Introduction to

Factor Analysis

MdAIR Spring Institute

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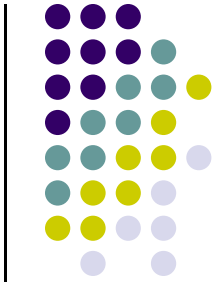
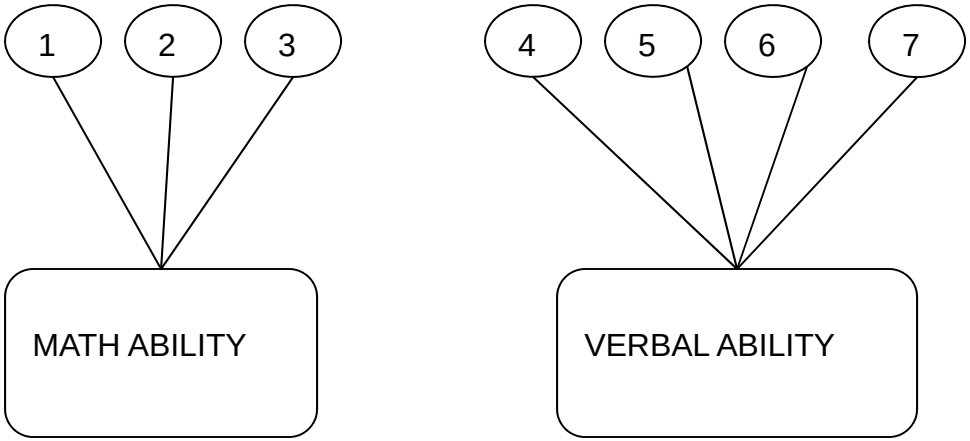
April 28, 2006

Today's Objective

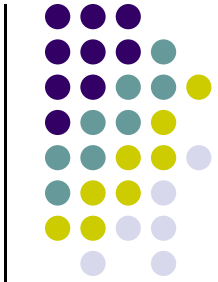


- To understand the general application
- To learn some of the language
- To review various decision points
- To interpret the basic output

What is a Factor?

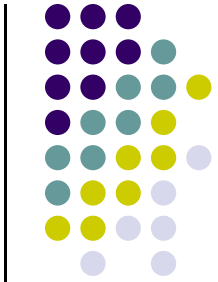


Why do it?



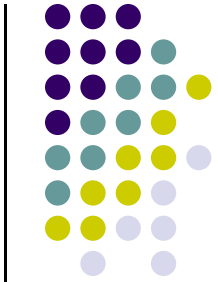
- Measure underlying constructs
- Validation
- Use fewer, simpler predictors
- Explore data to see what lies beneath!

Types of Factor Analysis



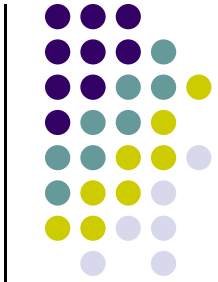
- Confirmatory
  - testing viability of specific constructs to see if they exist in the data
- Exploratory
  - data reduction technique to identify underlying “latent” constructs that may exist in the data

Extraction methods



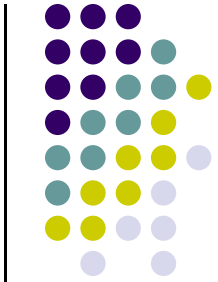
- Principle components analysis (PCA)
- Principle axis factoring (PAF)
- Maximum likelihood
- Least squares
- Image factoring
- Alpha factoring

Purpose of PCA



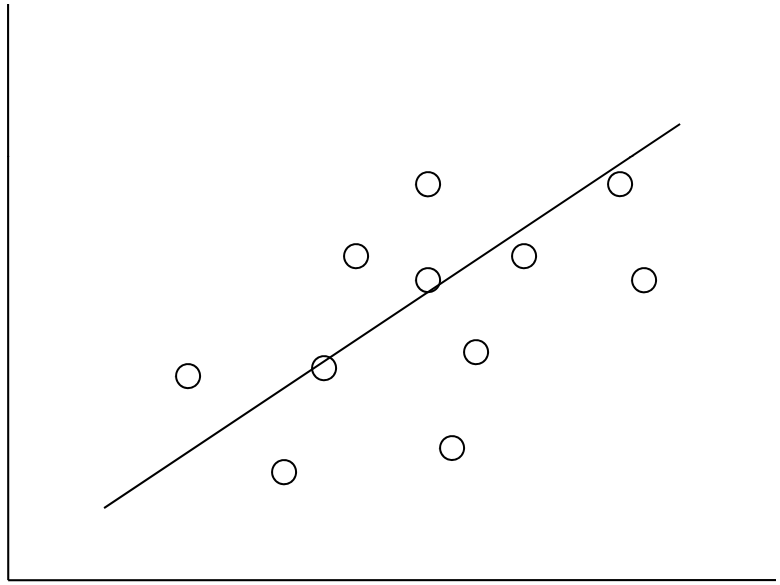
- Reduce a large number of correlated variables to a smaller set of underlying “factors” that are uncorrelated
- Statistically identify “latent” constructs that explain data

Principle Components Analysis

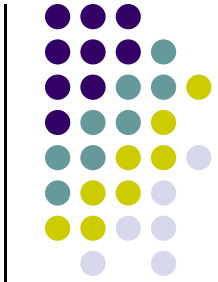


- Mathematical computations are based on correlation matrices
- Uses linear combinations of variables to explain variance and identify constructs

Linear Combinations

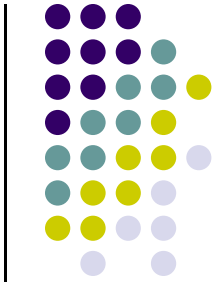


The Process



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

Dataset

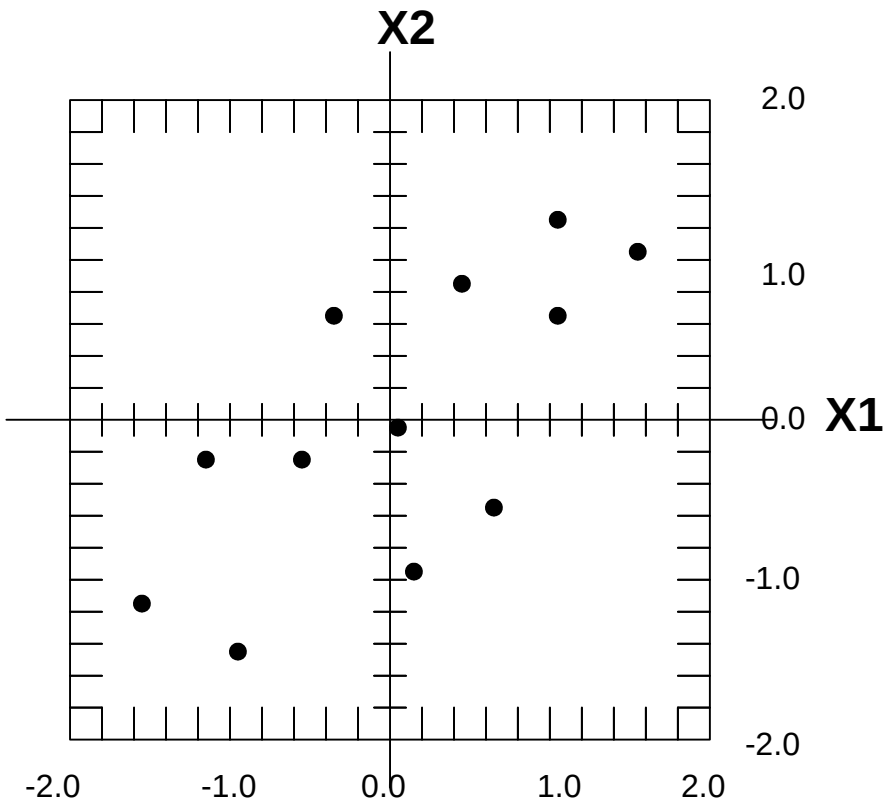


- Are there latent constructs hidden in the data that you want to know about?
- Do you have a lot of variables?
- Are the variables highly correlated?
- Is the sample size enough?
- Is the dataset adequate?
  - Kaiser-Meyer-Olkin (KMO)

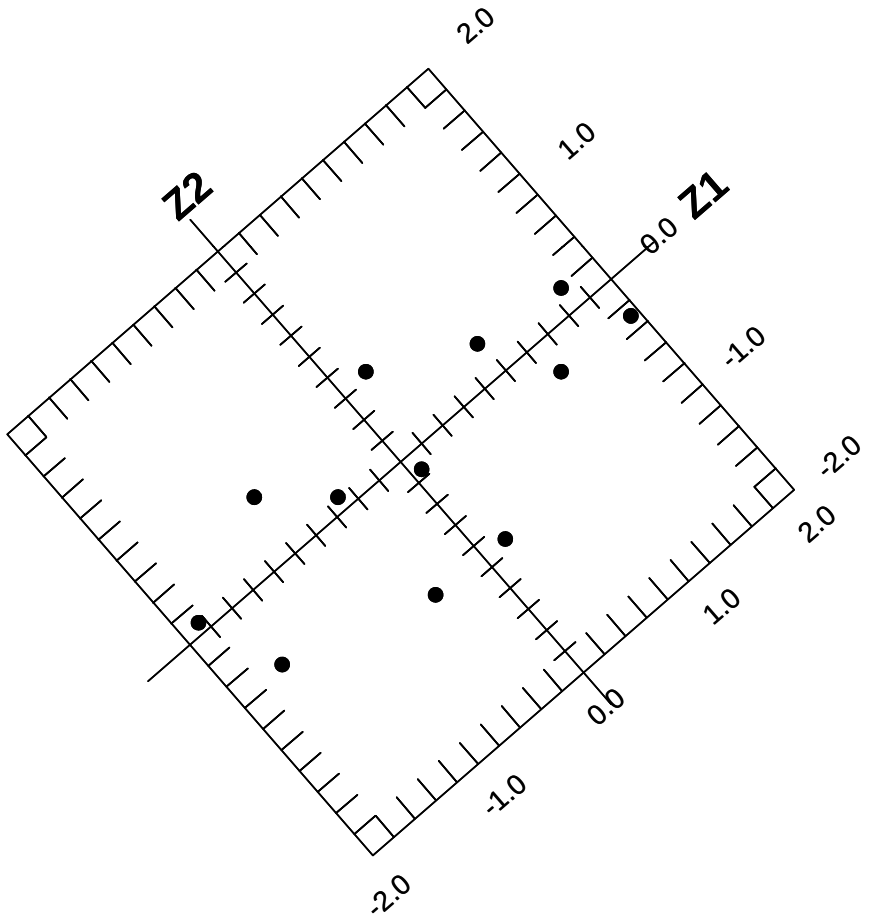
Rotation Methods

- 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

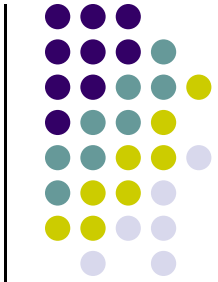
Unrotated axes



Rotated axes (orthogonal)

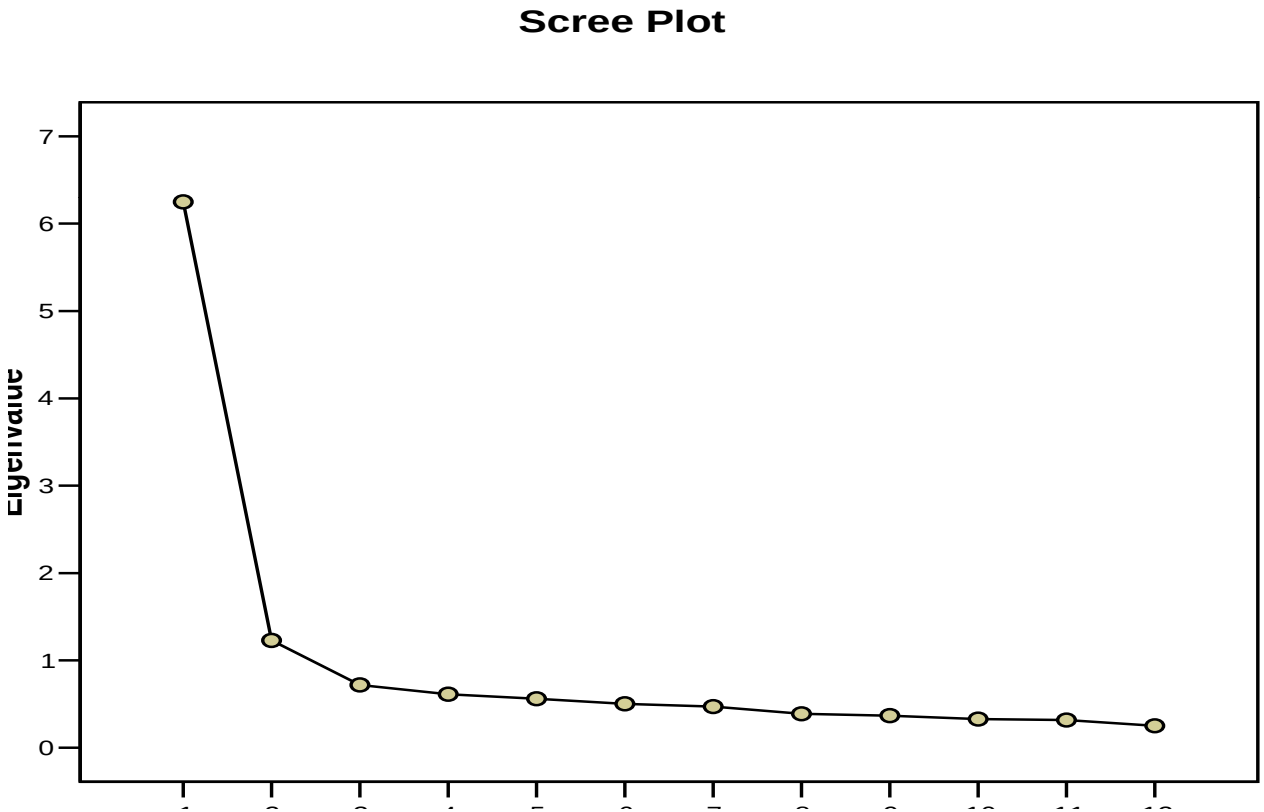


Factor Selection

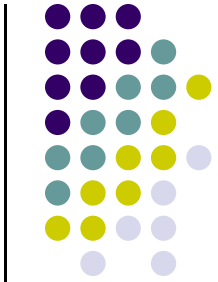


- Consecutive factors
  - Kaiser - Eigenvalues over 1
  - Catell - Scree plot
  - Explained Variance – Select enough factors to explain 80% or 90%
  - Common Sense

Scree Plot



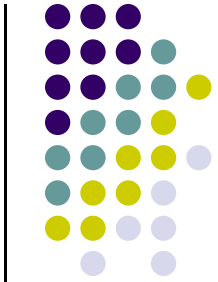
Eigenvalues



- 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)

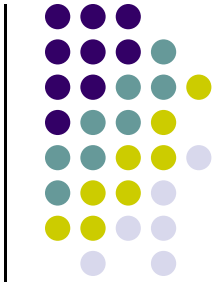
STATISTICA FACTOR ANALYSIS	Eigenvalues (factor.sta) Extraction: Principal components			
Value	Eigenval	% total Variance	Cumul. Eigenval	Cumul. %
1	6.118369	61.18369	6.11837	61.1837
2	1.800682	18.00682	7.91905	79.1905
3	.472888	4.72888	8.39194	83.9194
4	.407996	4.07996	8.79993	87.9993
5	.317222	3.17222	9.11716	91.1716
6	.293300	2.93300	9.41046	94.1046
7	.195808	1.95808	9.60626	96.0626
8	.170431	1.70431	9.77670	97.7670
9	.137970	1.37970	9.91467	99.1467
10	.085334	.85334	10.00000	100.0000

Communality



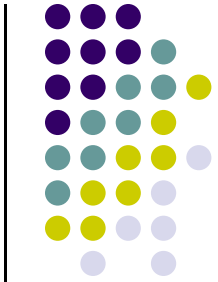
- The proportion of variance of a particular variable that is due to all common factors
- Can be interpreted as the reliability of the variable

Factor Loadings



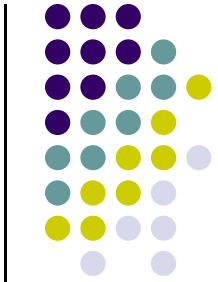
- Component matrix or factor matrix
- The correlation between the variable and the factor
- Plot the loading to see the impact of rotation
- Sum of squared loadings is the amount of explained variance attributed to a single factor

Review SPSS Output …



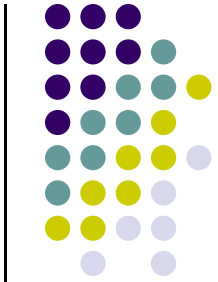
- Example 1
- Example 2

Tools and References



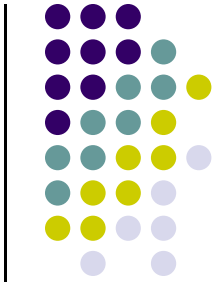
- SPSS
- SAS
- Statistica
- SYSTAT
- http://www.statsoft.com
- http://www.stata.com/capabilities/factor.htmlstata.com

Books



- Gorsuch, R. L. ***Factor Analysis.***
- Kim, J., and C. W. Mueller. ***Factor Analysis : What It Is and How To Do It*****.** (Sage Publications.)
- Kim, J., and C. W. Mueller. ***Factor Analysis : Statistical Methods and Practical Issues*****.** (Sage Publications.)
- Kline, P. ***An Easy Guide to Factor Analysis***.

Homework …



Thank you ….

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