**Course Description**

This course presents quantitative approaches to measurement in the psychological and social sciences. It is designed for doctoral students and is conducted jointly by the Departments of Mental Health and Biostatistics. Examples will be drawn from the social sciences, including stress and distress, social class and socioeconomic status, depression, functional impairment and disability. The instructional method will consist of lectures by the instructors as well as hands-on sessions in the computer laboratory and assigned problem sets.

This course is part of a two-quarter series on Statistics for Psychosocial Research, oriented towards structural equation models and related methods, taught jointly by the Departments of Mental Health and Biostatistics. The first quarter concentrates on measurement, and the second quarter on structural models. Credit for this course may be obtained without enrolling in the following course, but this course, or permission of the instructor, is required for enrollment in the second quarter course.

**Learning Objectives**

Upon successful completion of this course, students will be able to read and evaluate scientific articles as regards measurement in public health; to design simple measurement protocols; to design and conduct studies of reliability and validity; and to conduct and present standard quantitative analyses of measurement accuracy. Students will become familiar with the principles of psychometrics, including reliability and validity, and with latent variable-based measurement models, including factor analysis and latent class analysis.
Schedule
All lectures will be at 10:30 in Hampton House 14B (Basement Auditorium). The first lecture is on Friday, September 1st. All other lectures will be on Mondays and Wednesdays.

Problem Sets & Computer Labs
The problem sets will require active manipulation of datasets provided by the instructors, using standard statistical packages such as Stata and MPlus. The three problem sets are all due on Mondays in class; late homework will be accepted until the Wednesday class immediately following but will be penalized half a letter grade. Once the solutions are posted on Wednesday at 5pm, we will no longer be able to accept homework.

Computer lab sessions will be held each Friday (other than September 1st) from 10-12 in Bloomberg W3017. Students will want to bring their lecture notes, a pencil, and a thumb drive (http://en.wikipedia.org/wiki/Thumb_drive) in order to save their computing output. It is recommended that students read through the homework assignment prior to each week’s lab session.

CoursePlus Web site
http://courseplus.jhsph.edu/index.cfm?event=showPublicCourseSyllabus&catalogID=7563
The course web site will contain current and previous lectures, problem sets, and data sets for the course. Students must create an e-learning account in order to receive course communications and to access materials. Please do this as soon as possible. If you are not formally registered for the course, please contact us so that we may grant you guest access to the website. The website will also include a bulletin board (BBS) on which students may post questions about the course and its contents. It is requested that students post their questions on the BBS rather than e-mailing them directly to the course staff.

Grading Policy
Grades will be based on three problems sets and a final 90 minute open-notes/book, in-class exam (each contributing 25% toward the final grade).

Prerequisites
Biostatistics 621-624, or Biostatistics 651-654, or equivalent from another institution.

Textbooks
Required:

Highly recommended:

Readings
Readings are offered to help students master the material. “Alternative and additional” readings may be ignored, skimmed, or read in full if the student is interested. “Alternative and additional readings” will enrich the student’s knowledge of the material, but are not required for

**Honor Code**

The JHU Honor Code [http://www.jhsph.edu/schoolpolicies/policy_academic_ethics.html](http://www.jhsph.edu/schoolpolicies/policy_academic_ethics.html) should be followed throughout the course. You will be asked to write and sign the academic ethics statement, “I have neither given nor received unauthorized aid on this assignment” on your exam. Any infractions to the honor code will be referred to the Academic Ethics Board.

**Students with Disabilities**

If you are a student with a documented or suspected disability who requires an academic accommodation, please contact Betty Addison in the Office of Career Services and Disability Support at 410-955-3034, Room E-1002, or via email at dss@jhsph.edu. For information about this office and its services go to: [www.jhsph.edu/Student_Life/](http://www.jhsph.edu/Student_Life/).

**Lecture Schedule**

<table>
<thead>
<tr>
<th>Date</th>
<th>Day</th>
<th>Topic</th>
<th>Instructor</th>
<th>Homework</th>
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<tbody>
<tr>
<td>9/1</td>
<td>F</td>
<td>Introduction to Measurement</td>
<td>Bill</td>
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<tr>
<td></td>
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<td>(at 10:30 in HH Auditorium)</td>
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<tr>
<td></td>
<td>M</td>
<td>No school!</td>
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</tr>
<tr>
<td>9/6</td>
<td>W</td>
<td>Association and Dimensionality</td>
<td>Liz</td>
<td></td>
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<tr>
<td>9/8</td>
<td>F</td>
<td>LAB 0: Intro/Refresher to STATA</td>
<td>TAs</td>
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</tr>
<tr>
<td>9/11</td>
<td>M</td>
<td>Reliability I</td>
<td>Bill</td>
<td></td>
</tr>
<tr>
<td>9/13</td>
<td>W</td>
<td>Reliability II</td>
<td>Jeannie</td>
<td>PS#1 handed out</td>
</tr>
<tr>
<td>9/15</td>
<td>F</td>
<td>LAB1</td>
<td>TAs</td>
<td></td>
</tr>
<tr>
<td>9/18</td>
<td>M</td>
<td>Validity I</td>
<td>Bill</td>
<td></td>
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<tr>
<td>9/20</td>
<td>W</td>
<td>Validity II</td>
<td>Jeannie</td>
<td></td>
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<tr>
<td>9/22</td>
<td>F</td>
<td>LAB 2</td>
<td>TAs</td>
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<tr>
<td>9/25</td>
<td>M</td>
<td>Scale Development</td>
<td>Bill</td>
<td>PS#1 due &amp; PS#2 handed out</td>
</tr>
<tr>
<td>9/27</td>
<td>W</td>
<td>Factor Analysis I</td>
<td>Liz</td>
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<tr>
<td>9/29</td>
<td>F</td>
<td>LAB 3</td>
<td>TAs</td>
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</tr>
<tr>
<td>10/2</td>
<td>M</td>
<td>Factor Analysis II</td>
<td>Liz</td>
<td></td>
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<tr>
<td>10/4</td>
<td>W</td>
<td>Factor Analysis Examples</td>
<td>Liz</td>
<td></td>
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<tr>
<td>10/6</td>
<td>F</td>
<td>LAB 4</td>
<td>TAs</td>
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<tr>
<td>10/9</td>
<td>M</td>
<td>Latent Class Analysis I</td>
<td>Liz</td>
<td>PS#3 handed out</td>
</tr>
<tr>
<td>10/11</td>
<td>W</td>
<td>Latent Class Analysis II</td>
<td>Liz</td>
<td></td>
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<tr>
<td>Date</td>
<td>Day</td>
<td>Event</td>
<td>Instructor(s)</td>
<td>Notes</td>
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<td>10/13</td>
<td>F</td>
<td>LAB 5</td>
<td>TAs</td>
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<tr>
<td>10/16</td>
<td>M</td>
<td>LCA Examples</td>
<td>Jeannie</td>
<td>PS#2 due</td>
</tr>
<tr>
<td>10/18</td>
<td>W</td>
<td>Sample Size Issues in FA and LCA</td>
<td>Liz</td>
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<tr>
<td>10/20</td>
<td>F</td>
<td>LAB 6</td>
<td>TAs</td>
<td></td>
</tr>
<tr>
<td>10/23</td>
<td>M</td>
<td>Review</td>
<td>Jeannie &amp; Liz</td>
<td>PS#3 due</td>
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<tr>
<td>10/25</td>
<td>W</td>
<td>In-Class final</td>
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**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.

**Wednesday, September 6: Measuring Association and Dimensionality (Liz)**

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

*Reading*: Netemeyer, pages xiii-xiv and 1-40.

*Additional or alternative:*  


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
Monday, September 11: Principles of Psychometrics: Reliability I (Bill)
Types of reliability (Interrater, Test-retest reliability, Internal consistency)
Different types of reliability coefficients
  Correlation
  Split half measures
  Alpha coefficient
  Kuder Richardson Coefficient
  Kappa

Reading: Netemeyer, pages 41-59.

Additional or Alternative:
  Easy: DeVellis, pages 18-42

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

Wednesday, September 13: Principles of Psychometrics: Reliability II (Jeannie)
ANOVA model for reliability
Intra-class Correlation Coefficient
Research Designs

No additional readings for this lecture

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

Monday, September 18: Principles of Psychometrics: Validity I (Bill)
Types of Validity (face, content, criterion, construct)
Relationship of Reliability to Validity
Correction for attenuation

Reading: Netemeyer, pages 71-94

Additional or alternative:
Easy: DeVellis, pages 43-50.


After this class students will be able to:
▪ Distinguish four different types of validity
▪ Describe the conceptual and quantitative relationship of reliability to validity
▪ Estimate a true correlation from an observed correlation

Wednesday, September 20: Principles of Psychometrics: Validity II (Jeannie)
Internal Construct Validity
External Construct Validity
Multi-trait Multimethod Matrix
Sensitivity and Specificity
ROC Curves

No additional readings for this lecture

After this class students will be able to:
• Evaluate the relative utility of different cutoffs for a measure in relation to a gold standard.

Monday, September 25: Scale Development (Bill)

Readings: Netemeyer, pages 94-107


After this class students will be able to:
• Describe procedures for constructing a scale from scratch

Wednesday, 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

Reading: Netemeyer, pages 115-170.

Additional reading:

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

Monday, October 2: Factor Analysis II (Liz)
Factor extraction
Methods of estimation and rotation: orthogonal and oblique
Choosing the number of factors
Factor scores
Confirmatory factor analysis
Conditional independence
Dichotomous factor analysis

Additional Readings:

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

**Wednesday, October 4: Factor Analysis III: Journal Examples (Liz)**


In this class students will:

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

**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


*Additional reading:*

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

**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
- To interpret different criterion to choose among alternative models

**Monday, October 16: Latent Class: Examples in Journals** (Jeannie)


In this class students will:
- Apply latent class analysis to real data
- Critique published use of latent class analysis

**Wednesday, October 18: Sample Size in Reliability and Factor 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.
- Understand issues involved with sample size in latent class analysis.

**Monday, October 23: Review of Course** (Jeannie, Liz, & Bill)

**Wednesday, October 25: In-Class final exam**