

**EDRS 821: Advanced Applications of Quantitative Methods (3 credits)**  
**College of Education and Human Development, PhD Program**

**Spring 2019 Tues. 4:30- 7:10 PM Thompson Hall L014**

**Instructor: Angela Miller, Ph.D.**

**Office: West Building Room 2007**

**Office Hours: Monday 3 – 4 pm and by appointment (please email).**

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**Prerequisite:** Successful completion of EDRS 811 or the equivalent (knowledge of univariate statistics including ANOVA models).

**Catalog Description:** Advanced study of applications of quantitative methods in educational research, reinforcing and building on concepts and skills acquired in EDRS 811. Uses modular approach, and provides advanced study of techniques appropriate to survey research, group-experimental and quasi-experimental research, selected multivariate procedures and factor analysis, and quantitative synthesis (meta-analysis) of research. Combines reading assignments, critiques, and discussion of relevant journal articles; and application activities.

**Course Description:** This course will provide advanced study of applications of quantitative methods in the practice of educational research and will reinforce and build upon concepts and skills acquired in EDRS 811. It will employ a modular approach and will contain advanced study of techniques appropriate to analysis of data from tests and surveys; group-experimental and quasi-experimental design; selected multivariate procedures and factor analysis. Students will learn through a combination of text reading assignments, critical analysis of professional journal articles, and hands-on experience in using a computer program for data analysis, and application activities. Students will be expected to identify and report on quantitative methods used in published research, to analyze data using the Statistical Package for Social Sciences (SPSS), and to provide written reports of methodology and results.

**Course goals:** This course is a one-semester introduction to several widely used multiple regression (MR) and multivariate statistical methods. By the end of the semester, it is expected that you will be able to:

- Demonstrate a conceptual understanding of multiple regression with mediators and moderators and generalized linear modeling (e.g., logistic regression) as evidenced by your ability to select and justify the statistic that is appropriate to test a particular hypothesis, explain what the procedure is accomplishing and the logic underlying the given procedure.
- Explain what is meant by multivariate statistical techniques and demonstrate the ability to use multiple techniques that are introduced in this class.
- Explain the assumptions of the above analyses and make recommendations when assumptions are violated.
- Conduct all of the statistical techniques noted above using SPSS software, including testing the assumptions of the technique, interpret the results of the SPSS output and write the results in APA publication style.

**Format:** The class sessions will include both lecture and hands-on computer work.

**Required Materials:**

- (1) Tabachnick, B.G. & Fidell, L. S. (2019). *Using Multivariate Statistics*. (7th Ed.). NY: Pearson Education. ISBN: 9780134790541
- (2) Access to SPSS software. There are computer labs on campus that provide access to SPSS. You can access SPSS software through GMU's virtual computer library at [www.vcl.gmu.edu](http://www.vcl.gmu.edu). Information about how to use the virtual computer library is available at [http://itservices.gmu.edu/services/view-service.cfm?customel\\_dataPageID\\_4609=5689](http://itservices.gmu.edu/services/view-service.cfm?customel_dataPageID_4609=5689). It is the student's responsibility to ensure access to SPSS outside of class time as there will not be sufficient time in class to complete required assignments.
- (3) There are also required articles/book chapters that will be posted on Bb.

**Recommended Resources:**

American Psychological Association (2009). *Publication Manual of the American Psychological Association (6th edition)*. Washington, DC: APA.

*Note: In weeks one and two of the class, students are expected to review the reporting standards for statistics in APA style. Student may complete an optional short assignment covering the standards to verify knowledge. Feedback will be provided.*

Cooper, H. (2010). *Reporting Research in Psychology: How to Meet Journal Article Reporting Standards*. Washington, DC: American Psychological Association.

Nicol, A. A. M. & Pexman, P. M. (2010). *Presenting Your Findings: A Practical Guide for Creating Tables*. Washington, DC: American Psychological Association.

**Class Preparation:** Information on course assignments, weekly quizzes, and notes for class lectures are available on the course blackboard site. Occasionally, there will also be short video lectures posted on blackboard as introductions to the concepts we will be studying—these are intended to precede your reading of the assigned chapters and/or articles and help situate your reading.

**Class Attendance & Participation:** Students are expected to come to class on time, complete assignments, and participate in class discussions.

**My Teaching Philosophy (in a nutshell) and Expectations**

Many people tend to think of statistics as a static and “cut and dry” field when, in fact, it is neither. Advances in computing have enabled the rapid development of more sophisticated modeling tools. There is no way that you will ever know and understand all of them. What you need to understand are the basic assumptions underlying different models, how to select among them, and where to go to get information to learn more if you need something new.

As doctoral students, my main goal for you is to help you become *expert learners*. It is not realistic for me to be your only source of information, nor is it a viable learning model for the scientists and researchers that you are becoming. Make use of the many resources that are easily available on the web and work with one another.

The most important thing you can bring with you to class is a willingness to try to conceptually understand the material. *Please be active--ask questions and participate*. Outside of class, remember that reading statistical information takes a long time, and even when you read slowly and deliberately, you will need to go back and revisit it over and over. Many people find that this is not easy material; you should accept struggles as a normal part of the learning process.

## ASSESSMENT:

**Online Quizzes (10%):** For each topic there will be a short quiz posted on Blackboard. The quizzes are composed of short answer and multiple choice items which will cover the basic concepts presented in class and in the textbook. Quizzes are timed (usually 25 minutes) and must be completed during the specified time period (due by midnight on Mondays). These quizzes are designed to provide you (and me) with feedback about your course progress. Your quiz score cannot lower your overall course grade. **Please take the quiz as soon after class as possible.**

**Annotated Analysis (20%):** Each week you will work with data to replicate class or textbook analyses and/or run new analyses in a small group (2-3 students per group). The exercise may also include conceptual questions about the method to help you gain conceptual understanding as you work through the exercises. You may work together or individually on running the analysis; however your responses to the questions and annotations should be a collaborative effort. Your group will upload your annotated output (please cut and paste relevant output to Word) and responses on the Bb site. You will make corrections to your analyses before writing up and submitting the results in APA format.

**Full Write Up of Regression Results (10%):** For the first multiple regression assignment you will write a complete “dissertation style” methods and results section in **correct APA format** including (1) data cleaning (2) testing of appropriate assumptions, (3) inclusion of any necessary preliminary descriptive statistics and tables (4) results of hypotheses tests, and (4) interpretation of results.

**Commentaries on Published Results (10%):** Each week we will be learning a new statistical analysis. In addition to the textbook readings there will be an example article that is an application of the method we are learning. Please read this example article prior to the following class and be prepared for discussion. Students are required to turn in a one page (typed, 12 point font) commentary on the example article for the topic learned the previous week. This must be submitted (upload to Bb) by 9 am on Wednesday. The commentary should be an informal set of questions, comments, or summary information (summarize only if you cannot think of anything else to say) about the article. The purpose of this assignment is to provide information for the class discussion and to help me identify discussion topics and sources of confusion in your understanding of the usage of the statistical method. These are scored on a 2 point scale: 2

(complete and well considered), 1 (did not read thoroughly/lacking effort), or 0 (did not read/minimal effort/late/nothing submitted). There are 7 total topics; you may skip one (a freebie!) for the semester.

**‘Article Style’ Write Up of Results (10%):** These results are based on the analysis from your groups work on 3 of the topics. Each student may select which 3 topics they would like to work on writing up. You will write a results section in **correct APA format** including: results of hypotheses tests and interpretation of results similar to what would be found in a published research article. Note: Necessary tables should also be included and should be formatted in correct APA style (cutting and pasting from SPSS is not acceptable). Results are submitted individually and even though they are based on the group SPSS output they should reflect your individual interpretation and presentation. Duplicate work is considered plagiarism and will receive a score of 0.

**Exams (20% each):** The two exams will cover the material from the class and textbook and include short answer questions as well as interpretation of SPSS output.

### GRADING SCALE:

Grades will be assigned based on the following:

A+	98-100%	B+	88-89%	C	70-79%
A	93-100%	B	83-87%	F	below 70%
A-	90-92%	B-	80-82%		

Final grades are based in the assessments described above. “Extra credit” is not available.

**Late Assignments:** *As a general rule, late assignments will not be accepted.* If you believe you have EXCEPTIONAL circumstances and wish to negotiate to have extra time to complete course work, you must discuss this with me before the day the assignment is due. (Negotiating means that you will be sacrificing a portion, perhaps substantial, of your grade for extra time).

## GMU Policies and Resources for Students

### *Policies*

- Students must adhere to the guidelines of the Mason Honor Code (see <https://catalog.gmu.edu/policies/honor-code-system/> ).
- Students must follow the university policy for Responsible Use of Computing (see <http://universitypolicy.gmu.edu/policies/responsible-use-of-computing/>).
- Students are responsible for the content of university communications sent to their Mason email account and are required to activate their account and check it regularly. All communication from the university, college, school, and program will be sent to students **solely** through their Mason email account.

- Students with disabilities who seek accommodations in a course must be registered with George Mason University Disability Services. Approved accommodations will begin at the time the written letter from Disability Services is received by the instructor (see <https://ds.gmu.edu/>).
- Students must silence all sound emitting devices during class unless otherwise authorized by the instructor.

### *Campus Resources*

- Support for submission of assignments to Tk20 should be directed to [tk20help@gmu.edu](mailto:tk20help@gmu.edu) or <https://cehd.gmu.edu/aero/tk20>. Questions or concerns regarding use of Blackboard should be directed to <http://coursessupport.gmu.edu/>.
- For information on student support resources on campus, see <https://ctfe.gmu.edu/teaching/student-support-resources-on-campus>

### **Professional Dispositions**

See <https://cehd.gmu.edu/students/policies-procedures/>

### **Core Values Commitment**

The College of Education and Human Development is committed to collaboration, ethical leadership, innovation, research-based practice, and social justice. Students are expected to adhere to these principles: <http://cehd.gmu.edu/values/>.

**For additional information on the College of Education and Human Development, please visit our website <https://cehd.gmu.edu/students/> .**

## Tentative Schedule

	Class	Topic	Reading	Due
				Analyses(group) / Results (individual)
8/28	1	Intro and Review: Multiple Regression Basics of Matrix Algebra Using SPSS syntax	Chapter 1 Chapter 2:overview Appendix A *Review ch. 3 as needed (3.3, 3.4, 3.5)	
9/4	2	Multiple Regression Assumptions Cleaning Data	Chapter 4 Chapter 5 (5.1- 5.3, 5.7.1-5.7.3)	HW: Matrix Madness and APA style
9/11	3	MR/GLM Categorical Predictors Hierarchical Regression	Chapter 5 (5.4-5.6.4) Pdf on Bb	
9/18	4	MR-Mediation	Chapter 5 (5.6.7) Pdf on Bb	MR
9/25	5	MR-Moderation (cat.)	Pdf on Bb	<b>MR full write-up by 9/29</b>
10/2	6	MR-Moderation (cont.)	Pdf on Bb Chapter 5 (5.6.6)	#1: Med
10/9	7	Missing Data-Imputation Catch-up & Review	Pdf on Bb Chapter 5 (5.7.4)	#2: Mod
10/16	<b>8</b>	<b>Exam 1</b>		
10/23	9	Logistic Regression	Chapter 10	
10/30	10	Factor Analysis	Chapter 13 (13.1-13.4)	#3: Log
11/6	11	Factor Analysis (cont.)	Chapter 13 (13.5- 13.7)	
11/13	12	MANOVA (Profile Analysis) Discriminant Analysis	Chapter 7 Chapter 8 (8.1, 8.2, 8.6) Chapter 9 (9.1, 9.2, 9.6)	#4: FA
11/20	13	HLM & SEM: overview	Chapter 14 (14.1, 14.2) Chapter 15 (15.1, 15.2)	#5: MANOVA
11/27		<b>No Class-Thanksgiving Break</b>		
12/4	14	Multiway Frequency Analysis Catch-up & Review	Chapter 16	<b>Last Day to Submit Write-ups</b>
12/11		<b>Final Exam</b>		

## Other Readings and Useful References

### Regression Models and Assumptions

Cohen, J., Cohen, P., West, S.G., & Aiken, L.S. (2003). *Applied multiple regression/correlation for the behavioral sciences (3rd edition)*. Mahwah, NJ: Lawrence Erlbaum.

Fox, J. (1991). *Regression diagnostics*. Thousand Oaks, CA: Sage Publications, Inc.  
<http://dx.doi.org/10.4135/9781412985604>

Hardy, M.A. (1993). *Regression with dummy variables*. Thousand Oaks, CA: Sage Publications, Inc.  
<http://dx.doi.org/10.4135/9781412985628>

### Mediation & Moderation

\*Baron, R. M. & Kenny, D. A. (1986). The moderator-mediator variable distinction in social psychological research: Conceptual, strategic, and statistical considerations. *Journal of Personality and Social Psychology*, 51, 1173-1182. <http://dx.doi.org/10.1037/0022-3514.51.6.1173>

\*Hayes, A. F. (2009). Beyond Baron and Kenny: Statistical mediation analysis in the new millennium. *Communication Monographs*, 76, 408-420.  
<http://dx.doi.org/10.1080/03637750903310360>

\*Hayes, A. F. (2013). *Introduction to Mediation, Moderation, and conditional Process Analysis*. New York, NY: Guilford Press.

### Moderation

Jaccard, J. & Turrisi, R. (2003). *Interaction effects in multiple regression (2<sup>nd</sup> ed.)*. Thousand Oaks, CA: Sage Publications, Inc. <http://dx.doi.org/10.4135/9781412984522>

\*Hayes, A. F., Glynn, C. J., & Huge, M. E. (2012). Cautions regarding the interpretation of regression coefficients and hypothesis tests in linear models with interactions, *Communication Methods and Measures*, 6, 1-11.  
<http://dx.doi.org/10.1080/19312458.2012.651415>

### Mediation

Preacher, K. J., & Hayes, A. F. (2008). Asymptotic and resampling strategies for assessing and comparing indirect effects in multiple mediator models. *Behavior Research Methods*, 40, 879-891. <http://dx.doi.org/10.3758/BRM.40.3.879>

Preacher, K. J., Rucker, D. D., & Hayes, A. F. (2007). Addressing moderated mediation hypotheses: Theory, methods, and prescriptions. *Multivariate Behavioral Research*, 42, 185-227. <http://dx.doi.org/10.1080/00273170701341316>

MacKinnon, D.P., Fairchild, A.J., & Fritz, M.S. (2007). Mediation analysis. *Annual Review of Psychology*, 58, 593-614. <http://dx.doi.org/10.1146/annurev.psych.58.110405.085542>

MacKinnon, D.P. (2008). *Introduction to statistical mediation analysis*. New York: Lawrence Erlbaum.

MacKinnon, D.P., Lockwood, C.M., Hoffman, J.M., West, S.G., & Sheets, V. (2002). A comparison of methods to test mediation and other intervening variable effects. *Psychological Methods*, 7, 83-104. <http://dx.doi.org/10.1037/1082-989X.7.1.83>

Shrout, P.E., & Bolger, N. (2002). Mediation in experimental and nonexperimental studies: New procedures and recommendations. *Psychological Methods*, 7, 422-445. <http://dx.doi.org/10.1037/1082-989X.7.4.422>

### **Logistic Regression**

\*Grimes, D.A. and Schulz, K.F. (2008). Making sense of odds and odds ratios. *Obstetrics and Gynecology*, 111, 423-426. <http://dx.doi.org/10.1097/01.AOG.0000297304.32187.5d>

Hosmer, D.W. & Lemeshow, S. (2000). *Applied logistic regression* (2<sup>nd</sup> ed.). Hoboken, NJ: John Wiley & Sons, Inc. <http://dx.doi.org/10.1002/0471722146>

Menard, S. (2002). *Applied logistic regression analysis* (2<sup>nd</sup> ed.). Thousand Oaks, CA: Sage Publications, Inc. <http://dx.doi.org/10.4135/9781412983433>

### **General Resources**

Dugard, P., Todman, J., & Staines, H. (2010). *Approaching multivariate analysis* (2<sup>nd</sup> ed.). New York, NY: Routledge.

Grimm, L.G. & Yarnold, P.R. (1995). *Reading and understanding multivariate statistics*. Washington, DC: American Psychological Association.

Grimm, L.G. & Yarnold, P.R. (2000). *Reading and understanding more multivariate statistics*. Washington, DC: American Psychological Association.