Statistics for Psychosocial Research
Session 1: September 1
Bill

- Introduction to Staff
- Purpose of the Course
- Administration
- Introduction to Test Theory

Statistics for Psychosocial Research

Overview:

a) First term of a two-term course

b) This term focuses on the evaluation of psychosocial measures

c) Second term builds on the first and focuses on 'latent' constructs -- measures that cannot be directly observed.

1) Co-instructors
    1) William Eaton, Mental Health
    2) Jeannie Leoutsakos, Mental Health
    3) Liz Garrett-Mayer, Biostatistics
2) Teaching Assistants
    1) Amy Buchanan, Mental Health
    2) Lilian Ghandour, Mental Health
    3) Shu-Chih Su, Biostatistics
    4) Keson Theppeang, Biostatistics/Environmental Health Sciences
3) Contact information is on the syllabus
4) Course information is on the course website

Requirements:

a) Three problem sets

b) An in-class, open book final examination

c) Class participation

Role of statistics in this course:

1) We will present basic formulas, and expect you to be able to interpret them and tell us why they are important

2) We do not expect you to memorize formulas, unless we state otherwise

3) Do not need to know calculus

4) Do not need to be able to derive formulas

Session 1. Friday, September 1: Introduction
Bill

Introduction
Purpose of course
Review of syllabus
Classical test theory
Introduction to reliability, examples

After this class students will be able to

- briefly describe the concept of reliability in both intuitive and statistical terms, and
- identify the key assumptions of classical test theory.

Session 2. Wednesday, September 6: Dimensionality & Covariance, Correlation and Association
(Liz)

Covariance
Pearson correlation
Spearman correlation
Correlations with non-linear data
Polychoric correlation
Covariance, correlation, and odds ratio matrices

After this class students will be able to

- measure associations between continuous observed variables using covariances and correlations
- measure magnitudes of association between discrete observed variables
- Define multidimensionality regarding latent variables

Session 3. Monday, September 11: Reliability I
(Bill)

Types of reliability
- Inter-rater
- Test-retest reliability
- Internal consistency reliability

Different types of reliability coefficients
- Correlation
- Split half measures
- Alpha coefficient
- Kuder Richardson Coefficient
- Kappa

After this class students will be able to:
- Describe two definitions of the concept of reliability
- Predict how long a scale should be
- Estimate reliability for continuous and categorical measures

Session 4. Wednesday, September 13: Reliability II
(Jeannie)

ANOVA model for reliability
Intraclass Correlation Coefficient
Reliability Examples
Research Designs

After this class students will be able to:

- Describe the relationship of the intraclass correlation coefficient to other measures of reliability
- Correctly identify which intraclass correlation to use for different research designs

Session 5. Monday, September 18: Validity I
(Bill)

Face validity
Content validity
Criterion Validity
Construct Validity

Modalities of measurement
Relationship of Reliability to Validity
Correction for attenuation

Session 6. Wednesday, September 20: Validity II
(Jeannie)

Sensitivity and Specificity
ROC Curves
Internal Construct Validity
Multi-trait Multimethod Matrix

After this class students will be able to:

- Evaluate the relative utility of different cutoffs for a measure in relation to a gold standard.

Session 7. Wednesday, September 25: Scale Development (Bill)

Defining the construct
Creating items
Response Formats
Example: Depression

After this class students will be able to:

- Describe procedures for constructing a scale from scratch

Session 8. Monday, September 27: Factor Analysis I
(Liz)

Introduction to factor analysis
The orthogonal factor model
Loadings
Principal components
Eigenvalues
Introduction to rotation
Communalities/Uniqueness of items

After this class students will be able to:

- Identify when a factor analysis is appropriate and when it is not
- Run a one-factor and multi-factor analysis
- Interpret the results from a factor analysis

Session 9. Wednesday, October 2: Factor Analysis II
(Liz)

Factor extraction
Methods of estimation and rotation
Choosing the number of factors
More on rotations: orthogonal and oblique
Factor scores
Confirmatory factor analysis
Conditional independence
Dichotomous factor analysis

After this class students will be able to:

- Use the statistical procedure of rotation to aid in the interpretation of results from a factor analysis
- Be able to apply both orthogonal and oblique rotations and identify the assumptions underlying each
- Apply the appropriate method of estimation for factor analysis

Session 10. Monday, October 4: Factor Analysis III: Journal Examples

(Liz)

After this class students will be able to:

- Apply factor analysis to real data
- Critique published use of factor analysis

Session 11. Monday, October 9: Latent Class Analysis I
(Liz)

The latent class model
The response pattern matrix
Choosing the number of classes
Conditional probabilities
Interpreting the model
Examples: depression; functioning

After this class students will be able to:

- Differentiate when to use factor analysis and when to use latent class analysis
- Interpret output from a latent class analysis

Session 12. Wednesday, October 11: Latent Class Analysis II (Liz)

Statistical model and assumptions
Exploration: response patterns
Issues of model fitting
Identifiability
Checking the model: tests and displays

After this class students will be able to:

- Estimate a latent class analysis
- Interpret different critera to choose among alternative models

Session 13. Monday, October 16: Latent Class Analysis III: Examples in Journals
(Jeannie)

In this class students will:

- Apply latent class analysis to real data
- Critique published use of latent class analysis

Session 14. Monday, October 18: Sample Size Issues in Reliability, Factor Analysis, and Latent Class Analysis
(Liz)

After this class students will be able to:

- Estimate the sample size needed to for scales with targeted reliability levels
- Estimate the sample size needed for pilot studies that will use factor analysis.

Introduction to reliability:

1) consistency between two measures of the same thing

2) ratio of true to total variance

Example of test-retest reliability:

a) Elderly self-report of the extent to which arthritis affects their lives.

b) Elderly self-report of their ability to perform basic tasks such as eating, dressing, and walking.

chpe.buseco.monash.edu.au/pubs/wp116.pdf

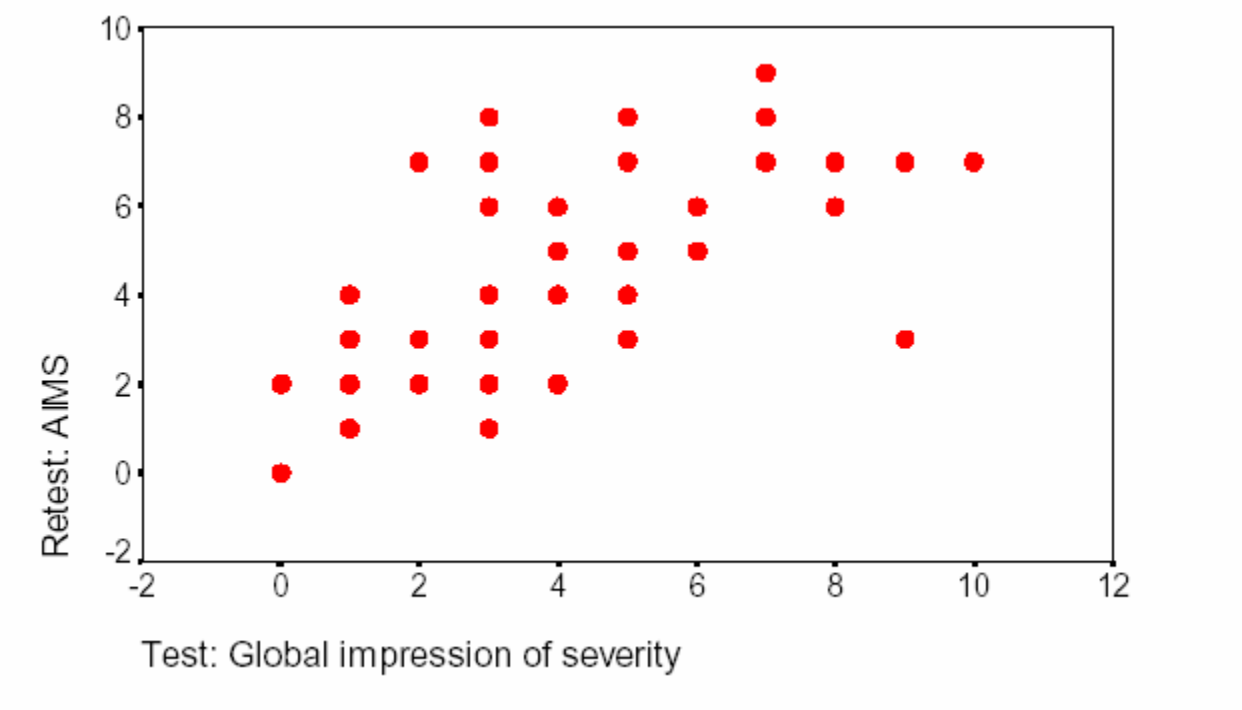


Figure 1: Test-retest scatterplot of 'global impression of severity,' which indexes respondents' global assessment of the extent to which arthritis affects them (0= not at all, 11=extreme). Correlation above is .66. (Mail questionnaire, test-retest time is two weeks n=51).

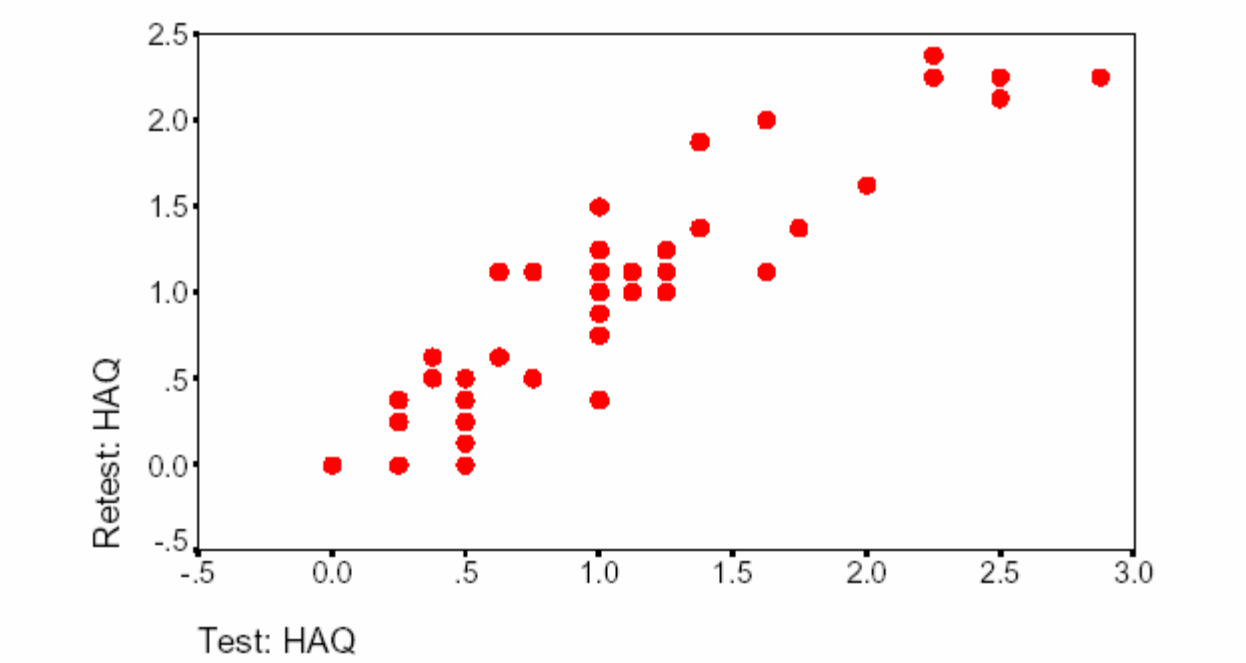


Figure 2: Test-retest scatterplot of the HAQ disability index, which comprised of eight weighted scales indexing ability to perform basic tasks such as eating, dressing, and walking (0=no difficulty, 3=extreme difficulty). Correlation above is .93

Example of inter-rater reliability

a) Correspondence between mother and father's report of their child's impulsivity.

b) Correspondence between mother and child's report of child's impulsivity.

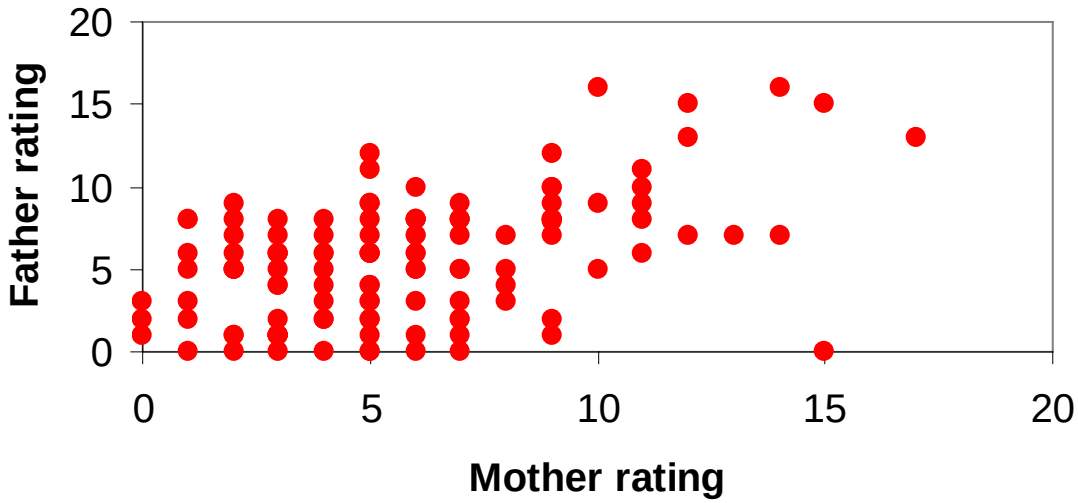


Figure 3: Inter-rater reliability of child's impulsivity, a scale that is comprised of twenty items (0=low and 20=high). Correlation above is .56

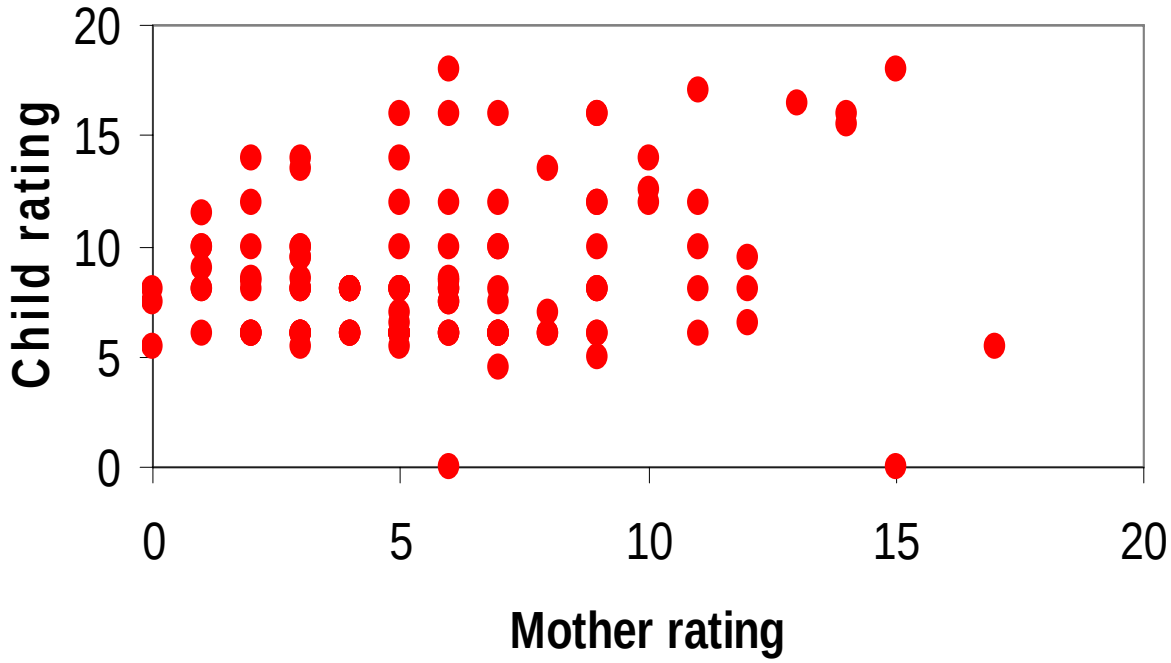


Figure 4: Inter-rater reliability of child's impulsivity, a scale that is comprised of twenty items (0=low and 20=high). Correlation above is .30

Internal Consistency Reliability
The degree to which items measuring the same construct are associated with each other

Strongly agree, agree somewhat, disagree somewhat, strongly disagree

"I am depressed"

"I feel sad"

"I am blue"

"I feel happy"

"I am content"

Classical test theory:

$x = T_x + e$

Assumptions:

1) $E(e) = 0$
2) $\text{cov}(T_x, e) = 0$
3) $\text{cov}(e_i, e_j) = 0$

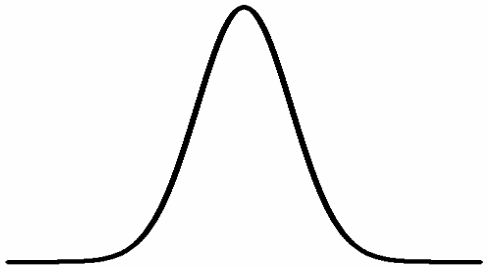
N.B.:

$$\text{Var}(X) = \text{Var}(T_x + e)$$

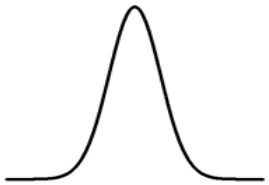
$$= \text{Var}(T_x) + 2\,\text{COV}(T_x, e) + \text{Var}(e)$$

$$= \text{Var}(T_x) + \text{Var}(e)$$

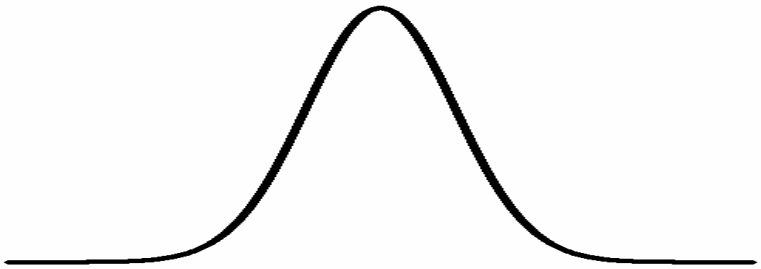
T



\+ +

e 

= =

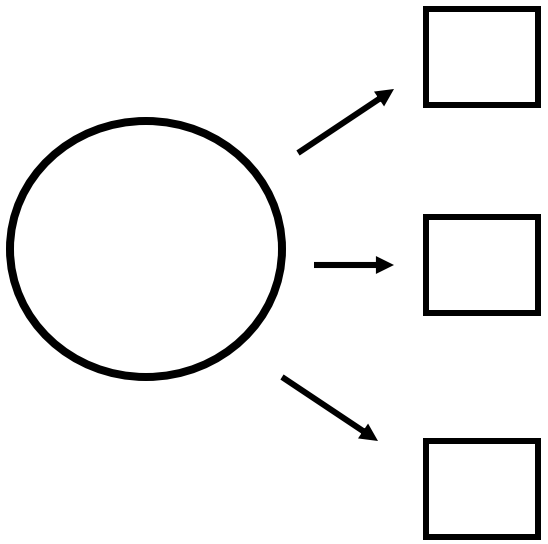
X 

Reliability is the consistency of measurement

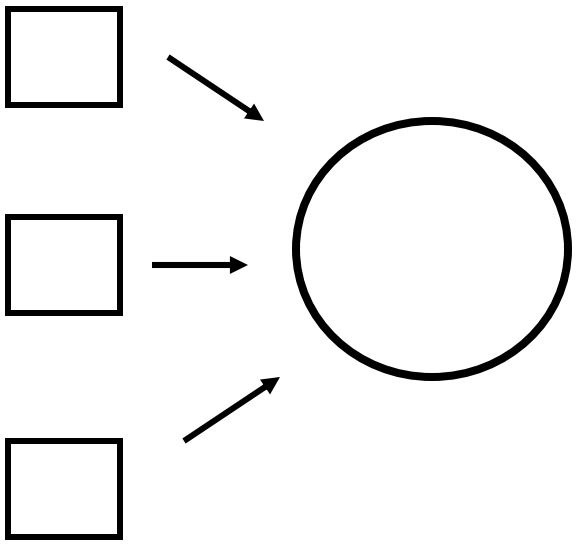
- 1) The correlation between parallel measures
  - $\rho_{xx} = r_{x1x2}$
- 2) The ratio of True score to Total score variance
  - $\rho_{xx} = \frac{V(T_x)}{V(O_x)} = \frac{V(O_x) - V(e_x)}{V(O_x)}$

Scale versus Index

Scale



Index



Scale versus Index

- Scales are often unidimensional
- Internal consistency not expected for index
- Examples of Scales
  - Distress
  - Self-esteem
  - Attitudes toward Abortion
- Examples of Indices
  - Life event scales
  - Socioeconomic status
  - Gross Domestic Product