Graduate School of Education
Program: Doctoral Studies in Education
Spring Semester, 2012
SYLLABUS

Course title: **EDRS 811: Quantitative Methods in Education**
  Meetings: Thompson Hall L014
   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.

Course Description
The purpose of this course is to develop students' understanding of statistical ideas and procedures required for conducting statistical analyses and applications of quantitative methods in the practice of educational research. The course will reinforce and build upon concepts and skills acquired in EDRS 620. Students will learn through a combination of reading assignments, 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 (i.e., journal articles), to analyze data using the Statistical Package for Social Sciences (SPSS), and to provide written reports of methodology and results.

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

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.[2]
- 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 Text
Moore, D. S., McCabe, G. P., & Craig, B. A. (2012). *Introduction to the practice of statistics* (7th ed.). New York: W.H. Freeman.

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

American Psychological Association. (2009). *Publication manual of the American Psychological Association* (6th ed.). Washington, DC: Author.
ISBN-13: 978-1433805615   **ISBN-10:** 1433805618

STATISTICAL SOFTWARE
Students are *not* required to purchase statistical software for this course. However, assignments will require the use of SPSS. This program is available for use in the computer labs on campus.

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[2] The information for this part of the class is not contained in the textbook but is available on the publisher's website.

I do not recommend purchase or lease of the software unless it is extraordinarily difficult for you to come to campus to use the university-owned and maintained software. For some people, however, the cost may be offset by their travel burden and competing time obligations. For those members of the class who do not believe me or for other reasons 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).

COLLEGE OF EDUCATION AND HUMAN DEVELOPMENT
STATEMENT OF EXPECTATIONS:

Student Expectations
- Students must adhere to the guidelines of the George Mason University Honor Code [See http://academicintegrity.gmu.edu/honorcode/].
- 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 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.
- Students must follow the university policy stating that all sound emitting devices shall be turned off during class unless otherwise authorized by the instructor.
- Students are expected to exhibit professional behaviors and dispositions at all times.

Campus Resources
- 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/].
- 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/].

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**.

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:

<div align="center">

\<your-last-name-here_assignment_one\>
or
\<your-last-name-here_midterm\>

</div>

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[3]:
It is expected that each person enrolled in this class will:
1. Read all assigned materials for the course.
2. Attend each class session[4] and participate in classroom activities that reflect critical reading of materials.
3. Complete homework 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).

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

4   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 he or she understands the material missed on the night of an absence.

4. Complete one in-class midterm examination and one take home exam[5].

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

RUBRIC FOR In Class/HOMEWORK ASSIGNMENTS
Adequate assignment (2 point): Assignment is thorough, thoughtful, correctly done, and submitted on time.
Marginal assignment (1 point): Assignment is carelessly prepared, not thoughtful, or incomplete.
Inadequate assignment (0 points): Assignment has little or no value, is characterized by inaccurate and incomplete work, or is not submitted on time.

RUBRIC FOR QUIZES
Adequate quiz score (1 point): Submitted on time; reflects a score of 90% or greater.
Marginal quiz score (.5 point): Score of 80 to 89% reflects lack of content knowledge.
Inadequate quiz score (0 points): Score below 80% or not submitted on time.

RUBRIC FOR MID-TRERM and FINAL EXAMINATION (30 points)
Item scoring criteria:
Exemplary responses: (26 - 30 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: (20 - 24 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: (15 - 19 points) Provides some relevant information, but does not demonstrate overall a clear or complete understanding of the relevant concepts.
Inadequate response: (<14 points) Weak response that does not appear to reflect course content

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[5] 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.

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

Weekly on line or in-class quizzes	10 pts
Homework assignments	30 pts
Mid-Term Examination	30 pts
Final Examination	30 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%	

Homework Assignments

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.

Tentative Course Schedule

Week	Date	Topic	Reading/Preparation	Due
1	01/24	Class introduction--Orientation	None	--
2	01/31	• 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	02/07	• 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, 1.21, 1.33, 1.34, 1.41, 1.69, 1.70, 1.114, 1.126, 1.129, 1.131, 2.13, 2.18, 2.24, 2.47, 2.61
.70	02/14	Probability and randomness	Chapter 4 (pp. 227 - 296)	Exercises 2.66, 2.67, 2.73, 2.77, 2.87, 2.94, 2.95, 2.105, 2.121, 2.124, 2.135, 2.138, 3.17, 3.19, 3.52, 3.53, 3.76, 3.83, 3.84, 3.93, 3.94
4	02/21	Sampling distributions Statistical Inference: Confidence Intervals	Chapter 5 (pp. 297 - 339) Chapter 6b (pp. 341 - 360	Exercises 4.2, 4.3, 4.19, 4.23, 4.25, 4.38, 4.42, 4.49, 4.53, 4.56, 4.61, 4.62, 4.72, 4.73, 4.75, 4.78, 4.86, 4.103, 4.105, 4.114, 4.102, 4.112, 4.113, 4.117, 4.122
5	02/28	Statistical Inference: Confidence Intervals, Significance Testing, Statistical Power	Chapter 6b (pp. 360 - 402)	Exercises 5.7, 5.9, 5.12, 5.18, 5.23, 5.41, 5.43, 5.54, 5.56, 5.61, 5.67, 6.10, 6.11, 6.14, 6.25, 6.34
6	03/06			Exercises 6.50, 6.51, 6.53, 6.56, 6.59, 6.77, 6.80, 6.89, 6.91, 6.92, 6.93, 6.94, 6.105, 6.110, 6.126, (If you submit these responses online by Friday, 03/02, I will return them to you before the end of the weekend.)
		Midterm examination	**All materials to date**	**In class**
7	03/13	No class—Mason Spring Break	You are more than ready!	Catch up on your work and relax a little.
8	03/20	Inference for Distributions: Inference re: the mean of a population, Comparing two means	Chapter 7 (pp. 403 – 472)	TBA
9	03/27	Inference for Proportions: Single proportions, Comparing Two Proportions	Chapter 8 (pp. 473 - 510)	TBA

Week	Date	Topic	Reading/Preparation	Due
10	04/03	Analysis of Two-Way Tables: Inference for two-way tables (Chi-Square), Goodness of Fit	Chapter 9 & 10.1 (pp. 511 - 564)	TBA
11	04/10	Inference in Regression: Simple linear regression & Multiple	Chapter 10.2— & 11: (pp 565 - 622)	TBA
12	04/17	One-Way Analysis of Variance	Chapter 12 (pp. 623 – 667)	TBA
13	04/24	• Two-Way Analysis of Variance • Introduction to Nonparametric statistics	Chapter 13 (pp. 669 – 694) Online chapter 15	TBA
13	05/01	No class meeting.		• Assignment completion and summary
14	05/08	No Class—Mason Reading Day		
15	05/15	**Final Exam**		**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.)

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.

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

Abelson, R. P. (1995). *Statistics as principled argument.* Hillsdale, N.J.: L. 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.