

## **RMS 4922: Item Response Theory**

### **Spring 2019 Syllabus**

**Instructor:** Denis Dumas (denis.dumas@du.edu)

**Office:** KRH 233; **Phone:** 303-871-4710

**Office hours:** Wednesdays 1-4pm

Make office hour appointments by going to: <https://denisdumas.youcanbook.me/>

Or Scan this QR Code:



This app will automatically send confirmation emails and put the appointment on my calendar.

Try and book at least 12 hours in advance so I know what appointments I need to plan for.

Appointments are typically 20 minutes

**Mailbox:** KRH 201A (or on office door)

**Class Meetings:**

Wednesdays 4:00-6:20pm

**Classroom:** Ruffatto Hall 305

**Graduate Teaching Assistant:**

Name: Jinjin Huang

Email: jinjin.huang@du.edu

Office Hours: Tuesdays 1-3pm (RMS Cubicles)

### **Prerequisites:**

Official Prerequisites: Graduate Standing, Psychometric theory (RMS 4921),

Preferred Prerequisites: Regression (RMS 4911), Factor Analysis (RMS 4924).

### **Purpose and Goals:**

Especially in the areas of educational and cognitive measurement, item response theory (IRT) is a critically important methodology for quantifying the latent attributes of students from observed test data. Essentially, IRT is a theoretical way to understand how observed behavior indicates underlying mental abilities of students or other test participants. In this lecture- and computer lab-based course, we will begin with an in-depth study of unidimensional IRT for both dichotomous and polytomously scored items. Then, we will build on those models by including a multi-dimensional latent structure on the abilities we are measuring. Finally, we will examine both uni- and multi-dimensional methods for assessing differential-item-functioning (DIF) between groups to determine whether observed variables indicate latent attributes in the same way across the groups (i.e., measurement invariance). We will utilize Stata and Mplus in our modeling, although you are more than welcome to bring in another program if you prefer.

### **Course Objectives:**

1. Students will understand the substantive and statistical origins of Item Response Theory (IRT) as a method.
2. Students will understand IRT-based ways to model item responses from both dichotomously and polytomously scored items.
4. Students will conduct and interpret a unidimensional IRT analysis on real data.
5. Students will differentiate between uses of unidimensional and multidimensional IRT (MIRT).
6. Students will learn computational code for conducting a MIRT analysis.
7. Students will conduct and interpret a MIRT analysis on real data.
8. Students will learn MIRT methods for determining the number of latent dimensions on a psychometric measure.
8. Students will understand the meaning and operationalization of differential-item-functioning (DIF).
9. Students will learn how to assess DIF across salient participant groups in unidimensional IRT and MIRT models

### **Materials**

#### **Texts**

##### Required Text:

1. Raykov, T. & Marcoulides, M. (2018) *A Course in Item Response Theory and Modeling with Stata*. Stata Press: College Station, TX.

##### Recommended Texts:

2. AERA, APA, & NCME, (2014). *Standards for Educational and Psychological Testing*. AERA press: Washington, DC.
3. Furr, R. M., & Bacharach, V. R. (2013). *Psychometrics: An Introduction*. Sage: Thousand Oaks, CA.

## Computer Programs

Officially, I am entirely program agnostic. If there is a particular program with which you are comfortable and to which you have access, great. However, I will always demonstrate all procedures we learn in whatever program that is available on campus that makes the analysis most simple. Some programs are just better for certain types of models. For this course, we will be focusing on *Stata* and *Mplus*. In addition, our textbook focuses its examples on Stata, but you can always import the datasets into another program if you wish. If you do not use Stata or Mplus, all lab assignments should be turned in APA style so we can interpret your output.

## Calculator

You may need a calculator that is capable of calculating square roots for the quizzes. Students are encouraged to bring calculators to class each day. *I will not provide calculators. No cell-phone calculators or computer calculators!*

## COURSE GRADES

Your attendance, quizzes, labs, and poster project will be combined according to the percentages shown. Final grades will then be assigned based on the scale below.

### Factors Effecting Course Grade

Attendance/Participation	15%
Quizzes (3)	15%
Lab Activities (3)	40%
Research Poster	30%

### Official DU description of grade categories:

Grade	Percentage	Description
A	93-100	Denotes work of <i>superior quality</i> , which may be demonstrated in terms of criticism, logical argument, interpretation of material, originality, and creativity.
A-	90-92	
B+	87-89	Denotes work of <i>predominantly good quality</i> , demonstrating a sound grasp of content, together with efficient organization, and the capacity to make some critical appraisal of the material.
B	83-86	
B-	80-82	Denotes work that is of <i>barely adequate quality</i> , with minimal achievement of the course objectives and understanding of the material.
C+	77-79	
C	73-76	Denotes work that is of weak quality, with <i>borderline achievement</i> of the course objectives and partial understanding of the material.
C-	70-72	Denotes work that is of low quality, and <i>minimal standing in terms of meeting University degree requirements</i> , with lowest level achievement of the course objectives and barely adequate understanding of the material.
D+	67-69	Denotes work that is unacceptable for meeting University degree requirements.
D	63-66	
D-	60-62	
F	0-59	

## INFORMATION ON ASSESSMENTS

**Attendance/participation (15%).** This class will feature a number of worked examples and in-class analyses. Some will be conducted by hand, with a calculator, or using another program. I think it is important for each student to be present in both body and mind for the class meetings, so attendance/participation is worth 15% of the grade.

**Quizzes (15%).** Quizzes in this course will be brief, multiple-choice, and take place in the very beginning of class. At only 15% of the final grade, the quizzes are designed to help you identify areas in which you need study, not to make/break anyone's grade. Quizzes are zeros if you miss them.

**Lab Activities (40%).** Lab activities are completed using provided datasets and statistical software in-class or in the week following the scheduled in-class lab time. Labs can be collaborative, and if you turn in your lab with a classmate, you both get the same grade. I see the labs as an opportunity to "get your hands dirty" doing a psychometric analysis, and they are the main way that you get to practice your analyses and interpretation in class. There are three of them over the quarter, each worth 13.33% of the grade.

**Research Poster (30%).** As a major graded project, and as a conceptual capstone to the RMS measurement track, you are required to conduct an independent research project in this course. This project can be conducted in a group, and if you turn in/present your poster with a classmate, you both get the same grade. To complete this project, you will need to identify or collect a dataset suitable for psychometric analysis and then conduct and present that analysis. You are required to perform at least a confirmatory factor analysis, unidimensional IRT model, or MIRT model, and you may also choose to include a DIF/invariance assessment, exploratory factor analysis, or classical test theory analysis depending on your research questions. You will turn in a PDF of your poster via canvas on or before the due date, and you will bring in a physical poster to present on the final day of class. Your poster and presentation will be graded on the following areas, which generally map to the parts of a presentable poster at a research conference, and in general, high marks on this assignment will indicate that your work would be of high-enough quality for professional presentation:

1. Scientific context / theoretical framing
2. Explanation of data source
3. Tasks / measures
4. Psychometric modeling methods
5. Discussion of results substantively

The following grading table will be used to assign grades to the research poster, although it should be noted that the specifics of what I'll be looking for will vary based on the type of measurement project you choose. If you're not sure, come in to office hours and talk through your project with me.

Score	Description
A	Nearing publishable quality: Poster closely reflects the quality of work required for professional presentation in the social sciences.
B	Good quality: Poster is clearly presented and thoughtfully written, but falls short of publication standard.
C	Middling quality: Poster “checks the boxes” but is otherwise not well-constructed or thoughtfully presented.
D	Poor quality: Poster is missing aspects of what would be expected at a professional conference. What is available is not clear or meaningful.
F	Very poor quality or missing: Poster is very poor or not turned in.

**Note:** Assignments are not accepted late. Grades will not be changed unless a computational error has been made. No grades will be dropped. There will be no extra credit. Grades of “Incomplete” will not be given unless the student can demonstrate that near catastrophic events have led to a cause of extreme hardship

**RMS 4922 CLASS SCHEDULE: SPRING 2019**

<b>Class Number</b>	<b>Class Day</b>	<b>Topic</b>	<b>R&amp;M Reading</b>	<b>Supplemental Reading</b>	<b>Assignment Due</b>
1	April 3rd	Introductory concepts	Preface – Ch. 4		
2	April 10th	Unidimensional-Dichotomous IRT	Ch. 5 - 9		
3	April 17th	Unidimensional-Polytomous IRT	Ch. 11		Quiz 1
4	April 24th	Unidimensional IRT Lab (Lab 1)			
5	May 1st	Multidimensional IRT	Ch. 12	Liu, Magnus, O'Connor & Thissen, 2018	Lab 1;
6	May 8th	MIRT Lab (Lab 2)			Quiz 2
7	May 15th	Differential Item Functioning	Ch. 10	Stark, Chernyshenko, & Fritz, 2006	Lab 2
8	May 22nd	DIF Lab (Lab 3)			
9	May 29th	Poster Project Collaborative Work-day			Lab 3 Quiz 3
10	June 5th	Research Poster Day			Final Poster Presentations