EFA

```
# library(extrafont)
# extrafont::loadfonts(quiet = TRUE)

set.seed(42)
library(igraph)
```

```
##
## Attaching package: 'igraph'
```

```
## The following objects are masked from 'package:stats':
##
##     decompose, spectrum
```

```
## The following object is masked from 'package:base':
##
##     union
```

```
library(QuantPsyc) # for the multivariate normality test
```

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

```
## Loading required package: dplyr
```

```
##
## Attaching package: 'dplyr'
```

```
## The following objects are masked from 'package:igraph':
##
##     as_data_frame, groups, union
```

```
## The following objects are masked from 'package:stats':
##
##     filter, lag
```

```
## The following objects are masked from 'package:base':
##
##     intersect, setdiff, setequal, union
```

```
## Loading required package: purrr
```

```
##
## Attaching package: 'purrr'
```

```
## The following objects are masked from 'package:igraph':
##
##     compose, simplify
```

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

```
##
## Attaching package: 'MASS'
```

```
## The following object is masked from 'package:dplyr':
##
```

```
##     select
```

```
##
## Attaching package: 'QuantPsyc'
```

```
## The following object is masked from 'package:base':
##
##     norm
```

```
library(nFactors) # for the scree plot
```

```
## 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(psych) # for PA FA
```

```
##
## Attaching package: 'psych'
```

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

```
library(tidyverse)
```

```
## -- Attaching core tidyverse packages ------------------------ tidyverse 2.0.0 --
## v forcats   1.0.0     v stringr   1.5.1
## v ggplot2   3.5.1     v tibble    3.2.1
## v lubridate 1.9.3     v tidyr     1.3.1
## v readr     2.1.5
```

```
## -- Conflicts ------------------------------------------ tidyverse_conflicts() --
## x lubridate::%--%()       masks igraph::%--%()
## x ggplot2::%+%()          masks psych::%+%()
## x ggplot2::alpha()        masks psych::alpha()
## x tibble::as_data_frame() masks dplyr::as_data_frame(), igraph::as_data_frame()
## x purrr::compose()        masks igraph::compose()
## x tidyr::crossing()       masks igraph::crossing()
## x dplyr::filter()         masks stats::filter()
## x dplyr::lag()            masks stats::lag()
## x MASS::select()          masks dplyr::select()
## x purrr::simplify()       masks igraph::simplify()
## i Use the conflicted package (<http://conflicted.r-lib.org/>) to force all conflicts to become errors
```

```
library(paletteer) # color palettes
```

```r
library(conflicted) # to resolve QuantPsyc x dplyr conflicts
conflict_prefer("select", "dplyr")
```

```
## [conflicted] Will prefer dplyr::select over any other package.
```

```r
conflict_prefer("filter", "dplyr")
```

```
## [conflicted] Will prefer dplyr::filter over any other package.
```

Load and tidy data

```r
data <- read_csv("../measurements/measurements.csv")
```

```
## Rows: 754 Columns: 96
## -- Column specification --------------------------------------------------------
## Delimiter: ","
## chr  (9): fpath, KUK_ID, class, FileName, FolderPath, subcorpus, DocumentTit...
## dbl (85): RuleAbstractNouns, RuleAmbiguousRegards, RuleAnaphoricReferences, ...
## lgl  (2): ClarityPursuit, SyllogismBased
##
## i Use `spec()` to retrieve the full column specification for this data.
## i Specify the column types or set `show_col_types = FALSE` to quiet this message.
```

```r
data_clean <- data %>%
  select(!c(
    fpath,
    # KUK_ID,
    # FileName,
    FolderPath,
    # subcorpus,
    DocumentTitle,
    ClarityPursuit,
    Readability,
    SyllogismBased,
    SourceDB
  )) %>%
  # replace -1s in variation coefficients with NAs
  mutate(across(c(
    `RuleDoubleAdpos.max_allowable_distance.v`,
    `RuleTooManyNegations.max_negation_frac.v`,
    `RuleTooManyNegations.max_allowable_negations.v`,
    `RuleTooManyNominalConstructions.max_noun_frac.v`,
    `RuleTooManyNominalConstructions.max_allowable_nouns.v`,
    `RuleCaseRepetition.max_repetition_count.v`,
    `RuleCaseRepetition.max_repetition_frac.v`,
    `RulePredSubjDistance.max_distance.v`,
    `RulePredObjDistance.max_distance.v`,
    `RuleInfVerbDistance.max_distance.v`,
    `RuleMultiPartVerbs.max_distance.v`,
    `RuleLongSentences.max_length.v`,
    `RulePredAtClauseBeginning.max_order.v`,
    `mattr.v`,
    `maentropy.v`
  ), ~ na_if(.x, -1))) %>%
```

```r
  # replace NAs with 0s
  replace_na(list(
    RuleGPcoordovs = 0,
    RuleGPdeverbaddr = 0,
    RuleGPpatinstr = 0,
    RuleGPdeverbsubj = 0,
    RuleGPadjective = 0,
    RuleGPpatbenperson = 0,
    RuleGPwordorder = 0,
    RuleDoubleAdpos = 0,
    RuleDoubleAdpos.max_allowable_distance = 0,
    RuleDoubleAdpos.max_allowable_distance.v = 0,
    RuleAmbiguousRegards = 0,
    RuleReflexivePassWithAnimSubj = 0,
    RuleTooManyNegations = 0,
    RuleTooManyNegations.max_negation_frac = 0,
    RuleTooManyNegations.max_negation_frac.v = 0,
    RuleTooManyNegations.max_allowable_negations = 0,
    RuleTooManyNegations.max_allowable_negations.v = 0,
    RuleTooManyNominalConstructions.max_noun_frac.v = 0,
    RuleTooManyNominalConstructions.max_allowable_nouns.v = 0,
    RuleFunctionWordRepetition = 0,
    RuleCaseRepetition.max_repetition_count.v = 0,
    RuleCaseRepetition.max_repetition_frac.v = 0,
    RuleWeakMeaningWords = 0,
    RuleAbstractNouns = 0,
    RuleRelativisticExpressions = 0,
    RuleConfirmationExpressions = 0,
    RuleRedundantExpressions = 0,
    RuleTooLongExpressions = 0,
    RuleAnaphoricReferences = 0,
    RuleLiteraryStyle = 0,
    RulePassive = 0,
    RulePredSubjDistance = 0,
    RulePredSubjDistance.max_distance = 0,
    RulePredSubjDistance.max_distance.v = 0,
    RulePredObjDistance = 0,
    RulePredObjDistance.max_distance = 0,
    RulePredObjDistance.max_distance.v = 0,
    RuleInfVerbDistance = 0,
    RuleInfVerbDistance.max_distance = 0,
    RuleInfVerbDistance.max_distance.v = 0,
    RuleMultiPartVerbs = 0,
    RuleMultiPartVerbs.max_distance = 0,
    RuleMultiPartVerbs.max_distance.v = 0,
    RuleLongSentences.max_length.v = 0,
    RulePredAtClauseBeginning.max_order.v = 0,
    RuleVerbalNouns = 0,
    RuleDoubleComparison = 0,
    RuleWrongValencyCase = 0,
    RuleWrongVerbonominalCase = 0,
    RuleIncompleteConjunction = 0
  )) %>%
```

```
  # norm data expected to correlate with text length
  mutate(across(c(
    RuleGPcoordovs,
    RuleGPdeverbaddr,
    RuleGPpatinstr,
    RuleGPdeverbsubj,
    RuleGPadjective,
    RuleGPpatbenperson,
    RuleGPwordorder,
    RuleDoubleAdpos,
    RuleAmbiguousRegards,
    RuleFunctionWordRepetition,
    RuleWeakMeaningWords,
    RuleAbstractNouns,
    RuleRelativisticExpressions,
    RuleConfirmationExpressions,
    RuleRedundantExpressions,
    RuleTooLongExpressions,
    RuleAnaphoricReferences,
    RuleLiteraryStyle,
    RulePassive,
    RuleVerbalNouns,
    RuleDoubleComparison,
    RuleWrongValencyCase,
    RuleWrongVerbonominalCase,
    RuleIncompleteConjunction,
    num_hapax,
    RuleReflexivePassWithAnimSubj,
    RuleTooManyNominalConstructions,
    RulePredSubjDistance,
    RuleMultiPartVerbs,
    RulePredAtClauseBeginning
  ), ~ .x / word_count)) %>%
  mutate(across(c(
    RuleTooFewVerbs,
    RuleTooManyNegations,
    RuleCaseRepetition,
    RuleLongSentences,
    RulePredObjDistance,
    RuleInfVerbDistance
  ), ~ .x / sent_count)) %>%
  # remove variables identified as "u counts"
  select(!c(
    RuleTooFewVerbs,
    RuleTooManyNegations,
    RuleTooManyNominalConstructions,
    RuleCaseRepetition,
    RuleLongSentences,
    RulePredAtClauseBeginning,
    sent_count,
    word_count,
    syllab_count,
    char_count
```

```
  )) %>%
  # remove variables identified as unreliable
  select(!c(
    RuleAmbiguousRegards,
    RuleFunctionWordRepetition,
    RuleDoubleComparison,
    RuleWrongValencyCase,
    RuleWrongVerbonominalCase
  )) %>%
  # remove artificially limited variables
  select(!c(
    RuleCaseRepetition.max_repetition_frac,
    RuleCaseRepetition.max_repetition_frac.v
  )) %>%
  # remove further variables belonging to the 'acceptability' category
  select(!c(RuleIncompleteConjunction)) %>%
  mutate(across(c(class), ~ as.factor(.x)))

# no NAs should be present now
data_clean[!complete.cases(data_clean), ]
```

```
## # A tibble: 0 x 71
## # i 71 variables: KUK_ID <chr>, class <fct>, FileName <chr>, subcorpus <chr>,
## #   RuleAbstractNouns <dbl>, RuleAnaphoricReferences <dbl>,
## #   RuleCaseRepetition.max_repetition_count <dbl>,
## #   RuleCaseRepetition.max_repetition_count.v <dbl>,
## #   RuleConfirmationExpressions <dbl>, RuleDoubleAdpos <dbl>,
## #   RuleDoubleAdpos.max_allowable_distance <dbl>,
## #   RuleDoubleAdpos.max_allowable_distance.v <dbl>, RuleGPadjective <dbl>, ...
```

```
data_clean_scaled <- data_clean %>%
  mutate(across(class, ~ .x == "good")) %>%
  mutate(across(5:length(names(data_clean)), ~ scale(.x)))
```

Important features identification

```
data_clean_good <- data_clean_scaled %>% filter(class == "good")
data_clean_bad <- data_clean_scaled %>% filter(class == "bad")

feature_importances <- tibble(
  feat_name = character(), p_value = numeric()
)

for (i in 5:ncol(data_clean)) {
  fname <- names(data_clean)[i]

  formula_single <- reformulate(fname, "class")
  # print(formula_single)

  glm_model <- glm(formula_single, data_clean, family = "binomial")
  glm_coefficients <- summary(glm_model)$coefficients
  row_index <- which(rownames(glm_coefficients) == fname)
  p_value <- glm_coefficients[row_index, 4]
```

```
  feature_importances <- feature_importances %>%
    add_row(feat_name = fname, p_value = p_value)
}
feature_importances
```

```
## # A tibble: 67 x 2
##    feat_name                                    p_value
##    <chr>                                          <dbl>
##  1 RuleAbstractNouns                            0.00187
##  2 RuleAnaphoricReferences                      0.660
##  3 RuleCaseRepetition.max_repetition_count      0.0722
##  4 RuleCaseRepetition.max_repetition_count.v    0.00479
##  5 RuleConfirmationExpressions                  0.0985
##  6 RuleDoubleAdpos                              0.312
##  7 RuleDoubleAdpos.max_allowable_distance       0.000154
##  8 RuleDoubleAdpos.max_allowable_distance.v     0.00000356
##  9 RuleGPadjective                              0.380
## 10 RuleGPcoordovs                               0.828
## # i 57 more rows
```

```
selected_features <- feature_importances %>%
  filter(p_value <= 0.05) %>%
  pull(feat_name)
```

Correlations

See Levshina (2015: 353–54).

```
analyze_correlation <- function(data) {
  cor_matrix <- cor(data)

  cor_tibble_long <- cor_matrix %>%
    as_tibble() %>%
    mutate(feat1 = rownames(cor_matrix)) %>%
    pivot_longer(!feat1, names_to = "feat2", values_to = "cor") %>%
    mutate(abs_cor = abs(cor))

  cor_matrix_upper <- cor_matrix
  cor_matrix_upper[lower.tri(cor_matrix_upper)] <- 0

  cor_tibble_long_upper <- cor_matrix_upper %>%
    as_tibble() %>%
    mutate(feat1 = rownames(cor_matrix)) %>%
    pivot_longer(!feat1, names_to = "feat2", values_to = "cor") %>%
    mutate(abs_cor = abs(cor)) %>%
    filter(feat1 != feat2 & abs_cor > 0)

  list(
    cor_matrix = cor_matrix,
    cor_matrix_upper = cor_matrix_upper,
    cor_tibble_long = cor_tibble_long,
    cor_tibble_long_upper = cor_tibble_long_upper
  )
```

```
}

data_purish <- data_clean %>% select(any_of(selected_features))
```

High correlations

```
analyze_correlation(data_purish)$cor_tibble_long %>%
  filter(feat1 != feat2 & abs_cor > 0.9) %>%
  arrange(feat1, -abs_cor) %>%
  print(n = 100)
```

```
## # A tibble: 20 x 4
##    feat1                        feat2                          cor abs_cor
##    <chr>                        <chr>                        <dbl>   <dbl>
##  1 RuleLongSentences.max_length ari                          0.944   0.944
##  2 RuleLongSentences.max_length gf                           0.922   0.922
##  3 ari                          fkgl                         0.984   0.984
##  4 ari                          gf                           0.978   0.978
##  5 ari                          smog                         0.951   0.951
##  6 ari                          RuleLongSentences.max_length 0.944   0.944
##  7 atl                          cli                          0.960   0.960
##  8 cli                          atl                          0.960   0.960
##  9 fkgl                         ari                          0.984   0.984
## 10 fkgl                         gf                           0.967   0.967
## 11 fkgl                         smog                         0.949   0.949
## 12 gf                           smog                         0.987   0.987
## 13 gf                           ari                          0.978   0.978
## 14 gf                           fkgl                         0.967   0.967
## 15 gf                           RuleLongSentences.max_length 0.922   0.922
## 16 maentropy                    mattr                        0.964   0.964
## 17 mattr                        maentropy                    0.964   0.964
## 18 smog                         gf                           0.987   0.987
## 19 smog                         ari                          0.951   0.951
## 20 smog                         fkgl                         0.949   0.949
```

exclude:

- **ari:** corr. w/ RuleLongSentences.max_length > 0.94; sentence length seems more universal, let's make it a substitute
- **gf:** corr. w/ RuleLongSentences.max_length > 0.92; sentence length seems more universal, let's make it a substitute
- **maentropy:** corr. w/ mattr > 0.96, but mattr is implemented in QuitaUp. besides, the interesting thing about maentropy is its variation
- **smog:** corr. w/ fkgl almost 0.95, but fkgl coefficients adjusted for Czech are available
- **atl:** corr. w/ cli around 0.96; unlike cli, atl is not a readability metric

```
data_pureish_striphigh <- data_purish %>% select(!c(
  ari, gf, maentropy, smog, atl
))

analyze_correlation(data_pureish_striphigh)$cor_tibble_long %>%
  filter(feat1 != feat2 & abs_cor > 0.9) %>%
  arrange(feat1, -abs_cor) %>%
  print(n = 100)
```

```
## # A tibble: 0 x 4
## # i 4 variables: feat1 <chr>, feat2 <chr>, cor <dbl>, abs_cor <dbl>
```

Low correlations

```
low_correlating_features <- analyze_correlation(data_pureish_striphigh)$
  cor_tibble_long %>%
  filter(feat1 != feat2) %>%
  group_by(feat1) %>%
  summarize(max_cor = max(abs_cor)) %>%
  filter(max_cor < 0.3) %>%
  pull(feat1)

feature_importances %>% filter(feat_name %in% low_correlating_features)
```

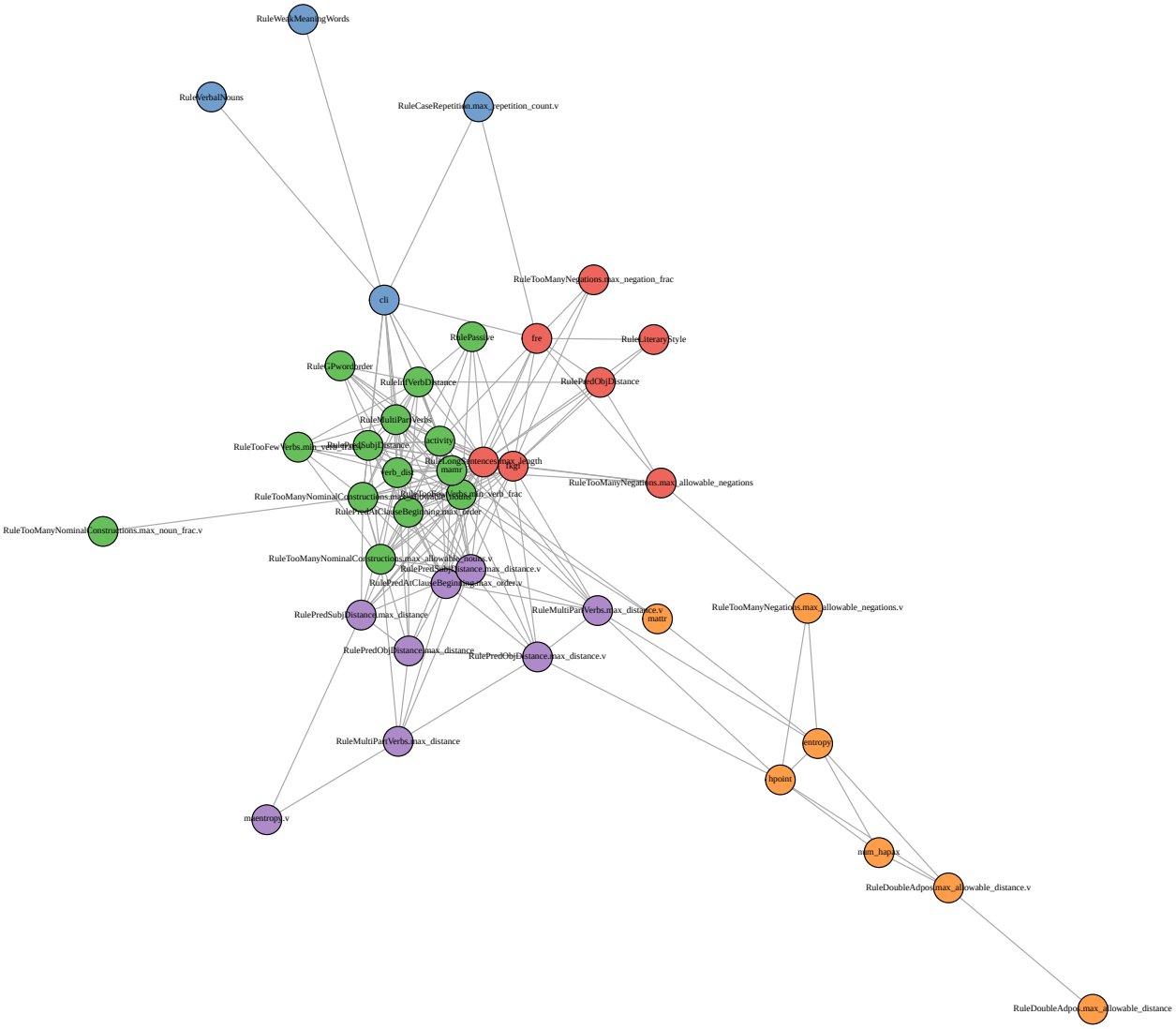
```
## # A tibble: 6 x 2
##   feat_name                                p_value
##   <chr>                                      <dbl>
## 1 RuleAbstractNouns                        0.00187
## 2 RuleGPdeverbaddr                         0.0112
## 3 RuleGPdeverbsubj                         0.0133
## 4 RuleRedundantExpressions                 0.0104
## 5 RuleRelativisticExpressions              0.00205
## 6 RuleTooManyNegations.max_negation_frac.v 0.0365
```

```
data_pure <- data_pureish_striphigh %>%
  select(!any_of(low_correlating_features))
```

Visualisation

```
my_colors <- paletteer::paletteer_d("ggthemes::Classic_10_Medium")

network_edges <- analyze_correlation(data_pure)$cor_tibble_long_upper %>%
  filter(abs_cor > 0.3)

network <- graph_from_data_frame(
  network_edges,
  directed = FALSE
)
E(network)$weight <- network_edges$abs_cor
network_communities <- cluster_optimal(network)

network_membership <- membership(network_communities)

plot(
  network,
  layout = layout.fruchterman.reingold,
  vertex.color = map(
    network_communities$membership,
    function(x) my_colors[x]
  ) %>% unlist(use.names = FALSE),
  vertex.size = 6,
  # vertex.frame.color = "#00000000",
  # vertex.label.family = "Public Sans",
```

```
  vertex.label.color = "black",
  vertex.label.cex = 0.5
)
```



Scaling

```
data_scaled <- data_pure %>%
  mutate(across(1:length(colnames(data_pure)), ~ scale(.x)))
```

Check for normality

```
mult.norm(data_pureish_striphigh %>% as.data.frame())$mult.test
```

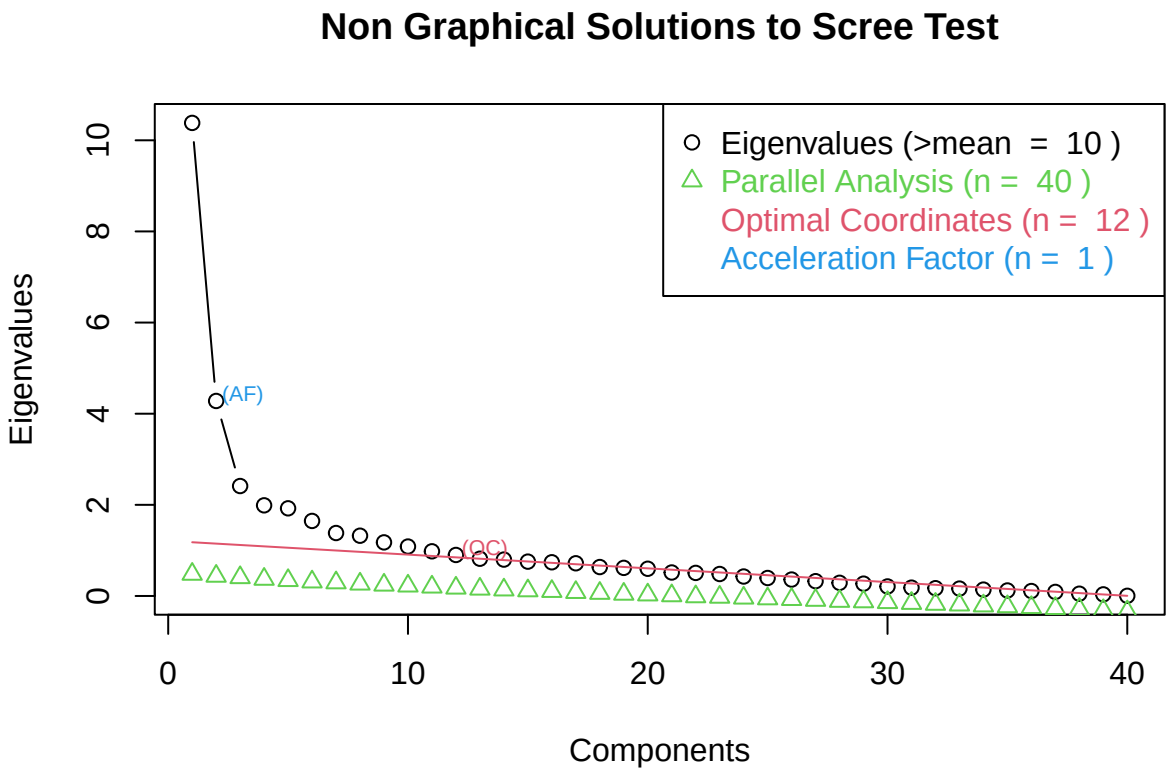
```
##          Beta-hat       kappa p-val
## Skewness  1622.36 203876.6315     0
## Kurtosis  4329.61    438.3355     0
```

Low (null) p-values show that we can reject the hypothesis that the data would be in a multivariate normal distribution. I.e. the distribution isn't multivariate normal.

FA

No. of factors

```
eigen <- eigen(cor(data_scaled))
par <- nFactors::parallel(
  subject = nrow(data_scaled),
  var = ncol(data_scaled),
  rep = 100,
  quantile = .05,
  model = "factors"
)
scree <- nScree(x = eigen$values, aparallel = par$eigen$qevpea)
plotnScree(scree)
```



Model

https://www.rdocumentation.org/packages/psych/versions/2.5.3/topics/fa

```
fa(
  cor(data_scaled),
  nfactors = 2,
  fm = "pa",
  rotate = "promax",
  oblique.scores = TRUE
  # n.obs = nrow(data_scaled),
```

```
  # n.iter = 2
)
```

```
## Loading required namespace: GPArotation
```

```
## Warning in fa.stats(r = r, f = f, phi = phi, n.obs = n.obs, np.obs = np.obs, :
## The estimated weights for the factor scores are probably incorrect.  Try a
## different factor score estimation method.
```

```
## Factor Analysis using method =  pa
## Call: fa(r = cor(data_scaled), nfactors = 2, rotate = "promax", fm = "pa",
##     oblique.scores = TRUE)
## Standardized loadings (pattern matrix) based upon correlation matrix
##                                                    PA1   PA2    h2   u2
## RuleCaseRepetition.max_repetition_count.v          0.01  0.22 0.048 0.95
## RuleDoubleAdpos.max_allowable_distance             0.22  0.11 0.084 0.92
## RuleDoubleAdpos.max_allowable_distance.v          -0.08  0.47 0.200 0.80
## RuleGPwordorder                                   -0.37 -0.02 0.140 0.86
## RuleInfVerbDistance                               -0.67  0.26 0.377 0.62
## RuleLiteraryStyle                                  0.16  0.34 0.184 0.82
## RuleLongSentences.max_length                       0.76  0.30 0.847 0.15
## RuleMultiPartVerbs                                -0.69  0.09 0.436 0.56
## RuleMultiPartVerbs.max_distance                    0.26  0.16 0.128 0.87
## RuleMultiPartVerbs.max_distance.v                  0.20  0.42 0.284 0.72
## RulePassive                                        0.27  0.17 0.143 0.86
## RulePredAtClauseBeginning.max_order                0.74 -0.01 0.548 0.45
## RulePredAtClauseBeginning.max_order.v              0.43  0.30 0.386 0.61
## RulePredObjDistance                               -0.08  0.51 0.233 0.77
## RulePredObjDistance.max_distance                   0.41  0.00 0.168 0.83
## RulePredObjDistance.max_distance.v                 0.20  0.41 0.279 0.72
## RulePredSubjDistance                              -0.73  0.15 0.469 0.53
## RulePredSubjDistance.max_distance                  0.45  0.00 0.205 0.79
## RulePredSubjDistance.max_distance.v                0.40  0.34 0.384 0.62
## RuleTooFewVerbs.min_verb_frac                     -0.86 -0.07 0.790 0.21
## RuleTooFewVerbs.min_verb_frac.v                    0.54 -0.26 0.247 0.75
## RuleTooManyNegations.max_allowable_negations       0.10  0.46 0.262 0.74
## RuleTooManyNegations.max_allowable_negations.v    -0.16  0.53 0.241 0.76
## RuleTooManyNegations.max_negation_frac            -0.08 -0.33 0.138 0.86
## RuleTooManyNominalConstructions.max_allowable_nouns    0.91 -0.09 0.766 0.23
## RuleTooManyNominalConstructions.max_allowable_nouns.v  0.46  0.09 0.254 0.75
## RuleTooManyNominalConstructions.max_noun_frac.v   -0.23 -0.08 0.076 0.92
## RuleVerbalNouns                                   -0.24 -0.01 0.061 0.94
## RuleWeakMeaningWords                              -0.32  0.11 0.083 0.92
## activity                                          -0.82 -0.03 0.690 0.31
## cli                                               -0.53  0.22 0.238 0.76
## entropy                                           -0.30  0.79 0.524 0.48
## fkgl                                               0.49  0.55 0.753 0.25
## fre                                               -0.08 -0.62 0.432 0.57
## hpoint                                            -0.36  0.84 0.586 0.41
## maentropy.v                                        0.09  0.05 0.014 0.99
## mamr                                              -0.77 -0.05 0.623 0.38
## mattr                                              0.21  0.15 0.093 0.91
## num_hapax                                          0.30 -0.73 0.440 0.56
## verb_dist                                          0.94 -0.22 0.758 0.24
##                                                   com
```

```
## RuleCaseRepetition.max_repetition_count.v            1.0
## RuleDoubleAdpos.max_allowable_distance               1.5
## RuleDoubleAdpos.max_allowable_distance.v             1.1
## RuleGPwordorder                                      1.0
## RuleInfVerbDistance                                  1.3
## RuleLiteraryStyle                                    1.4
## RuleLongSentences.max_length                         1.3
## RuleMultiPartVerbs                                   1.0
## RuleMultiPartVerbs.max_distance                      1.7
## RuleMultiPartVerbs.max_distance.v                    1.4
## RulePassive                                          1.7
## RulePredAtClauseBeginning.max_order                  1.0
## RulePredAtClauseBeginning.max_order.v                1.8
## RulePredObjDistance                                  1.1
## RulePredObjDistance.max_distance                     1.0
## RulePredObjDistance.max_distance.v                   1.5
## RulePredSubjDistance                                 1.1
## RulePredSubjDistance.max_distance                    1.0
## RulePredSubjDistance.max_distance.v                  1.9
## RuleTooFewVerbs.min_verb_frac                        1.0
## RuleTooFewVerbs.min_verb_frac.v                      1.4
## RuleTooManyNegations.max_allowable_negations         1.1
## RuleTooManyNegations.max_allowable_negations.v       1.2
## RuleTooManyNegations.max_negation_frac               1.1
## RuleTooManyNominalConstructions.max_allowable_nouns  1.0
## RuleTooManyNominalConstructions.max_allowable_nouns.v 1.1
## RuleTooManyNominalConstructions.max_noun_frac.v      1.3
## RuleVerbalNouns                                      1.0
## RuleWeakMeaningWords                                 1.2
## activity                                             1.0
## cli                                                  1.3
## entropy                                              1.3
## fkgl                                                 2.0
## fre                                                  1.0
## hpoint                                               1.4
## maentropy.v                                          1.5
## mamr                                                 1.0
## mattr                                                1.8
## num_hapax                                            1.3
## verb_dist                                            1.1
##
##                        PA1  PA2
## SS loadings           8.95 4.66
## Proportion Var        0.22 0.12
## Cumulative Var        0.22 0.34
## Proportion Explained  0.66 0.34
## Cumulative Proportion 0.66 1.00
##
##  With factor correlations of
##      PA1  PA2
## PA1 1.00 0.41
## PA2 0.41 1.00
##
## Mean item complexity =  1.3
```

```
## Test of the hypothesis that 2 factors are sufficient.
##
## df null model =  780  with the objective function =  31.6
## df of  the model are 701  and the objective function was  16.68
##
## The root mean square of the residuals (RMSR) is  0.08
## The df corrected root mean square of the residuals is  0.09
##
## Fit based upon off diagonal values = 0.9
```