.42943931 -0.384203335  0.669179040 -1.050915428
```

```
##  [35,]  1.08255364 -1.123271997  0.345028487 -0.097438200
##  [36,] -1.25564444 -0.040803180  1.692995036  0.139861819
##  [37,]  0.11030655  2.121443524  0.058957960 -0.506849376
##  [38,]  0.07135509  2.110490554 -0.621907161  0.271598822
##  [39,] -0.45602786  1.972541682 -1.171247231  0.382879279
##  [40,] -0.24461482 -0.182016007  1.332220829  2.009597438
##  [41,]  1.83032787  1.832995248 -0.639412835  1.421612694
##  [42,]  1.04723764  0.525012182 -0.540116495  0.613311974
##  [43,]  0.09093744 -0.594565401  0.012050611  1.122787154
##  [44,]  1.60563547  0.141308455  0.927853576  0.145010253
##  [45,]  2.22517322  0.029416850  0.949873454 -0.958981269
##  [46,]  1.18074056 -1.291606445 -0.457116742  0.684152945
##  [47,] -0.21410591 -0.762756412 -1.446227672 -0.882115749
##  [48,] -0.09580098 -0.439916104 -1.724428491 -0.450425902
##  [49,] -0.63688491 -0.164215628 -0.970060431 -0.158172736
##  [50,] -0.32122099 -0.764310052 -1.981571982 -2.009030943
##  [51,] -0.30673300 -0.740319178 -2.006330926 -1.033263603
##  [52,] -1.15564274 -0.656921609  1.717526130 -0.523247216
##  [53,] -2.41470263  1.255967189  1.323176579 -3.221996545
##  [54,]  0.55491704 -1.134317282  0.367010823  0.163925283
##  [55,] -0.54246951  1.088827910  0.066853058  0.348746303
##  [56,]  0.77070638 -1.011616494  1.187108205  0.299389164
##  [57,]  0.51952644  0.545272180 -1.483156916 -1.037960489
##  [58,]  2.10487994  0.564252306  0.374797513 -0.612479675
##  [59,] -0.73642661 -0.477320347  1.140137355 -0.751104512
##  [60,]  1.17974964  0.643866342 -0.061525703 -0.552154378
##  [61,] -0.04303307 -0.410101000  0.700354123  0.288558458
##  [62,]  0.02259126  0.630315188  0.604091050 -0.060073304
##  [63,]  0.71976628 -1.061022823 -1.312242896 -1.567813865
##  [64,]  1.36997584  1.843044882 -1.173159222  0.334535568
##  [65,]  0.02545623 -1.024150401  1.015525582 -0.474830861
##  [66,] -1.28382279 -1.099834382  0.276894535 -0.164955817
##  [67,]  1.57059768 -1.516410667  1.213414042  1.184095266
##  [68,]  1.38101947  0.480763569  1.750915841 -1.490946319
##  [69,] -0.35006721  1.674604122  0.463994822 -0.620284628
##  [70,] -0.56191423 -0.276678615  1.717490256 -1.809189775
##  [71,]  0.90256844 -0.928658038  1.032517860 -0.226537699
##  [72,]  0.82862434 -0.410275549  1.296419305 -0.114098307
##  [73,] -0.96936509 -0.339759804  0.756870728  2.038345878
##  [74,]  0.73290353 -0.566679307 -3.010571369  0.887573134
##  [75,] -0.61419883 -0.862356723 -1.861301818 -0.769565962
##  [76,] -2.69984201 -0.680603475 -1.220098980 -2.420189802
##  [77,]  0.08125614  0.270188622 -0.736056459  1.950997645
##  [78,] -1.19422677  0.197021144 -1.323848670  0.364989871
##  [79,]  1.31861761 -0.823385558  0.576772573  1.970071651
##  [80,] -2.34584049  0.796924581  0.614005181 -0.184458252
##  [81,]  0.45382205 -0.620072004 -0.700370107 -1.397488741
##  [82,] -1.39868890 -1.323433855 -1.538287682 -2.135826897
##  [83,] -0.80522356 -0.333108214 -0.715787719 -0.050909783
##  [84,] -1.63198205  0.891490724 -1.125396646  1.036146299
##  [85,] -3.06246234  1.802176080 -1.239596493  2.301428422
##  [86,]  0.82096117 -1.633595700 -1.065631249 -0.269078308
##  [87,]  0.95599426  2.046828736  1.243696402  0.208763078
##  [88,]  0.33859599  0.438475558 -0.966059174  1.454729248
```

```
##  [89,] -0.11003803 -1.093991695 -0.096634182  0.488141399
##  [90,]  0.09624230 -0.441990340 -0.673227571 -2.028232652
##  [91,] -1.21845461  1.772097669 -0.299439573 -1.120857613
##  [92,] -0.05636651 -1.176794095  0.343187654  1.483276718
##  [93,]  0.34888906 -0.960361863 -1.147321103 -0.332097729
##  [94,]  0.60426442 -0.195609748  0.576100405 -0.433748741
##  [95,]  0.04982200 -0.278663584 -0.059707838  0.492266265
##  [96,] -0.86116555 -0.526752572  1.060581924 -1.571264935
##  [97,]  0.39583876  0.111326170 -0.260124047 -0.450879855
##  [98,]  0.37027025  0.105990333 -1.012980181 -0.003534142
##  [99,] -0.25528892 -1.712048732 -0.339727815 -0.875120341
## [100,]  0.83321833  2.004028007 -0.522046044 -0.504897151
## [101,]  0.63093593  2.226762956 -0.061846523 -0.645210409
## [102,] -0.07608873 -1.567043664 -0.208601741 -0.275661397
## [103,] -0.07608873 -1.567043664 -0.208601741 -0.275661397
## [104,]  0.59083855  0.843925620 -1.304614094 -0.119338491
## [105,] -0.14149716 -1.256169811 -1.030325596  0.915368633
## [106,] -1.17310884 -0.733164406 -0.222291261  0.258068487
## [107,] -1.40387551 -0.668239548 -0.135150993  0.691052778
## [108,] -0.35366925  1.540366014 -0.075702514 -0.434864380
## [109,] -1.28725384 -1.462818560  0.199668731  1.189999013
## [110,] -0.42430203 -1.319574530 -0.061355572  0.641338261
## [111,] -0.43655200 -0.332975096 -1.595331483 -0.111488209
## [112,] -0.08903248 -1.438415045  0.107235342 -0.555934809
## [113,] -0.17797537  0.493694263 -1.439625550 -0.802770746
## [114,] -0.38078591  2.288380103  0.975080700  0.163855198
## [115,]  0.22605256  0.739689308 -2.150179658  0.350422809
## [116,] -0.35052667 -0.425755885 -1.303772098  0.716307022
## [117,] -0.28338399 -0.235766097 -2.095948803  1.071293688
## [118,] -0.69137647  0.617945342 -0.728391501 -0.080588387
## [119,] -0.53009153 -0.963693531  0.296817337  0.674706538
## [120,] -0.69165228 -0.493349914  1.256876412  0.702854432
## [121,] -0.16089326  1.751819678 -1.368535622 -0.316753624
## [122,]  0.96991401  0.281541272 -0.673952120 -0.458047939
## [123,] -0.17832328 -0.337257555  1.334298672 -0.323552133
## [124,]  0.36454451 -0.727063271  1.114011206  0.473269182
## [125,]  0.78684600 -0.398522532  0.201638891 -0.804606887
## [126,] -1.78679404  2.068672694  0.246013835 -0.210221469
## [127,]  1.22639290  1.441590746 -1.982101756 -0.345269090
## [128,] -0.20830262 -0.831520723  0.184094791  0.307448817
## [129,] -0.70951858 -0.472846807  1.408567663 -1.500262911
## [130,] -1.47291301 -0.592283112  1.109057091 -1.746426850
## [131,]  0.24869597 -0.196699688  0.915600636  1.484310322
## [132,]  0.68427300  0.856736952 -0.693542042  0.687238857
## [133,]  0.25067926 -0.922596896  0.732195265 -0.004058970
## [134,]  0.49934917 -0.676760575 -0.205953947 -1.052558767
## [135,]  0.13745058  0.270840125  0.806287498  0.753192949
## [136,] -1.96186692  1.713961451  0.976504010  0.096539326
## [137,] -0.18017429  0.938955698  0.892168744  1.677308849
## [138,] -0.65478029  0.998416412  0.990266741  0.963308010
## [139,] -0.35135177 -0.198097855  0.989837466  0.633197554
## [140,] -1.42660413 -0.242353334  0.320887842 -0.255269656
## [141,] -0.19605555  0.261978924  0.575383436 -1.211901960
## [142,]  0.19400535  0.672302774 -0.889941762 -0.709224580
```

```
## [143,] -1.53665709 -1.135649734  0.185756825 -2.325922399
## [144,] -0.31752521  0.119582980  0.125896041 -0.515577147
## [145,]  0.94841646  0.185076245  0.578845292 -0.738374908
## [146,] -0.01041401 -0.324046091  1.500465376 -1.591236809
## [147,]  0.51689578 -1.054145265  1.118374344  0.718141862
## [148,] -0.17954780 -0.332759846 -0.187398175 -0.323624564
## [149,]  0.75483615 -0.679360168  0.072084205  1.217979229
## [150,]  0.18740347  1.346815752  0.802931097 -0.144372318
## [151,]  0.17978611  1.089984701  1.331907963 -0.440975721
## [152,] -0.10087502 -1.427145760 -1.791407785 -0.348716080
## [153,]  0.46180947  1.814510869 -0.650499761  0.771872904
## [154,]  1.51422137 -0.713354697  0.900933883  2.116964262
## [155,]  0.73169704  1.051869131  1.077097802  0.378227070
## [156,] -0.74337566  0.340693146  0.153526666  0.293076074
## [157,]  0.01929532 -0.578385353  0.401510382 -0.150353688
## [158,] -1.05138919  0.696800230  0.446481104  0.217547150
## [159,]  0.75550583 -0.112973319 -0.487380267  2.506351247
## [160,] -0.04547784  0.357513483 -2.467709899  1.825964767
## [161,]  0.35623119  0.394210815 -1.233244170 -1.014333045
## [162,]  0.38774390  0.779977592 -1.005560805 -1.064450093
## [163,]  1.33283680 -0.335870393  0.052321737  0.513546676
## [164,]  2.38913012  0.382648504  0.142981501 -1.467223238
## [165,]  0.95043402  1.588149757  1.460176098  0.847453272
## [166,] -0.30432662  0.248499819  0.120968916  0.018526251
## [167,] -0.67956805  0.712333875  0.518167264 -0.208573399
## [168,] -0.62136200 -0.603189011 -0.874247846 -0.119696452
## [169,]  0.10027255 -0.581108517 -0.556848059  0.743378098
## [170,]  1.21050656 -0.666072025  0.922793976  1.838765353
## [171,]  0.18842939 -0.085217023  0.905174499  2.269255235
## [172,] -1.01330166  0.071940350 -0.021297369  1.060846303
## [173,] -1.29861354  0.013611999 -0.135086855  0.882929486
## [174,] -1.59627790  0.824169932  0.143081905 -0.306921930
## [175,] -1.69553141 -0.893706181 -0.910634040  0.054086893
## [176,] -1.38868125 -0.552229784 -0.574926127 -0.070317073
## [177,] -0.60612768 -1.100253595  0.374222952  0.299762806
## [178,]  1.14191415  0.363051411 -0.754455664 -0.404799027
## [179,]  1.20123367  0.318242233 -0.532375295 -0.584652518
## [180,]  0.97454786 -0.198004907  0.085176204 -0.898189721
## [181,]  0.24078402 -0.547390117 -0.358580178  1.076267571
## [182,] -3.21060020  0.543766603 -0.880993185  1.669432430
## [183,] -0.08653167 -0.217972545  0.543603902  0.032068287
## [184,]  0.67177592  0.859937856  0.152960984  1.011412442
## [185,]  1.13280627  0.736171823  0.011609568 -0.961015514
## [186,]  0.97078041  0.855675400 -0.657364555 -0.955502736
## [187,] -0.21621582  0.910145133  0.679650076  0.569969038
## [188,] -0.12017500 -0.462194225 -1.155565215 -0.415866596
## [189,]  0.91083253 -1.185761082  0.912649137 -1.208666558
## [190,]  1.14218790  0.687947915  0.199954347 -0.998606506
## [191,] -0.58012563 -0.514284287  1.323627225  1.675105827
## [192,] -0.01947634  0.200651104  0.830192289  2.327932861
## [193,] -0.58519765  0.142861377  0.900102591  1.290601961
## [194,] -0.71547045 -1.434011940  1.009146650  0.372909672
## [195,] -1.24554514  0.810669350  1.476405530  0.129766968
## [196,]  0.49036517 -0.148046689 -1.355383110 -0.939653566
```

```
## [197,]  0.35729081 -0.904022824  1.397886844  0.691024493
## [198,]  0.04515414 -0.870351683 -0.622549497 -0.678736470
## [199,]  0.04515414 -0.870351683 -0.622549497 -0.678736470
## [200,]  0.40134177 -1.482332059  0.405473246 -0.023267382
## [201,]  0.58644036  0.379673324  0.113452312 -0.439271614
## [202,]  0.67410792 -1.439559683 -0.352479505  0.398864169
## [203,] -1.54440163  2.451807625  0.970606711  0.191084604
## [204,]  0.40821913 -1.057599036  1.285704962  1.562702946
## [205,] -1.67125969 -0.197247182  0.075319798  0.522631304
## [206,]  0.94029136 -1.008550823  0.622105177  1.385494611
## [207,]  1.19019273  1.129003866 -0.262594696  1.126764874
## [208,] -0.24815398 -1.231241482  0.783396309 -1.426627190
## [209,]  1.66660906 -0.536555365 -1.105557488 -1.229087990
## [210,]  0.73595347 -0.411301651 -1.742544284 -1.219603591
## [211,] -0.07602369  1.268311999  0.816837724 -0.843460048
## [212,]  0.73724128  1.367777994 -1.199527836 -0.159686276
## [213,] -0.31112381  0.446331474  0.350041827 -0.771373179
## [214,]  0.28763050 -1.087462458  0.937651557  1.168440170
## [215,] -0.90835610  0.257012916  1.671999798 -0.124048644
## [216,] -0.34195225 -1.249504916  0.043193236 -0.257129325
## [217,] -0.50503161  1.915426320  0.133651466 -0.045080972
## [218,] -1.82948598  0.342174247  0.190401762  0.523524833
## [219,] -1.82948598  0.342174247  0.190401762  0.523524833
## [220,]  2.09595655  1.114499838  0.647593945 -0.040443008
## [221,]  1.80914090  0.239507767  0.048953696  0.054078993
## [222,]  1.80914090  0.239507767  0.048953696  0.054078993
## [223,] -0.55912794  0.197916510 -1.550861464 -0.054726065
## [224,] -1.98342550  0.073785562 -0.052817180  0.458896951
## [225,] -0.50098549 -1.472554828  0.007159695  0.068023850
## [226,] -0.50098549 -1.472554828  0.007159695  0.068023850
## [227,] -0.61380475 -0.590506385 -0.438185584 -0.392988860
## [228,] -1.40819062 -0.196975456  0.082193156 -0.508258201
## [229,] -2.07236231  1.218448327 -0.201370789 -0.715761079
## [230,]  0.01933376 -0.386110425 -1.169518392  0.365665933
## [231,] -0.27838561 -1.178322968  0.371207195  0.436412064
## [232,]  0.81590859  1.336811500 -0.914997235 -0.544006981
## [233,]  0.20506715 -0.907228287  0.135126533 -0.394353964
## [234,] -0.92957092 -0.491339191 -0.424630852 -0.275176306
## [235,]  0.09351029 -1.501259115  0.227931930 -0.095697921
##
## $weights
##                    PC1         PC2          PC3         PC4
## Filling     0.11477452  0.02639180 -0.028752718  0.13542769
## Natural     0.11516388 -0.06752865 -0.052579966  0.07774413
## Fibre       0.11238932 -0.06329408 -0.132947793  0.10654231
## Sweet       0.01366582  0.20454402 -0.073954126  0.11025607
## Easy        0.05331460  0.03744400  0.108218400  0.09350980
## Salt       -0.03419716  0.14374205 -0.054441604  0.28788861
## Satisfying  0.11442492  0.04222876  0.068336795  0.11743504
## Energy      0.11182134  0.03570241 -0.028495689  0.10105524
## Fun         0.06315443  0.13879442  0.102495197 -0.08682973
## Kids        0.03351686  0.06617098  0.315144404  0.06460749
## Soggy      -0.01695238 -0.07290844  0.071612232  0.34369866
## Economical  0.02463047 -0.07528710  0.231534278  0.06424330
```

```
## Health      0.12476977 -0.08277174 -0.050272250  0.05228957
## Family      0.04870361  0.05092261  0.291258353  0.01446183
## Calories   -0.02632530  0.16623959 -0.069761083  0.16660147
## Plain      -0.05059206 -0.10661278  0.099961269  0.28806482
## Crisp       0.04747969  0.12925087  0.107999744 -0.14280874
## Regular     0.09523002 -0.03834978 -0.089632172  0.05326172
## Sugar      -0.03905638  0.19703737 -0.090111244  0.15514056
## Fruit       0.06051295  0.07579254 -0.216363237 -0.08554538
## Process    -0.05236305  0.07944013  0.002460185  0.20300852
## Quality     0.11544805 -0.04100187  0.014941336 -0.00744730
## Treat       0.07456248  0.15494214  0.037689856 -0.11593581
## Boring     -0.06359881 -0.07818437 -0.053183254  0.25738483
## Nutritious  0.12390581 -0.05957491 -0.064408151  0.08785306
##
## $r.scores
##                PC1           PC2           PC3           PC4
## PC1  1.000000e+00  1.387779e-17 -2.844947e-16 -6.52256e-16
## PC2  3.469447e-18  1.000000e+00 -2.579534e-15  4.14252e-15
## PC3 -3.712308e-16 -2.596881e-15  1.000000e+00  1.16053e-15
## PC4 -6.245005e-16  4.211909e-15  1.235123e-15  1.00000e+00
##
## $missing
##   [1] 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
##  [36] 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
##  [71] 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
## [106] 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
## [141] 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
## [176] 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
## [211] 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
##
## $R2
## [1] 1 1 1 1
```

```
# factors after rotation

rotate_cereal <- principal( cerealDR ,  nfactors = 4 , rotate = "varimax")
rotate_cereal
```

```
## Principal Components Analysis
## Call: principal(r = cerealDR, nfactors = 4, rotate = "varimax")
## Standardized loadings (pattern matrix) based upon correlation matrix
##              RC1   RC2   RC4   RC3   h2   u2 com
## Filling     0.75  0.11  0.14  0.20 0.63 0.37 1.3
## Natural     0.79 -0.20  0.02  0.04 0.66 0.34 1.1
## Fibre       0.84 -0.11  0.01 -0.13 0.74 0.26 1.1
## Sweet       0.08  0.74  0.34  0.06 0.68 0.32 1.4
## Easy        0.26  0.08  0.04  0.40 0.24 0.76 1.9
## Salt       -0.09  0.76 -0.12  0.01 0.60 0.40 1.1
## Satisfying  0.66  0.09  0.17  0.43 0.65 0.35 1.9
## Energy      0.70  0.11  0.19  0.19 0.58 0.42 1.4
## Fun         0.17  0.21  0.51  0.45 0.53 0.47 2.6
## Kids       -0.03  0.03  0.04  0.86 0.74 0.26 1.0
## Soggy       0.08  0.07 -0.65  0.16 0.45 0.55 1.2
## Economical  0.06 -0.33 -0.25  0.53 0.45 0.55 2.2
```

```
## Health      0.84 -0.28  0.04  0.05 0.78 0.22 1.2
## Family      0.06 -0.06  0.11  0.80 0.67 0.33 1.1
## Calories   -0.11  0.72  0.10 -0.02 0.54 0.46 1.1
## Plain      -0.15 -0.06 -0.73  0.12 0.57 0.43 1.2
## Crisp       0.05  0.14  0.53  0.41 0.47 0.53 2.1
## Regular     0.67 -0.10  0.08 -0.06 0.46 0.54 1.1
## Sugar      -0.19  0.82  0.16 -0.06 0.74 0.26 1.2
## Fruit       0.41  0.22  0.46 -0.35 0.55 0.45 3.4
## Process    -0.24  0.47 -0.20  0.03 0.32 0.68 1.9
## Quality     0.68 -0.25  0.16  0.20 0.59 0.41 1.6
## Treat       0.26  0.26  0.62  0.32 0.63 0.37 2.3
## Boring     -0.15  0.10 -0.61 -0.24 0.46 0.54 1.5
## Nutritious  0.85 -0.17  0.04  0.04 0.75 0.25 1.1
##
##                        RC1  RC2  RC4  RC3
## SS loadings           5.65 3.13 2.87 2.84
## Proportion Var        0.23 0.13 0.11 0.11
## Cumulative Var        0.23 0.35 0.47 0.58
## Proportion Explained  0.39 0.22 0.20 0.20
## Cumulative Proportion 0.39 0.61 0.80 1.00
##
## Mean item complexity =  1.6
## Test of the hypothesis that 4 components are sufficient.
##
## The root mean square of the residuals (RMSR) is  0.06
##  with the empirical chi square  428.91  with prob <  9e-18
##
## Fit based upon off diagonal values = 0.96
```

```
print(rotate_cereal$loadings ,  sort = TRUE)
```

```
##
## Loadings:
##            RC1    RC2    RC4    RC3
## Filling     0.746  0.114  0.136  0.195
## Natural     0.786 -0.205
## Fibre       0.839 -0.114        -0.134
## Satisfying  0.657         0.166  0.427
## Energy      0.705  0.112  0.193  0.190
## Health      0.835 -0.284
## Regular     0.667
## Quality     0.680 -0.246  0.165  0.201
## Nutritious  0.846 -0.173
## Sweet               0.743  0.342
## Salt                0.760 -0.120
## Calories   -0.108  0.716  0.103
## Sugar      -0.191  0.822  0.161
## Fun         0.171  0.210  0.511  0.446
## Soggy                     -0.646  0.160
## Plain      -0.150         -0.726  0.122
## Crisp               0.141  0.527  0.408
## Treat       0.258  0.260  0.624  0.323
## Boring     -0.151         -0.613 -0.236
## Kids                              0.858
```

```
## Economical        -0.329 -0.251  0.527
## Family                    0.114  0.804
## Easy         0.264                0.400
## Fruit        0.415  0.221  0.457 -0.347
## Process     -0.242  0.472 -0.202
##
##                  RC1   RC2   RC4   RC3
## SS loadings    5.645 3.129 2.866 2.840
## Proportion Var 0.226 0.125 0.115 0.114
## Cumulative Var 0.226 0.351 0.466 0.579
```

```
cat("Fitment : ", rotate_cereal$fit)
```

```
## Fitment :  0.9077224
```

```
factor.scores(cerealDR , rotate_cereal$loadings)
```

```
## $scores
##                RC1           RC2         RC4          RC3
##   [1,]  1.45578300 -1.4598510950 -1.83416904  0.190366957
##   [2,] -2.37231455 -0.8283466309 -0.97977943  1.757714629
##   [3,]  1.40744906  0.7080257244  0.74213641  1.276477655
##   [4,]  1.88766900 -0.0611209623  0.88784170  0.255020486
##   [5,]  0.36951637 -0.6493991115  1.33860489  1.230269755
##   [6,]  0.13652933 -0.3582859910  1.37238535  1.701289811
##   [7,]  0.21786014 -0.6972884587  1.54417441  1.774360652
##   [8,] -0.35523734 -1.1566090712  0.73556983  1.157570524
##   [9,] -0.35523734 -1.1566090712  0.73556983  1.157570524
##  [10,] -0.35523734 -1.1566090712  0.73556983  1.157570524
##  [11,]  0.80899969 -0.6319115926 -2.02388955 -0.063881976
##  [12,]  0.27008865  0.2973381401 -0.57556662 -0.452417416
##  [13,] -0.08036370  2.4079619640  0.20069274 -0.220878909
##  [14,] -0.21406444  2.0343125934  0.37415176  0.027179401
##  [15,]  0.44864331  2.2008724019  0.32109989  1.614316226
##  [16,]  0.31327772 -0.2506149739  0.22477775 -1.224734055
##  [17,] -2.27990692 -0.7141135715  1.20887301  1.695610471
##  [18,] -0.08923139  0.1326782900 -0.21749953  1.112748566
##  [19,]  1.27873240 -0.3426059130 -1.50034999  0.499786246
##  [20,]  0.45351547  3.0616924891 -0.44060812 -1.630585539
##  [21,]  0.59254650  0.8965945637 -0.54847440 -0.482832766
##  [22,] -0.08754949  0.4543181964 -1.76055543 -1.638722031
##  [23,]  1.34079098 -0.3065847616  1.46790258 -1.698650950
##  [24,]  0.71998354 -0.2422500802  1.69091663  0.276101518
##  [25,]  1.28022450 -0.0128174719  0.69296304 -0.545857386
##  [26,]  0.48136612  0.4643556271 -2.10106165  0.246352748
##  [27,]  0.44440183 -0.7098954643  0.54764070 -0.954389508
##  [28,] -1.08062149 -1.1675663743 -0.02047024 -0.783632680
##  [29,] -0.32926821 -1.0056520787  0.59058733 -1.338931143
##  [30,] -0.85769292 -0.7810394484  0.54088166  0.763120355
##  [31,] -0.58437991  0.6621531673  1.02389186  0.792634420
##  [32,]  1.75759469 -0.1723328222 -0.94438841 -1.018120998
##  [33,]  0.25422776  0.5400750668  1.34594644  1.650175979
##  [34,]  0.81102590 -1.2509136110  0.97449137  0.755613296
```

```
##  [35,]  1.00507237 -1.1750859425 -0.23573450  0.340048587
##  [36,] -1.54520275 -0.1877064717 -0.72400388  1.231679550
##  [37,] -0.39255853  1.3536147704  1.59512510  0.492202463
##  [38,]  0.01324643  1.9466576321  1.06269534 -0.028697858
##  [39,] -0.24820606  2.1102474296  0.78889924 -0.692954724
##  [40,]  0.07628009  0.6756808774 -1.84400587  1.429524223
##  [41,]  1.99729069  2.1142550065  0.61766710  0.546851103
##  [42,]  1.20500127  0.7311792502  0.23144900  0.001439029
##  [43,]  0.52371709  0.1372328049 -1.15073675  0.072569566
##  [44,]  1.19996330 -0.2675672193  0.39405071  1.346548730
##  [45,]  1.41160254 -1.0592039007  1.36569913  1.339588413
##  [46,]  1.59156911 -0.6938471027 -0.80015550 -0.290949450
##  [47,]  0.04485622 -0.7004043575  0.32820083 -1.702071452
##  [48,]  0.31853660 -0.1580722806  0.25130880 -1.785954254
##  [49,] -0.32353402  0.1129681624 -0.07502502 -1.129407008
##  [50,] -0.26015845 -1.1771038565  1.20141838 -2.398650369
##  [51,]  0.06743707 -0.6159066432  0.48551384 -2.261756537
##  [52,] -1.58338311 -1.0571747488 -0.53676415  1.038221322
##  [53,] -3.74074190 -0.7682796114  2.19793624  0.354926908
##  [54,]  0.61255524 -0.9688199803 -0.61441967  0.254616291
##  [55,] -0.55269000  1.1081583900  0.15879225  0.217293517
##  [56,]  0.60078079 -1.0294860824 -0.66696350  1.118300744
##  [57,]  0.46793992  0.1425833197  1.41939987 -1.261091640
##  [58,]  1.49682669 -0.2906408818  1.42551969  0.952594405
##  [59,] -1.14635941 -0.9613390306 -0.06440322  0.625915047
##  [60,]  0.80005427  0.0451640018  1.16891828  0.326399106
##  [61,] -0.08203616 -0.3274072274 -0.53689738  0.584476121
##  [62,] -0.26112287  0.3101770279  0.33835545  0.698185538
##  [63,]  0.66687053 -1.4800860882  0.97086798 -1.498632340
##  [64,]  1.38726210  1.7191824665  1.35141787 -0.235478421
##  [65,] -0.26205299 -1.3171056736 -0.31477412  0.635426426
##  [66,] -1.11483450 -0.8360750380 -0.93924390 -0.371027108
##  [67,]  1.66466080 -1.0589421881 -1.35726998  1.380614960
##  [68,]  0.19689175 -1.0729295513  1.65525224  1.870072578
##  [69,] -0.88753514  0.9079677537  1.23675377  0.620649889
##  [70,] -1.51925346 -1.5541697545  0.84058490  1.088614440
##  [71,]  0.58187057 -1.2358487859 -0.16360271  0.949624432
##  [72,]  0.40131515 -0.8211588930 -0.01245547  1.308875412
##  [73,] -0.37761276  0.8130269787 -2.12832800  0.670394118
##  [74,]  1.86453376  0.6757871852 -0.41806455 -2.569366968
##  [75,] -0.14573387 -0.5572253707  0.10188585 -2.198967110
##  [76,] -2.74183606 -1.1815260841  0.69657536 -2.387350430
##  [77,]  0.86120861  1.4566734389 -1.21560417 -0.294115799
##  [78,] -0.60875708  0.8517928522 -0.41261002 -1.443746706
##  [79,]  1.76633828  0.1102114960 -1.57748684  1.004988977
##  [80,] -2.44398030  0.7112959294 -0.25157315  0.082540467
##  [81,]  0.24723175 -1.1515709610  0.93435278 -0.879592223
##  [82,] -1.30482461 -1.6385429327  0.58427211 -2.430458641
##  [83,] -0.48599877  0.0018145361 -0.33300243 -0.962912883
##  [84,] -0.94374196  1.7813267481 -0.69714851 -1.117339681
##  [85,] -1.92039081  3.4278418934 -1.60076948 -1.207982873
##  [86,]  1.18694554 -1.2873507485 -0.32264630 -1.174892740
##  [87,]  0.27043339  1.2783497647  1.16111497  1.907431609
##  [88,]  0.97238696  1.3339345764 -0.63775490 -0.474095349
```

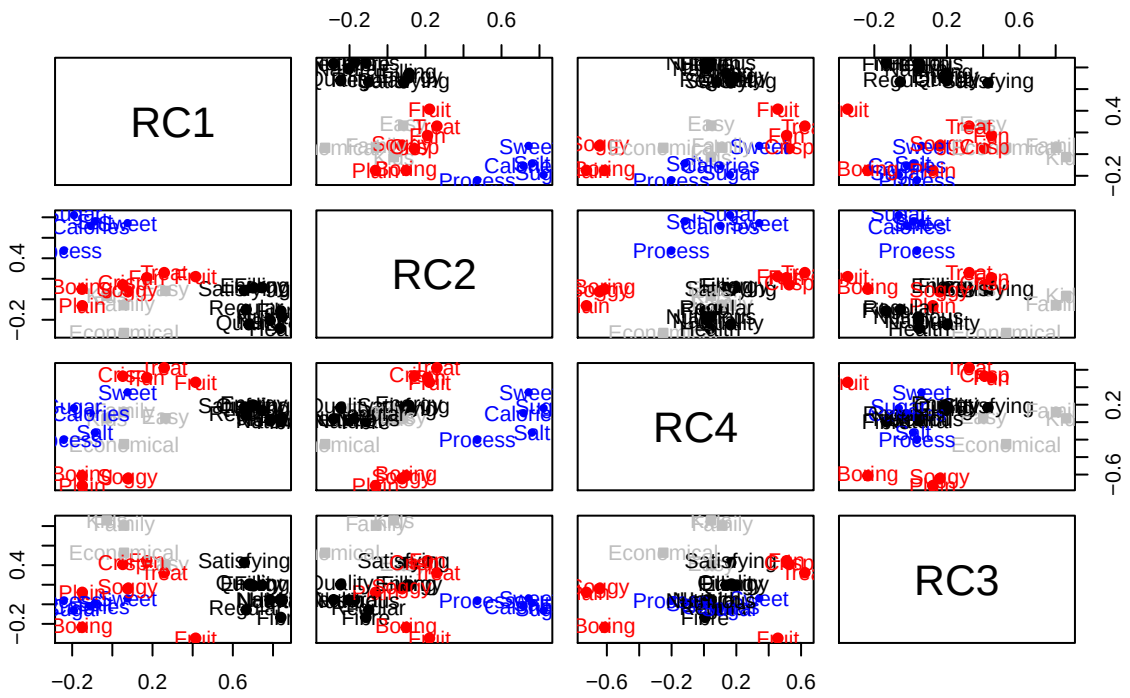
```
##  [89,]  0.24583353 -0.5490487102 -1.00398486 -0.294401377
##  [90,] -0.30727820 -1.3150340428  1.38979703 -1.008122456
##  [91,] -1.62356839  1.0200931445  1.46782834 -0.373982987
##  [92,]  0.50026123 -0.1801529377 -1.83183222  0.259968208
##  [93,]  0.66869463 -0.7061365614 -0.04542716 -1.234021118
##  [94,]  0.26897639 -0.6207267618  0.35356348  0.583756084
##  [95,]  0.25935853  0.0605178270 -0.50420867 -0.029514251
##  [96,] -1.48984544 -1.4152212125  0.49508900  0.381022628
##  [97,]  0.26622110 -0.1549683731  0.56046263 -0.176158380
##  [98,]  0.59769605  0.2754524712  0.29337865 -0.809499651
##  [99,] -0.15955016 -1.7055743414 -0.34036111 -0.909531814
## [100,]  0.43389901  1.3004316588  1.82823611  0.126475713
## [101,]  0.04670404  1.3143220204  1.94197190  0.525163209
## [102,]  0.13364868 -1.3189885822 -0.66771864 -0.614392543
## [103,]  0.13364868 -1.3189885822 -0.66771864 -0.614392543
## [104,]  0.73062478  0.8297331947  0.89623169 -0.867213509
## [105,]  0.63940421 -0.2076583965 -1.32554982 -1.135082611
## [106,] -0.79527935 -0.2090273008 -0.96356868 -0.651997609
## [107,] -0.89729650  0.0927726860 -1.33935107 -0.552830182
## [108,] -0.66066808  1.0374910222  1.07953462  0.119926483
## [109,] -0.61051931 -0.3536946882 -2.15733987 -0.317610993
## [110,]  0.03734871 -0.6047249155 -1.35218094 -0.375377117
## [111,]  0.07031866  0.1303831899 -0.07063216 -1.682863284
## [112,] -0.07473873 -1.4481290303 -0.42304167 -0.340440498
## [113,] -0.08473082  0.3218471059  0.97990108 -1.386146044
## [114,] -0.89850372  1.7014312958  0.92116570  1.344837784
## [115,]  0.80676175  1.2665487172  0.45609282 -1.697432737
## [116,]  0.34326165  0.4307028520 -0.75094999 -1.284443485
## [117,]  0.71029945  0.9595781521 -0.80475753 -1.898318588
## [118,] -0.53051097  0.7179082858  0.25829234 -0.730313228
## [119,] -0.19930957 -0.3795552606 -1.25263051  0.012727473
## [120,] -0.67289292 -0.2066279085 -1.16915977  0.965973669
## [121,] -0.11991764  1.5567889318  1.31222648 -0.952927641
## [122,]  0.86756524 -0.0070407658  0.89386303 -0.363741548
## [123,] -0.58642860 -0.7435350718 -0.14750204  1.054552522
## [124,]  0.27190221 -0.6339569150 -0.76465501  1.032467394
## [125,]  0.44858028 -0.9192549621  0.62103006  0.184567152
## [126,] -2.03730504  1.7037319812  0.70007592  0.182578081
## [127,]  1.32789586  1.2477518377  1.68197079 -1.216940322
## [128,] -0.01691971 -0.4973965433 -0.78399105 -0.030013382
## [129,] -1.43712527 -1.4407221723  0.48328758  0.766339392
## [130,] -2.09613150 -1.4869015584  0.38517979  0.217438244
## [131,]  0.46825433  0.4050485832 -1.24864641  1.095261513
## [132,]  0.89836659  1.1219583312  0.25842100 -0.151298092
## [133,]  0.15368502 -0.9409022432 -0.50897122  0.531209642
## [134,]  0.26783567 -1.1331484453  0.60336620 -0.371267216
## [135,]  0.09730686  0.4110330786 -0.46050113  0.958732537
## [136,] -2.24810142  1.4414761575  0.13379077  0.774436639
## [137,] -0.01425725  1.4696826316 -0.89911552  1.246936881
## [138,] -0.70224413  1.1667840504 -0.49299970  1.112017334
## [139,] -0.35987368  0.0026907802 -0.81142054  0.869188462
## [140,] -1.40999430 -0.2036505392 -0.44454713 -0.186779156
## [141,] -0.76150072 -0.5756885573  0.93417457  0.350514484
## [142,]  0.09713737  0.3254882661  1.07078700 -0.722953568
```

```
## [143,] -1.99921967 -1.9978202774  0.59948405 -0.864806141
## [144,] -0.50101728 -0.1757106357  0.33823634 -0.022262003
## [145,]  0.42233171 -0.5405845000  0.90820999  0.720114788
## [146,] -0.88928579 -1.4975122114  0.85387509  1.061164709
## [147,]  0.53313842 -0.7783679409 -1.08247348  1.040697043
## [148,] -0.16206937 -0.3678090820  0.02043755 -0.347634535
## [149,]  1.14286865  0.0128521447 -1.05899995  0.303615805
## [150,] -0.30214572  0.7531499009  0.83377757  1.077433335
## [151,] -0.51381713  0.2598439963  0.85440754  1.458522856
## [152,]  0.51082043 -0.8590152086 -0.37024703 -2.059548018
## [153,]  0.57330246  1.9412885130  0.65095214  0.060331610
## [154,]  1.88092869  0.1700855822 -1.59830515  1.404834379
## [155,]  0.31752560  0.6647002826  0.42315232  1.491072686
## [156,] -0.66384991  0.4985398302 -0.29151252  0.062649765
## [157,] -0.05785222 -0.6374803687 -0.24636316  0.219763146
## [158,] -1.09767052  0.7089049561 -0.16873892  0.318939358
## [159,]  1.62757402  1.3046129511 -1.65480410  0.116186874
## [160,]  1.18016345  1.8978331881 -0.92536994 -1.924255048
## [161,]  0.28189287 -0.0003977858  1.23663668 -1.106043180
## [162,]  0.17339665  0.2142480832  1.47506359 -0.806929790
## [163,]  1.38938779 -0.1850013236 -0.14419373  0.412692199
## [164,]  1.56981246 -0.8890002711  2.08796434  0.642901743
## [165,]  0.47623174  1.2189538249  0.39776566  2.098802790
## [166,] -0.33648925  0.2193991960  0.01171135  0.088574119
## [167,] -0.92379917  0.4148132494  0.27560986  0.424024437
## [168,] -0.25947665 -0.2357037755 -0.35416531 -1.131479911
## [169,]  0.56836063  0.0761835588 -0.79173883 -0.504722040
## [170,]  1.50776834  0.0921068510 -1.46374555  1.310413968
## [171,]  0.65127938  0.9368368517 -1.79774153  1.215699409
## [172,] -0.57147901  0.7931037510 -1.09038090 -0.115203244
## [173,] -0.84264526  0.7181541322 -1.06961119 -0.338424090
## [174,] -1.68556613  0.6721443514  0.15286062 -0.160484018
## [175,] -1.11060615 -0.2038416879 -0.99516431 -1.496785814
## [176,] -1.02054604 -0.1310344178 -0.64693906 -1.044827018
## [177,] -0.38837299 -0.7014962652 -1.07901018 -0.025607540
## [178,]  1.04872837  0.0811421305  0.96420197 -0.364333894
## [179,]  0.98876756 -0.1160917022  1.07024539 -0.181435162
## [180,]  0.58944953 -0.8122401588  0.87763816  0.159736201
## [181,]  0.73957679  0.2175714282 -0.99986091 -0.224747663
## [182,] -2.16913802  2.0259634692 -1.91276876 -1.303233402
## [183,] -0.18715473 -0.2736726067 -0.23329631  0.432646018
## [184,]  0.75308088  1.0981723263 -0.08086473  0.676369589
## [185,]  0.59359996 -0.1191696550  1.50573649  0.339234299
## [186,]  0.62032778  0.1645168771  1.58801712 -0.293322198
## [187,] -0.33591885  0.8932289371 -0.06776737  0.864066289
## [188,]  0.15176631 -0.2920481797  0.14283935 -1.267916909
## [189,]  0.34745701 -1.9512786945  0.45034804  0.631205404
## [190,]  0.54435839 -0.2251326733  1.48978624  0.498586408
## [191,] -0.27873003  0.2810319773 -1.88564605  1.202776880
## [192,]  0.46309799  1.2417022523 -1.74258683  1.164576215
## [193,] -0.38423663  0.6884774612 -1.18448914  0.902247322
## [194,] -0.59129749 -1.0623387681 -1.42529341  0.464832366
## [195,] -1.60433788  0.5259389236 -0.21476744  1.228227750
## [196,]  0.53972934 -0.3739006544  0.93516839 -1.294889434
```

```
## [197,]  0.28148757 -0.7209341783 -1.06102417  1.285209255
## [198,]  0.12654601 -0.9113347702  0.10983178 -0.865559960
## [199,]  0.12654601 -0.9113347702  0.10983178 -0.865559960
## [200,]  0.45620797 -1.3322791731 -0.72159565  0.139784424
## [201,]  0.29599897 -0.0569540813  0.72302903  0.283310717
## [202,]  1.04048735 -0.9198186335 -0.84456299 -0.410025740
## [203,] -1.95218183  2.0134997117  0.61113008  1.066045389
## [204,]  0.65910695 -0.3402975674 -1.77587843  1.294707589
## [205,] -1.31829916  0.3562812211 -1.06009938 -0.349531499
## [206,]  1.25650579 -0.3140870550 -1.36819216  0.811495841
## [207,]  1.32968871  1.3996716030  0.19710199  0.513577333
## [208,] -0.71454114 -1.9084854792  0.22407523  0.153020690
## [209,]  1.48553900 -1.0689679887  1.29509304 -0.878411882
## [210,]  0.81707546 -0.6755665726  1.12237377 -1.688479993
## [211,] -0.75279294  0.3404236535  1.23004810  0.892994867
## [212,]  0.74184627  1.1714633790  1.25524983 -0.616760579
## [213,] -0.68785984 -0.1163519863  0.69121241  0.221567448
## [214,]  0.52748914 -0.4787771729 -1.49642645  0.873489719
## [215,] -1.35718634 -0.1447309380 -0.24268647  1.334293564
## [216,] -0.21529788 -1.0829805913 -0.61917738 -0.378938329
## [217,] -0.78549997  1.5173259039  0.92196592  0.417732766
## [218,] -1.57115696  0.7744600944 -0.82439254 -0.162749963
## [219,] -1.57115696  0.7744600944 -0.82439254 -0.162749963
## [220,]  1.51377211  0.3910879378  1.26775293  1.415805084
## [221,]  1.58440305 -0.0551853451  0.67985038  0.600083982
## [222,]  1.58440305 -0.0551853451  0.67985038  0.600083982
## [223,] -0.11183716  0.5848250969  0.13750533 -1.544838362
## [224,] -1.62159501  0.6099978487 -0.94914622 -0.500250739
## [225,] -0.21065914 -1.0467344902 -1.03718519 -0.456398084
## [226,] -0.21065914 -1.0467344902 -1.03718519 -0.456398084
## [227,] -0.46388894 -0.4842675140 -0.18578483 -0.766600896
## [228,] -1.41409347 -0.2519556398 -0.19620276 -0.430400699
## [229,] -2.20298325  0.9086102301  0.56296941 -0.580106616
## [230,]  0.51838039  0.1821528692 -0.35760522 -1.105061317
## [231,] -0.03963678 -0.7338381080 -1.11804553  0.063863739
## [232,]  0.61441670  0.8542024064  1.52292001 -0.399349930
## [233,]  0.15337602 -0.9916480693 -0.15561440 -0.088226905
## [234,] -0.72681960 -0.2992750915 -0.32433642 -0.799076486
## [235,]  0.21061433 -1.2992894889 -0.75893277 -0.123059506
##
## $weights
##                      RC1           RC2          RC4           RC3
## Filling     0.149892346  0.0859037398 -0.046815976  0.0315941751
## Natural     0.152365653 -0.0138070922 -0.052902857 -0.0206639952
## Fibre       0.180955080  0.0254546005 -0.064438292 -0.0901049851
## Sweet       0.037918879  0.2373508458  0.043323924 -0.0006312356
## Easy        0.041628165  0.0468131658 -0.044055270  0.1372390642
## Salt        0.055327169  0.2898174901 -0.142490672  0.0177790720
## Satisfying  0.114315475  0.0647062771 -0.035093532  0.1218636549
## Energy      0.134844459  0.0746016190 -0.016668475  0.0278670597
## Fun        -0.020453914  0.0267617658  0.152455005  0.1300767385
## Kids       -0.047462811  0.0056528839 -0.035244520  0.3247541406
## Soggy       0.085190781  0.1174107403 -0.313499929  0.0976480837
## Economical -0.011238284 -0.0837533447 -0.107636472  0.2127994334
```

```
## Health      0.154429427 -0.0417555355 -0.039288032 -0.0233373800
## Family     -0.040953407 -0.0303242643  0.001690921  0.2956452699
## Calories    0.024642102  0.2431452652 -0.034126962 -0.0077316757
## Plain       0.034424818  0.0582012751 -0.304391406  0.0983506655
## Crisp      -0.052447335 -0.0106964842  0.183666382  0.1200829308
## Regular     0.132820564  0.0074993579 -0.020642106 -0.0573285333
## Sugar       0.010769210  0.2677840168 -0.010255805 -0.0246641336
## Fruit       0.076182635  0.0564084744  0.150232969 -0.1788343762
## Process     0.005572601  0.1812633644 -0.126402440  0.0374979285
## Quality     0.102622989 -0.0565631996  0.018944450  0.0346171359
## Treat      -0.003780590  0.0375643587  0.194229436  0.0726486125
## Boring      0.051712551  0.1028857038 -0.252953714 -0.0445844829
## Nutritious  0.165539072 -0.0003603661 -0.051949391 -0.0258135067
##
## $r.scores
##              RC1           RC2           RC4           RC3
## RC1 1.000000e+00  9.111635e-16  3.663736e-15  1.484923e-15
## RC2 9.124645e-16  1.000000e+00 -1.670539e-15 -1.099815e-15
## RC4 3.653328e-15 -1.731169e-15  1.000000e+00 -2.246901e-15
## RC3 1.493597e-15 -1.127882e-15 -2.280294e-15  1.000000e+00
##
## $missing
##   [1] 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
##  [36] 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
##  [71] 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
## [106] 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
## [141] 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
## [176] 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
## [211] 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
##
## $R2
## [1] 1 1 1 1
```

```
plot(rotate_cereal , row.names(rotate_cereal$loadings))
```



Based on the analysis from PCA , the fitment of the model is 0.9077224 i.e. 90%. The root mean square of the residuals (RMSR) is 0.06 which is an indicator of the fit

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The preview shows you a rendered HTML copy of the contents of the editor. Consequently, unlike *Knit*, *Preview* does not run any R code chunks. Instead, the output of the chunk when it was last run in the editor is displayed.