EDPY 507: Measurement Theory I

Term: Winter 2025

Meeting day/time: Wednesday / 9:00 AM - 11:50 PM

Room: ECHA 1-451

Instructor: Dr. Okan Bulut

Contact Information:

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Office Hour: Please email to set up an in-person or virtual meeting.

Prerequisites: An introductory statistics course (e.g., EDPY 500 or equivalent).

General Description

EDPY 507 is designed for graduate students, researchers, and practitioners who will develop, evaluate, and select measurement instruments in their professional roles. The course provides an introduction to the measurement concepts and models related to both classical test theory (CTT) and item response theory (IRT). The foundational concepts necessary to understand both theoretical positions will be presented first. Then, we will apply these two test theories to solve important contemporary problems in educational and psychological measurement.

After completing EDPY 507, students should be able to:

1. read, interpret, and critically evaluate measurement methodology and reported outcomes as found in educational or psychological literature,

2. understand the important procedures required to develop and analyze test items,

3. calculate and interpret reliability and validity-related statistics, and

4. conduct a complete item/test analysis from CTT and IRT perspectives using a psychometric software program.

Please note that the concepts, principles, and content presented in this course are intended for a broad audience of administrators, policy makers, decision makers, researchers, and practitioners across a variety of fields and disciplines. This course is also the starting point. EDPY 607 – Measurement Theory II will focus on more sophisticated test theories and applications of these theories using the same logical structure as EDPY 507. In order to have a comprehensive and complete view of educational and psychological measurement, we recommend you to consider taking both Measurement Theory I and Measurement Theory II.

Course Format

During Winter 2025, we will follow an in-person delivery format in EDPY 507 - Measurement Theory I. For each lecture, we will meet at ECHA 1-451 for face-to-face lectures between 9 am and 11:50 am on Wednesdays. For some lectures, we may use asynchronous learning (i.e., pre-recorded lectures), if needed (please see the course schedule on the last page of this document for further details).

Lecture Notes & Readings

All of the lecture notes will be available on eClass. The lectures will focus on "basic" concepts and principles in educational measurement. In addition to the lectures, I will also share recommended readings related to the concepts and principles that we will discuss during each lecture. I suggest that you focus on the lecture notes first, but also complete the recommended readings before each lecture as your time permits. In addition, I will share software-related materials for conducting psychometric analysis via https://okanbulut.github.io/edpy507/. Please see the "**Software**" section for further details.

Required Textbooks

In EDPY 507, we will use the following textbooks that not only cover important topics in measurement but also demonstrate their applications:

Finch, W. H., & French, B. F. (2018). *Educational and psychological measurement* (1st ed.). New York, NY: Routledge.

Desjardins, C. D., & Bulut, O. (2018). *Handbook of educational measurement and psychometrics using R*. Boca Raton, FL: CRC Press.

Note: To read the textbooks online and download the digital versions through the U of A Libraries, please click on the blue-coloured hyperlinks above. After entering your CCID and password, the U of A Libraries will give you access to the textbooks.

Optional Textbooks

For students who want to learn more about applied measurement and psychometrics, I also recommend the following textbook:

DeVellis, R. F. (2017). *Scale development: Theory and applications* (4th ed.). Los Angeles, CA: SAGE Publications, Inc.

Software:

This semester, we will use the following software programs for conducting psychometric analysis:

- R (https://cran.r-project.org/)

- RStudio Desktop (https://posit.co/download/rstudio-desktop/#download)

Note: You should download these program before attending the first class. If you have any difficulties with downloading or installing R and RStudio, please contact me immediately.

Why R?

There are many reasons why R is the ideal software program for this course. Here are some of those reasons:

- R is free, open-source, and cross-platform (e.g., available on Windows, Mac OS, and Linux). So, you can download and use it anytime with any type of computer (except for iPads or similar tablets).

- The built-in functions in R help us organize and manipulate data, run various statistical analyses, and create high-quality data visualizations.

- R is being actively developed and is growing exponentially, with a very attentive R core team and developers who submit packages to the Comprehensive R Archive Network (CRAN) and regularly update their algorithms in R, fix bugs, and add new enhancements.

- There are many user-created R packages that allow researchers to conduct a variety of psychometric analysis efficiently. In fact, as a passionate R user, I also created a psychometric package (called eirm) and made it available to other researchers around the world through CRAN. We will use some of these packages in EDPY 507.

- R also has a component called Shiny that allows users to build an interactive version of the functions available in R. With Shiny applications, R turns into a point-and-click type of program. In EDPY 507, I will introduce some of those Shiny apps that facilitate conducting psychometric analysis in R.

- Although R is particularly useful for statistical computing and data visualization, it can also be used in a myriad of ways (e.g., data science and web programming).

Please note that learning R from scratch can be slow and cumbersome for those of you who have no programming experience or are only familiar working with point-and-click statistical software programs (e.g., SPSS). To get you prepared for learning R, I recommend the following resources:

- Chapter 1 in Desjardins and Bulut (2018): This chapter will help you learn about the basics of the R programming language (see the link to download this book under "Required Textbooks").

- Getting Started with Data in R: This chapter in ModernDive will give you similar information on how to use R.

- Statistical Analysis and Visualizations Using R: Check out the first three chapters in the digital book that I created for my R training course at the Technology Training Centre.

- An Introduction to R: This is a free, online course with a nice e-book (https://intro2r.com/) designed by Professor Alex Douglas for learners with no previous experience or knowledge of using either R or RStudio. You can check out How-to and Lectures videos under the "Learn R" tab.

Class Engagement & Study Groups

EDPY 507 can be a difficult course because graduate-level measurement and statistics tends to be challenging, especially for those who do not have a quantitative background. In addition, we will be covering a lot of materials during this semester and some of the topics will be very technical. Thus, it is very important to ask your questions as soon as you have problems understanding the information I am presenting. When questions arise, please feel free to ask me during the lecture, or email me your questions after class, or email me to set up a video call. Lastly, I strongly recommend you to consider forming your own study groups. Sharing questions and hearing others describe concepts taught in the course will help you better learn the materials we will cover in EDPY 507. Please remember that the best way to understand any subject area is to teach it.

Evaluation

There will be two quizzes, a final exam, and two hands-on assignments in EDPY 507. The quizzes are scheduled throughout the course (see the tentative schedule on the last page). The focus of each quiz is the concepts and theories taught before the quiz. The final exam will be held on the last day of the term. The final exam will be cumulative and focus on applied measurement concepts, such as the use of item development approaches, differential item functioning analyses, and modern test administration methods. Both quizzes and the final exam must be completed **individually** on eClass. That is, each student must respond to the questions without any assistance from anyone, including classmates, friends, the Internet, or generative AI tools such as ChatGPT. Students are only allowed to use their textbook, lecture notes, and other course materials. The hands-on assignments require students to conduct psychometric analysis of real (or simulated) data with R and RStudio, interpret the output, and answer a set of questions. The assignments can be completed either individually or in a group (up to 3 students per group). Further instructions on each assignment will be available on eClass.

Grading

The final grade of EDPY 507 will be determined based on a weighted combination of grades from a set of evaluation components. The following summarizes the evaluation components and their individual weights in the final grade.

- Quiz 1: Classical Test Theory (25%)
- Quiz 2: Item Response Theory (25%)
- Final Exam (30%)
- Assignment I (10%)
- Assignment II (10%)

Submission of Assignments

All written assignments must be submitted as a Word document via eClass on the due date, unless otherwise specified. Assignments sent via email or submitted in a different format (e.g., PDF or Google Docs) will **not** be accepted. For homework assignments completed as a group, one submission per group is sufficient (i.e., one of the group members will submit the assignment on

behalf of their group). Marks for late assignments will be reduced by 20% per day and will **not** be accepted if more than **three** days late.

Statement of Expectation for AI Use

In this course, our primary focus is to cultivate an equitable, inclusive, and accessible learning community that emphasizes individual critical thinking and problem-solving skills. To ensure a fair and consistent learning experience for all students, the use of generative AI tools, such as ChatGPT or Dall-E, is strictly prohibited for all academic (written/coding/creative/etc.) work, assignments, and assessments in this course. Each student is expected to complete all tasks **without** substantive assistance from others, including generative AI tools.

IMPORTANT: Please note that any use of generative AI tool in your academic work may result in academic penalties and be considered an act of cheating and a violation as outlined in the relevant sections of the University of Alberta's Code of Student Behaviour.

Grading Policy

Information about the U of A grading system can be found at the University of Alberta Policies and Principles Online (UAPPOL) website at `https://policiesonline.ualberta.ca`. According to the University of Alberta Grading Policy, "Grades reflect judgments of student achievement made by instructors and must correspond to the associated descriptor. These judgments are based on a combination of absolute achievement and relative performance in a class." In this course, your work will be evaluated using the general grading descriptors established by the University, as well as the more detailed assessment criteria provided for specific assignments. Your grade on each assignment will be in one of three formats: a descriptor (excellent, good, satisfactory, etc.), a letter (A, B, C, etc.), or a number. When necessary, descriptor and letter grades will be converted into numerical equivalents in order to weight them properly and average them into a final course grade. Conversions between descriptors, letters, and numbers will be made in accordance with the Universitys grading policy and the table provided below. Your final course grade will be reported as letter grade. It will not be official until it has been approved by the Graduate Coordinator and posted on Bear Tracks.

In EDPY 507, after all the assessments and assignments are completed, students' raw scores (i.e., percentages) will be weighted (please see the weights shown above), summed, and then students will be ranked by their total score. Then, the course instructor (Dr. Okan Bulut) will look for meaningful cut points that differentiate Excellent (A) from Good (B) from Satisfactory (C+) achievement and assign the final letter grades accordingly. Please note that the conversion from percentages to letter grades is at **the full discretion** of the course instructor and is **NOT** determined ahead of time.

Grading - Graduate Courses		
Descriptor	Letter Grade	Point Value
Excellent	A+	4.0
	A	4.0
	A-	3.7
Good	B+	3.3
	B	3.0
Satisfactory	B-	2.7
	C+	2.3
Failure	C	2.0
	C-	1.7
	D+	1.3
	D	1.0
	F	0.0

Important Dates

- January 6, 2025: First day of classes in Winter 2025
- January 8, 2025: First class of EDPY 507
- February 19, 2025: No class due to Reading Week
- April 9, 2025: Final exam & Last day of classes in Winter 2025

You can also consult the University Calendar for other important dates.

Course Outline Policy

Policy about course outlines can be found in Academic Regulations, Evaluation Procedures and Grading System (2.) of the University Calendar.

Course Outline Retention Statement

Please retain this document for your records, as it may be required by licensing or accreditation bodies. The Faculty of Education does not guarantee course outlines will be retained indefinitely.

Code of Student Behaviour

The University of Alberta is committed to the highest standards of academic integrity and honesty. Students are expected to be familiar with these standards regarding academic honesty and to uphold the policies of the University in this respect. Students are particularly urged to familiarize themselves with the provisions of the Code of Student Behaviour (online at https://www.ualberta.ca/en/governance/resources/policies-standards-and-codes-of-conduct/index.html) and avoid any behaviour which could potentially result in suspicions of cheating, plagiarism, misrepresentation of facts and/or participation in an offence. Academic dishonesty is a serious offence and can result in suspension or expulsion from the University.

Equity Statement and Inclusive Language Policy

The Faculty of Education is committed to providing an environment of equality and respect for all people within the university community, and to educating faculty, staff and students in developing teaching and learning contexts that are welcoming to all. In seeking to achieve a climate of respect and dignity, all staff and students must use inclusive language to create a classroom in which an individuals experience and views are treated with equal respect and value in relation to his/her gender, racial background, sexual orientation, and ethnic background. We are encouraged to use gender-neutral or gender-inclusive language and become more sensitive to the impact of devaluing language in order to create a thoughtful and respectful community.

Personal or Academic Difficulties

Support is available within the University for students experiencing academic or personal difficulties. A list of resources can be found at the following link: https://www.ualberta.ca/current-students/index.html

Student Accessibility Services

Students who require accommodations in this course due to a disability affecting mobility, vision, hearing, learning, or mental and physical health are advised to discuss their needs with the Academic Success Centre, 1-80 Students' Union Building (SUB), 780-492-3381, e-mail: arrec@ualberta.ca. Communicate with your instructor promptly if you need accommodations in terms of due dates, quiz times, or accessibility concerns. Where appropriate, try to take advantage of any online sessions offered by the Academic Success Centre.

Recording of Lectures

Audio or video recording, digital or otherwise, of lectures, labs, seminars or any other teaching environment by students is allowed only with the prior written consent of the instructor or as a part of an approved accommodation plan. Student or instructor content, digital or otherwise, created and/or used within the context of the course is to be used solely for personal study, and is not to be used or distributed for any other purpose without prior written consent from the content author(s).

Cell Phones

Cell phones are to be turned off when in class. Cell phones are not to be brought into exams.

Tentative List of Topics

A tentative list of topics is presented below. The list may be amended as the semester progresses given different problems, concerns, and interests.

EDPY 507 – Measurement Theory I (Winter 2025)		
Day	**Topic**	**Quiz/Exam/Assignment**
Wednesday, Jan 8	Introduction to Measurement Theory	
Wednesday, Jan 15	Classical Test Theory (CTT)	
Wednesday, Jan 22	Scaling Using CTT; Item Analysis	
Wednesday, Jan 29	NO LECTURE	CTT Quiz (25%)
Wednesday, Feb 5	Item Response Theory (IRT)	
Wednesday, Feb 12	Scaling Using IRT; Item Analysis - Part I	
Wednesday, Feb 19	NO CLASS (Reading Week)	
Wednesday, Feb 26	Scaling Using IRT; Item Analysis - Part II	
Wednesday, Mar 5	Item and Test Development[†]	Assignment I Due (10%)
Wednesday, Mar 12	NO LECTURE	IRT Quiz (25%)
Wednesday, Mar 19	Test Fairness, DIF, & Bias	
Wednesday, Mar 26	Modern Test Administration	
Wednesday, April 2	Standard Setting	Assignment II Due (10%)
Wednesday, April 9	NO LECTURE	Final Exam (30%)[§]

[†] Instead of attending an in-person lecture, you will watch pre-recorded lecture videos on item and test development during this week. The links to these videos will be available on eClass.

[§] Students will have 3 hours 30 minutes to complete and submit the final exam on eClass **anytime between 9:00 AM on and 23:59 PM on April 9, 2025**.