Graduate School of Education
Program: Doctoral Studies in Education
Spring Semester, 2014
SYLLABUS

Course title: **EDRS 811-002: Quantitative Methods in Education**
CRN: 13643 Three Credits
Meetings: Thompson Hall 318
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: 2:00 – 4:00 Monday and 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 "failsafe" 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.[1]
- 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.

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[1] This information is not contained in your textbook. It will be provided in supplemental readings.

- Explain and apply the concept of "prediction interval."
- Conduct analysis of variance for regression.
- Explain the difference between linear and non-linear 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 and carry out and interpret the statistical procedures for two-way ANOVA.
- 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.

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
Moore, D. S., McCabe, G. P., & Craig, B. A. (2012). *Introduction to the practice of statistics* (7th ed.). New York: W.H. Freeman.*

      Hardcover: ISBN13: 978-1-4292-4020-8ISBN10: 1-4292-4020-2

      Paper:ISBN13: 978-1-4292-7407-4 ISBN10: 1-429274070-4

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

* There are extended and international versions of this text. Both will work for our purposes but the page numbers are a little different for the sections. Also, some of the assigned problems are different from the standard version. We can work around that, so get the one that is least expensive. Moore, et al., is a very useful text and I recommend buying rather than renting it. That choice, of course, is yours. There is also a loose leaf format for the text. I find that to be the most convenient but previous students have disagreed with me frequently enough that I only point out

that it is available for those who wish to seek it out.

STATISTICAL SOFTWARE
We will use the Excel spreadsheet and SPSS extensively. You probably have access to Excel on your 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 your distance away from campus makes coming over to do computations on university machines inconvenient, it might be worth looking into a student version of SPSS at Patriot computers. 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.

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 Requirements[2]:
It is expected that each person enrolled in this class will:
1. Read all assigned materials for the course.
2. Attend each class session[3] 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 take home exam[4].

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

In Class/HOMEWORK ASSIGNMENTS
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 half 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.

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

3   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.

4   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.

RUBRIC For Reporting Of Data Exercises
Adequate report (2 points): Submitted on time; reflects a score of 90% or greater.
Marginal report (1 point): Score of 80 to 89% reflects lack of content knowledge.
Inadequate report (0 points): Score below 80% or not submitted on time.

RUBRIC FOR MID-TRERM and 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

Reporting results exercises	20 pts	
Homework assignments	Expected, feedback but no points awarded for assignments.	
Mid-Term Examination	40 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

Reporting Results Exercises

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.

COLLEGE OF EDUCATION AND HUMAN DEVELOPMENT
STATEMENT OF EXPECTATIONS:

GMU Policies and Resources for Students

- Students must adhere to the guidelines of the George Mason University Honor Code [See http://oai.gmu.edu/honor-code/].
- Students must follow the university policy for Responsible Use of Computing [See http://universitypolicy.gmu.edu/1301gen.html].
- 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.
- 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/].
- 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/].
- Students must follow the university policy stating that all sound emitting devices shall be turned off during class unless otherwise authorized by the instructor.
- 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/].
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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 additional information on the College of Education and Human Development, Graduate School of Education, please visit our website [See http://gse.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	1/23	Class introduction--Orientation	None	--
2	1/30	• Considering data sources and data types. Numeric descriptions of data sets. • Data relationships and characteristics: Scatterplots, correlation,	Chapters 1 & 2a (pp.1-108)	• Excel orientation exercise from week 1 (Online submission of EXCEL spreadsheet)
3	2/06	• Data relationships and characteristics: least squares regression, and two-way tables. • Designing experiments and producing data.	Chapters 2b & 3 (pp. 108 – 226)	Exercises 1.16, 1.34, 1.70, 1.114, 1.126, 1. 2.18, 2.24, 2.48
.70	2/13	Probability and randomness	Chapter 4 (pp. 227 - 296)	Exercises 2.66, 2.94, 2.124, 2.138, 3.52, 3.76, 3.84, 3.94
4	2/20	Sampling distributions Statistical Inference: Confidence Intervals	Chapter 5 (pp. 297 - 339) Chapter 6a (pp. 341 - 360	Exercises 4.2, 4.38, 4.42, 4.56, 4.62, 4.72, 4.78, 4.86, 4.114, 4.122
5	2/27	Statistical Inference: Confidence Intervals, Significance Testing, Statistical Power	Chapter 6b (pp. 360 - 402)	Exercises 5.12, 5.18, 5.54, 5.56, 6.10, 6.14, 6.26, 6.42
6	3/06	**Midterm examination**	**All materials to date**	Exercises 6.50, 6.52, 6.56, 6.64, 6 92, 6.93, 6.94, 6.104 **Take Home** (If you have questions before beginning the exam, I will be available to meet with you during class time. If everyone is set, we will not meet. Please let me know if you wish to meet with me during this time.)
7	3/13	Mason Spring Break	You are more than ready!	Catch up on your work and relax a little. **Midterm Due 3/16 @ 11:59 PM**

Week	Date	Topic	Reading/Preparation	Due
8	3/20	Inference for Distributions: Inference re: the mean of a population, Comparing two means	Chapter 7 (pp. 403 – 472)	
9	3/27	Inference for Proportions: Single proportions, Comparing Two Proportions	Chapter 8 (pp. 473 - 510)	Exercises 7.023, 7.24, 7.30, 7.66, 7.84, 7.118
10	4/03	Analysis of Two-Way Tables: Inference for two-way tables (Chi-Square), Goodness of Fit	Chapter 9	Exercises 8.20, 8.28, 8.42, 8.68
11	4/10	Inference in Simple Linear Regression	Chapter 10	
12	4/17	No class meeting		Practice using the software & work ahead if you are brave!
13	4/24	Intro to Multiple Regression	Chapter 11	Exercises 10.10, 10.12, 10.20, 10.28, 10.34.
14	5/01	One-Way Analysis of Variance	Chapter 12	Exercises 11.12, 11.30, 11.31, 11.32, 11.51, 11.52
15	5/08	**Final Exam**		Exercises 12.10, 12.14, 12.34, 12.42, 12.43, 12.62 **Comprehensive** (It kind of has to be, don't you think?)

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.

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 wanred, 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.

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.

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.)