

## Psy 712: Psychometrics

### Course Objectives

This course will introduce students to some of the many ways to understand and evaluate reliability and validity, and the many techniques for creating reliable and valid tests. Students will learn how to evaluate the quality of existing tests and the quality of research they are reading, how to determine which tests to use in their own research and clinical practice, and how to design new tests that are reliable and valid.

### Course Description

This course has two primary objectives. First, this course covers the theoretical underpinnings of psychometrics, including reliability, validity, assessment of test bias, and factor analysis. These topics are covered in readings and lecture, and students will practice the relevant data analyses using actual research data. Second, this course covers the development of psychological tests, including item writing and scale construction, item analysis, and test revision. This material is covered in readings and lecture, and students apply the theory they have learned by designing new psychological measures and by revising existing measures. In this course, the primary focus will be on tests of individual differences (e.g., personality, intelligence, interests, etc.), but the same principles apply to other testing situations.

As a part of these primary objectives, this course addresses how reliability and validity are assessed and how tests are designed to be reliable and valid when the test will be completed by people who belong to disparate subgroups (such as men and women, or ethnic groups), or by people who belong to different groups than the test was originally designed for. In particular, the presence of homogeneous subgroups on correlations and factor analyses will be discussed in lecture and explored using data analysis with actual research data, and slope and intercept bias will be discussed in lecture. As well, in one of the term projects, students are asked to consider how their constructs and research conclusions might differ if participants from another culture completed their measures.

The secondary goal of this course also is to provide students with additional experience in writing research reports. To support this goal, students will write a research report analyzing the quality of an existing test, using data selected by the students. They will write this paper one section at a time and receive feedback on each section.

### Relative Breakdown

Evaluating tests and questionnaires	65%
Designing tests and questionnaires	30%
Writing research reports	5%

## Course Format

This course is delivered using a flipped format. In a traditional class, lectures are delivered during class time, and students complete projects and exercises at home. In this class, students will complete lectures and readings at home, leaving class time free for projects and exercises. Since I started teaching this course, I've always used class time for projects. However, for the last three years, we have also spent class time doing exercises.

In Spring 2013, I started to flip the lectures about half-way through the semester. Rather than delivering the lectures in person, I handed students a transcript of my lectures. During class, we did active learning exercises to help students really understand the concepts. Students unanimously said that this was a better way to spend class time. Therefore, in 2014, I flipped all the lectures.

To prepare for class, you should read the chapters and other readings that are listed on the syllabus. I will hand out the transcripts at the end of each class. You should read them before the next class. If you have questions about the transcripts, ask me the next week, during office hours.

Eventually, I may turn the transcripts into videos. In 2014 and 2015, the students said this was not necessary. I look forward to receiving your feedback on that issue.

Many of the class exercises we will do are experimental. Although I have taught this course for about a decade, this will be the second or third time I have had sufficient class time to do many of these exercises. I look forward to your feedback on the exercises.

## Required Readings

Lecture Transcripts – I have created transcripts of the lectures. These transcripts are required reading, and their content will be tested on exams regardless of whether the specific ideas in the transcripts were covered during class time.

Murphy, K.R. & Davidshofer, C.O. (2005). *Psychological testing: Principles and applications, 6th edition*. Upper Saddle River, NJ: Prentice-Hall. Available from UNLV bookstore.

Cortina, J.M. (1993). What is coefficient alpha? An examination of theory and applications. *Journal of Applied Psychology, 78*, 98-104. Available through WebCampus.

Fabrigar, L.R., Wegener, D.T., MacCallum, R.C. & Strahan, E.J. (1999). Evaluating the use of exploratory factor analysis in psychological research. *Psychological Methods, 4*, 272-299. Available through WebCampus.

## Recommended Readings

Thompson, B. (2004). *Exploratory and confirmatory factor analysis: Understanding concepts and applications*. Washington, CD: American Psychological Association. Available from APA website at <http://www.apa.org/books/4316025.html>

Thorndike, R. M. (1997). *Measurement and evaluation in psychology and education, sixth edition*. Upper Saddle River, NJ: Prentice-Hall. Read Chapter 15: Principles of Objective Test Development. Available through WebCampus.

## Structure and Grade Breakdown

Projects            70%

Projects will be completed through a series of detailed lab assignments. These assignments will be graded for quality and will have short deadlines to keep everyone on track.

I will grade lab assignments and projects using behavioral observation scales that are based entirely on the instructions given on the lab assignments. Therefore, it is extremely important that students follow the instructions given.

*Project 1: Creating a New Rating Scale*    20%

You will design a new rating scale that uses either an agreement scale or a frequency scale.

Psychologists use rating scales in a large proportion of their studies. Designing a good rating scale is harder than it looks. This project will be broken into detailed steps to help you create a good first draft, and to incorporate feedback from other students and from the instructor.

Students are encouraged (but not required) to design measures that they would be interested in using in their own research. Talk to Dr. Barchard about your particular research ideas.

### *Project 2: Evaluating an Existing Measure 50%*

This project begins with several background assignments on SPSS so that you can use SPSS to evaluate the quality of an existing measure. If you have used SPSS before, these assignments should be straight-forward, but you are still required to complete them.

Next, you will write a short APA-style paper evaluating the quality of an existing measure and suggesting revisions to improve the measure. This project will be broken into a number of detailed lab assignments that help you write this paper one section at a time. At the end, you will incorporate the feedback you received on the previous assignments before handing in your final paper.

I have broken this paper down into the smallest component parts that I can, to ensure that students receive specific feedback on every part of the paper. Students will therefore notice that there are a large number of assignments, and so it is critical that you work at them consistently.

Ideally, students will use their own data for this project, so that they can examine a measure that is of interest to them, and then present their projects at professional conferences. In the past, some students have expanded their analyses and published their work in refereed journals. If students are unable to locate their own data, I have a dataset that students can use and they are welcome to present that research at a conference; however, students may be less interested in expanding that work for professional publication.

### Quizzes 30%

There will be a total of three quizzes. The lowest grade on these quizzes will only count for half as much as the remaining two quizzes.

All quizzes will be cumulative: They may cover material from any previous lecture, handout, or reading.

The quizzes will be given through WebCampus. Quizzes will become available at 8am on Friday morning and will close on Monday at midnight.

Quizzes will be a combination of closed ended and short answer questions. They will be designed so that they can be completed in 1 hour, but you will have 3 hours to complete them.

Quizzes are open-book and open-notes. You may use your textbook, the required readings, class handouts, and your lecture notes during the exam. If you missed a class and obtained lecture notes from another student to make up for that missed class, you may also use those lecture notes. You may not use any other resource or person to help you during the exam. In particular, you may not consult library resources or do an Internet search to try to find the answer to a question. If you have any questions about what resources are allowed during the quizzes, ask Dr. Barchard.

### **Working in Groups**

Most lab assignments will be done in groups of two or three students. Working in groups will improve your learning and reduce the time required to complete the assignments. It will also prepare you for professional research projects, which are almost always completed in groups.

Groups may contain either two or three students. Assignments will be marked identically, regardless of whether two or three students completed the assignment. No more than three team members are allowed, because only three students can see the same computer screen easily. You may switch groups at any time, but this may make it harder for you.

Even though you are working with one set of students on a project, you should still talk with

other students about the project. Your projects will be slightly different from other groups (you will not be designing the same measures or analyzing the same data), but the steps involved will be the same and so talking to other students can be very helpful. I therefore encourage you to work on your assignments at the same time as other students and to talk to them about it extensively. However, when you hand in an assignment for your group, everything you hand in must be something that your group created: don't hand in someone else's output or someone else's answers as your own. **In practical terms, this means that the only hands that touched the keyboard or mouse belong to members of your group, and no information was ever copied from any file where non-group members touched the keyboard or mouse.**

Similarly, although you will be working in groups, the assignments are not simply group assignments. **Everything that has your name on it must be something that you yourself helped to create.** Having one person do an assignment and putting two or three names on it is **NOT** acceptable. If one student does one assignment and another student does the next assignment, it is **NOT** acceptable to put both names on both assignments. If someone is unable to contribute to one of the assignments, they can simply skip it: This will have only a small influence on their final course grade, because the final projects are worth far more than the individual assignments. Alternatively, if a student is unable to contribute to an assignment, then they may contact Dr. Barchard about a make-up assignment.

In addition, students are strongly encouraged to find one or more study partners to assist them in learning the material. You can discuss difficult topics and share notes for any classes you miss.

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Academic integrity is a legitimate concern for every member of the campus community; all share in upholding the fundamental values of honesty, trust, respect, fairness, responsibility and professionalism. By choosing to join the UNLV community, students accept the expectations of the Academic Misconduct Policy and are encouraged when faced with choices to always take the ethical path. Students enrolling in UNLV assume the obligation to conduct themselves in a manner compatible with UNLV's function as an educational institution. An example of academic misconduct is plagiarism. Plagiarism is using the words or ideas of another, from the Internet or any source, without proper citation of the sources. See the *Student Academic Misconduct Policy* (approved December 9, 2005) located at: <http://studentconduct.unlv.edu/misconduct/policy.html>

## **Workload**

This course is a lot of work. Previous students reported that they spent approximately 2 hours per day on this course, not including class time, for a total of 10 – 15 hours per week. Almost all previous students have also recommended that I retain all of the lecture content and all of the project content. Three years ago, students recommended that I remove one of the projects (on designing multiple choice tests). Therefore, the workload will be somewhat lighter than it was four years ago, but will still be quite heavy. The workload will be quite high for the first three weeks and high for the middle of the course, but somewhat lighter for the last three weeks of the course.

## Grading Scheme

The grading scheme for the course is as follows:

A	93 – 100
A –	90 – 92
B+	87 – 89
B	83 – 86
B –	80 – 82
C+	77 – 79
C	73 – 76
C –	70 – 72
D+	67 – 69
D	63 – 66
D –	60 – 62
F	Below 60

Grades may be scaled to ensure an appropriate class average.

## Disability Resource Center

The Disability Resource Center (DRC) determines accommodations that are “reasonable” in promoting the equal access of a student reporting a disability to the general UNLV learning experience. In so doing, the DRC also balances instructor and departmental interests in maintaining curricular standards so as to best achieve a fair evaluation standard amongst students being assisted. In order for the DRC to be effective it must be considered in the dialog between the faculty and the student who is requesting accommodations. For this reason faculty should only provide students course adjustment after having received an “Academic Accommodation Plan.” If faculty members have any questions regarding the DRC, they should call a DRC counselor.

UNLV complies with the provisions set forth in Section 504 of the Rehabilitation Act of 1973 and the Americans with Disabilities Act of 1990. The DRC is located in the Student Services Complex (SSC-A), Room 143, phone (702) 895-0866, fax (702) 895-0651. For additional information, please visit: <http://drc.unlv.edu/>.

## Absences

Students who are legally required to miss class (e.g., jury duty) will be given the opportunity to make up missed assignments or quizzes. In addition, any student missing class quizzes, examinations, or any other class or lab work because of observance of religious holidays shall be given an opportunity during that semester to make up missed work. The make-up will apply to the religious holiday absence only. It shall be the responsibility of the student to notify the instructor no later than the last day of late registration of his or her intention to participate in religious holidays which do not fall on state holidays or periods of class recess. This policy shall not apply in the event that administering the test or examination at an alternate time would impose an undue hardship on the instructor or the university which could have been avoided. See the following website for more information: <http://catalog.unlv.edu/content.php?catoid=6&navoid=531>

## Statistics Background

Students will not learn a lot of statistics in this course. However, you will apply a lot of statistics that you should already have learned. The following is the necessary and expected statistics background. Students should be able to:

- Explain the difference between samples and populations
- Explain the difference between descriptive and inferential statistics
- Define and give examples of the four levels of measurement (nominal, ordinal, interval, ratio), and determine what level of measurement a test item is
- Draw and interpret histograms and scatterplots
- Define, calculate, and interpret mean, median, and mode, and know when to use each
- Define, calculate, and interpret standard deviation, variance, and range
- Define, calculate, and interpret z-scores
- Calculate probabilities associated with the standard normal curve [e.g.,  $P(z > 1.2)$ ]
- Define, calculate, and interpret other standard scores (e.g., T, CEEB, GRE, IQ)
- Draw histograms of data that have normal distributions, positive or negative skew, are uni-modal or bi-modal. Identify the shape of a set of data, from either a histogram or raw data.
- Define, calculate, and interpret covariance and correlation
- Understand and apply the logic of hypothesis testing
- Define Type I errors, Type II errors, power, alpha, beta; state the relationships between these
- Define, calculate, and interpret p-values

In addition, it would be helpful if students could:

- Write and interpret statistical results in sentence form [e.g., The treatment group had a higher average score than the control group ( $t(23) = 3.4, p < .05$ ).] [This topic will be reviewed in assignments]
- Explain how restriction of range, homogeneous sub-samples, and non-normality influence the size of population correlations [This topic will be reviewed in lecture.]
- Explain and interpret one-way analysis of variance (e.g., rationale, sums of squares, mean squares, F-ratios), and calculate it using a computer [This will not be covered in lecture or text.]
- Explain and interpret repeated measures analysis of variance (e.g., rationale, sums of squares, mean squares, F-ratios), and calculate it using a computer [This will not be covered in lecture or text.]
- Explain and interpret multiple regression (e.g., rationale, predicted values, R-squared, b-weights, Beta-weights), and calculate it using a computer [This will not be covered in lecture or text.]

## Lab Assignments

Lab assignments will be due Wed at 3pm, unless otherwise specified.

### Project 1

- Lab 1-1: Drafting Rating Scale
  - Lab 1-2: Editing and Formatting Rating Scale
  - Lab 1-3: Final Rating Scale
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### Project 2

Lab 2-0: Proposal

#### Project 2: Background

- Background 1: Introduction to SPSS
- Background 2: Syntax Windows
- Background 3: Checking Your Work
- Background 4: Recoding
- Background 5: Correlation

#### Project 2: Part A

- Lab 2-1: Introduction
- Lab 2-2: Method: Sample
- Lab 2-3: Method: Measures and Procedures, Appendix A

#### Project 2: Part B

- Lab 2-4: Recoding and Internal Consistency
- Lab 2-5: Validity
- Lab 2-6: Item Analysis for Internal Consistency
- Lab 2-7: Item Analysis for Validity

#### Project 2: Part C

- Lab 2-8: First Principle Component
- Lab 2-9: Number of Factors

#### Project 2: Part D

- Lab 2-10: Rotation and Interpretation
- Lab 2-11: Factor Scores

#### Project 2: Part E

- Lab 2-12: Discussion, Scale Revision, and Appendix B
- Lab 2-13: References and Abstract

#### Project 2: Final Project

## Tentative Course Schedule

Week	Date	Lectures	Readings	Lab	Project 1 handout	Project 1 due Wed	Project 2 handout	Project 2 due Wed	Quizzes
1	22-Jan	1. Item writing	Ch 11; handouts. Recommended Thorndike Ch 15	Proj 1: Lab 1-1	Overview, Lab 1-1				
2	29-Jan	2. Correlation	Ch 4, 5; handouts	Proj 1: Lab 1-2	Lab 1-2	Lab 1-1	Proposal		
3	5-Feb	3. Reliability	Ch 6, 7; handouts	Proj 1: Lab 1-3	Lab 1-3	Lab 1-2			
4	12-Feb	4. Reliability	Cortina; handouts	Bonus DE; Proj 2: SPSS Background	Bonus DE	Lab 1-3	Background	Proposal	
5	19-Feb	5. Validity	Ch 8; handouts	Background re-do's; Proj 2: Part A			Background re-do's; Overview; Final Report; Part A	Background	Quiz 1: Ch 11, 4, 5, 6, 7; Cortina; Lect 1, 2, 3, 4; Syllabus
6	26-Feb	6. Validity	Ch 9; handouts	Proj 2: Part A				Background re-do's	
7	4-Mar	7. Item analyses	Ch 10; handouts	Proj 2: Part B		Bonus DE	Part B	Part A	
8	11-Mar	8. EFA: First Principle Component	handouts. Recommended Thompson Ch1	Proj 2: Part B					
9	18-Mar	9. EFA: Multiple components, rationale and uses	handouts. Recommended Thompson Ch 2 & 3	Proj 2: Part C			Part C	Part B	
Spring Break	25-Mar								
10	1-Apr	10. EFA: Number of factors	Fabrigar	Proj 2: Part C					Quiz 2: Ch 8, 9, 10; Lect 5, 6, 7, 8, 9
11	8-Apr	11. Factor Analysis: Rotation and interpretation	handouts. Recommended Thompson Ch 4, 5, & 6	Proj 2: Part D; BOS Bonus			Part D	Part C	
12	15-Apr	12. Scale development & revision		Proj 2: Part E			Part E	Part D; BOS Bonus	
13	22-Apr	Lab time	handouts	Proj 2: Part E			Poster Bonus		
14	29-Apr	Lab time or WPA		Proj 2: Part E; Poster Bonus				Part E	
15	6-May	Lab time		Proj 2: Final; Poster Bonus				Fri 8pm: Proj 2 Final	Quiz 3: Fabrigar, Ch 3; Lect 10, 11, 12