HRM 727: Theory & Practice of Measurement

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Office: McMaster Innovation Park, Suite 201A
Fridays: 9am-12pm
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Course overview:
This course introduces students to important theoretical concepts and practical methods in the measurement of subjective states including attitudes, feelings, perceptions, function, beliefs or aptitude. Topics are based on areas of importance in the design, development and validation of a measure and will include principles from both educational and psychological measurement. Students will be introduced to the statistical underpinnings of scale measurement and applications of both traditional and modern measurement approaches. The primary concepts explored in the measurement of latent traits are reliability and validity as they apply to instrument design and evaluation. Examples will be drawn from the fields of health, psychology and educational assessment.

Course objectives:
1) To understand how to measure subjective states using measurement theory and related procedures.
2) Define different types of validity and reliability and understand different approaches to their evaluation.
3) Be able to critically evaluate a measure, interpreting reports of psychometric properties.
4) Gain practical experience in designing a new measurement scale and developing procedures to evaluate its measurement properties.
6) Conduct statistical analyses including descriptive statistics, correlations, factor analysis, and ANOVA.

Course description:
Course materials will be taught using a combination of assigned readings, structured presentations, worked examples, student-led presentations, discussions and assessments. Class lectures will cover selected topics that are generally applicable to measurement theory and practice. They will also include practical, worked examples of measurement development and evaluation. Student-led presentations, discussions and assignments will require an understanding of content covered in the readings that is not always covered in class. Students are expected to do this learning independently. Students should be familiar with basic statistical procedures in a statistical software of their choice. They will be provided with opportunities to develop their skills through practice problems using existing data but must also use acquired knowledge and skills to create a new measurement instrument for their final assignment. Students must seek instructor approval for final assignment topics. Quizzes will take place during class time. Assignments and practice problems are considered homework, outside of class time. Additionally, office hours may be scheduled to review concepts and application. Avenue to Learn will be used as the web platform to support all course-related communication.

Statistics knowledge prerequisites: Requires an understanding of core concepts in descriptive and inferential statistics and ANOVA. Please review the following online tutorials if you need a refresher:
Descriptive statistics: https://www.youtube.com/watch?v=AUHwZ3m6HZ4
Inferential descriptives: https://www.youtube.com/watch?v=jDRawkgsoUA
ANOVA: https://www.youtube.com/watch?v=TKTWIyC3LOQ

Course format:
Lecture time will be structured as follows:
Part 1: Structured lecture followed by brief discussion session
Part 2: Workshop session providing worked example of applied concept or statistical analysis procedure
Part 3: Student presentations and/or in-class discussion

The order and length of the lecture and each of the parts will vary from week to week. When scheduled, quizzes will take place at the start of class.

Evaluation:
There are 3 components for assessment of learning:

(1) Participation (20%)
This will be assessed in the following two ways:

- Practice Problems (5%) All students will be assigned practice problems to conduct various analyses (descriptive statistics, internal consistency reliability, factor analysis, item response theory, generalizability study). Proof of completion of the practice problems will constitute 5% of the participation grade. These may be completed individually or in groups, however each student must submit their own proof of completion. Practice problems must be handed in during class.
- In-class presentations & discussion (15%): Students will be assigned to groups and will lead an in-class presentation on an existing measurement tool. Students will also be asked to peer-evaluate other group presentations. Marking rubrics will be provided. Some weeks will include an in-class discussion that students will be expected to participate in.

In-class presentation guidelines: This component of the course challenges students to work through the flowchart (Figure 1.1) from the HMS textbook. Students present their findings to the class and lead a discussion on issues and challenges identified along the way. An example will be provided. Working in a group, select a subjective state to measure - emotions, satisfaction, patient safety, clinical competence, reflection skills, quality of evidence in guidelines, comfort with uncertainty. Then select a population you are interested in. Develop a short (5 sentence max) study goal that describes why you are interested in measuring that subjective state in that population. Using only the last 5 years of literature, determine answers to the questions posed by the flowchart. In particular:
1. Determine if there is a need for a new scale or a validation study of an old scale
2. Determine if the existing evidence establishes validity and/or reliability for your population or goal
3. Conduct a critical evaluation of the prior uses of existing scales or current lack of measurement scale. What are the implications of this not being measured before? What are the implications of existing data?

Note that a 5-year review of the literature may only reveal 1 or 2 articles or it may reveal 50. It is still possible to summarize the evidence related to the measurement properties of the selected latent trait.

The grade will be assigned individually but will incorporate class feedback on the group performance and participation in peer evaluation of other group presentations. Groups will be given 10-15 minutes per presentation and discussion.

(2) Quizzes (30%)
Short quizzes (multiple choice and short answer) will be given throughout the course and will cover content from the *key readings, lectures*, and *discussions*. Each quiz is worth 10% of the final grade and will be completed in class.

- Quiz 1 will cover content from Week 1, 2 and 3 and will take place on **January 31, 2020**
- Quiz 2 will cover content from Week 4, 5 and 6 and will take place on **February 28, 2020**
- Quiz 3 will cover content from Week 7, 8 and 9 and will take place on **March 13, 2020**

(3) Final assignment – Measurement instrument development & evaluation (50%)
The final assignment requires students to design a new measurement instrument, collect data using the instrument, and assess and evaluate its measurement properties. The first step towards completing the assignment requires an approval form that outlines the trait or state being measured, the population of interest, ethics review requirement and whether existing data will be used or if new data collection will be

conducted. The second step is to submit a written description of the purpose of the measurement instrument and the plan for development and evaluation, including data collection strategy. The final project is a complete report on the development and evaluation of the new measurement instrument. Appropriate statistical analysis must be selected and justified to fit with the purpose of the measurement instrument. Students will also be required to select and interpret relevant statistics as part of their results.

The submission and assessment of this assignment will happen in four parts:

- Approval form (5%): This is required for all students. Due **January 24, 2020.**
- Outline and plan (5%): A written description of the purpose of the measurement tool and plan for design and data collection. Due **February 7, 2020.**
- Final project (30%): Due **April 3, 2020**
- Oral presentation (10%): Presentations will be scheduled to occur during class time on **March 13 to 27**. Presentations are to be 10 minutes with 3 minutes allowed for questions. Marking rubrics will be provided. Students will be required to demonstrate how they integrated principles of measurement from the design, data analysis and interpretation phases of their final assignment.

Important dates:

Quizzes:	January 31, Feb 28, Mar 13 (in class)
Practice problems due in class:	January 24, January 31, February 14, February 28, March 6
In-class presentation:	Assigned in week 1
Approval form due:	January 24 by 5pm
Outline & plan due:	February 7 by 5pm
Final project due:	April 3 by 5pm
Final project presentations:	Assigned in week 1

Course readings:

Primary readings for the course are from "Health Measurement Scales: A practical guide to their development and use" (5th edition) by Streiner/Norman/Cairney (HMS), which is available in the Health Sciences bookstore. Supplementary readings by topic area are also assigned to augment student learning and offer alternate perspectives or deeper context for the relevant concepts. These will be posted on Avenue to Learn.

Useful websites & resources:

1) DeVellis, R. F. (2016). Scale development: Theory and applications (Vol. 26). Sage publications.

2) Psychological Assessment (2019) Vol 31(12): Special issue on Methodological and Statistical Advancements in Clinical Assessment. Includes articles about reliability, item response theory, factor analysis, scale development, construct validity, clinical decision making, multicultural/diversity contexts, response bias, neuroscience, and experience sampling.

Course policies:

Content: This syllabus is subject to change. Students are responsible for finding out about announced changes if they miss class. Updated versions will be posted on the Avenue to Learn website for the course. The instructor and university reserve the right to modify elements of the course during the term. The university may change the dates and deadlines for any or all courses in extreme circumstances. If either type of modification becomes necessary, reasonable notice and communication with the students will be given with explanation and the opportunity to comment on changes. It is the responsibility of the student to check their McMaster email and course websites weekly during the term and to note any changes.

Late assignments: No late assignments will be accepted. Assignments are due at the beginning of class or day/time indicated above. Late assignments received within 24 hours of the due date will be docked 5% of the grade assigned. Assignments received between 24 and 48 hours will be docked 10% after which late assignments will no longer be accepted. If you anticipate having problems meeting these deadlines, please contact me before the assignment is due to discuss your situation.

Special needs: Students with documented special needs will be accommodated as much as possible. Please see me in the first few weeks of the semester if you anticipate needing special accommodations.

Missed classes: Class attendance is crucial to your success and is expected of all graduate students. Students who miss class will need to make their own arrangements for covering material covered in class.

Academic Integrity: Academic dishonesty is to knowingly act or fail to act in a way that results or could result in unearned academic credit or advantage. It is your responsibility to understand what constitutes academic dishonesty. However, if you have questions regarding a particular assignment, it is always best to ask me prior to completing the assignment. For information on the various types of academic dishonesty please refer to the Academic Integrity Policy, located at
http://www.mcmaster.ca/academicintegrity
The following illustrates only three forms of academic dishonesty:
1. Plagiarism, e.g. the submission of work that is not one's own or for which other credit has been obtained.
2. Improper collaboration in group work.
3. Copying or using unauthorized aids in tests and examinations.

Lectures/Topics:
This is an approximate schedule and list of topics. Changes may be made to respond to the needs and progress of the class.

Date	Week	Theme	Practice Problem/ Assignments due
Jan 10	1	Introduction to measurement: concepts, theories & statistical underpinnings ***Student-led presentation example***	
Jan 17	2	Validity ***In-class discussion***	
Jan 24	3	Reliability ***Student-led presentation (15%)***	Descriptives (1%) Topic Approval Form (5%)
Jan 31	4	***Quiz 1(10%)*** Item generation & methods of test development ***Student-led presentation (15%)***	Internal consistency & correlations (1%)
Feb 7	5	Item evaluation & analysis ***Student-led presentation (15%)***	Assignment Outline & Plan (5%)
Feb 14	6	Item Response Theory (IRT) ***Student-led presentation (15%)***	PCA (1%)
Feb 21	7	***Reading Week***	
Feb 28	8	***Quiz 2 (10%)*** Generalizability theory ***Student-led presentation (15%)***	IRT (1%)
Mar 6	9	Choosing a measurement framework & measuring change ***In-class discussion***	G-Study using an ANOVA (1%)
Mar 13	10	***Quiz 3 (10%)*** Practical considerations ***In-class discussion***	
Mar 20	11	Student Oral Presentations (10%)	
Mar 27	12	Student Oral Presentations (10%)	
April 3	13	Student Oral Presentations (if needed)	Final Assignment (30%)

Week 1 (January 10th, 2020)
Theme: Introduction to measurement: concepts, theories & statistical underpinnings
Learning objectives:
1) Review course outline, assignments and dates
2) Introduce context and objectives of measurement of subjective states
3) Outline importance/relevance of measurement in health research & systems
3) Define concepts of the latent trait, validity & reliability
4) Review student areas of measurement interest/focus and software preference

Workshop: Review of descriptive and inferential statistics

Reading:
HMS: Chapters 1, 2

In-Class Presentations & Groups Assigned (Example given)
