Statistical Inference in Education

**EPSY 580, Section A (CRN 30296) AND Section ONL (CRN 69382)**

## Tuesdays and Thursdays 9:00 a.m. – 10:50 a.m.

**Fall, 2017**

Instructor: Dr. Cromley

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Telephone: (217) 300-1092

Office hours: Wed 3:00 pm – 5:00 pm in person or electronically via Skype (please email me your Skype handle). First come, first served (no appointments possible). Other times available by appointment.

#### Course Description (from Graduate Catalogue):

Prerequisite: EPSY480 or equivalent.

Intermediate statistical methods in education; includes probability theory, distribution theory, interval estimation, hypothesis testing, regression and correlational analysis, and analysis of variance.

**Course Outline**

This course is designed to introduce educators, counselors, and future researchers to educational statistics and research methods beyond the basic level covered in EPSY480, with an emphasis on regression and Analysis of Variance (ANOVA) models. These statistics are powerful tools for answering questions from a wide range of research designs, especially experiments and cross-sectional (one-time) research.

Regression might be used to answer questions such as

* What is the relative contribution of phonemic awareness, word reading, and oral vocabulary to reading comprehension?
* What are the effects of internalizing and externalizing problems on school achievement?
* How do quality of note-taking, hours spent studying, and self-explanation contribute to exam scores?
* After controlling for grades from the previous year, how do differences in math instruction affect achievement for the current year?
* How well do high school GPA and SAT scores predict freshman GPA?

ANOVA might be used to answer questions such as

* Which is best at increasing standardized test scores: a 10-hour test prep program, a 2-hour program, or nothing?
* For stereotype threat scores, are there differences between the sexes? between races? different effects of sex depending on the student’s race?
* Which has the best effects on a transfer measure: teaching conventions (vs. no conventions), teaching coordination (vs. no coordination), or a combination of conventions and coordination?
* Who has the lowest scores on a productive vocabulary measure: children with autism, children with Asperger’s syndrome, children with dyslexia, or matched-age students in regular education?

and many, many other questions.

The emphasis for this course is on understanding appropriate uses and the common misuses of regression and ANOVA, not on memorization.

**What I expect from you:**

You will engage in six types of activities to build your understanding:

1. Textbook and other readings (1-2 hrs./wk.)
2. Attending lectures and doing in-class exercises. **Please check Compass 2g/Blackboard for new postings at least once a week and be sure that email notifications are turned on for the course.** The course is listed on Blackboard as Statistical Inference in Educ (3 hrs./wk.)
3. Completing statistical analysis homework assignments (3-6 hrs./wk.)
4. Completing article homework assignments (1-2 hrs./wk.)
5. Preparing for and taking periodic online quizzes and in-class paper tests (1-2 hrs./wk.)
6. Practicing applying statistical concepts taught in class

These activities all reinforce each other. If you expect to learn this material well and succeed in this class, you will need to budget *at least* 8 hours per week for the course outside of class time. **Most of your learning will take place out of class meetings.** Only 4 hours/wk are in class; you need to spend twice that amount of time studying outside of class. Practice in using and interpreting statistics is key to learning and understanding it. Unlike most math-related classes you have taken, memorization will only occasionally be helpful. I expect you to apply what you learn; this means doing some thinking on your own, not just going through a series a steps that I give you.

**What you should expect from me:**

1. I will be in my office for office hours, and you can schedule other times to meet if you can't make it to office hours.
2. I will answer email promptly, usually within 2 hours but always within 24 hours. I will answer questions to clarify a topic, help with homework, or other questions or obstacles to your learning.
3. I will post clarifications or hints to Blackboard if students are having difficulty (or had difficulty) with an assignment or assessment.
4. I will return on-time assignments to you at the next class meeting. You should keep all graded assignments (except for the midterm and final exams, which I need to keep—you may come review them in my office).
5. I will grade assignments with a high level of attention to detail. Some of you will be carrying out analyses at some point in your career that can have very serious consequences (e.g., trials of therapy techniques for suicidal patients).
6. I will also be humane in my grading; if no one in the class answered a question correctly, then I did not teach it well and I will take responsibility for that.

**Course objectives:**

At the end of this course, with the aim of becoming a better consumer and user of educational statistics, students will be able to:

1. Import data into SPSS (or R packages including car) and screen for appropriate statistical assumptions
2. Conduct and interpret the results of a simple and multiple linear regression using continuous and categorical predictors, commonality analysis, and curvilinear regression, in SPSS (or R packages including car)
3. Conduct and interpret the results of a one-way and factorial ANOVA, a repeated-measures ANOVA, and a mixed (within- and between ANOVA) using SPSS (or R packages including car and ggplot)
4. Conduct the appropriate multiple comparison procedures on the above tests
5. Report all of these in proper APA style
6. Be able to identify common errors made when conducting and interpreting the above-mentioned statistical tests.
7. State the most common research designs that are appropriate for the above-mentioned statistical tests.

**Text, readings, and software:**

There are two textbooks for this course. I expect you to buy the first as soon as possible from an online bookseller; the second will be used after the midterm exam and will probably need to be purchased on the Internet.

1) Keith, T. Z. (2005). *Multiple regression and beyond.* Boston, MA: Allyn & Bacon. ISBN-13: 978-0205326440. List price $143.18, available used for less. A sheet with some minor corrections to the book should be downloaded from http://wps.ablongman.com/ab\_keith\_regression\_1/36/9410/2409109.cw/index.html

2) Howell, D. R. (2002). *Statistical methods for psychology (5th ed).* Pacific Grove, CA: Duxbury. ISBN: 0-534-37770-X. No list price (out of print)—available at a wide range of prices from online booksellers.

You will also need access to the SPSS statistical analysis program OR the free—but not straightforward—R program (PC and Mac compatible)**.** A “Personal use license” for SPSS is available from the UIUC webstore for around $70 (PC and Mac compatible). **Lack of convenient access to SPSS is not an excuse for turning in late or shoddy work.** I will explain in class how to download the free R program if that is what you choose to use.

**Access to computers:**

This course **requires** access to the following computer resources, together with basic computer literacy skills (e.g., downloading and saving a file, opening and printing files):

*Compass 2g/Blackboard*—access via the Internet on campus OR from home

*SPSS or R*—see above

A *printer* for PowerPoints, homework, SPSS or R output, and journal articles

#### Class Attendance/Video Recordings

 Students should attend class each session OR view the entire lecture from my video recording. In addition to homeworks that are due in class, course content, instruction in using software, and other material that is not in the assigned readings will be covered in class. Out of respect for all of us in the classroom, I ask that you not check email or do other computer work during class time.

 I will video-record myself at every class lecture and post the recording; lectures will be converted to an MP4 file by about noon of each class meeting day and posted to Compass 2g/Blackboard. The great advantages of this are: 1) You can watch the class any time you have Internet access, which will save some students from a long commute and prevent having to cancel class due to weather, 2) If you want to just focus on listening during class and not have to worry about taking notes, it may free up your attention to do that, 3) You can replay any segment of the class to help you with homework or studying for exams, and 4) If you are ill, you can be considerate of others’ health without compromising your learning. The disadvantages of video recording are that 1) You may miss out on learning from classmates and 2) It is almost impossible to ask questions anonymously. The recording will never capture student faces, but it will capture your voice. If you do not feel comfortable having your voice recorded, please write down your question and pass the paper to me. Student questions are a really important part of the class; if you have question, chance are other students do as well. Please don’t let anything get in the way of asking!

**Academic Dishonesty**

 It is assumed that all students understand the consequences of academic dishonesty. Honesty includes doing homework assignments independently and writing up your own results (i.e., cut-and-paste is not OK); after you have done your best with the assignment individually, you may wish to compare answers with a study group. I have not in the past hesitated to bring matters of academic dishonesty before the appropriate authorities.

 Academic dishonesty may result in a failing grade. Every student is expected to review and abide by the Academic Integrity Policy: http://education.illinois.edu/edpsy/about/academic-integrity. Please note that you are responsible for reading this policy. Ignorance is not an excuse for any academic dishonesty. Plagiarism or fair use violations will be dealt with without exceptions. http://education.illinois.edu/edpsy/academicintegrity.

The Illinois Student Code should also be considered as a part of this syllabus. Students should pay particular attention to Article 1, Part 4: Academic Integrity. Read the Code at the following URL: http://www.admin.uiuc.edu/policy/code/

If you have not used Blackboard/Compass 2g before for your courses, helpful information will be found at <https://online.illinois.edu/getting-started/learning-management-systems/illinois-compass-2g>

Evaluation:

Student grades will be earned by students’ achievement on the following assignments. Please see the weekly schedule for due dates:

|  |  |
| --- | --- |
| Statistical analysis homework assignments (6 x 5% ea.) | 30% |
| Completing article homework assignments (5 x 1% ea.) | 5%  |
| Online quizzes ([6 given minus 1 dropped = 5] x 2% ea.) | 10% |
| Midterm examination | 30% |
| Final examination | 25% |
| TOTAL | 100% |

*No Extra Credit:*

 Your course grades are based only on the above information. There will be no extra-credit opportunities. Please do not ask for exceptions.

#### Assignments

**1) Analysis homework assignments (6 x 5% ea.).** The goal of these assignments is to help you understand different statistical techniques by carrying them out on data sets that are posted on Blackboard; all homeworks for the semester are in one large Word file on Blackboard. Homework must be typed **or neatly handwritten** and handed in at the beginning of class (online students, please email these to me [scan or send a photo as needed]). **Please pay close attention to detail when you are answering questions.** Please attach all relevant parts of the printout (input and output for R), and in SPSS be sure to open and print the *Notes* boxes for all analyses (I will explain this in class). If printing output is an obstacle, please save it (from your Print menu—I know this sounds strange, but that’s where you make a pdf) as a pdf (Adobe Acrobat) file and email it to me before the assignment is due. Also, for your own protection, please make a backup copy of the homework before you turn it in to me. Unless prior arrangements are made, 5% of the grade for that assignment will be deducted for each day assignments are handed in late (online students, emailed); the “day” begins when assignments are collected at the beginning of each in-class meeting on those dates when assignments are due.

In order to encourage mastery of the material, if you wish to revise a homework assignment based on my comments, you may do so **within one week of the last date I could provide feedback (i.e., the next class meeting after the due date)**. Your grade will be based on the best score of the two submissions—original and revised.

If you have not used Blackboard before for your courses, helpful information will be found at [link here](http://www.temple.edu/cs/helpdesk/documentation/bb.htm)

Optional computation exercises (0%)

The goal of these assignments is to help you practice calculations that you may need to be able to do, and do quickly, on quizzes and exams. Anyone who chooses to hand these in (email for online students) will receive an answer key and written feedback.

2) Completing article homework assignments (5 x 1% ea.)

The goal of these assignments is to help you, in small steps, learn how to critically read some of the statistics in published journal articles in your field. Homework must be typed **or neatly handwritten**. Article homework assignments **may not** be revised for a higher grade. Unless prior arrangements are made, 5% of the grade will be deducted for each day assignments are handed in late; the “day” begins when assignments are collected in class.

3) Online quizzes (completed online by dates shown on pp. 7-8; [6 given minus 1 dropped = 5] x 2% ea. = 10%)

 There will be an online quiz lasting 15 minutes shortly before every other class meeting (approximately). Each quiz will consist of 4-6 questions of 1-2 points each for a total of 6 points, **to be completed online by Tuesdays before class meets**. You may use a printed or handwritten crib sheet with notes of up to two sides of one 8½” x 11” sheet of paper. Please have a calculator handy for quizzes. I will supply online any needed tables or other handouts. No other papers, books, electronic, Internet, help from classmates, or other resources are permitted to be used for taking quizzes. Each timed quiz will “open” on Blackboard on the Saturday morning (6 a.m.) before the quiz completion date, and will close at 5:25 pm on the quiz completion date (for example, the quiz to be completed before class on Tuesday 9/12 can be begun any time between Saturday 9/9 at 6:00 a.m. and Tuesday 9/12 at 8:40 a.m.). The lowest quiz grade will be dropped; therefore, the quiz must be completed in a single session, and no makeup quizzes are permitted. **A major goal of the quizzes is to help you figure out what you know and what you still need to study more** (to become more metacognitive about statistics).

4) Midterm (30%) and Final (25%) Examinations

 There will be an in-class paper-and-pencil midterm examination lasting one entire class period—see the calendar for the date—covering all topics up to this date, including the first class meeting. You should bring a crib sheet with notes of up to 2 sides each on three 8½” x 11” sheets of paper. Please bring a calculator to class for exams—nothing fancy is needed, just one that can calculate square roots. I will supply any needed scratch paper, tables, or other handouts. No other papers, books, or resources are permitted on exams.

 There will be an in-class paper-and-pencil final examination lasting the entire class period—see the calendar for an approximate date—in our usual classroom at our usual class time. **Please plan your winter break travel around the final exam date; I am not inclined to give an exam based on your vacation dates.** The final covers all topics since the midterm (and topics from before the midterm implicitly). You should bring a crib sheet with notes of up to 2 sides each on three 8½” x 11” sheets of paper. Please bring a calculator to class for exams. I will supply any needed scratch paper, tables, or other handouts. No other papers, books, or resources are permitted on exams. A special grading rule is in place for the final exam—raw scores of less than 66.6% on the final exam will earn a grade of F for the final.

## Important Regulations

Students are responsible for all information transmitted in the classroom. This includes lecture material that may or may not be included in the readings, announcements about deadlines or changes of deadlines, meeting course requirements, etc.

No makeup tests will be given without written documentation, e.g., a note from a physician on her/his letterhead. I will not schedule makeup exams to accommodate vacations; I will do so for conferences/other professional duties, illness, and other legitimate reasons.

Submission of all course requirements must be made directly to the course instructor, or submitted to and date-stamped by a staff member in EPSY by the beginning of class on the due date. If homeworks, etc., are merely placed in the instructor's mailbox without a date stamp from a departmental secretary, the day on which the instructor picks it up from the mailbox will be considered as the date of submission.

**Students with disabilities**

To obtain disability-related academic adjustments and/or auxiliary aids, students with disabilities must contact the course instructor and the Disability Resources and Educational Services (DRES) as soon as possible. To contact DRES you may visit 1207 S. Oak St., Champaign, call 333-4603 (V/TDD), or e-mail a message to disability@uiuc.edu.

 To insure that disability-related concerns are properly addressed from the beginning, students with disabilities who require assistance to participate in this class are asked to see the instructor as soon as possible.

Please notify me in advance if any assignment deadlines conflict with a religious observance.

**Grades will be earned according to the following system**

|  |  |  |
| --- | --- | --- |
| 96.0-100 = A+ | 93.0-95.9 = A  | 90.0-92.9 = A- |
| 86.0-89.9 = B+ | 83.0-85.9 = B  | 80.0-82.9 = B- |
| 76.0-79.9 = C+ | 73.0-75.9 = C  | 70.0-72.9 = C- |
| 66.0-69.9 = D+ | 63.0-65.9 = D  | 60.0-62.9 = D- |
| 59.9 and below = F |  |  |

# Weekly Schedule

| Date | Topic | Readings to complete before class | Assignments due in class **on** **Tuesdays\*** |
| --- | --- | --- | --- |
| 8/29 & 31Week 1 | Introduction to the course, simple linear regression, and SPSS or R | None—first day of class | None—first day of class |
| 9/5 & 7Week 2 | Multiple linear regression  | Keith Ch. 1-2 and Ch 3 pp. 46-55 | Analysis Homework 1Article Homework A |
| 9/12 & 14Week 3 | Statistical assumptions of regression, testing for | Keith Ch. 9, pp. 187-202 and Ch. 3 pp. 43-46 | Quiz 1 (Covers wks. 1-2)Optional calculation HW 1 |
| 9/19 & 21Week 4 | Review and consolidation of simple and multiple linear regression | Keith Ch. 4 | Analysis Homework 2Article Homework BOptional calc HW 2 |
| 9/26 & 28Week 5 | Dummy coding and Interactions  | Keith Ch. 6-7, focus on pp. 105-114, 125-128, 129-155, 156-160 | Quiz 2 (Covers wk. 3)Optional calc HW 3 |
| 10/3 & 5Week 6 | Hierarchical regression  | Keith Ch. 5  | Analysis Homework 3Article Homework C |
| 10/10 & 12Week 7 | Review and consolidation of interactions and hierarchical regression | Keith Ch. 8, pp. 170-179 | Quiz 3 (Covers wks 5-6)Optional calc HW 4 |
| 10/17 & 19Week 8 | Mandatory exam review 10/17Midterm exam 10/19 | None | Midterm exam **Thursday** 10/19(Covers wks 1-3 & 5-6) |
| 10/24 & 26Week 9 | Introduction to Analysis of Variance (ANOVA)—t test as an ANOVA | Howell Ch. 7, focus on pp. 178-180, 198-216and Cromley PowerPoint on *t* tests | Analysis Homework 4 Article Homework D |
| 10/31 & 11/2Week 10 | One-way ANOVA | Howell Ch. 11, ignore random models | Quiz 4 (Covers wk 9 only) Optional calc HW 5 |
| 11/7 & 9Week 11 | Multiple Comparison Procedures for ANOVA | Howell Ch. 12, pp. 370-375, 384-408 | Analysis Homework 5Article Homework E Optional calc HW 6 |
| 11/14 & 16 Week 12 | Two-way ANOVA a.k.a. factorial ANOVA | Howell Ch. 13, focus on pp. 422-456, ignore random models | Quiz 5 (Covers wks 10-11) Optional calc HW 7 |
| 11/21 & 23 | THANKSGIVING BREAK NO CLASS |
| 11/28 & 30Week 13 | Repeated measures ANOVA | Howell Ch. 14, pp. 472-480 | Analysis Homework 6 Optional calc HW 8 |
| 12/5 & 7Week 14 | Mixed ANOVA (combination of Factorial and Repeated measures) | Howell Ch. 14, pp. 480-493 | Quiz 6 (Covers wks 12-13)Optional calc HW 9 |
| 12/12Week 15 | Mandatory review session for final exam  | None | You may wish to bring your crib sheetOptional calc HW 10 |
| 12/19Week 16 | Final Exam (in our usual room at the usual time) | None | Final exam (Covers wks. 9-15) |

\* The one exception is the midterm on Thursday, 10/19

**Student Profile**

To help me customize this course to your background and interests,

please complete this page **front and back** and hand it in (online students, please email)

on the first day of class

Name: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Program (M.Ed./Ph.D., etc; Department): \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_

Advisor: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Preferred e-mail address: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Phone number (in case email does not work): \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

What year of graduate school are you in? (if first semester, write 1st; if part-time, count 18 credits as one year)\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

What type(s) of research are you interested in reading or doing, now and/or in the future?

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What school subjects/domains are you most interested in? (e.g., English, Social Studies [History], Science [Biology, Chemistry, Physics, Earth/Environmental Science], Math, Physical Education, TESOL, Special Ed., etc.)

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What ages/grades are you most interested in? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

What courses (if any) have you already taken in:

|  |  |  |
| --- | --- | --- |
| Area | Topic (software used, if applicable) | Year taken (approx., e.g., 2005) |
| Statistics  |  |  |
|  |  |  |
|  |  |  |
| Psychology  |  |  |
|  |  |  |
|  |  |  |
| Research methods  |  |  |
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|  |  |  |

**CONTINUED**

**Name: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**

Write down one or more research questions that would use a regression or ANOVA analysis. These questions could be for a study you would like to do or for a study someone has done (for example, a research article you have read or heard about).