APSTA GE 2093: Psychometric Theory and Applications

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Office: Kimball Hall, 246 Greene Street, 207
Office Hours: TBD
Credits: 3
Class Schedule: Weekly meetings of 120 minutes; total class time 33 hours
Semester: Fall 2017

Class Meeting Time / Room: TBD

Course Description: This course reviews and expands on the topics of validity and reliability for psychological and educational tests. The starting point is classical test theory, moving on to unidimensional and multidimensional factor models for continuous data, and followed by item response theory for dichotomous and categorical data. These core topics are complimented by a number of special issues that often arise in applied settings: multi-group comparisons (measurement invariance and differential item functioning); bi-factor models; multi-level factor analysis; and cognitive diagnostic models. The final lesson introduces structural models.

Additional Course Information: The course is suitable for students who are familiar with linear regression at the level of APSTA GE 2003, and who have either a theoretical or applied interest in psychometrics. It is especially well suited for students who have collected or plan to collect test/questionnaire data, and want to assess the quality of the test/questionnaire. Class time is split between 1/2 theoretical discussion and 1/2 hands-on examples and exercises. Students can use a software of their choice, but class material focuses on R and Mplus (a free demo of Mplus is available at www.statmodel.com and the full version is available at the Bobst 5th floor Digital Studio). Evaluation is centered on data-based homework assignments and a final project. For the final project, students may work in pairs and are encouraged to use data from their own research.

Student Learning Outcomes: The course will enable students to

1. Understand foundational concepts and specific models used in psychometrics.
2. Conduct psychometric analyses using statistical software.
3. Interpret and write-up results of psychometric analyses.

Prerequisites: Multiple regression at the level of APSTA-GE 2003.
**Website:** The course uses NYU Classes for lecture notes, handouts, readings, homework assignments, and general information.

**Text:** Readings from the research literature and book chapter excerpts will be provided by the instructor. A bibliography is provided at the end of this syllabus.

**Grading:**

<table>
<thead>
<tr>
<th>Assignment weight and final grade</th>
<th>Final course grade and letter grade</th>
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<tbody>
<tr>
<td>10% Class attendance and participation</td>
<td>A: 90% and above</td>
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<tr>
<td>45% Homework</td>
<td>B: 80-89%</td>
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<tr>
<td>5% Final project proposal presentation</td>
<td>C: 70-79%</td>
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<tr>
<td>5% Final project first draft</td>
<td>D: 60-69%</td>
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<tr>
<td>5% Final project second draft</td>
<td>F: 60% or lower</td>
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<td>30% Final project paper</td>
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**Participation:** Participation is evaluated on a class-by-class basis. Each class, up to one participation point can be earned -- one-half point for attendance, and another for contributing to classroom discussion / activities. The final participation grade computed from the average over the classes.

**Homework:** Weekly homework is assigned. Homework will require some basic mathematics (algebra) but focuses on data analysis and interpretation. Students have one week to complete assignments and some time at the end of class is dedicated to working on assignments when they are distributed. Students can work together, but each individual must hand in their own work.

**Final Project:** The final project can be on a spectrum between applied and theoretical. Applied projects typically use real data to address a specific research question about a specific measure or test. Theoretical projects may focus on statistical questions about measurement, and can use simulated data or real data. The project paper is expected to be about 10 pages, double-spaced, including figures and tables.

Students propose their project to the class in a short, informal presentation. As part of the project proposal, students will suggest the work to be accomplished in the first and second drafts of the proposal, and the instructor will provide feedback on the proposal during the presentation. The first and second draft materials are due in the following two weeks. Feedback is provided, and the final project is due on the last day of class.

Students are encouraged to consult NYU Library Data Services (http://guides.nyu.edu/dataservices) for information about publicly available data sources, and the course instructor can suggest a number of publicly available data sources in education. Students can work together, and may optionally hand-in the project in pairs.
Academic Integrity: All students are responsible for understanding and complying with the NYU Steinhardt Statement on Academic Integrity. A copy is available at: http://steinhardt.nyu.edu/policies/academic_integrity.

Students with Disabilities Statement: Students with physical or learning disabilities are required to register with the Moses Center for Students with Disabilities at 726 Broadway, 2nd Floor, (212-998-4980) and are required to present a letter from the Center to the instructor at the start of the semester in order to be considered for appropriate accommodation.

Time line: This time line is approximate and may be altered during the semester.

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<thead>
<tr>
<th>Week</th>
<th>Topic</th>
<th>Readings Assigned</th>
<th>Homework Due</th>
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<tbody>
<tr>
<td>1</td>
<td>Overview and math refresher; introduction to classical test theory (CTT); reliability and validity</td>
<td>Math notes Miller 2009 Messick 1996</td>
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<td>2</td>
<td>CTT main results (coefficient alpha; KR-20; corrections for attenuation; Spearman-Brown; item difficulty and discrimination); limitations of CTT</td>
<td>Brennan 1996 Gwet 2008a; 2008a</td>
<td>Math review</td>
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<tr>
<td>3</td>
<td>Generalizability-theory; inter-rater reliability (IRR)</td>
<td>Fabrigar 1999 Steiger Chap6 Yanai 2007</td>
<td>CTT</td>
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<tr>
<td>4</td>
<td>Exploratory factor analysis (EFA) for continuous data; identification and factor rotation</td>
<td>Hu 1999 Millsap 2001 Mulaik 1988</td>
<td>IRR</td>
</tr>
<tr>
<td>5</td>
<td>Confirmatory factor analysis (CFA) for continuous data; goodness of fit</td>
<td>Distefano 2009 Grice 2001</td>
<td>EFA</td>
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<tr>
<td>6</td>
<td>Methods for computing and evaluating factor scores (FS) for continuous data</td>
<td>Hambleton 1993 Wirth 2007</td>
<td>CFA</td>
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<td>7</td>
<td>Item response theory for categorical data (binary, ordered categorical, and nominal)</td>
<td>Hambleton 1993, chap. 3 &amp; 5 Mislevy 1991</td>
<td>FS</td>
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<tr>
<td>8</td>
<td>Methods for computing and evaluating factor scores using continuous data; item and test information</td>
<td>Millsap 2011, chap 1 &amp; 2</td>
<td>IRT</td>
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<tr>
<td>9</td>
<td>Comparisons over groups; measurement invariance (MI) and differential item functioning (DIF)</td>
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<td>FS2</td>
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Bibliography


