EPSY 8226: Item Response Theory
Spring Semester, 2017
Mondays, 9:05 – 11:55 AM

Instructor: Michael C. Rodriguez	Classroom: Wulling Hall 220
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Email: mcrdz@umn.edu	Office Hours: Monday 1-3
Web: www.edmeasurement.net/8226	Or by Appointment

Texts:

De Ayala, R.J. (2009). *The theory and practice of item response theory*. New York, NY: Guilford.

The Course:

The topic of the course is item response theory and its application in education, psychology, and social science measurement. Several models will be reviewed, including the 1-, 2-, and 3-parameter models for dichotomous data as well as graded-response, partial-credit, and nominal models for polytomous data. Applications will include equating, differential item functioning, and computerized adaptive testing. Explanatory item response models and multidimensional models will be introduced. In addition, attention will be given to diagnostic uses of IRT for item and test development. The course is intended for advanced graduate students with a specialization in quantitative methods of measurement in education, psychology, and the social sciences. The course will employ a combination of lectures and class discussion, and will include assignments requiring IRT analyses.

Primary Course Objectives:

By the end of the course, students will be able to
- read the applied literature on item response theory and its applications
- implement various IRT models for dichotomous and polytomous data
- employ IRT models to address practical measurement problems
- conduct diagnostic analyses to evaluate the quality of test items and test scores
- analyze data with Winsteps and IRTPRO software to address applied problems

Course Requirements:

Readings. You are encouraged to read the assigned portions of the textbook prior to discussion in class. We will not cover all of the material in the text during class discussion—you are responsible for material covered in the textbook and class.

Quizzes. Throughout the course, there will be several quizzes. The quizzes will be used for class discussion only – these are not counted in final grades.

Assignments. There will be five IRT application problems requiring the exploration of the models reviewed in class (Winsteps or IRTPRO optional). Any IRT program can be used and you are encouraged to identify data that meet the model requirements to answer questions specified in each assignment. The assignments should be single-spaced MS-Word documents. Each of the assignments will be worth 30 points for a total of 150 pts.

Course Paper. A paper of up to 8 pages of text (not including appendices, tables, figures, and references) is required. The paper may be a research study based on an analysis of your own data by comparing methods of analyses, a review of an IRT application literature (e.g., differential item functioning, computerized adaptive testing, automated test assembly, or equating and linking), a Monte Carlo simulation study, or a review of a technical literature (e.g., assessing model fit, dimensionality, or estimation). To complete the paper, you will need to demonstrate familiarity with original research in the field. In that process, you may investigate the major research in the field to identify models for your own research. The paper should be a single-spaced MS-Word document in APA format. The paper will be worth 50 points.

Assignments and the paper will be returned via email with comments and Track-Changes edits. You will be able to ***resubmit*** each revised assignment and paper once for full credit. This will constitute the measures of learning in the course. Your final course grade will be based on the final grade of each assignment and paper.

There will be 200 points total for the course. Student grades will be based on the percentage of points earned (100% – 92% A; 91% – 90% A-, 89% – 88% B+; 87% – 82% B; 81% – 80% B-; etc.)

Format for Submitting Assignments via EMAIL:

Submit assignments in Word format, in an email message with EPSY8226 in the subject line, using the following document naming system:

Lastname-EPSY8226-assignmentname-yearmonthday.docx

For example: **Kaler-EPSY8226-lab1v1-20170213.docx**

This indicates an assignment from Kaler, for Lab 1 version 1, 2017 February 13.

Journal Articles (From Previous Instructor)

Adams, R. J., Wilson, M., & Wang, W-C. (1997). The multidimensional random coefficients multinomial model. *Applied Psychological Measurement*, *21*, 1 – 23.

Bielinski, J. & Davison, M. L. (1998). Gender differences by item difficulty interactions in multiple-choice mathematics items. *American Educational Research Journal, 35*, 455-476.

Bielinski, J. & Davison, M. L. (2001). A sex difference by item difficulty interaction in multiple-choice mathematics items administered to national probability samples *Journal of Educational Measurement*, *38*, 1-79.

Browne, M. W. & Cudeck, R. (1993). Alternative ways of assessing model fit. In Bollen, K. & Long, J. (Eds), *Testing structural equation models*. Sage: Newbury Park, CA. 136 – 162.

Chen, W-H., & Thissen, D. (1997). Local dependence indices for item parameters using item response theory. *Journal of Educational and Behavioral Statistics*, *22*, 265 – 289.

Davison, M. L., Semmes, R., Huang, L., & Close, C. N. (2011). On the reliability and validity of a numerical reasoning speed dimension derived from response times collected in computerized testing. *Educational and Psychological Measurement*, *72*, 245 – 263..

Diao, Q. & van der Linden, W. J. (2011). Automated test assembly using Ip-Solve Version 5.5 in R. *Applied Psychological Measurement*, *35*, 398 – 409.

Du Toit, M. (2003). *IRT from SSI: Bilog-MG, Multilog, Parscale, and Testfact*. Chicago: Scientific software.

De Ayala, R. J. (2009). *The theory and practice of item response theory*. New York: Guilford.

Ferrando, P. J. (2009). Difficulty, discrimination, and information indices in the linear factor analysis model for continuous item responses. *Applied Psychological Measurement*, *33*, 9 - 24.

Garcia-Perez, M. A., Alcala-Quintana, R. & Garcia-Cueto, E. (2010). A comparison of anchor-item designs for the concurrent calibration of large banks of Likert-type items. *Applied Psychological Measurement*, *34*, 580-599.

Hu, L., & Bentler, P. M. (1998). Fit indices in covariance structure modeling. *Psychological Methods*, *3*, 424 – 453.

Kamata, A. (2011). Item analysis by the hierarchical generalized linear model. *Journal of Educational Measurement*, *38*, 79 – 43.

Kang, T. & Cohen, A. S. (2007). IRT model selection methods for dichotomous items. *Applied Psychological Measurement*, *31*, 331 – 358.

Kang, T., Cohen, A. S., & Sung, H-J. (2009). Model selection indices for polytomous items. *Applied Psychological Measurement*, *33*, 499 – 518.

Lei, P. W. & Zhao, Y. (2012). Effects of vertical scale estimation methods on linear growth estimation. *Applied Psychological Measurement*, *36*, 21 – 39.

Magis, D., & Raiche, G. (2011). catR: An R package for computerized adaptive testing. *Applied Psychological Measurement*, *35*, p. 576 – 577.

Orlando, M. & Thissen, D. (2000). Likelihood based item-fit indices for dichotomous item response theory models. *Applied Psychological Measurement*, *34*, 50 – 64.

Park, R., Kim, J., Dodd, B. G., & Chung, H. (2011). JPLEX: Java simplex with branch-and-bound search for automated test assembly, *35*, 643 – 644.

Semmes, R., Davison, M. L., & Close, C. N. (2011). Modeling individual differences in numerical reasoning speed as a random effect of response time limits. *Applied Psychological Measurement, 35*, 433 – 446.

Assignment	Due Date
Rasch and 1-PL Models	February 13
2- and 3-Parameter Models	February 27
Polytomous Models	March 10
Advanced Models Consider exploring a multidimensional or multigroup CFA analysis.	March 17
DIF Analysis	April 24
Course Paper	April 24

Mondays	Topic	DeAyala	IRTPro
January 23	Review of CTT and introduction to IRT	1 [409-413]	1-4
30	Dichotomous items: The Rasch model and 1-parameter model	2	(11, 12, 14, as needed)
February 6	Joint maximum likelihood estimation	3	
13	Marginal maximum likelihood estimation	4 [A, B]	13
20	Dichotomous items: 2-parameter models	5 [C]	5.1, 5.2, 5.4
27	Dichotomous items: 3-parameter models	6	8, 10
March 6	The partial credit model: a Rasch model for ordered polytomous data	7	
13	*SPRING BREAK*		
20	The generalized partial credit and graded-response models: Non-Rasch models for ordered polytomous data	8	5.3.1, 5.3.2 6.2
27	Models for nominal polytomous items	9	5.3.3
April 3	Models for multidimensional items (M-CFA)	10	7.1, 7.3 7.5 (optional)
10	Linking and Equating	11	
17	Differential item functioning	12	6.1
24	Computerized Adaptive Testing	[D]	
May 1	*AERA*		
Friday 5	*Final Day of Semester*		

Note on Grading Policy:

Evaluation of successful achievement of the course objectives is based on a grading policy that is focused on learning. The focus is on achievement of the learning objectives. This is accomplished by allowing each student to submit each assignment and paper twice, once for initial review, and a resubmission for final review.

Instruction:

Each course meeting will include lecture on key points of the day's topic(s) and a period of class discussion. Many of the sessions will include time to debate issues and challenge assumptions raised by students, the instructor, and the text authors. Several sessions will include small group work (e.g., writing and critiquing test items, evaluating validity arguments). As the instructor, I assume the following responsibilities: to present material in a clear and contextualized format, to provide opportunity for students to pursue additional clarification in and out of class, to develop and employ fair and meaningful assessment activities, to use results of evaluation activities for instructional feedback, and to provide opportunities for recourse if students believe they have been unfairly evaluated.

Technology:

Technology is becoming increasingly important in education and we will pursue learning with the aid of technology in several ways. Students are asked to submit assignments electronically. Students are encouraged to investigate measurement-related web sites to support their reading and project work. Additional readings and resources are available at the class website. A class website has been developed that contains class resources, as well as links to additional resources, publicly available software, and some class notes. We will review at least two software packages during class demonstrations.

Diversity:

The College of Education and Human Development is committed to have every course contribute to our understanding of diversity, including but not limited to: age, creed, disability, ethnicity, gender, global perspectives, international background, language background, learning differences, marital status, multicultural perspectives, national origin, public assistance status, race, religion, sex, sexual orientation, and veteran status. Each of these characteristics plays a role in educational and psychological measurement. They are factors that contribute to individual differences -- they (may) affect the constructs we set out to measure and the way we interpret and report test results. These issues will be addressed throughout the course and will be used as topics of debate and considerations in cases of responsible test use and analysis of item and test score bias, particularly through Differential Item Functioning.

Late Work and Incompletes
Late work will be accepted, but please notify me so I can keep track of your work – no points will be deducted for late work. It is up to you to stay on track. An incomplete (I) will be assigned only if agreed to prior to the last week of class. If at the end of the semester course work is incomplete and no prior notification has been given, the grade based on points obtained at that time will be awarded. No options will be given to submit incomplete work after grades have been submitted.

Makeup Work for Legitimate Absences:
Students will not be penalized for absence during the semester. This is a more flexible policy than that generally given based on University policy. For information on the U's policy regarding absences, please see: http://policy.umn.edu/education/makeupwork

Returning Papers, Exams, and Projects
Given the size of the class and the extensiveness of student projects, I will try to return work within one week of the due date. If necessary, you may pick up work prior to the following class period if agreed upon. If, at the end of the semester, you would like to receive remaining work through U.S. mail, submit a self-addressed stamped envelope. Otherwise, you may pick up final projects once grades are submitted in the Psychological Foundations' office in 250 Education Sciences Building with a student ID. Papers will be available there until July 1, 2017. Uncollected papers will be destroyed.

Academic dishonesty: academic dishonesty in any portion of the academic work for a course shall be grounds for awarding a grade of F or N for the entire course.

University Grading Policy
https://policy.umn.edu/education/gradingtranscripts

A	4.000 - Represents achievement that is outstanding relative to the level necessary to meet course requirements
A-	3.667
B+	3.333
B	3.000 - Represents achievement that is significantly above the level necessary to meet course requirements
B-	2.667
C+	2.333
C	2.000 - Represents achievement that meets the course requirements in every respect
C-	1.667
D+	1.333
D	1.000 - Represents achievement that is worthy of credit even though it fails to meet fully the course requirements
S	Represents achievement that is satisfactory, which is equivalent to a C- or better.

I - There will be a symbol I (incomplete) awarded to indicate that the work of the course has not been completed. The I will be assigned at the discretion of the instructor when, due to extraordinary circumstances (as determined by the instructor), the student who has successfully completed a substantial portion of the course's work with a passing grade was prevented from completing the work of the course on time. The assignment of an I requires a written agreement between the instructor and student specifying the time and manner in which the student will complete the course requirements. In no event may any such written agreement allow a period of longer than one year to complete the course requirements.

How to Access Your Grades
Go to OneStop for Students (http://onestop.umn.edu/onestop/), click on Grades & Transcripts; on the right side under Quick Links, click on Grades/Unofficial transcript.

Workload Expectation (Policy: Expected Student Academic Work per Credit)
The Senate affirms the standard (first adopted by the University Senate on February 16, 1922, and reaffirmed 1993) that one semester credit is to represent, for the average University of Minnesota undergraduate student, three hours of academic work per week (including lectures, laboratories, recitations, discussion groups, field work, study, and so on), or approximately 45 hours of work over the course of an enrollment period. Expectations of faculty and students will be made clear. It is expected that the academic work required of graduate and professional students will exceed three hours per credit per week or 45 hours per semester.

Scholastic Dishonesty
You are expected to do your own academic work and cite sources as necessary. Failing to do so is scholastic dishonesty. Scholastic dishonesty means plagiarizing; cheating on assignments or examinations; engaging in unauthorized collaboration on academic work; taking, acquiring, or using test materials without faculty permission; submitting false or incomplete records of academic achievement; acting alone or in cooperation with another to falsify records or to obtain dishonestly grades, honors, awards, or professional endorsement; altering, forging, or misusing a University academic record; or fabricating or falsifying data, research procedures, or data analysis. (Student Conduct Code: http://regents.umn.edu/sites/regents.umn.edu/files/policies/Student_Conduct_Code.pdf) If it is determined that a student has cheated, he or she may be given an "F" or an "N" for the course, and may face additional sanctions from the University. For additional information, please see: http://policy.umn.edu/education/instructorresp.

The Office for Student Conduct and Academic Integrity has compiled a useful list of Frequently Asked Questions pertaining to scholastic dishonesty: http://www1.umn.edu/oscai/integrity/student/index.html. If you have additional questions, please clarify with your instructor for the course. Your instructor can respond to your specific questions regarding what would constitute scholastic dishonesty in the context of a particular class-e.g., whether collaboration on assignments is permitted, requirements and methods for citing sources, if electronic aids are permitted or prohibited during an exam.

University Policies
See http://onestop.umn.edu/onestop/faculty/Teaching/Policies.html for a list of policies related to teaching with links to those policies.
Also see http://policy.umn.edu/Policies/Education/Education/STUDENTRESP.html for University policies related to Teaching and Learning – Student Responsibilities.

Student Conduct Code
The University seeks an environment that promotes academic achievement and integrity, that is protective of free inquiry, and that serves the educational mission of the University. Similarly, the University seeks a community that is free from violence, threats, and intimidation; that is respectful of the rights, opportunities, and welfare of students, faculty, staff, and guests of the University; and that does not threaten the physical or mental health or safety of members of the University community. As a student at the University you are expected adhere to Board of Regents Policy: Student Conduct Code. To review the Student Conduct Code, please see: http://regents.umn.edu/sites/default/files/policies/Student_Conduct_Code.pdf.

Note that the conduct code specifically addresses disruptive classroom conduct, which means "engaging in behavior that substantially or repeatedly interrupts either the instructor's ability to teach or student learning. The classroom extends to any setting where a student is engaged in work toward academic credit or satisfaction of program-based requirements or related activities."

Use of Personal Electronic Devices in the Classroom
Using personal electronic devices in the classroom setting can hinder instruction and learning, not only for the student using the device but also for other students in the class. To this end, the University establishes the right of each faculty member to determine if and how personal electronic devices are allowed to be used in the classroom.
http://policy.umn.edu/Policies/Education/Education/STUDENTRESP.html.

Appropriate Student Use of Class Notes and Course Materials
Taking notes is a means of recording information but more importantly of personally absorbing and integrating the educational experience. However, broadly disseminating class notes beyond the classroom community or accepting compensation for taking and distributing classroom notes undermines instructor interests in their intellectual work product while not substantially furthering instructor and student interests in effective learning. Such actions violate shared norms and standards of the academic community.
http://policy.umn.edu/Policies/Education/Education/STUDENTRESP.html

Sexual Harassment
"Sexual harassment" means unwelcome sexual advances, requests for sexual favors, and/or other verbal or physical conduct of a sexual nature. Such conduct has the purpose or effect of unreasonably interfering with an individual's work or academic performance or creating an intimidating, hostile, or offensive working or academic environment in any University activity or program. Such behavior is not acceptable in the University setting. For additional information, please consult Board of Regents Policy:
http://regents.umn.edu/sites/regents.umn.edu/files/policies/SexHarassment.pdf

Equity, Diversity, Equal Opportunity, and Affirmative Action
The University provides equal access to and opportunity in its programs and facilities, without regard to race, color, creed, religion, national origin, gender, age, marital status, disability, public assistance status, veteran status, sexual orientation, gender identity, or gender expression. For more information, please consult Board of Regents Policy:
http://regents.umn.edu/sites/regents.umn.edu/files/policies/Equity_Diversity_EO_AA.pdf

Disability Accommodations

The University of Minnesota views disability as an important aspect of diversity, and is committed to providing equitable access to learning opportunities for all students. The Disability Resource Center (DRC) is the campus office that collaborates with students who have disabilities to provide and/or arrange reasonable accommodations.

- If you have, or think you have, a disability in any area such as, mental health, attention, learning, chronic health, sensory, or physical, please contact the DRC office on your campus (UM Twin Cities - 612.626.1333) to arrange a confidential discussion regarding equitable access and reasonable accommodations.
- Students with short-term disabilities, such as a broken arm, can often work with instructors to minimize classroom barriers. In situations where additional assistance is needed, students should contact the DRC as noted above.
- If you are registered with the DRC and have a disability accommodation letter dated for this semester or this year, please contact your instructor early in the semester to review how the accommodations will be applied in the course.
- If you are registered with the DRC and have questions or concerns about your accommodations please contact your (access consultant/disability specialist).

Additional information is available on the DRC website: https://diversity.umn.edu/disability/ or e-mail drc@umn.edu with questions.

Mental Health and Stress Management:

As a student you may experience a range of issues that can cause barriers to learning, such as strained relationships, increased anxiety, alcohol/drug problems, feeling down, difficulty concentrating and/or lack of motivation. These mental health concerns or stressful events may lead to diminished academic performance and may reduce your ability to participate in daily activities. University of Minnesota services are available to assist you. You can learn more via the Student Mental Health Website: http://www.mentalhealth.umn.edu.

Academic Freedom and Responsibility:

Academic freedom is a cornerstone of the University. Within the scope and content of the course as defined by the instructor, it includes the freedom to discuss relevant matters in the classroom and conduct relevant research. Along with this freedom comes responsibility. Students are encouraged to develop the capacity for critical judgment and to engage in a sustained and independent search for truth. Students are free to take reasoned exception to the views offered in any course of study and to reserve judgment about matters of opinion, but they are responsible for learning the content of any course of study for which they are enrolled.* When conducting research, pertinent institutional approvals must be obtained and the research must be consistent with University policies.

Reports of concerns about academic freedom are taken seriously, and there are individuals and offices available for help. Contact the instructor, the Department Chair, your adviser, the associate dean of the college, or the Vice Provost for Faculty and Academic Affairs in the Office of the Provost.

* Language adapted from the American Association of University Professors "Joint Statement on Rights and Freedoms of Students".

This publication/material is available in alternative formats upon request. Please contact the Educational Psychology Department, 250 Education Sciences Building, 612-624-6083 or edpsych@umn.edu.

College of Education & Human Development Mission Statement

The mission of the University of Minnesota College of Education and Human Development is to contribute to a just and sustainable future through engagement with the local and global communities to enhance human learning and development at all stages of the life span.

Department of Educational Psychology Mission Statement

Educational psychology involves the study of cognitive, emotional, and social learning processes that underlie education and human development across the lifespan. Research in educational psychology advances scientific knowledge of those processes and their application in diverse educational and community settings. The department provides training in the psychological foundations of education, research methods, and the practice and science of counseling psychology, school psychology, and special education. Faculty and students provide leadership and consultation to the state, the nation, and the international community in each area of educational psychology. The department's scholarship and teaching enhance professional practice in schools and universities, community mental health agencies, business and industrial organizations, early childhood programs, and government agencies.

Quantitative Methods in Education Mission Statement

To prepare students to become cutting-edge professionals in educational measurement, evaluation, statistics, and statistics education, through excellence in teaching, research, and service; and through investigating and developing research methodology in education.

Six Intellectual Principles of Ph.D./Ed.D./Master's Research Education
(Currently under review)

1. *Scholarly Formation*
2. *Communication*
3. *Leadership and Collaborative Skills*
4. *Global Context*
5. *Professional Responsibility*
6. *Personal and Professional Management Skills*