Course Description

A central theme in psychological and educational measurement is the establishment of the technical criteria and statistical models for ensuring the reliability, fairness, and validity of the measurement instruments. Whether it is a state-level end-of-grade test, an aptitude test for admissions (e.g., the GRE), a licensure examination (e.g., US Medical Licensing Examination; USMLE), a large-scale educational survey (e.g., National Assessment of Educational Progress; NAEP), a quality of life scale for patients with a chronic disease, or a depression inventory used for clinical diagnosis, the underlying measurement models and methods are similar. One particular set of measurement theory, models, and techniques that is of foundational importance in modern psychometrics is Item Response Theory (IRT). This course will examine current advanced topics in IRT in depth. The topics include various multidimensional/multilevel item factor models, their estimation related issues, and applications. The topics will be covered through both lectures and discussions that are facilitated by the instructor and students.

Prerequisites

This is an advanced measurement course. I assume that you have taken introductory courses on educational or psychological measurement (examples include EDMS 623: Applied Measurement: Issues and Practices and EDMS 724: Modern Measurement Theory: An Introduction to Item Response Theory.) For instance, you should be familiar with terms such as reliability, validity, latent variables, factor loadings, and item characteristic curves. I also assume that you are familiar with basic concepts in statistics such as model fit assessment, statistical testing, and maximum likelihood estimation. Please contact me as soon as possible if you do not think you meet these prerequisites.
Objectives

It is my hope that students will be able to have a solid understanding of item response theory so that you become a capable researcher, an informed consumer, and a clear communicator. You should be able to use IRT methods correctly and in a constructive manner in your own research. You should be able to interpret the results from item analysis and communicate the results effectively, whether for your own work or for evaluating the adequacy of other researchers’ work. You should also be able to demonstrate your ability to run an IRT software program for data analysis. For statistics/quantitative psychology/advanced quantitative methodology students, an additional objective is for you to become familiar with a general IRT framework, so that you may contribute to the educational and psychological measurement literature in the future.

Reading Materials

There is no required textbook. We will be reading book chapters and journal articles each week that will be made available as pdf downloads from the course website.

Course Delivery

Course slides and supplemental materials (if there are any) will be made available by 9AM every Monday on ELMS CANVAS course delivery system (https://elms.umd.edu). An email notification will be sent out when new materials are posted on the board. It is your responsibility to print them or bring them to class.

Software

You may use any competent software program of your choosing (e.g., IRTPRO, some packages in R, mvIRT from Multivariate Software, Mplus, and occasionally SAS). For the most part I will use flexMIRT:
Occasionally, R and Mplus are also used when they are useful depending on the context and topics.

Formal Course Assessment

Homework Assignments: There will be THREE assignments (45%) throughout the semester, each of them designed to give students an opportunity to apply and practice concepts and techniques learned in class and to explore more options beyond the class materials.

I do expect that students’ word-processed homework will conform as closely as possible to APA style presentation of tables, graphics, and references. Therefore, students should cut and paste relevant portions of the computer output into the appendix in your homework to show how you
arrived at your solution. One of the goals of this class is to be able to write-up statistical results as if it were going into a journal article or a thesis.

Please note that late homework assignments will not be accepted unless pre-approval is given for exceptional circumstances. Only a hard copy of the homework assignment is accepted at the beginning of class on the specified due date. It might be wise to keep a photocopy or at the very least save assignments electronically for your own protection. Appendices or code can be emailed to the instructor. Graded assignments will generally be returned during the next class.

One of the three grades (check minus, check, and check plus) will be given to each homework assignment. Getting a check means that the student or the group gets full credit for the assignment. For the assignments with check minus, there is one more opportunity to re-submit the assignment to get full credit. However, this submission should be made no later than a week from the day the assignment is returned. The second version should be a hard copy as well. If an assignment ends up with a check minus without resubmission or so, the student or group will get only partial credit for the assignment depending on the level of completion. A “check plus” means an excellent work, but there is no extra credit for the work other than getting full credit. So, a check plus is simply an acknowledgement for a great job.

**Discussion leading**

From mid-semester to the end, each student should lead an in-class discussion on a topic of choice. The topic list and the minimal list of reading materials on each topic will be provided. Such session leading typically includes brief presentation of key points from the readings, posing of questions for discussion, and moderating of discussion/debate. Discussion leaders will also be expected to prepare by reading additional relevant papers and to use knowledge gained from these papers to help the class consider the topic of the day. While the topic and readings are provided, these are just core suggestions - you should not feel obligated to constrain yourself to them. With previous consulting with the instructor, the topic can be refined or narrowed down if it is needed. The credit for discussion leading is a 20% of the total.

**The final project: Presentation and paper**

Toward the end of the semester, you will need to conduct a small project involving some aspect of item response theory, do a 20-minute oral presentation (10%), and produce a short written report summarizing your findings (20%). The remaining 5% is based on your participation in class.

There are three options for the project: (a) it can be a more methodologically focused project (studying and extending the current methodology), (b) it can be more applied (using the existing methodology in an innovative way), or (c) a computational project (e.g., expansion of a computation algorithm to a multidimensional IRT model).

**Course Grades**

**Overall Course Percent Grade:**

98.00% ~ 100.00%: A+
92.00% ~ 97.99% : A
88.00% ~ 91.99% : A-
85.00% ~ 87.99% : B+
82.00% ~ 84.99% : B
78.00% ~ 81.99% : B-
75.00% ~ 77.99% : C+
72.00% ~ 74.99% : C
68.00% ~ 71.99% : C-
65.00% ~ 67.99% : D+
62.00% ~ 64.99% : D
58.00% ~ 61.99% : D-
≤ 57.99% : F

Notes: With exceptions of computational error or human mistakes, grades will not be changed once they are posted. There will be no extra credit opportunities. Incomplete option is not for poor performance in the course. Incomplete for this course will be given on a case-by-case basis. However, unless the student can provide very compelling reasons with proof documents, incomplete will not be given.

Tentative Course Schedule

<table>
<thead>
<tr>
<th>Week</th>
<th>Date</th>
<th>Topics</th>
<th>Assignment Due</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Aug 27</td>
<td>Introduction and review of some standard models/assumptions</td>
<td></td>
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<tr>
<td>2</td>
<td>Sep 3</td>
<td>Labor Day (No Class)</td>
<td></td>
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<tr>
<td>3</td>
<td>Sep 10</td>
<td>Review: Local dependence, testlets, and goodness-of-fit</td>
<td></td>
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<tr>
<td>4</td>
<td>Sep 17</td>
<td>Item factor models: Simple and bifactor structure</td>
<td>HW1</td>
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<tr>
<td>5</td>
<td>Sep 24</td>
<td>Hierarchical IRT models</td>
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<tr>
<td>6</td>
<td>Oct 1</td>
<td>Estimation for MIRT models I</td>
<td></td>
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<tr>
<td>7</td>
<td>Oct 8</td>
<td>Estimation for MIRT models II</td>
<td>HW2</td>
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<tr>
<td>8</td>
<td>Oct 15</td>
<td>Longitudinal IRT models</td>
<td>Final Project description</td>
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<tr>
<td>9</td>
<td>Oct 22</td>
<td>Multilevel IRT models</td>
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<tr>
<td>10</td>
<td>Oct 29</td>
<td>Multidimensional IRT scoring</td>
<td>HW3</td>
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<tr>
<td>11</td>
<td>Nov 5</td>
<td>Multidimensional IRT linking</td>
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<td>12</td>
<td>Nov 12</td>
<td>Nonnormal latent density</td>
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<td>13</td>
<td>Nov 19</td>
<td>Restricted re-calibration</td>
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<tr>
<td>14</td>
<td>Nov 26</td>
<td>Latent regressions and PVs</td>
<td></td>
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<tr>
<td>15</td>
<td>Dec 3</td>
<td>Project Presentations</td>
<td>Final paper due (Dec 10th)</td>
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Note: The bold topics are for student discussion leading.

Course Procedures and Policies

Accommodations for Emergencies & Email Communication:
When the University closes on the day of class, we will have no class. Otherwise, I strongly urge you to be vigilant about your email and/or the course website on CANVAS if there are any threats (e.g. extreme weather) that could potentially prohibit having class at our regular time.

If you need to be absent from class or late for the class significantly (or leaving early), letting me know about it ahead of the time would be much appreciated. All students are expected to take the exams and/or submit assignments on the specified dates and no make-up exams are given. You must contact me before an exam if you are going to be absent or you will receive a zero for that assessment.

The primary communication tool will be emails. However, I would like to remind you that you should allow me at least 24 hours to take care of emails due to my other duties as a faculty member. Emergencies deserve prompt replies, but last minute questions with respect to assignments might not be well taken. I strongly recommend that you should plan ahead to meet the deadlines properly.

Academic Accommodations:
In compliance with and in the spirit of the Americans with Disabilities Act (ADA), I would love to work
with you if you have a documented disability that is relevant to successfully completing your work in this course. If you need academic accommodation by virtue of a documented disability, please contact me as soon as possible to discuss your needs.

**Academic Integrity:**
The University of Maryland, College Park, has a nationally recognized Code of Academic Integrity, administered by the Student Honor Council. This Code sets standards for academic integrity at Maryland for all undergraduate and graduate students. As a student you are responsible to uphold these standards for this course. It is imperative that you are aware of the consequences of cheating, fabrication, facilitation, and plagiarism. For more information on the code of Academic Integrity or the Student Honor Council, please visit [http://www.studenthonor council.umd.edu/code.html](http://www.studenthonor council.umd.edu/code.html) for details. Plagiarism and other forms of academic fraud are a violation of university regulations and unacceptable under any circumstance. These instances have to be and will be reported to the Honor Council in writing. Notes on plagiarism in this class: Due to the nature of reporting statistical results, some expressions are commonly used and should be phrased in the same/similar ways. However, how to approach a problem and end up with the solution is definitely a result of logic process, and this should not be stolen and used with proper citations.

**Religious observances:**
The University of Maryland policy on religious observances states that students not be penalized in any way for participation in religious observances. Students shall be allowed, whenever possible, to make up academic assignments that are missed due to such absences. However, the must contact the instructor before the absence with a written notification of the projected absence, and arrangements will be made for make-up work or examinations.

**Student Participation:**
The classes will be composed of lectures and small group/class discussions. Each student’s meaningful participation is very appreciated and will contribute to entire learning process, promoting critical thinking skills. Throwing questions and bringing in topic-related problems to class are always welcomed.