

EDP 381E: Advanced Item Response Theory

Fall 2017

Time:	Wed 1:00 – 3:45pm	Location:	SZB 432
Instructor:	Hyeon-Ah Kang	Office:	SZB 538G
Email:	hkang@austin.utexas.edu	Office hours:	Tue 3:30 – 5:00pm

| Course Description

The course will introduce advanced item response theory (IRT) models and their extensions. IRT is one of the most influential developments in the field of educational and psychological measurement. It provides a foundation for statistical analysis of items, implemented at various stages of testing practice. In this course we will conduct a survey of sophisticated IRT models that deal with complex response data sets. The subject matters include multidimensional IRT and testlet response theory models, cognitive diagnostic models, response time models, rater models, explanatory item response modeling, and related topics.

The course formats will be based on lectures, discussion, and computer lab work. Lectures are used to introduce key concepts of the models, including the mathematical formulation, assumption, parameter estimation, and model fit assessment. The computer lab work is designed to help students have hands-on experience in fitting the models using computer software. Discussions are interspersed with lectures and labs to facilitate students' understanding of the materials. The scope and depth of the course are targeted at doctoral students who want to do research in advanced psychometric methodologies or apply modern IRT models to empirical data or simulated testing settings.

| Pre-requisites

- EDP 380D Item Response Theory
- Background in probability, statistics, calculus, and matrix algebra
- Programming knowledge in R and writing skills in APA style

| Learning Goal

By the end of this course, you should be able to:

- Understand the statistical language and mathematical underpinning of the advanced IRT models.
- Use appropriate probabilistic models for complex response data and apply relevant statistical techniques to test hypotheses and draw inference about parameters.
- Demonstrate ability to program in computer software for IRT analysis.
- Interpret results from item analysis and evaluate the adequacy of the obtained solutions.
- Communicate peers and other professionals and write research papers on IRT effectively.

Materials

- Class materials, supplemental resources, announcements, and assignments will be posted on Canvas: <http://canvas.utexas.edu>. All assignments, including a final project, should be submitted to this website. No assignment will be accepted over email unless agreed in advance.
- We will use R (<https://www.r-project.org>) as a primary programming language. Relevant packages can be found at <https://cran.r-project.org/web/views/Psychometrics.html>.
- Main references for this course are:
 - van der Linden, W. J. (2016). *Handbook of Item Response Theory, Volume One: Models*. Chapman & Hall/CRC Statistics in the Social and Behavioral Sciences.
 - van der Linden, W. J. (2016). *Handbook of Item Response Theory, Volume Two: Statistical Tools*. Chapman & Hall/CRC Statistics in the Social and Behavioral Sciences.
 - Rao, C. R. & Sinharay, S. (2006). *Handbook of Statistics Volume 26*, 1–1170.
 - Boomsma, A., van Duijn, M., Snijders, T. (2001). *Essays on Item Response Theory*. Springer-Verlag: New York.
 - van der Linden, W. J. & Hambleton, R. (1997). *Handbook of Modern Item Response Theory*. Springer-Verlag: New York.

Course Outline

L1 Unidimensional IRT	Aug 30
Concepts, Assumptions, Dichotomous & polytomous response models	
L2 Parameter Estimation and Model Fitting	Sep 6
Maximum likelihood estimation, Bayesian estimation, Model fit assessment	
L3 Multidimensional IRT	Sep 13
Normal-ogive models, Logistic models, Linear logistic models, Multicomponent models	
L4 Cognitive Diagnostic Models	Sep 20
Latent class modeling, Conjunctive and disjunctive models, Loglinear models	
L5 Testlet Response Theory Models	Sep 27
Local item dependence, Testlet response models, Bifactor models	
L6 Response Time Models	Oct 4
Response time distributions, Proportional hazards models, Continuous response models	
L7 Rater Models	Oct 11
Facets model, Generalizability theory approach, Hierarchical rater model	
L8 Multilevel Response Models	Oct 18
Multilevel IRT models, Multiple-group models, Models for repeated measures	
L9 Generalized Linear Mixed Models	Oct 25
Generalized linear modeling, Mixed-coefficient multinomial logit model, Exploratory models	
L10 Nonmonotone Response Models	Nov 8
Hyperbolic cosine model, Generalized graded unfolding model	
L11 Nonparametric Models	Nov 15
Assumptions, Mokken scale analysis	

Assessment

A major component of this course involves developing a research project that uses the models and methods covered in class. You will each select a project at the beginning of the term and will work through fundamental questions to complete the research project by the end of the semester. Through this assignment, you will have an opportunity to apply your understanding of the IRT methodologies and practice technical skills learned in class.

There are three major options for your research project.

- Proposal of new method(s):
You could study and extend the current methodology by presenting original methods.
- Applications to:
 - (a) Empirical data: You could use the advanced IRT techniques to analyze existing data and discuss findings relevant to the data set.
 - (b) Particular test settings or psychometric analysis: You could apply the advanced IRT techniques to fictitious testing situations (e.g., CAT, MST, ATA) or psychometric analyses (e.g., item bias (DIF/IPD), linking/equating/scaling, item and person fit evaluation).
- Review of methods:
You could read articles pertaining to the theoretical IRT topics or real-world applications of interest.

Grading Policy

Final grades will be determined based on the extent to which you have successfully completed the task outlined below. For details, see page 4.

Research proposal (20%)
 Peer review (20%)
 Proposal presentation (15%)
 Research presentation (15%)
 Final paper (30%)

A tentative rubric for the assignment of final grades is listed below. The instructor reserves the right to modify this rubric.

		B ⁺ [87, 90)	C ⁺ [77, 80)	
A [94, 100]	B [84, 87)	C [74, 77)	D [65, 70)	
A ⁻ [90, 94)	B ⁻ [80, 84)	C ⁻ [70, 74)	F < 65	

Important Dates

Proposal Presentation Nov 1
 Writing Workshop Nov 29
 Research Presentation Dec 6
 Final Paper Submission Dec 13

| The Research Project

Research proposal (20%): Throughout the semester, I will post questions to prepare you for the research project. The assignments will be given bi-weekly and are meant for formative purposes—as you turn in your answers, you will receive feedback from me, TA, and one of your classmates. The feedback will include suggestions for improving your project and the written work. To receive the review, you need to submit your answers by **6:00 pm Tuesday**. Late assignments can be accepted with a penalty of 20% credit, but feedback will not be guaranteed.

Identify a research area	Sep 5
Present research questions	Sep 19
Literature review	Oct 3
Describe your modes of inquiry	Oct 17
Progress report	Nov 14

Peer review (20%): Once your classmates submit their work, you are required to review one of the fellow students' work (most likely the one submitted just before your submission). Provide feedback based on the questions below:

- (a) What is the best part of the paper?
- (b) Which area(s) needs the most improvement (e.g., the argument, the organization, sentence structure or word choice, evidence)?

All feedback must be submitted by **11:59 pm on the following Wednesday**. Late review will not be accepted.

Reviews	Sep 6, Sep 20, Oct 4, Oct 18
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Proposal presentation (15%): You will present a proposal for your independent project to the class in **Nov 1**. The presentation should cover: i) the motivation for the research, ii) the main research question(s), iii) relevant details about the existing methods, and iv) how the research will be carried out. Each student has 15 minutes for presentation and will need to prepare slides or handouts to accompany the presentation. Your presentation grade includes your participation in the discussion of other students' presentations.

Research presentation (15%): Research presentation comprises a 20-minute individual presentation to the class on **Dec 6**. Be sure to present i) your research questions, ii) the methods proposed or employed, iii) a summary of the results, and iv) implications of the findings. Please prepare slides and/or handouts to accompany your presentation. Through discussion, we will identify any important shortcomings or critiques of the research. Your presentation grade includes your participation in the discussion of other students' presentations.

Final paper (30%): Your final paper should provide a description of your research project carried out throughout the semester. The paper should include: i) research questions and objectives, ii) theoretical framework, iii) rationale for the proposed research, iv) methods, v) data sources, vi) results, vii) findings or substantiated conclusions, and viii) scholarly significance. It is expected that the paper will be well composed in the APA6 style and reasonably improved based on the feedback provided throughout the semester. The paper is due on **Dec 13**. The word limit for the paper is 6000, not including figures, table, and references.

| Class Expectations

- *Attendance:* You are responsible for being present in class and for all material covered during class meetings. If you miss a class, it is your responsibility to obtain and review both notes and announcements from your fellow classmates without regard to the reason for being missed. Frequent or unexcused absences and tardiness can adversely affect your grade.
- *Religious Holidays:* You must notify the instructor of a pending absence due to religious observance at least fourteen days in advance. If you must miss a class, a work assignment, or a presentation, you will be given an opportunity to complete the missed work within a reasonable time after the absence, provided that you have properly notified the instructor ahead.
- *Classroom Behavior:* Please refrain from using cell phones and laptops—the heavy use of electronic devices distracts not only yourself but also your peers and the instructor.

| Graduate Student Writing Center

The university has an outstanding support system in place to help graduate students with professional writing and presentation. Their services can be reviewed at <http://uwc.utexas.edu>.

| Academic Integrity

Students are expected to abide by the University's honor code and maintain absolute integrity in scholastic work. All assignments must be completed with the utmost honesty, which includes acknowledging the contributions of other sources to your scholastic efforts, avoiding plagiarism, and completing assignments independently unless expressly authorized otherwise. Assignments containing any plagiarized material will not be accepted.

| Student Accommodations

The University of Texas at Austin provides upon request appropriate accommodations for qualified students with disabilities. For more information, please contact the Office of the Dean of Students at 471-6259, 471-4671 TTY. If they certify your needs, I will work with you to make appropriate arrangements.