



Graduate School of Education
Program: Doctoral Studies in Education
Spring Semester, 2015
SYLLABUS

Course title: EDRS 811-002: Quantitative Methods in Education
CRN: 12515 Three Credits

Meetings: Innovation Hall 323
Tuesdays 4:30 – 7:10

Instructor: Frederick J. Brigham, Ph.D.

Office: 220 Finley Hall (Second floor, across from the elevator)

Phone: 703 993 1667 (email is the better way to contact me, my voice mail has an intermittent problem of failing to forward voicemail to me.)

Email: fbrigham@gmu.edu

Hours: 4:00 – 6:00 Monday and 2:00 – 4:00 Tuesday afternoons. Other times may be available by appointment. Please notify me if you are coming, even during office hours, if at all possible. If I know you are coming, I will wait in my office, otherwise; I might be in another room and miss you even though I am there.

Virtual Office Hours: I am pleased to respond to questions by telephone or email; however, I am unable to be “on call, 24/7.” Therefore, I am instituting a practice “virtual office hours” this semester. Members of the class may email me at any time, but I am reserving two hours on Monday and also on Wednesday afternoons to respond to emails. Please expect responses to your emails to be made during those hours.

Prerequisites: Successful completion of EDRS 620 (or its equivalent) or permission of instructor.

Course Description

Emphasizes advanced methods of conducting research using quantitative methods of data collection, and analysis appropriate for research in education. Includes design of experimental and quasi-experimental research studies, and methods of analysis appropriate to these studies, including analyzing variance and multiple linear regression.

Course Objectives

Upon successful completion of the course, students will:

- Discriminate among different types of data and describe their uses and limitations.
- Create graphs to display data characteristics.
- Describe data sets with a five number summary and Box and Whisker Plot.
- Apply appropriate measures of central tendency and dispersion to describe data sets.
- Use normal quantile plots and other tools to discriminate between normal and non-normal

data sets.

- Calculate Z scores for data and find cumulative proportions of data sets using standardized tables.
- Compare two data sets with scatterplots, correlation coefficients, least squares regression lines, and two-way tables.
- Describe the importance of randomization in experimental design
- Identify basic experimental designs and match them to appropriate statistical analyses.
- Describe the nature of statistical inference, identify and define its basic terminology.
- Describe the relationship of probability models to statistical inference and apply basic probability rules to sampling and independence in probability.
- Discriminate between discrete and continuous random variables and apply characteristics of normal distributions to probability problems.
- Calculate means and variances of random variables.
- Define and explain the law of large numbers in relation to probability distributions.
- Define conditional probability and employ the concept in data analysis.
- Create and interpret tree diagrams to explain complex probability problems.
- Calculate descriptive statistics for samples and populations.
- Apply the central limit theorem to explain various phenomena related to sampling.
- Calculate binomial probabilities, means, and standard deviations for distributions.
- Carry out linear transformations of data sets and explain the rationale for doing so.
- Calculate and interpret statistical confidence intervals.
- Employ confidence intervals and descriptive statistics to estimate "fail-safe" sample sizes.
- Explain the logic, limits, and terminology related to significance testing.
- Describe the statistical meaning of the word, "significant" and contrast it with the common meaning of the word, "important."
- Explain the difference between one-sided and two-sided significance tests and confidence intervals, including their use and limits.
- Explain "Statistical Power" and how it relates to "Type I" and "Type II" errors
- Calculate basic effect sizes using Cohen's d formula and Hedge's g formula and explain the relation of Effect Size to statistical significance.
- Define the term "standard error" and its importance in statistical inference.
- Calculate and interpret one-sample and matched pairs t statistics.
- Calculate and interpret two-sample z statistics, t statistics, and pooled t statistics.
- Carry out inferential procedures for single proportions, including confidence intervals, z statistics, and power estimates.
- Carry out inferential procedures for two proportions, including confidence intervals, z statistics, and power estimates.
- Carry out inferential procedures for two-way tables, including chi-square statistics, z statistics, and goodness of fit comparisons.
- Analyze the relationship between an explanatory variable and a response variable using linear regression.
- Explain and apply the concept of "prediction interval."
- Conduct analysis of variance for regression.

- Compare and contrast the conditions where simple linear and multiple linear regression are appropriate.
- Carry out and interpret analyses of appropriate data sets using multiple regression procedures.
- Identify the conditions necessary for One-Way Analysis of Variance and carry out and interpret the statistical procedures for one-way ANOVA.
- Describe the concept of "family-wise error" and carry out and interpret multiple comparison methods to protect against "family-wise error."
- Identify the conditions necessary for Two-Way Analysis of Variance or Three-Way Analysis of Variance and carry out and interpret the appropriate statistical procedures.
- Identify the conditions necessary for Analysis of Covariance and carry out and interpret the appropriate statistical procedures for ANCOVA.
- Identify the conditions necessary for Random and Mixed Effects Analysis of Variance or models and carry out and interpret the appropriate statistical procedures.
- Identify, graph, and explain significant and non-significant interactions.
- Identify and interpret SPSS outputs for each of the procedures considered in the class.
- Identify and interpret basic nonparametric equivalents to procedures above.
- Carryout analyses of data for the procedures in the class using Excel and SPSS as appropriate.

Nature of Course Delivery

The course is delivered in a face-to-face manner. There are some sessions where the PowerPoint presentation on the topic appears on the class website with a voice-over narration. You may find these useful, but I intend to work with people in class on those chapters as well as having this option available. Note that I am not intending to load all of the topics with voice-over PowerPoints. Only some topics will have this option available.

Course Methodology

This course will be taught using lectures, discussions, and group activities in a computer classroom. The course is technology-enhanced using Blackboard (<http://courses.gmu.edu>). Students are expected to have a GMU email account to be used for communication regarding the course. (go to <http://password.gmu.edu> to set an account) and are responsible for any information posted on the Blackboard site.

For assistance with Blackboard students may email courses@gmu.edu, call (703) 993-3141, or go to Johnson Center Rm 311 (office hours: 8:30am-5pm). For general technical assistance, students may call (703) 993-8870 or go to the counter in Innovation Hall.

Required Texts

Lomax, R. G., & Hahs-Vaughn, D. L. (2012). *An introduction to statistical concepts* (3rd ed.). New York: Routledge.

ISBN: 978-0-415-88005-3

American Psychological Association. (2009). *Publication manual of the American Psychological Association* (6th ed.). Washington, DC: Author.

STATISTICAL SOFTWARE

We will use the Excel spreadsheet and SPSS extensively. You probably have access to Excel on your own computer or at work. The university provides SPSS in the computer labs and also online in the virtual lab. Students in previous sections have reported great dissatisfaction with access to the virtual lab. If distance away from campus makes coming here to do computations on university machines inconvenient, it might be worth looking into a student version of SPSS. For those members of the class who wish to purchase their own software, options for purchasing SPSS are available at: http://www.spss.com/vertical_markets/education/online.htm.

There is also an option to lease the program from six months to one year
<http://estore.e-academy.com/index.cfm?loc=spss/main>.

TaskStream Requirement

Every student registered for a course with a required performance-based assessment is required to submit this assessment to TaskStream (regardless of whether a course is an elective, a onetime course or part of an undergraduate minor). Evaluation of the performance-based assessment by the course instructor will also be completed in TaskStream. Failure to submit the assessment to TaskStream will result in the course instructor reporting the course grade as Incomplete (IN). Unless the IN grade is changed upon completion of the required TaskStream submission, the IN will convert to an F nine weeks into the following semester. *There is no required TaskStream assignment for this course, but the people who inspect these documents require this paragraph to be present.*

COURSE ASSIGNMENTS AND EXAMINATIONS

File Names for Online Submission

You must include your name in the file name when you submit in the Blackboard Assignment Folder. I will add five percent of the possible points for each submission if your file downloads with your name in the title. The system will *not* add your name to your submission as is required for this class. It will label it on the server but when it downloads, only the name of the file *as it appears on your computer* will be transmitted. The name must be assigned to the file on your computer before you send it to the Assignments file. For example:

<your-last-name-here_assignment_one>

or

<your-last-name-here_midterm>

I have set the points on the Blackboard site to reflect the bonus points. Grades for the course will be based on the point values stated in the syllabus.

General Course Requirements¹:

It is expected that each person enrolled in this class will:

1. Read all assigned materials for the course.
2. Attend each class session² and participate in classroom activities that reflect critical reading of materials.
3. Complete all assignments, including weekly online or in-class quizzes and submit results to professor prior to each class meeting (immediately after the quiz is completed for in-class quizzes).
4. Complete one in-class midterm examination and one final exam³.

Statistics Study Tips.

1. Read widely; then read some more. Look at the way that studies are designed and analyzed. Also, consult more than one source when trying to understand a concept.
2. Search for information regarding difficult concepts. There is lots of helpful statistical information on the web. Never miss a chance to listen to Andy field describe a procedure. He is incredibly competent and absolutely crazy!
3. Check for understanding frequently. I will help you with this too. This means that when a formula is presented, take time to see if you can explain how the formula works and what it is designed to do. If Greek letters are difficult for you, write out what each letter means.
4. Complete as many questions/problems as possible at the end of the chapters. Find one that has the answer given and complete it before checking the answer. If you and the book agree, you probably have it under control. If not, work your way back through the solution and identify your mistake. That is the way that I learned this stuff.
5. Develop examples of research questions and hypotheses relevant to your area(s) of interest that are appropriate for each statistical technique. If you believe that there are no useful questions in your area of interest that will yield to quantitative analysis, I suggest that you need to attain a deeper grasp of your field.
6. Form a study group. Misery loves company in many cases.
7. ***Start the homework as soon as possible after class***; waiting until the night before it is due prevents you from benefitting from the activities that we carried out in class.

¹ Late assignments will not be accepted by the instructor. If you fall behind in this class, all is lost!

² Don't ask me if it is all right to miss class. It is not. It is, however, sometimes necessary to miss a class meeting. The decision about whether or not it is *necessary* is yours. I believe that it is demeaning to both of us for me to evaluate the legitimacy of your reasons. If something happens that you want me to know about, feel free to tell me, but if you need to miss class and it is a rare occurrence, I don't need to know why. If it is a long-term or recurring problem, we should devise a strategy to deal with it together. In either case, missing class does not alter the due dates for assignment. It is the responsibility of the student to ensure that the material missed on the night of an absence is understood.

³ All exams are open-book, open-notes activities. You may use any resource in the class but you *must* work independently. It is important for me to see what you understand as an individual so that I can help you. Therefore, seeking help from another person on the mid-term and final will be considered violations of the honor code and result in the grade for the assignment being reduced to an F. If that happens, I will not allow the individual to retake the examination, nor will I remove the grade from the student's scores.

Specific Course Requirements

Bring flash drive or other relevant media to class in order to save work completed during class. You may also attempt to email your work from the computer used in class to your own email account. Be aware that the technology support team reinstalls a new disc image on each university-owned computer in each lab every night. The disc image contains no user-created files and has the effect of erasing everything that was saved on the drive during the previous day. Any failure in email transmission will, therefore, result in the loss of your work and require you to complete it again. Saving to your own device is a far more secure procedure.

Course Evaluation

ASSIGNMENTS: In Class/Homework

I am not assigning grades for these assignments as an experiment this semester. I will provide feedback to class members for the responses to each assigned exercises so that they can be checked ahead of class meetings. I will spend *no more than* the first quarter hour of each session addressing questions that are of meaningful to the majority of the class. If an individual student needs more support, I am available during office hours.

QUIZZES: In Class Quizzes

People who study the psychology of learning (not education which is more related to user satisfaction than to outcome) have amassed a substantial body of evidence that repeated *low-stakes* tests are strongly related to mastery outcomes (Brown, Roediger, & McDaniel, 2014). We are going to follow their advice and have seven in-class quizzes according to the schedule on the syllabus. Each quiz will be completed in a 30 to 45 minute time frame, depending on the material to be covered. The quizzes will be open book, open note events, and will cover material that has been addressed earlier in the class. Each quiz is worth 10 points.

There will be seven quizzes throughout the semester. You may drop the low score of the seven, so that in actuality, only six of them count. If you miss a quiz, you may take a zero and drop that quiz from the grade book (you will have to count each of the remaining quizzes though) or you may come to my office during office hours and complete the quiz there. Missed quizzes must be completed within two weeks. After two weeks, the score becomes a zero for the item.

The quizzes will only focus on already covered material, but any material covered to the date of the quiz may be included. That means that the sampling for each quiz is comprehensive.

RUBRIC FOR FINAL EXAMINATION (40 points)

Item scoring criteria:

Exemplary responses: (36 - 40 points) Provides direct and thorough response to question, defines relevant terms, provides specific examples or instances of the concepts being discussed. Answer is directly reflective of lecture, readings, activities, or assignments, or other material of direct relevance to class.

Adequate response: (30 - 35 points) Provides direct and relevant response to question, provides accurate information directly relevant to class readings, notes, or activities. May provide less information, less elaboration, or a less thoughtful overall response than an exemplary response.

Marginal response: (25 - 29 points) Provides some relevant information, but does not demonstrate overall a clear or complete understanding of the relevant concepts.

Inadequate response: (<24 points) Weak response that does not appear to reflect course content or activities. May include inaccurate information.

No response: (0 points) no response or response that is entirely inaccurate.

RUBRIC FOR PARTICIPATION, HOMEWORK AND ATTENDANCE

I am not awarding direct points for attending class. If you miss class, you are responsible for making arrangements to master the material. This material is unfamiliar enough for most people that it is a poor idea to miss class. Students who keep up with the class have a good chance of mastering the material. If one falls behind with this material, it is extremely difficult to catch up at the same time that new material is being presented. **DO NOT ALLOW THIS TO HAPPEN TO YOU!**

Grading Scale

Homework assignments	Expected, feedback but no points awarded for assignments. ⁴
In-class quizzes ⁵	60 pts
Final Examination	40 pts
TOTAL	100 pts

Letter grades will be assigned as follows:

A+ 98-100%	A 93-97.49%	A- 90-92.49%
B+ 88-89.49%	B 83-87.49%	B- 80-82.49%
C 70-79.49%	F below 70%	

Practice Exercises and Performance-Based Assessments

Practice Exercises

Homework assignments will be selected from the exercises in the textbook and also from supplemental materials provided by the instructor. I have provided the first week's homework assignments in the tentative course schedule. I want to work with the students in the class for a few weeks to determine the amount of time that these assignments require for most students. before establishing the rest of the assignments. You will have one week for between notification of the assignment and the due date.

Performance-Based Assessments

In-Class Quizzes

At various points in the semester, I will provide you with raw data and a brief statement of the research question and methodology that led to the collection of the data. Your task will be to carry out a proper analysis or analyses and then present the data in summary form with an accompanying results statement in APA format for the text as well as data tables and any accompanying graphics.

⁴ It is my preference to conduct our business in this manner. We will discuss this option on the first night of class. If most members of the class wish to have graded homework, I will revise the syllabus and send the updated copies to you.

⁵ See explanation of the multiple midterm format in subsequent sections.

**COLLEGE OF EDUCATION AND HUMAN DEVELOPMENT
STATEMENT OF EXPECTATIONS:**

GMU Policies and Resources for Students

- a. Students must adhere to the guidelines of the George Mason University Honor Code [See <http://oai.gmu.edu/the-mason-honor-code/>].
- b. Students must follow the university policy for Responsible Use of Computing [See <http://universitypolicy.gmu.edu/policies/responsible-use-of-computing/>].
- c. Students are responsible for the content of university communications sent to their George Mason University 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.
- d. The George Mason University Counseling and Psychological Services (CAPS) staff consists of professional counseling and clinical psychologists, social workers, and counselors who offer a wide range of services (e.g., individual and group counseling, workshops and outreach programs) to enhance students' personal experience and academic performance [See <http://caps.gmu.edu/>].
- e. Students with disabilities who seek accommodations in a course must be registered with the George Mason University Office of Disability Services (ODS) and inform their instructor, in writing, at the beginning of the semester [See <http://ods.gmu.edu/>].
- f. Students must follow the university policy stating that all sound emitting devices shall be turned off during class unless otherwise authorized by the instructor.
- g. The George Mason University Writing Center staff provides a variety of resources and services (e.g., tutoring, workshops, writing guides, handbooks) intended to support students as they work to construct and share knowledge through writing [See <http://writingcenter.gmu.edu/>].

Professional Dispositions

Students are expected to exhibit professional behaviors and dispositions at all times.

Core Values Commitment

The College of Education & 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 GSE Syllabi:

For additional information on the College of Education and Human Development, Graduate School of Education, please visit our website [See <http://gse.gmu.edu/>] For RHT Syllabi:

For additional information on the College of Education and Human Development, Graduate School of Education, please visit our website [See <http://rht.gmu.edu/>]

Plagiarism

Plagiarism is a growing concern among faculty at the university level as it is in elementary and secondary education. It is critical that each student complete his or her own assignments, particularly in a course such as EDRS 811 that provides training in an arena of professional performance that is quite technical, so that appropriate formative evaluation, feedback and guidance may be provided. Toward that end, the following definition of plagiarism is provided:

Plagiarism is the intentional or unintentional use of others' ideas, words, data, figures, pictures, sequence of ideas, or arrangement of materials without clearly acknowledging the source (based on the Mason Honor Code online at:

<http://mason.gmu.edu/~montecin/plagiarism.htm>).

Electronic tools (e.g., SafeAssign) may be used to detect plagiarism.

Students who commit plagiarism on assignments and assessments in this course will be assigned a grade of "F" and a recommendation for dismissal from the university will be forwarded to the Dean of the Education School and the GMU Honor Council.

George Mason Blackboard:

Our class will be using the new version of Courses, called **Bb Learn 9.1 (Bb 9.1)**.

To log in, visit the myMason portal site at <http://mymason.gmu.edu>.

If you cannot log into Blackboard, contact the **ITU Support Center** at **(703) 993-8870**.

Tentative Course Schedule

Week	Date	Topic	Reading/Preparation	Due
1	1/20	Class introduction—Orientation <ul style="list-style-type: none"> • Review: <ul style="list-style-type: none"> ○ Considering data sources and data types. Numeric descriptions of data sets. ○ Data representation. Graphic display of data. 	None I will present material from: Chapters 1 & 2	--
2	1/27	<ul style="list-style-type: none"> • Univariate population parameters and sample statistics • Normal distribution and standard scores 	Chapters 3 & 4	<ul style="list-style-type: none"> • Excel orientation exercise from week 1 (Online submission of EXCEL spreadsheet)
3	2/03	<ul style="list-style-type: none"> • Probability and sample statistics • Hypothesis testing for a single mean 	Chapters 5 & 6	Exercises loaded on class website
4	2/10	<ul style="list-style-type: none"> • Statistical Inference: <ul style="list-style-type: none"> ○ Confidence Intervals, ○ Significance Testing, ○ Statistical Power 	Chapters 6 & 7	Exercises loaded on class website Quiz 1
5	2/17	<ul style="list-style-type: none"> • Inference for Proportions: Single proportions, Comparing Two Proportions, <ul style="list-style-type: none"> ○ Normal distributions and ○ Chi-Square distributions 	Chapter 8	Exercises loaded on class website Quiz 2
6	2/24	<ul style="list-style-type: none"> • Bivariate measures of association (correlation) <ul style="list-style-type: none"> ○ Scatterplot ○ Correlation coefficients ○ Inference about correlation coefficients 	Chapter 10	Exercises loaded on class website
7	3/03	<ul style="list-style-type: none"> • One-Way Analysis of Variance 	Chapters 11 & 12	Exercises loaded on class website Quiz 3
8	3/10	<i>Spring Break</i>		

Week	Date	Topic	Reading/Preparation	Due
9	3/17	<ul style="list-style-type: none"> • Factorial ANOVA models <ul style="list-style-type: none"> ○ Two-way ANOVA ○ Three-way ANOVA ○ ANOVA with unequal n 	Chapter 13	Exercises loaded on class website Quiz 4
10	3/24	Analysis of Covariance (ANCOVA)	Chapter 14	Exercises loaded on class website Quiz 5
11	3/31	Inference in Simple Linear Regression	Chapter 17	Exercises loaded on class website
12	4/07	Intro to Multiple Regression	Chapter 18	Exercises loaded on class website Quiz 6
13	4/14	Random and Mixed Effects Analysis of Variance Models	Chapter 15	Exercises loaded on class website Quiz 7
14	4/21	Logistic Regression	Chapter 19	Exercises loaded on class website
15	4/28	Open day for review and cleaning up loose ends		Exercises loaded on class website
16	5/05	<i>Reading Day</i>		
17	5/12	Final Exam	Comprehensive (It kind of has to be, don't you think?) Due by 8:00 PM	

Bibliography

Readings for this course:

- American Psychological Association. (2009). *Publication manual of the American Psychological Association* (6th ed.). Washington, DC: Author.
- Cohen, J. (1992). A power primer. *Psychological Bulletin*, 112(1), 155-159. doi: 10.1037/0033-2909.112.1.155
- Cohen, J. (2003). A power primer *Methodological issues & strategies in clinical research* (3rd ed.). (pp. 427-436): Washington, DC, US: American Psychological Association. (This is a reprint of Cohen's 1992 paper of the same name posted on our website.)
- Davidian, M., & Louis, T. A. (2012). Why statistics? *Science*, 336(6077), 12. doi: 10.1126/science.1218685
- Durlak, J. A. (2009). How to select, calculate, and interpret effect sizes. *Journal of Pediatric Psychology*. doi: 10.1093/jpepsy/jsp004
- Moore, D. S., McCabe, G. P., & Craig, B. A. (2012). *Introduction to the practice of statistics* (7th ed.). New York: W.H. Freeman.
- or
- Moore, D. S., McCabe, G. P., & Craig, B. A. (2014). *Introduction to the practice of statistics* (8th ed.). New York: W.H. Freeman.

Optional References that *might* help **during** this course:

- Cronk, B. C. (2012). *How to use SPSS: A step-by-step guide to analysis and interpretation* (7th edition). Los Angeles, CA.: Pyrczak Publishing.
- Field, A. P. (2009). *Discovering statistics using SPSS: (and sex and drugs and rock 'n' roll)* (3rd ed.). Los Angeles: SAGE. (This book is hilarious, given my sense of humor, consider yourself warned, it also includes SPSS syntax and examples of text for reporting results. Highly recommended.)

Great stuff to read **after** this course captures your imagination (and how could it not?):

- Abelson, R. P. (1995). *Statistics as principled argument*. Hillsdale, NJ: Erlbaum Associates.
- Brown, P. C., Roediger, H. L., III, & McDaniel, M. A. (2014). *Make it stick: The science of successful learning*. Cambridge, MA: The Belknap Press of Harvard University Press.
- Cooper, H. M., Hedges, L. V., & Valentine, J. C. (2009). *The handbook of research synthesis and meta-analysis* (2nd ed.). New York: Russell Sage Foundation.
- Ellenberg, J. (2014). *How not to be wrong: The power of mathematical thinking*. New York: The Penguin Press. (This book was written by the mathematical consultant for the TV show, *Numbers*. If you liked that show, you will probably enjoy this book. More about using mathematical reasoning and logic than statistical formulae. I think it is a great book!)
- Hedges, L. V., & Rhoads, C. (2010). *Statistical power analysis in education research*. Washington, DC: U.S Department of Education.
- Huck, S. W. (2009). *Statistical misconceptions*. New York: Routledge.
- Hunter, J. E., & Schmidt, F. L. (2004). *Methods of meta-analysis: Correcting error and bias in research findings* (2nd ed.). Thousand Oaks, Calif.: Sage.
- Lipsey, M. W., & Wilson, D. B. (2001). *Practical meta-analysis*. Thousand Oaks, Calif.: Sage Publications.

- Pearson, R. W. (2010). *Statistical persuasion: How to collect, analyze, and present data-- accurately, honestly, and persuasively*. Los Angeles: Sage.
- Thompson, B. (2004). *Exploratory and confirmatory factor analysis: Understanding concepts and applications* (1st ed.). Washington, DC: American Psychological Association.
- Thompson, B. (2006). *Foundations of behavioral statistics: An insight-based approach*. New York: Guilford Press. (This is a fantastic book if you are really wanting to understand this stuff deeply.)