Multidimensionality

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Multidimensionality

The Rasch model assumes that a questionnaire measures only one single latent trait or construct.

In presence of multidimensionality, the scale measures different aspects of a construct and single interval scaled sum score is not meaningful anymore.

Standardised Residuals

The analysis for multidimensionality searches the standardised residuals for patterns indicating items loading strongly on different dimensions.

The method to analysis the standardised residuals is called principal component analysis (PCA).

Principal Component Analysis (PCA)

- is a dimensionality reduction technique

- allow to identify clusters of similar variables.

- needs no distributional assumptions.

- is an exploratory method bases on singular value decomposition (SVC).

Central idea: reduce the dimensionality of a dataset, while preserving as much 'variability' (i.e. statistical information) as possible, i.e. through maximizing the variance in each dimension.
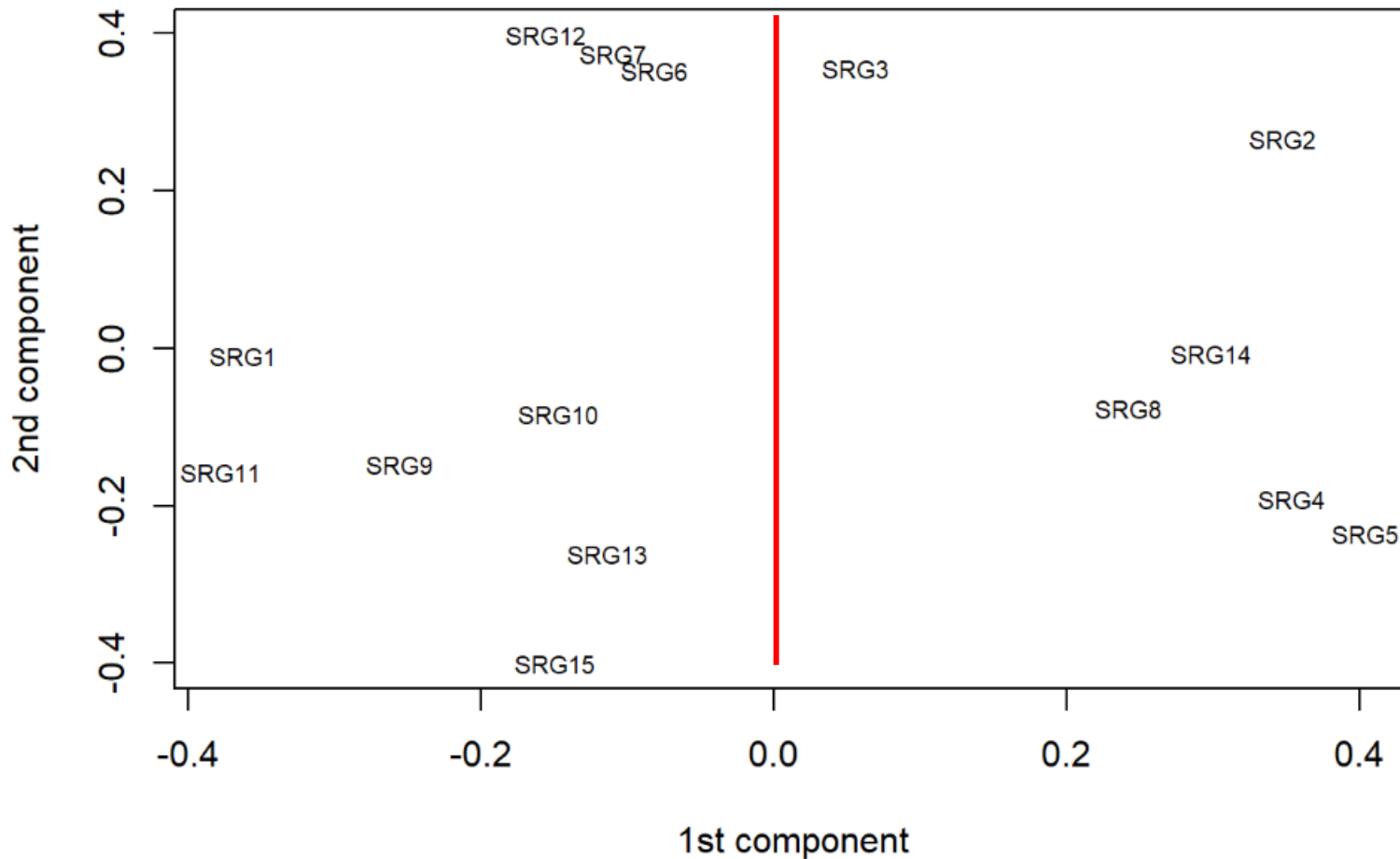
PCA: Component Loading

SRG Item PCA-Loading
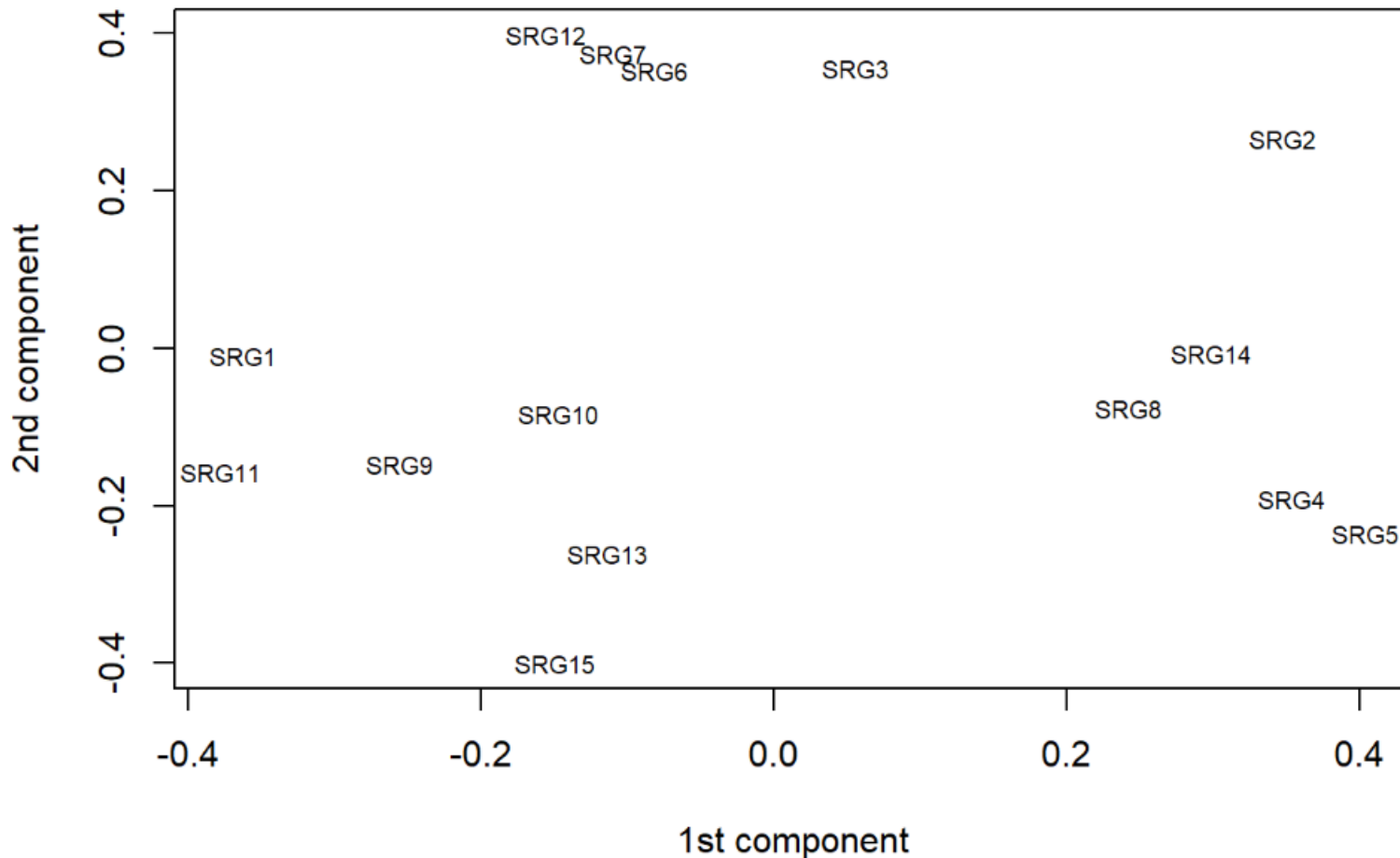
SVD factorizes the original residual matrix into several component matrices, including a component loading matrix. Here, the first 2 columns of the component loading matrix provides the x and y coordinates for the plot above.
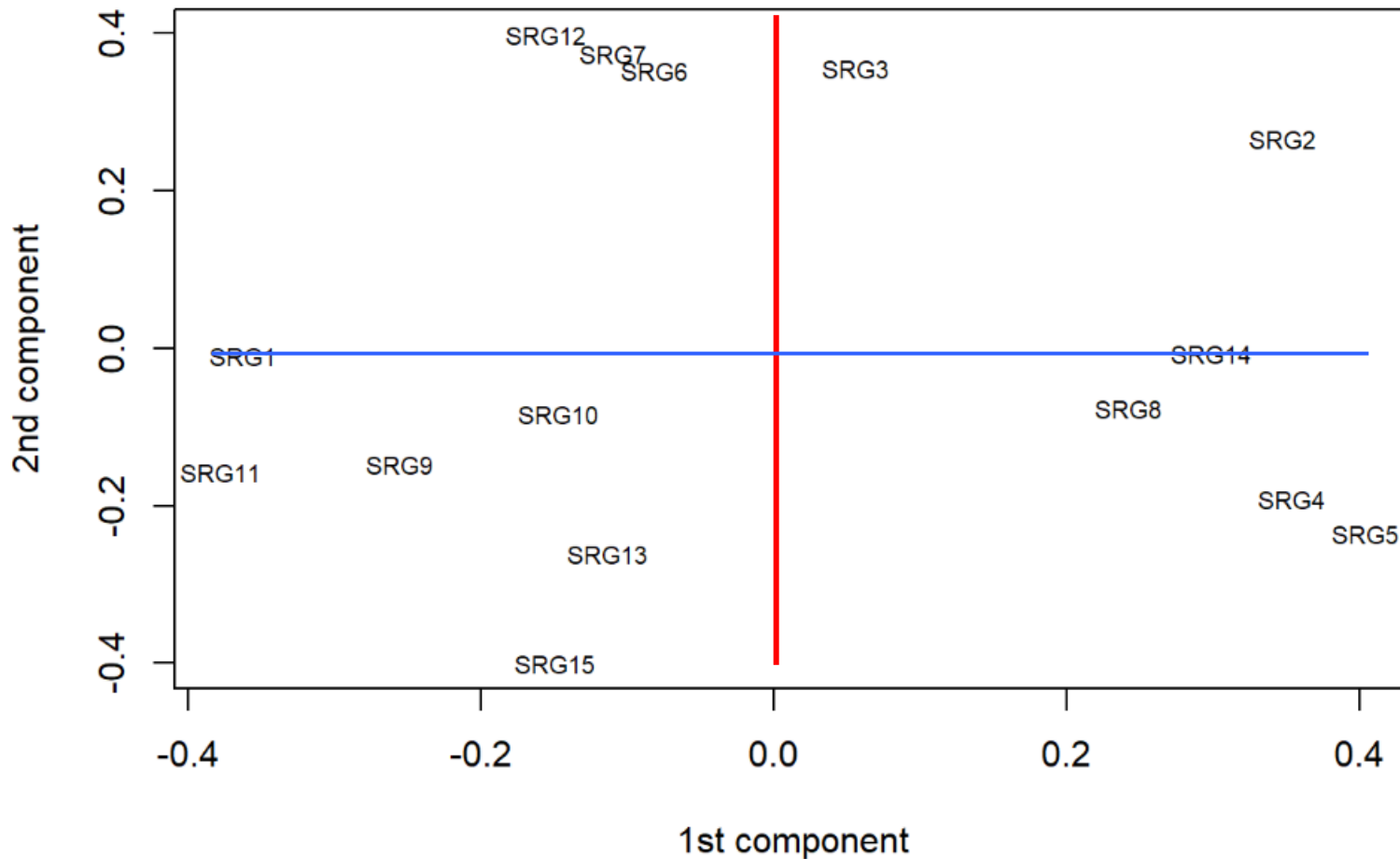
PCA: Component Loading

SRG Item PCA-Loading

The opposition on the x-axis is the most important.

# PCA: Component Loading

SRG Item PCA-Loading

The opposition on the x-axis is the most important. Let's open the html workbook.

Eigenvalues

- The component loadings do not allow to determine if the display is unidimensional or indicative of multidimensionality.

- The eigenvalue vector allows to determine if a set of items is unidimensional or multidimensional.

- Diverse rules are available to interpret the eigenvalue vector.

  - the first eigenvalue should not be too large, at least < 2
  - Analysis of a screeplot to determine the number of dimensions – number of components left of the elbow

Eigenvalues and Screeplot
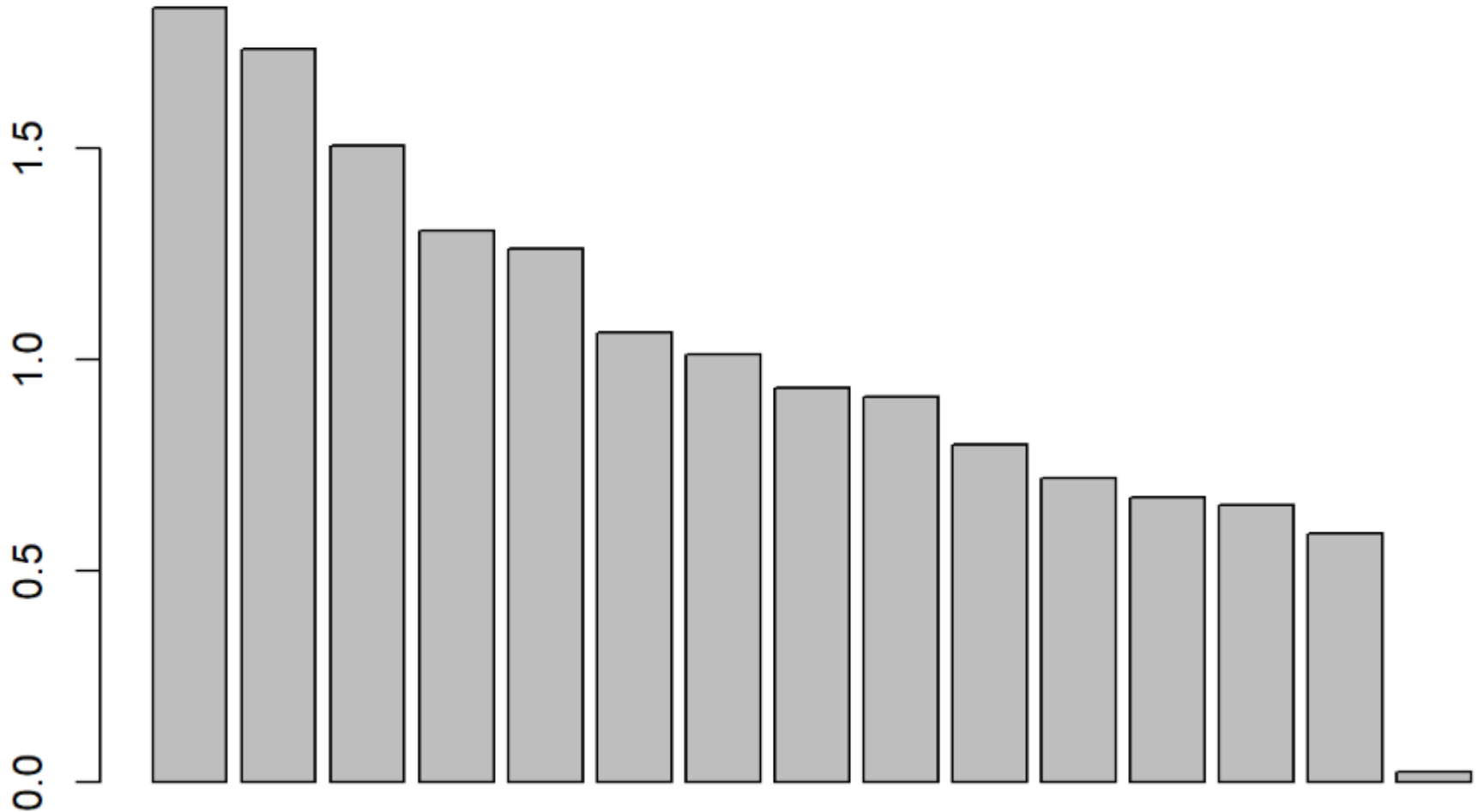
To determine the number of dimensions a rule is to determine where the elbow is…
This figure does not indicate any change in direction.

Let's go to R-Studio

Open the R-Script MS8_Rscript.r that you find in the OLAT or the MS-Teams Course Materials.

Exercise

Using the MDS Data :

    a. compute eigenvalues and

    b. draw a scree plot which shows the proportion of variation that each PC accounts for.

    c. Is it unidimensional?

Based on the proportion of variance that the 3 first PC explain:

    d. Draw a 2-dimensional or a 3-dimensional PC loading plot. What do you observe?