Modern Measurement Theory: Item Response Theory  
EDMS 724  
Spring 2015  
EDU2102  
Monday 4:15-7:00pm

**Instructor**  
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**Office Hours**  
Monday 1:00-3:00pm  
or by appointment

**Course Prerequisites**

This course is a graduate-level measurement course. The prerequisites of this course include classical test theory and statistical models up to regression.

**Course Objectives**

Item response theory (IRT) models have been widely applied as modern measurement models in test or instrument development in education and psychology to measure cognitive (such as achievement, aptitude) or non-cognitive (such as attitude, personality) latent traits. Recent years, these latent trait models are gaining increasing popularity as an item response data analysis tool in multiple disciplines such as education, psychology, health, marketing, genetic biology, and sociology. In educational and psychological areas, these latent traits could be ability, proficiency, aptitude, or attitude; in marketing, they could be purchasing power or consumer preferences; in biological or medical research, they could refer to subjective health status, treatment outcomes, quality of life, or predisposition to a certain disease; in sociology, they could measure racial prejudice or political attitude. Evidently IRT models facilitate better understanding of the nature of item response data in different disciplines.

This course is an introductory course to IRT known as latent trait theory and modern measurement/test theory, a framework for designing, analyzing, and scoring tests, questionnaires, and similar instruments measuring abilities, attitudes, or other variables. It covers the basics of IRT models in item response data analysis. The course starts with a review of classical test theory. Its focuses are on the unidimensional IRT models for both dichotomously scored (0, 1 scores) or polytomously scored (0, 1, 2, 3 scores) item response data. Model parameter estimation, estimation software programs, and model selection will be addressed. Some applications of IRT models are demonstrated such as constructing a test or designing an instrument and developing a computerized adaptive version of a test or an instrument. Further some possible extensions of the basic models which address the potential issues with the elaborated unidimensional IRT models will be briefly introduced in this course. Overall this course focuses on the statistical theory underlying IRT models as well on their application to real and simulated data sets using modern software programs, whenever possible. Throughout the course, we will look at illustrative examples from a variety of disciplines with an emphasis on education and psychology.
Recommended Textbook


Additional Reference Textbooks


Special Journal Issues:

- *Applied Psychological Measurement* (Spring, 1995), Polytomous item response theory. (Special Issue)

Other Resources:

Baker’s IRT Book: The Basics of Item Response Theory.

Course Topics and Readings

The following table lists the topics to be covered in this course. This timetable is tentative. Adjustment is very likely to be made along the semester.

All additional reading materials will be uploaded onto elms.

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<th>Week</th>
<th>Date</th>
<th>Topics</th>
<th>Assignments</th>
<th>Readings</th>
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<td>1</td>
<td>1/26</td>
<td>Course overview&lt;br&gt;Review of classical test theory&lt;br&gt;Overview of IRT models</td>
<td>HW1</td>
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<td>2</td>
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<td>3</td>
<td>2/9</td>
<td>Estimation of dichotomous models</td>
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<td>Ch. 7, 8 computer lab</td>
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<td>5</td>
<td>2/23</td>
<td>Estimation of polytomous models</td>
<td>HW3</td>
<td>Ch. 8 computer lab</td>
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<td>6</td>
<td>3/2</td>
<td>MCMC estimation</td>
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<td>7</td>
<td>3/9</td>
<td>Assessing unidimensionality &amp; local independence</td>
<td>Midterm project</td>
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<td>3/16</td>
<td>Spring break</td>
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<td>9</td>
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<td>Model selection, Person fit and item fit</td>
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<td>IRT based equating methods</td>
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<td>Current psychometric issues: Innovative items, Computerized adaptive test</td>
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<td>14</td>
<td>4/27</td>
<td>Complex IRT models</td>
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<td>15</td>
<td>5/4</td>
<td>Research project presentation</td>
<td>Presentation</td>
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<tr>
<td>16</td>
<td>5/11</td>
<td>Final research project</td>
<td>Final project due</td>
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Statistical Software

You can choose SPSS, R, S-Plus, and SAS for data analysis in addition to the WINSTEPS, CONQUEST, OpenBUGS, BILOG-MG, PARSCALE, MULTILOG and other IRT software.

Download textpad from http://www.textpad.com/ for your convenience in manipulating item response data.

Formal Course Assessment

Homework Assignments

There will be five assignments spaced evenly throughout the semester to give students an opportunity to apply, practice, and think about the concepts learned in class. It is expected that students will be using a variety of software for their homework where computer work is required. When working on the
assignments, students are expected to pull together the material from lecture, the text, and the supplemental notes where applicable. Late homework assignments will be accepted with a penalty of 10% credit. Graded assignments will generally be returned on the following day in class after they are submitted. Students are encouraged to work in groups on homework, but each student must turn in their own write-up.

In the assignments students should cut and paste relevant portions of the computer output into the appropriate places in the homework to show how solutions are arrived. Assignments should be well-organized and must be word-processed.

Projects

There will be two projects: a midterm project and a final research project. For the final project, you will propose an original research study and write up a proposal based on one of the call for proposals for a conference like AERA, NCME, NCME Graduate Student Poster Session, or APA including background, literature review, research questions, methodology, or results if available.

Scoring rubrics for final research proposal:

*Objectives or purposes Min: 1: (Insignificant) Max: 5: (Critically Significant)

*Perspective(s) or theoretical framework: Min: 1: (Not Articulated) to Max: 5: (Well Articulated)

*Methods, techniques, or modes of inquiry: Min: 1: (Not Well Executed) to Max: 5: (Well Executed)

*Data sources, evidence, objects or materials Or, for theory or methods based papers, what would be the equivalent bases: Min: 1: (Inappropriate) to Max: 5: (Appropriate)

*Results and/or substantiated conclusions or warrants for arguments/point of view (Not available): Min: 1: (Ungrounded) to Max: 5: (Well Grounded)

*Scientific or scholarly significance of the study or work: Min: 1: (Routine) to Max: 5: (Highly Original)

Presentation

This assessment requires you present on your proposed research for the final project. You will be given 10-15 minutes to present your study and 3-5 minutes for questions. You presentation will be rated based on some evaluation criteria. Each student will rate other students’ presentations anonymously and students’ ratings will be counted towards the final score for this assessment. Outlier ratings will be dropped.

Course Grades

All course assessments are Major Graded Events. Students’ homework, exams, and projects’ grades will be combined using a weighted average grading scheme with the corresponding weights given below. Final letter grades will then be assigned based on the given scale.
Assessment          Weight   Overall Course Percent  Grade
Total homework points 50%   100%-95%        A+
Total midterm project points 20%   94% - 91%        A
Total presentation points 10%   90% - 88%        A-
Total final project points 20%   87% - 85%        B+
                  84% - 81%        B
                  80% - 78%        B-
                  77% - 75%        C+
                  74% - 70%        C
                  69% - 65%        C-
                  64% - 60%        D+
                  59% - 55%        D
                  54% - 50%        D-
                  ≤ 49%          F

Incompletes
Incompletes for this course will be given on a case-by-case basis. The most valid reason for an
incomplete is an unforeseen event that gravely interferes with a student’s ability to perform at an
adequate level. Incompletes will not be given for unqualified poor performance.

CLASS POLICIES

Academic integrity: The University of Maryland, College Park has a student-administered Honor Code
and Honor Pledge. For more information on the Code of Academic Integrity or the Student Honor
Council, please visit http://www.studenthonorcouncil.umd.edu/whatish.html. This Code sets standards for
academic integrity at Maryland for all undergraduate and graduate students. As a student you are
responsible for upholding these standards for this course. It is very important for you to be aware of the
consequences of cheating, fabrication, facilitation, and plagiarism. The code prohibits students from
cheating, fabrication, facilitating academic dishonesty, and plagiarism. Instances of this include
submitting someone else’s work as your own, submitting your own work completed for another class
without permission, or failing to properly cite information other than your own (found in journals,
books, online, or otherwise). Any form of academic dishonesty will not be tolerated, and any sign of
academic dishonesty will be reported to the appropriate University officials.

Special needs: If you have a registered disability that will require accommodation, please see the
instructor so necessary arrangements can be made. If you have a disability and have not yet registered
with the University, please contact Disability Support Services in the Shoemaker Building
(301.314.7682, or 301.405.7683 TTD) as soon as possible.

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.
**Course evaluations:** As a member of our academic community, students have a number of important responsibilities. One of these responsibilities is to submit course evaluations each term through CourseEvalUM in order to help faculty and administrators improve teaching and learning at Maryland. All information submitted to CourseEvalUM is confidential. Campus will notify you when CourseEvalUM is open for you to complete your evaluations for fall semester courses. Please go directly to the website (www.courseevalum.umd.edu) to complete your evaluations. By completing all of your evaluations each semester, you will have the privilege of accessing online, at Testudo, the evaluation reports for the thousands of courses for which 70% or more students submitted their evaluations.

**Missed single class due to illness:** Once during a semester, a student’s self-authored note will be accepted as an excuse for missing a minor scheduled grading event in a single class session if the note documents the date of the illness, acknowledgement from the student that information provided in the note is correct, and a statement that the student understands that providing false information is a violation of the Code of Student Conduct. Students are expected to attempt to inform the instructor of the illness prior to the date of the missed class.*

**Major scheduled grading events:** Major Scheduled Grading Events (MSGE) are indicated on the syllabus. The conditions for accepting a self-signed note do not apply to these events. Written, signed documentation by a health care professional, or other professional in the case of non-medical reasons (see below) of a University-approved excuse for the student’s absence must be supplied. This documentation must include verification of treatment dates and the time period for which the student was unable to meet course requirements. Providers should not include diagnostic information. Without this documentation, opportunities to make up missed assignments or assessments will not be provided.

**Non-consecutive, medically necessitated absences from multiple class sessions:** Students who throughout the semester miss multiple, non-consecutive class sessions due to medical problems must provide written documentation from a health care professional that their attendance on those days was prohibited for medical reasons.

**Non-medical excused absences:** According to University policy, non-medical excused absences for missed assignments or assessments may include illness of a dependent, religious observance, involvement in University activities at the request of University officials, or circumstances that are beyond the control of the student. Students asking for excused absence for any of those reasons must also supply appropriate written documentation of the cause and make every attempt to inform the instructor prior to the date of the missed class.