UNIVERSITY OF WISCONSIN - MILWAUKEE
HELEN BADER SCHOOL OF SOCIAL WELFARE

SocWrk 963
Measurement Methods and Related Multivariate Statistics

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Office Hours: TBA
Time and location: TBA

Course Description

This course will cover essential concepts from Classical True Score (CTT) and Modern (IRT) Test Theories, their applications, and several multivariate statistical techniques used in the construction or evaluation of test items, including exploratory and confirmatory factor analysis and principal components analysis. The class is not intended to provide the student with an in-depth knowledge of either test theory but will seek to develop an understanding of key concepts and fundamental skills necessary to evaluate available instruments and to types of tests commonly used in the social science.

Prerequisites

Doctoral-student status in social work and completion of SocWrk 961 and 962, or written consent of the instructor. Students who lack the two prerequisite courses are expected to have taken a graduate-level course in multiple regression analysis that covered OLS and logistic regression and to be familiar with analysis of variance and matrix algebra. Additionally, students should be comfortable with the use of SAS, SPSS, Stata, Systat or a similar statistical package.

Course Objectives

On completion of this course, the students will be able to:

- demonstrate a working understanding of key concepts in CTT and IRT.
- apply procedures for the development of tests for social science settings, including those associated with item writing, item analysis, and detecting test and item bias.
- understand the different procedures for scaling tests in the CTT framework and item calibration in IRT.
- understand and apply concepts of validity and reliability in the CTT and IRT frameworks including methods for estimating interrater reliability.
- describe and apply procedures used to determine the reliability and validity of criterion-referenced tests
- run and interpret the output from multivariate procedures used in test development (e.g., principal components and factor analysis).

Required Texts / Readings

- Bond, T. G. & Fox, C. M. (2007). *Applying the Rasch model: Fundamental measurement in the human sciences, 2nd ed.* Mahwah, NJ: Lawrence Erlbaum.

- Brown, T. A. (2006). *Confirmatory factor analysis for applied research*. New York: Guilford.

- Crocker, L., & Algina, J. (2006). Introduction to classical and modern test theory. Pacific Grove, CA: Wadsworth.

Recommended Supplementary Texts

- Anastasi, A. & Urbina, S. (1997). *Psychological testing (7th Edition).* Upper Saddle River, NJ. Prentice Hall.

- Cudeck, R & MacCallum, R. C (Eds.) (2007). *Factor analysis at 100: Historical developments and future directions*. Mahwah, NJ: Lawrence Erlbaum.

- Devellis, R. F. (2003). *Scale development: Theory and applications (2nd ed.).* Thousand Oaks, CA: Sage Publications.

- Dunteman, G. H. (1989). *Principal components analysis*. Thousand Oaks, CA: Sage Publications.

- Brennan, R. L (2006). *Educational measurement (4th ed.).* Westport, CT: Praeger Publishers.

- Embretson, S. E., & Reise, S. P. (2000). *Item response theory for psychologists*. Mahwah, NJ: Lawrence Erlbaum.

- Gorsuch, R. L. (1983). *Factor analysis (2nd ed.).* Hilldale, NJ: Lawrence Erlbaum.

- Kelloway, E. K. (1998). *Using LISREL for structural equation modeling: A researcher's guide*. Thousand Oaks, CA: Sage Publications.
- Kim, J. & Mueller, C. W. (1978). *Introduction to factor analysis: What it is and how to do it.* Beverly Hills, CA: Sage Publications.

- Kruscal, J. B. & Wish, M. (1978). *Multidimensional scaling*. Beverly Hills, CA: Sage Publications.

- Long, J. S. (1983). *Confirmatory factor analysis: A preface to LISREL*. Beverly Hills, CA: Sage Publications.

- McDonald, R. P. (1999). *Test theory: A unified treatment*. Mahwah, NJ: Lawrence Erlbaum.

- Osterlind, S. J. (1997). *Constructing test items: Multiple-choice, constructed-response, performance and other formats (2nd ed).* Norwell, MA: Kluwer Academic Publishers.

- Rogers, H. J., Swaminathan, H. & Hambleton, R. K. (1991). *Fundamentals of item response theory*. Beverly Hills, CA: Sage Publications, Inc

- Schiffman, S. S., Reynolds, M. L., Young, F. W. (1981). *Introduction to multidimensional scaling: Theory, methods and applications*. New York: Academic Press.

- Schumacker, R. E., & Lomax, R. G. (2004). *A beginner's guide to structural equation modeling (2nd ed.).* Mahwah, NJ: Lawrence Erlbaum.

- Shrock, S. A., & Coscarelli, W. C. (2007). *Criterion-referenced test development: Technical and legal guidelines for corporate development (3rd ed.).* San Francisco, CA: John Wiley & Sons.

- Spector, P. E. (1991). *Summated rating scale construction: An introduction*. Beverly Hills, CA: Sage Publications.

- Stevens, J. P. (2001). *Applied multivariate statistics for the social sciences*. Mahwah, NJ: Lawrence Erlbaum Associates.

- Wilson, M. (2005). *Constructing measures: An item response modeling approach*. Mahwah, NJ: Lawrence Erlbaum Associates.

Lecture Notes

Extensive lecture notes on all topics will be made available on the D2L site prior to the class in which they will be covered. Students have the option of printing them out to facilitate note taking during lectures.

Course Policies

Campus policy information regarding participation by students with disabilities, accommodations for religious observances, academic conduct/misconduct, incomplete grading policies, complaint procedures, grade appeal procedures, sexual harassment and safety policies, final exam date requirements, and other standing policies/procedures is available on-line at: http:www.uwm.edu/Dept/SecU/SyllabusLinks.pdf.

Academic Misconduct: Academic misconduct is an act in which a student seeks to claim credit for the work or efforts of another without authorization or citation, uses unauthorized materials or fabricated data in any academic exercise, forges or falsifies academic documents or records, intentionally impedes or damages the academic work of others, engages in conduct aimed at making false representation of a student's academic performance, or assists other students in any of these acts. Prohibited conduct includes cheating on an examination; collaborating with others in work to be presented, contrary to the stated rules of the course;

submitting a paper or assignment as one's own work when a part or all of the paper or assignment is the work of another; submitting a paper or assignment that contains ideas or research of others without appropriately identifying the sources of those ideas; stealing examinations or course materials; submitting, if contrary to the rules of a course, work previously presented in another course; tampering with the laboratory experiment or computer program of another student; knowingly and intentionally assisting another student in any of the above, including assistance in an arrangement whereby any work, classroom performance, examination or other activity is submitted or performed by a person other than the student under whose name the work is submitted or performed.

Students' work must be in their own words except where appropriately cited. Excerpts from other authors may be used judiciously, but direct quotes involving even a few words must include the source, date, and page number(s) and must be indented or enclosed in quotations. Failure to comply with these requirements constitutes plagiarism and is grounds for a failing grade.

Late assignments and make-up policy: Students are expected to be present for examinations and *to turn in assignments on or before the due date* unless they contact the instructor in advance of the exam or due date. If an extension is given for a particular assignment, the grade may be reduced at the discretion of the instructor. Alternatives such as make-up exams or substitute assignments may then be made available at the instructor's discretion, but these will only be offered as a result of circumstances beyond the student's control. Failure to comply with the above requirements will result in a grade of zero for the relevant assignment.

Attendance and class participation: Because the material will be covered at a rapid pace, attendance is mandatory for all lectures and labs unless prior arrangements have been made with the instructor. Students with unexcused absences will receive a one-third reduction in their final grade for each unexcused absence (e.g., a final grade of A will be reduced to an A- following one absence).

Participation by Students with Disabilities: If you need special accommodations in order to meet any of the requirements of this course, please contact me and the Student Accessibility Center as soon as possible to make the necessary arrangements.

Accommodation for Religious Observances: Students will be allowed to complete examinations or other requirements in advance of a religious observance.

Determination of Student Grade

Letter grades will not be assigned on individual assignments or exams. Rather, each assignment and exam will be allotted a specific number of points. Points earned will be summed into a final point total and letter grades assigned based on these final point totals by the percents listed below.

94 – 100% = A	80 – 82% = B-	67 – 69% = D+
90 – 93% = A-	77 – 79% = C+	63 – 66% = D
87 – 89% = B+	73 – 76% = C	60 – 62% = D-
83 – 86% = B	70 – 72% = C-	0 – 59% = F

Your grade will be determined in the following way:

1. Test construction project 25%
2. Computing assignments 30%
3. Midterm Exam 20%
4. Final Exam 20%
5. Final presentation 5%

Test construction project: Students will develop a measure for a construct of interest that uses a self-report response format (other options will be allowed depending on the interest of the student). Students will write items, collect data, perform item, factor, reliability, validity and other analyses as necessary and write a summary of the results. The final report will be in the form of a technical report to be turned in for grading. The report should include a brief literature review focused on the construct measured, summary of the steps taken to construct the measure, appendices of output for all analyses, written summary and interpretation of the results, and suggestions for future modifications of the measure. Additional guidelines will be given in class early in the semester.

Computing assignments: Approximately 10 homework assignments will be given over the course of the semester focusing on the application of the concepts learned in class to the computer analysis of test data. Students are required to have a familiarity with SAS, SPSS, Stata, Systat or a similar package and will be required to learn new software applications such as Winsteps and LISREL in order to complete the homework assigned. These assignments will include a computing component in which analyses must be run and a written component involving summarization of the results.

Midterm and Final Exam: The exams will assess students' understanding and ability to apply the concepts learned in the course. The exams will be take-home and students will be allowed 1 week in which to complete them.

Presentation on the results of the test construction effort: Students will be required to give a presentation (approx. 20 min. in length) in class on the results of their test construction efforts at the end of the semester.

The topics listed in the table will be covered in the order listed.

Class Schedule and Reading Assignments

Topic	*Reading Assignment*
Introduction to measurement theory	Ch 1 Crocker & Algina Ch 1&2 Bond & Fox; TBA - readings
Classical true-score-based methods	
Statistical concepts for test theory	Ch 2 Crocker & Algina
Test scores as composite variables	Ch 5 Crocker & Algina
Reliability	Ch 6, 7, & 9 Crocker & Algina
Validity	Ch 10 Crocker & Algina
Principal components analysis, exploratory and confirmatory factor analysis	
Overview of PCA and the common factor model	Ch 1& 2 Brown
Introduction to LISREL	TBA – Handouts
Exploratory and confirmatory factor Analysis	Ch 3, 4, 5, 7 & 8 Brown; TBA – readings
Classical true-score-based methods (cont.)	
Overview of classical scaling methods	Ch 3 Crocker & Algina
Steps in test construction	Ch 4 Crocker & Algina
Item analysis	Ch 14 Crocker & Algina
Midterm Exam	
Rasch/IRT	
Overview of IRT	Ch 15 Crocker & Algina; TBA - readings
Rasch model basics	Ch 3 & 4 Bond & Fox
Introduction to Winsteps	Handout
Rating scale model	Ch 6, Appendix A, Bond & Fox
Partial credit model	Ch 7 Bond & Fox
Dichotomous analysis of checklists	Ch 10 Bond & Fox
Rating scale design	Ch 11 Bond & Fox
Model fit	Ch 12 Bond & Fox
Other IRT models	

1p, 2p, 3p	Readings available on D2L
Interrater reliability	
Generalizability Theory	Ch 8 Crocker & Algina
Many Faceted Rasch Model	Ch 8 Bond & Fox, TBA-handouts
Test Bias	
Bias in selection	Ch 12 Crocker & Algina
Detecting Item Bias	Ch 16 Crocker & Algina
DIF and IRT	Readings TBA
Final Exam	