Introduction to Factor Analysis

MdAIR Spring Institute
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Today’s Objective

- To understand the general application
- To learn some of the language
- To review various decision points
- To interpret the basic output
What is a Factor?

MATH ABILITY

VERBAL ABILITY
Why do it?

- Measure underlying constructs
- Validation
- Use fewer, simpler predictors
- Explore data to see what lies beneath!
Types of Factor Analysis

- Confirmatory
  - testing viability of specific constructs to see if they exist in the data
- Exploratory
  - data reduction technique to identify underlying “latent” constructs that may exist in the data
Extraction methods

- Principle components analysis (PCA)
- Principle axis factoring (PAF)
- Maximum likelihood
- Least squares
- Image factoring
- Alpha factoring
Purpose of PCA

- Reduce a large number of correlated variables to a smaller set of underlying “factors” that are uncorrelated
- Statistically identify “latent” constructs that explain data
Principle Components Analysis

- Mathematical computations are based on correlation matrices
- Uses linear combinations of variables to explain variance and identify constructs
Linear Combinations
The Process

- Select the type of Factor Analysis
- Is the dataset adequate?
- Select a rotational method
- Extract factors
- Interpret!
Dataset

- Are there latent constructs hidden in the data that you want to know about?
- Do you have a lot of variables?
- Are the variables highly correlated?
- Is the sample size enough?
- Is the dataset adequate?
  - Kaiser-Meyer-Olkin (KMO)
Rotation Methods

- Varimax Rotation – variables identify with different factors
- Quartimax Rotation – mainly one factor
- Equimax – compromise of the two
- Direct Oblimin – non-orthogonal
- Promax – non-orthogonal
- SPSS Default - none
Unrotated axes
Rotated axes (orthogonal)
Factor Selection

- Consecutive factors
  - Kaiser - Eigenvalues over 1
  - Catell - Scree plot
  - Explained Variance – Select enough factors to explain 80% or 90%
  - Common Sense
Scree Plot
Eigenvalues

- Amount of variance from all variables accounted for in a single factor
- The larger the value, the more variance the factor captures (good)
- As the value decreases the factor is capturing a smaller amount of variance (not so good)
<table>
<thead>
<tr>
<th>Value</th>
<th>Eigenval</th>
<th>% total Variance</th>
<th>Cumul. Eigenval</th>
<th>Cumul. %</th>
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<td>61.18369</td>
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<td>61.1837</td>
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Communality

- The proportion of variance of a particular variable that is due to all common factors
- Can be interpreted as the reliability of the variable
Factor Loadings

- Component matrix or factor matrix
- The correlation between the variable and the factor
- Plot the loading to see the impact of rotation
- Sum of squared loadings is the amount of explained variance attributed to a single factor
Review SPSS Output …

- Example 1
- Example 2
Tools and References

- SPSS
- SAS
- Statistica
- SYSTAT
- [http://www.statsoft.com](http://www.statsoft.com)
- [http://www.stata.com/capabilities/factor.html](http://www.stata.com/capabilities/factor.html)
Books

- Gorsuch, R. L. *Factor Analysis*.
- Kline, P. *An Easy Guide to Factor Analysis*.
Homework ...
Thank you ....

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