Introduction to Quantitative Research Methods in Education
Education 793
Fall 2013
Syllabus

Professor

Dr. Peter Riley Bahr
School of Education 2108D
prbahr@umich.edu

Graduate Student Instructors (GSIs)

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Course Description

This course provides an introduction to quantitative reasoning in empirical research, particularly the execution and interpretation of commonly used descriptive and inferential statistical techniques.

Knowledge Goals

- basic approaches to sampling
- basic terminology of statistics
- levels of measurement
- frequency distributions
- bar graphs
- histograms
- stem-and-leaf plots
- univariate measures of central tendency
- univariate measures of dispersion
- outliers
- sampling distribution
- point estimates
- types of inferential error
- confidence interval for a mean
- confidence interval for a proportion
- test of significance of a mean
- test of significance of a proportion
- test of difference of two means
- test of difference of two proportions
- one-way analysis of variance
- contingency tables
- odds ratios
- chi-squared
- gamma
- scatter plots
- ordinary least squares regression
- linear correlation coefficient
- coefficient of determination
- dummy variables in regression
- multiple linear regression
- causal diagrams
- nested regression models
Schedule

Class Meeting @ School of Education, Room 2229  Wednesdays 1:00pm–4:00pm
Lab with Samuels @ Angell/Mason Hall, Room G444B  Thursdays 9:00am–11:00am
Lab with Kim @ Angell/Mason Hall, Room G444B  Thursdays 1:00pm–3:00pm

Bahr’s Office Hours  by appointment
Kim’s Office Hours  Tuesdays 9:00am–12:00pm
Samuels’ Office Hours  Mondays 9:00am–12:00pm

Assignment #1 Due  12:00pm on Friday, September 13
Assignment #1 Returned  12:00pm on Monday, September 16
Exam #1  Wednesday, September 18
Assignment #2 Due  12:00pm on Friday, October 11
Assignment #2 Returned  12:00pm on Monday, October 14
Exam #2  Wednesday, October 16
Deadline for Meeting #1 with GSIs concerning Final Paper  Friday, November 8
Assignment #3 Due  12:00pm on Friday, November 8
Assignment #3 Returned  12:00pm on Monday, November 11
Exam #3  Wednesday, November 13
Deadline for Meeting #2 with GSIs concerning Final Paper  Friday, December 6
Assignment #4 Due  12:00pm on Friday, December 6
Assignment #4 Returned  12:00pm on Monday, December 9
Exam #4  Wednesday, December 11
Final Paper Due  12:00pm on Monday, December 16

Required Texts


Other Required Materials and Resources

- Daily access to your U-M email account and to ctools.umich.edu.
- One pencil (pencil, not pen, must be used to complete the exams)
- One basic hand calculator for class and lab exercises, assignments, and exams
- One deck of standard playing cards
- One flash drive for use in the lab
Grading

The components of your course grade include:

- Assignments (4 assignments @ 5 points each) 20 points
- Exam #1 10 points
- Exam #2 15 points
- Exam #3 15 points
- Exam #4 15 points
- Final Paper 25 points

Total of 100 points

Course grades will be determined by the total number of points achieved, as follows:

<table>
<thead>
<tr>
<th>Points Range</th>
<th>Grade</th>
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<tbody>
<tr>
<td>98–100</td>
<td>A+</td>
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<tr>
<td>92–97</td>
<td>A</td>
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<tr>
<td>90–91</td>
<td>A-</td>
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<td>88–89</td>
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<td>82–87</td>
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<td>80–81</td>
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<td>68–69</td>
<td>D+</td>
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<td>62–67</td>
<td>D</td>
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<td>&lt; 60</td>
<td>F</td>
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Participation

Learning is a collaborative process, and this course is structured around the assumption of active collaboration and co-ownership. Although the Professor will take responsibility for the overall design and direction of the course, all participants in the course must share in the responsibility of creating a rich intellectual environment and a fruitful dialogue. Therefore, please read each assigned reading carefully and come to each class and lab meeting prepared to participate actively and respectfully, to ask questions, to discuss the salient issues and problems that emerge from the readings, and to utilize and contribute your knowledge and professional experiences in addressing the course material. Active, thoughtful, respectful participation and contribution in class and lab activities are required in this course.

Assignments

Four assignments will be made available to you via CTools. Each assignment will provide to you the opportunity to master the statistical techniques and interpretive logic that will be addressed in the corresponding exam. Each assignment is due in hardcopy (paper) format in your Graduate Student Instructor’s mailbox (in Room 2117 of the School of Education) no later than 12:00pm on the Friday prior to the corresponding exam. Each assignment will be returned no later than 12:00pm on the following Monday (i.e., within 72 hours). Although you will receive feedback on your work, each assignment will be graded only as “complete” (5 points) or “incomplete” (0 points). In other words, if you complete and submit each assignment on time, you will receive full credit even if corrections to your work are necessary. It is recommended strongly, but not required, that you write your answers to the assignment questions by hand and in pencil, as you are required to do on the exams.
Exams

Four non-comprehensive, in-class exams will be administered in this course. During each exam, you will be allowed to use a basic hand calculator and two pages (both sides of two 8.5" x 11" sheets of paper) of handwritten (not typed, photocopied, or electronically printed) notes. You will not be allowed to use the course textbooks, a computer, a graphing or programmable calculator, or any other aids during the exams. Each exam will be offered on one date only, at one time only, and in one place only, except in cases in which the Americans with Disabilities Act applies. A missed exam will result in zero credit on that exam.

Final Paper

The culmination of this course is a single paper on a topic of the student’s choosing. The paper will take the form of an empirical research manuscript of modest length. Students may work on the final paper alone or in a team of two. The requirements of the assignment are the same whether students choose to work alone or in a team. Details about the assignment are provided later in this document.

Selected Course Policies (a guide, not an exhaustive list)

Attendance

Class and lab attendance is a necessary cause, though not a sufficient cause, of participation in the course, and participation is expected and required.

Assigned Reading

The assigned reading is fundamental to this course. It is each student’s responsibility to complete all assigned reading prior to the associated class meeting and to be prepared to participate actively in class and in lab by raising questions or points of discussion about the reading.

E-Communication

It is assumed that students have read any electronic communication that is sent to them by the Professor or the GSIs within 24 hours of it being sent. Students may assume the same about electronic communication that is sent to the Professor or GSIs. However, students should anticipate that it may be as long as 72 hours before the Professor or GSIs respond to electronic communication that is sent to them.

Late Assignments and Missed Exams/Quizzes

Late assignments will not be accepted, nor will exams or quizzes be rescheduled, except under the most extreme and unusual of situations. Situations that are sufficiently extreme and unusual to warrant the acceptance of a late assignment or the rescheduling of an exam or quiz may include, but are not limited to, cataclysmic destruction of the planet by an asteroid,
abduction for a prolonged period of time by beings of extraterrestrial origin and hostile intention, widespread outbreak of zombies, or other extraordinary circumstances that would make for a good action flick with Bruce Willis or Angelina Jolie as the lead actor. Extenuating conditions of similar magnitude will be considered on a case-by-case basis.

Recording of Lectures, Labs, and Other Class Activities

Audio and/or video recording of class activities is prohibited, except as a pre-arranged accommodation for students with disabilities. Under all other circumstances, students are prohibited from using recording equipment, including cellular phones, to make recordings of lectures, labs, or other class activities.

Citations and References

The APA citation format must be employed in all documents submitted in this course, not because it is a particularly logical or user-friendly citation method, but because it is ubiquitous (and, in many cases, required) in educational research publications.

Plagiarism

Plagiarism — the intentional or unintentional use of the ideas or words of another person or organization without citing the source appropriately — is among the most stigmatizing of academic offenses. Plagiarism in any form will not be tolerated in this course and will result in a failing grade on the associated assignment and a report to the appropriate institutional authorities. Please see http://www.lib.umich.edu/shapiro-undergraduate-library/understanding-plagiarism-and-academic-integrity for more information about plagiarism.

Retention of Documents

Documents that are submitted by students in this course that are not returned to students will be retained by the Professor until May 31, 2014, and then discarded.

Accommodations for Students with Disabilities

If you need accommodations for a disability, please speak with me about the matter as early in the semester as possible (preferably within the first week). As soon as you make me aware of your needs, we will work with the Office of Services for Students with Disabilities to determine appropriate academic accommodations. Please see http://ssd.umich.edu/ for more information about services for students with disabilities.

Students’ Rights and Responsibilities

Membership in the academic community that is the University of Michigan affords students a number of important rights, as well as a number of important responsibilities. Please see http://www.oscr.umich.edu/statement/ for information about these rights and responsibilities.
## Schedule of Topics, Readings, and Exams

<table>
<thead>
<tr>
<th>Date</th>
<th>Topic</th>
<th>Readings</th>
<th>Exams</th>
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| Wed 04-Sept-13 | Course Introduction; Terminology; Data Matrices; Frequency Distributions; Measures of Central Tendency; Measures of Dispersion; Outliers | Agresti & Finlay, chap 1-3  
Acock, chap 1-2 | none         |
| Wed 11-Sept-13 | Describing Data with Graphs; Probabilities; Normal Probability Distribution and Percentiles; Sampling Distributions; z-scores | Agresti & Finlay, chap 4  
Acock, chap 3-5  
*Bring a deck of standard playing cards to class* | none         |
| Wed 18-Sept-13 | none                                                                 | no additional reading                                                   | Exam #1      |
| Wed 25-Sept-13 | Hypothesis Testing; Alpha; t-distribution; Tests of Significance of Means; Point Estimates; Confidence Intervals for Means | Agresti & Finlay, chap 5-6  
Acock, pgs. 147-165  
*Bring a deck of standard playing cards to class* | none         |
| Wed 02-Oct-13  | Tests of Significance for Proportions; Confidence Intervals for Proportions; Tests of Differences in Means and Proportions; Confidence Intervals for Differences in Means and Proportions | Agresti & Finlay, chap 7  
*Bring a deck of standard playing cards to class* | none         |
| Wed 09-Oct-13  | One-Way Analysis of Variance                                          | Agresti & Finlay, pgs. 369-378  
Acock, pgs. 205-218  
Bahr (2007) [bring to class] | none         |
| Wed 16-Oct-13  | none                                                                 | no additional reading                                                   | Exam #2      |
| Wed 23-Oct-13  | Contingency Tables; Chi-Squared; Adjusted Residuals for Contingency Tables; Odds Ratios; Gamma | Agresti & Finlay, chap 8  
Acock, pgs. 119-135 | none         |
| Wed 30-Oct-13  | Scatter Plots; Ordinary Least Squares Regression; Pearson’s Correlation Coefficient; Coefficient of Determination | Agresti & Finlay, chap 9  
Acock, chap 8 | none         |
| Wed 06-Nov-13  | Assumptions of Linear Regression; Linear Regression with a Dichotomous or Categorical Independent Variable (i.e., Dummy Variables) | Agresti & Finlay, chap 10  
Agresti & Finlay, pgs. 379-381 | none         |
| Wed 13-Nov-13  | none                                                                 | no additional reading                                                   | Exam #3      |
| Wed 20-Nov-13  | Multiple Linear Regression                                            | Agresti & Finlay, chap 11  
Agresti & Finlay, pgs. 413-419  
Acock, pgs. 249-289 | none         |
| Wed 27-Nov-13  | No Class Meeting (Thanksgiving Holiday)                               | no additional reading                                                   | none         |
Wed 04-Dec-13 | Causal Diagrams; Nested Regression Models; Causal Interpretation of Regression | Bahr (2007) [bring to class] | none
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Wed 11-Dec-13 | none | no additional reading | Exam #4
Mon 16-Dec-13 | Final Paper Due at 12:00pm | --- | ---

References

Introduction to Quantitative Research Methods in Education
Education 793
Fall 2013
Final Paper

Description

The culmination of this course is a single paper on a topic of the student’s choosing. The paper will take the form of an empirical research manuscript of modest length, including all ten of the following sections:

1. introduction
2. literature review
3. hypotheses
4. data
5. measures
6. method of analysis
7. results
8. discussion of findings
9. references
10. tables and figures

Students may work on the paper alone or in a team of not more than two. The requirements of the assignment are the same whether students choose to work alone or in a team.

Due Dates

1. Each student (or team) must meet with his/her GSI to discuss his/her research plan no later than Friday, November 8, 2013. The purpose of the meeting is to refine the student’s goals for the completion of the project. Appointments are recommended.

2. Each student (or team) must meet with his/her GSI to review draft materials for the final paper no later than Friday, December 6, 2013. Appointments are required. Note that, generally speaking, this is the only time that a member of the instructional team will review a draft of the final paper. Therefore, it is in each student’s (or team’s) best interest to provide a draft that is as complete and polished as possible.

3. The final paper is due at noon on Monday, December 16, 2013.

Submission Instructions

1. Prepare a single electronic copy of the paper. The electronic copy of the paper must be in Microsoft Word format. Use the following conventions in naming the electronic copy of the paper. Note that you should replace the word “last name” with your last name.

   finalpaper_lastname.doc (if working alone)
   finalpaper_lastname#1_lastname#2.doc (if working in a team)

2. Prepare a single printed copy (one copy per student or per team) of the paper. The printed copy of the paper must be stapled.
3. Upload the electronic copy of the paper into the “Drop Box” on the course CTools website **no later than 12:00pm on December 16, 2013**. If you are working in a team, the electronic copy should be uploaded into only one drop box.

4. Place the printed copy of the paper in your GSI’s mailbox in the CSHPE main office **no later than 12:00pm on December 16, 2013**.

**Requirements**

At a minimum, the research that underlies the content of the paper must meet all of the following criteria:

1. use data from the dataset provided in the course
2. use at least three variables in the execution of the required statistical methods
3. use a statistical software package to execute at least one statistical method from each of the following three groups:
   - Group #1: t-test comparison of two means or one-way analysis of variance
   - Group #2: z-test comparison of two proportions or chi-squared
   - Group #3: multiple regression of a quantitative dependent variable

**NOTE:** Requirement #1 demands a quantitative dependent variable and a categorical or dichotomous independent variable. Likewise, Requirement #3 demands a quantitative dependent variable and at least two independent variables that may be quantitative, categorical, or dichotomous. In contrast, Requirement #2 demands two categorical or dichotomous variables, though one reasonably might collapse a quantitative variable into an ordinal or dichotomous variable if doing so is analytically justified. You also are encouraged to employ other variables in your analyses, in addition to the few that are necessary to meet the requirements of the assignment.

4. provide descriptive statistics (e.g., measures of central tendency and dispersion) as appropriate to the levels of measurement of the chosen variables
5. provide at least three tables, one of which must address the descriptive statistics
6. provide at least one computer-generated graphical figure (e.g., bar graph, histogram, scatter plot)

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1 The tables may not be copied and pasted from Stata or any other statistical program. You must create your own tables and strive for professional presentation in the preparation of your tables.
Useful Websites

- http://nces.ed.gov/surveys/nels88/

Format

The final paper must meet all of the following format criteria:

1. include all ten of the sections noted in the “Description” on the first page of this assignment, in the exact order in which these sections are listed

2. not include any tables that are copied from Stata output or the output of any other statistical program (note: it is acceptable to copy graphs and figures, but not tables, from Stata output or from the output of another statistical program)

3. be not more than 3,000 words in length, excluding references, tables, and figures

4. cite at least six peer-reviewed journal articles, in addition to any other reputable sources that you deem appropriate and useful

5. employ APA-formatted citations and references

6. utilizes efficient “to the point” writing

7. be free of spelling, grammatical, and punctuation errors

8. include a title page that lists the title of the paper, the word count (excluding references, tables, and figures), the date of submission, and the full legal names of all authors

9. be typed in a 12-point Times New Roman font

10. be double-spaced

11. be left-justified (except the title page, section headings, tables, and figures)

12. be stapled

13. be printed on only one side of each page

14. have one-inch margins throughout
Description of Required Sections

Important Note: The word counts noted below are approximate and are provided only so that you will have a general sense of the relative length of the various sections of the paper.

Introduction (approximately 250 words in length)

- Provide a brief explanation of why the reader should keep reading, by addressing questions such as:
  - Why, based upon prior research, should the reader care about this topic?
  - Why is this topic important?
  - What are the implications of this topic?

- Provide a framework for the reader to understand where this paper is heading, by addressing questions such as:
  - What specific research question is being addressed in this paper?
  - How is this research question related to prior research?
  - Why should the reader care about this particular research question within the context of the larger topic?

- Describe briefly the data that you will employ in this study to address the research question that you have posed.

Literature Review (approximately 750 words in length)

- The focus of your literature review is determined by your research question.

- As it pertains to your research question, your literature review should summarize, interpret, and integrate the prior empirical work that constitutes the current state of scientific knowledge on your chosen topic.

- The literature review also lays a foundation for your hypotheses by providing the rationale for particular suppositions (i.e. hypotheses, deductions, educated guesses) concerning what you expect to find in the data that you plan to analyze.

Hypotheses (approximately 200 words in length)

- Your hypotheses should follow logically from your literature review, which itself is driven by your research question. In this section, you should seek to make your deductive logic (the justification) for your hypotheses clear to your reader. In other words, your hypotheses should follow logically from the literature that you have discussed and cited, but you should seek to make your deductive reasoning in this respect fully transparent to your reader in this section of the manuscript.

- Describe in words (not equations) the hypotheses to be tested in this study, recognizing that hypotheses always are “falsifiable” statements (i.e., statements that the evidence,
which is your analyses, either supports or contradicts but about which there can be no equivocation).

○ Note that, in research manuscripts, one tends to describe the alternative hypotheses, rather than the null hypotheses. The null hypotheses are assumed to be understood.

○ Note also that, although the literature review tends to be used to discuss broad concepts (e.g., integration, persistence, proficiency, achievement), the hypotheses inevitably must address actual variables to which the researcher has access. These variables serve to represent (indicate the degree of presence or absence of) the concepts that were addressed in the literature review and that are the focus of your research question. For example, socioeconomic status is a broad concept that often is measured with variables such as educational attainment and income. However, educational attainment and income do not fully represent and capture all aspects of the concept of socioeconomic status. Educational attainment and income serve simply as indicators of varying levels of the concept of socioeconomic status.

Data (approximately 200 words in length)

○ Describe the data to be employed in the tests of your hypotheses. Important aspects of the data include but are not limited to:
  – the source of the data,
  – the elements of which the data are composed (e.g., students, institutions),
  – the method of sampling,
  – the period of time that the data address,
  – the population, if any, to which inferences from the data may be generalized,
  – etc.

Measures (approximately 300 words in length)

○ Describe the variables that are the focus of the analysis. Important aspects of the variables include but are not limited to:
  – what concept each variable is intended to measure, represent, or indicate,
  – the level of measurement of each variable,
  – the categories of each variable that is measured as dichotomous, nominal, or ordinal,
  – the potential range of values of each variable that is measured as interval or ratio,
  – etc.

Method of Analysis (approximately 200 words in length)

○ Describe the statistical methods that you will use to test the hypotheses that you discussed earlier, making specific reference to the variables that will be employed in these tests.

○ Describe any important assumptions of these methods, and discuss the extent to which the data meet, or do not meet, these assumptions.
If the data do not meet the assumptions of a particular statistical test that you are using in your analysis, discuss the potential ramifications for the interpretation of the results of that statistical test.

**Results (approximately 400 words in length)**

- Describe the distributions of your variables, making reference to the table of descriptive statistics that you constructed and any associated figure(s).
- Describe the results of your statistical tests, making reference to the table(s) and figure(s) that you constructed to present this analysis.
- Note that you should strive at this point to describe the results of your analyses in your own words, rather than relying on Bahr’s *Guide to Statistics*.

**Discussion of Findings (approximately 700 words in length)**

- Restate your research question, briefly referencing the most important pieces of literature that you cited in your literature review.
- Restate your hypotheses, and then explain whether the evidence (your findings) from the statistical tests supports or contradicts your hypotheses.
- Tie the results of the tests with respect to your hypotheses back to your research question and to your literature review, explaining how your findings add to or reshape the understanding of the issues that you addressed in your literature review.
- Discuss the implications of your study for future research, for policy, and/or for practice with regard to your topic.
- Discuss the limitations and weaknesses of your study, the data and measures that you used, and your analytical techniques. Discuss how these limitations and weaknesses may influence the interpretation of your findings, and how researchers may resolve these limitations and weaknesses in future research on your topic.
- Provide recommendations for future research on your topic.

**References (not included in the total word count of paper)**

- Provide in APA format a complete reference list of all works cited in your paper. Do not provide references for works that are not cited in your paper.
Tables and Figures (not included in the total word count of paper)

- Provide each table and each figure on a separate page, titled and labeled appropriately, using as examples the various tables presented in the handouts provided to you in class throughout the semester.

- Go back through your paper and add the bracketed and centered notation “[insert Table X about here]” or “[insert Figure X about here]” in the place in which each table or figure should be located, substituting the designate number of the table or figure for “X”. A given table or figure should be located between paragraphs, immediately after the paragraph in which the table is first mentioned.

Appendix (not included in the total word count of paper)

- In a section labeled “Appendix 1”, provide your complete Stata “do” file, formatted in Courier New font with one-inch margins throughout. Note that the requirement to double-space the paper does not apply to this particular appendix.