



**EPsy 8261: Probability & Inference**  
Burton Hall 125, M,W 9:05 AM—11:35 AM  
Summer 2013

## EPsy 8261: Probability & Inference

Andrew S. Zieffler, Ph.D.

### Instructor and Teaching Assistants

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Course Website: <http://www.tc.umn.edu/~zief0002/8261.php>

### Course Description

EPsy 8261 is the first course of the two-semester Ph.D. level statistics sequence in Educational Psychology at the University of Minnesota. This course will cover statistical methods used in educational research. (See the course calendar for a more detailed list of topics that will be covered.) The course will emphasize the conceptual framework underlying these methods along with their application to education related research.

The course is applied, meaning the focus is on topics and issues pertinent to applied researchers, one of which is computing. We will devote considerable time, especially during the beginning of the course, to learning the computational skills that are, in today's world, an integral part of statistical work. This includes computations for data preparation, exploration, and analysis.

A consequence of the applied focus of the course is that the mathematical underpinnings of the methods will not be stressed (e.g. no mathematical proofs will be given in the course). When I believe that your understanding will be enhanced by knowing more about the mathematical underpinnings, I will offer (what I hope are) straightforward conceptual explanations that do not sacrifice intellectual rigor. The student wishing more mathematical rigor is referred to EPsy 8252.

Though this course is applied in nature, it is assumed that the student has at least a working knowledge of high school algebra. In addition, *it is assumed that the student has had at least one undergraduate-level or masters' level introductory statistics*



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*course.* If a student feels nervous about mathematics and has never had a statistics course, it is recommended that the student drop this course and enroll in the masters' level course sequence EPsy 5261 & 5262 (although these courses are not preparatory courses for EPsy 8261). Alternatively, the nervous student might consider dropping this course and enrolling in an appropriate college-level algebra course.

Some of our time in class will also be spent learning how to do data analysis. Good data analysis is craft knowledge; it involves more than using software to generate reams of output. Thoughtful analysis can be difficult and messy, raising delicate problems of model specification and parameter interpretation. We will confront such issues directly, offering concrete advice for sound decision making.

Finally, we will use class time to illustrate how to present statistical results in words, tables and figures. We will pay special attention to the presentation of results in the APA desired format.

### **Course Philosophy**

In my mind, statistics is more than a particular methodology used in different disciplines; it is more than a just an application of mathematics. Statistics is a principled way of thinking about the world, in particular it is a principled approach to data collection, pre- diction, and scientific inference.

Statistics is a discipline that has, like many others, undergone a tremendous amount of growth and change in the last two decades. In today's dynamic and interdisciplinary world, success in confronting new analytical issues requires both substantial knowledge of a scientific or technological area and highly flexible problem-solving strategies.

Internalizing a disciplines' way of thinking about and solving problems is a time consuming process, with the key-word being "process". It is not something that can be taught to students in a semester or even year-long course. Learning "statistics" takes much more than memorizing formulae or R functions. It requires active participation and thought in and out of the classroom. I can pose questions, direct you to resources, provide you with opportunities to learn the material, and impart what little wisdom I have, but in the end, you will have to do all of the hard work.

### **Course Requirements**

Students will be expected to develop proficiency in writing coherent summaries and interpretations of data analyzed by the methods introduced in the course. The homework assignments include problems that will help students learn the course material and software through reflection and practice.



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Submitted homework assignments must be typed—handwritten assignments will ordinarily receive no credit. Homework assignments that are submitted via e-mail without prior instructor approval will receive no credit. If approval is granted to turn in an assignment via e-mail the only acceptable format is a PDF file.

To foster cooperation and collaboration, you are permitted to form groups to talk about and work through the labs. If you work in a group, please turn in only one homework assignment with all your names on it. You do not need to join a group to be successful in this course. If you decide to work in a group, please choose your work group partners carefully as I am not willing to manage intragroup conflicts or assign varying grades within a group. If you are taking the course as S/N I strongly discourage you from joining a group unless the others members are S/N as well. If you are auditing the course I forbid you from joining a group unless you band together with other auditors (auditors hand in no work).

Homework will make up your entire course grade. Each assignment will make up an equal proportion of the grade.

## Textbook

The required textbooks for the course are the *R Graphics Cookbook* and *Presenting your Findings: A Practical Guide to Creating Tables*. I have also had the bookstore order a book entitled *Reporting Research in Psychology: How to Meet Journal Article Reporting Standards* that will serve as a good companion to the class. It should also be a useful reference for you in the future. Lastly, although I did not order it, I recommend purchasing both the *Publication Manual of the American Psychological Association (6th edition)* and *Displaying your Findings: A Practical Guide for Creating Figures, Posters, and Presentations*.

### Required

Chang, W. (2013). *R graphics cookbook*. Sebastopol, CA: O'Reilly.

Nicol, A. A., & Pexman, P. M. (2010). *Presenting your findings: A practical guide for creating tables (6th edition)*. Washington, DC: American Psychological Association.

### Optional

American Psychological Association. (2010). *Publication manual of the American Psychological Association (6th edition)*. Washington, DC: Author.

Cooper, H. (2010). *Reporting research in psychology: How to meet journal article reporting standards*. Washington, DC: American Psychological Association.



Nicol, A. A., & Pexman, P. M. (2010). *Displaying your findings: A practical guide for creating figures, posters, and presentations (6th edition)*. Washington, DC: American Psychological Association.

## Calendar

The calendar below lists the tentative dates of the lecture topics and the due dates for the homework assignments. These dates can change at the instructor's discretion.

Session	Date	Topic
1	June 17	Introduction/Introduction to R
2	June 19	Introduction to R
3	June 24	<b>ggplot2</b> and Grammar of Graphics <i>Homework 1 Due</i>
4	June 26	ANOVA Model
5	July 1	Inference for the ANOVA Model <i>Homework 2 Due</i>
6	July 3	Examining Model Assumptions
7	July 8	Effect Size <i>Homework 3 Due</i>
8	July 10	Statistical Power
9	July 15	One-Factor ANOVA
10	July 17	Unplanned Contrasts
11	July 22	Multifactor ANOVA (main effects) <i>Homework 4 Due</i>
12	July 24	Multifactor ANOVA (main effects)
13	July 29	Multifactor ANOVA (interaction effects) <i>Homework 5 Due</i>
14	July 31	Multifactor ANOVA (interaction effects)
15	Aug. 5	Random effects model ANOVA
16	Aug. 7	Random effects model ANOVA <i>Homework 6 Due</i>



## Statistical Computing & Technology

Statistical computing is an integral part of statistical work and subsequently EPsy 8261. To support your learning in this area, this course will emphasize the use of R. R is a free software environment for statistical computing and graphics. It compiles and runs on a wide variety of UNIX platforms, Windows and MacOS (<http://www.r-project.org>). I assume that everyone is comfortable using a computer to perform basic statistical analysis (although I don't assume that you have necessarily used R).

While I do teach some R programming during class time, there are also a lot of resources to help you learn how to program on your own at your own pace:

- The R code that produces the output included in each set of notes can be downloaded from the course website as a script file.
- You can download many tutorials and documentation from the Web (especially through the [Contributed Documentation](#) link on the R homepage). While students have found many useful materials online, I strongly encourage you to at least obtain the document called [simpleR](#).

EPsy 8261 is technologically intensive, both during instruction and for homework. Student difficulty with obtaining or operating the various software programs and technologies will not be acceptable as an excuse for late work. Due to the variation in computer systems and the difficulty in assessing problems via email, the instructor and TA may not be able to assist in trouble shooting all problems you may have. In these cases, contact the university Academic and Distributed Computing Services (ADCS) at <http://www1.umn.edu/adcs/help/>, or your systems administrator (if you have one).

## Downloading and Installing Software

The first course requirement is that you download and install the free R software. In order to download and install R your computer must be connected to the Internet. The latest version of R can be obtained from the R Project for Statistical Computing at <http://www.r-project.org/>

After navigating to the website click on CRAN under Download Packages on the left-hand side of the welcome screen. You must choose a server in your country of origin, called a CRAN mirror. After doing so, select the appropriate operating system for your computer—Linux, MacOS, or Windows. For Linux and MacOS, follow the directions at the top of the download page. For Windows, download the base package and install it like any other executable file. On Windows machines you might need to have “administrator” privileges to successfully install and use the program.

You also may want to get *RStudio*<sup>TM</sup>. *RStudio*<sup>TM</sup> is a powerful integrated development environment (IDE) for R which combines an intuitive user interface with cod-



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ing tools to help you get the most out of R. The desktop version of *RStudio*™ is free and can be downloaded at <http://www.rstudio.org/download/>

### **Course Website**

Supplemental notes, lab assignments, data files, etc. are available on the course website (<http://www.tc.umn.edu/~zief0002/8261.php>). The website works best with a recent version of *Mozilla Firefox*, *Google Chrome*, or *Safari*.

### **Mac Users**

If you are using a Mac and seem to have problems downloading files, hold the option-key while clicking on the link. This should download the file to your desktop. You may then need to erase the .txt suffix that is appended to the end of the file. For example, a comma separated value (CSV) file should have the suffix .csv, and not .csv.txt. If all else fails, the materials can be downloaded and printed in the Educational Psychology Computer Lab (see section below).

### **Educational Psychology Computer Lab**

The Peik Hall Computer Labs (Peik Hall 325 and Peik Hall 355) will have some open times during the week. All the machines in the computer lab of Peik Hall 325 have R. There are other various computer labs on campus that have this program installed. You are encouraged to visit the <http://www.oit.umn.edu/computerlabs/> Office of Information Technology (OIT) website to locate these computer labs.

### **Use of Personal Electronic Devices in the Classroom**

Using personal electronic devices in the classroom setting can hinder instruction and learning, not only for the student using the device but also for other students in the class. To this end, the University establishes the right of each faculty member to determine if and how personal electronic devices are allowed to be used in the classroom. For complete information, please reference: <http://policy.umn.edu/Policies/Education/Education/CLASSROOMPED.html>.

### **Email**

Email is the primary source of communication among instructors, TAs and students for this course. As such, you will be expected to check your email frequently (i.e., at least once per day). As per the University policy, “students are responsible for all information sent to them via their University assigned email account. If a student chooses to forward their University email account, he or she is responsible for all information, including attachments, sent to any other email account.”



## Evaluation of Student Performance

Grades will be based on the equal weighting of the six homework assignments. Students who wish to receive a satisfactory letter grade (S) must obtain the total points required for a B– grade; anything less will be graded as NS (not satisfactory).

Cutoff	Grade	Cutoff	Grade	Cutoff	Grade
92.5%	A	82.5%	B	72.5%	C
89.5%	A–	80.5%	B–	69.5%	C–
86.5%	B+	76.5%	C+	59.5%	D

A grade of F will be given to any student who does not complete the six labs and who has not made prior arrangements with the instructor. Your class participation will be used as way of determining grades if you are between two grades. Class participation is an important part of learning, especially in a course like EPsy 8262. If you have a question, it is likely that others do as well. I encourage active participation and course grades will take into account students who make particularly strong contributions.

Shortly after the course, you may access your grades on-line at <http://www.onestop.umn.edu>, or by calling the Gopher Student Line at 612-624-5200. Labs will be handed back in class or during office hours. Uncollected labs and final projects will be retained for six weeks after the course and then discarded.

## Miscellany Regarding Student Evaluation

### Satisfactory/Not Satisfactory (S/NS) Grading and Incompletes

Students fulfilling the Educational Psychology statistics core requirement are not allowed to take this course as satisfactory/unsatisfactory. If a student is not fulfilling a core requirement, he/she may choose to take the course on a satisfactory/unsatisfactory basis. Satisfactory performance requires an average of B– or better, and completion of all assignments.

Due to possibly differing motivation levels, it is recommended that students taking the course as S/N not be part of a group whose other members are taking the course for a letter grade. S/N people should band together.

People officially auditing the course are not allowed to join work groups or hand in any work. Unofficial audits (just “hanging out”) are also not allowed.



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An incomplete for this course will be given on a case-by-case basis and require a written agreement between the student and instructor. The University's Senate Committee on Educational Policy states, the I (incomplete) shall be assigned "at the discretion of the instructor when, *due to extraordinary circumstances* (e.g., hospitalization), a student is prevented from completing the work of the course on time." Note the italicized phrase in the previous sentence. The most valid reason for an incomplete is an unforeseen event that gravely interferes with a student's ability to perform at an adequate level. Incompletes will not be given for avoidable problems such as unwise planning. The complete language covering the incomplete can be found in the online [Policy Library](#).

You are expected to hand in all work on the dates to be determined in the course. If illness or other legitimate scenario prevents the timely handing in of work, you must inform me of this fact during office hours or via email. I reserve the right to judge what constitutes a "legitimate scenario" and I may impose a penalty for late work.

## **Mission Statements**

### **Quantitative Methods in Education (QME)**

The Quantitative Methods in Education (QME) track offers educational opportunities in both quantitative and qualitative methods with a broad array of introductory and advanced coursework. Students who choose QME as their track within educational psychology may specialize in any of four areas: measurement, evaluation, statistics, and statistics education. The goal of QME is to provide students with broad but rigorous methodological skills so that they may conduct research on methodologies, may help to train others in methodology, or will have the skills necessary to conduct research in related fields.

### **Psychological Foundations of Education Program Mission Statement**

To apply and generate knowledge of psychological processes and methodological procedures involved in learning and teaching for the betterment and improvement of humans in a wide range of situations.





### **Department of Educational Psychology Mission Statement**

Educational psychology involves the study of cognitive, emotional, and social learning processes that underlie education and human development across the lifespan. Research in educational psychology advances scientific knowledge of those processes and their application in diverse educational and community settings. The department provides training in the psychological foundations of education, research methods, and the practice and science of counseling psychology, school psychology, and special education. Faculty and students provide leadership and consultation to the state, the nation, and the international community in each area of educational psychology. The department's scholarship and teaching enhance professional practice in schools and universities, community mental health agencies, business and industrial organizations, early childhood programs, and government agencies.

*Adopted by the Dept. of Educational Psychology faculty October 27, 2004.*

### **College of Education & Human Development Mission Statement**

The new College of Education and Human Development is a world leader in discovering, creating, sharing, and applying principles and practices of multiculturalism and multidisciplinary scholarship to advance teaching and learning and to enhance the psychological, physical, and social development of children, youth, and adults across the lifespan in families, organizations, and communities.



## Policies and Statements

### University Senate Grading Policy

The University of Minnesota's grading policy can be found at <http://www.fpd.finop.umn.edu/groups/senate/documents/policy/gradingpolicy.html>. For additional information, please refer to <http://policy.umn.edu/Policies/Education/Education/GRADINGTRANSCRIPTS.html>.

The University utilizes plus and minus grading on a 4.000 cumulative grade point scale in accordance with the following:

A	4.000	Represents achievement that is outstanding relative to the level necessary to meet course requirements
A–	3.667	
B+	3.333	
B	3.000	Represents achievement that is significantly above the level necessary to meet course requirements
B–	2.667	
C+	2.333	
C	2.000	Represents achievement that meets the course requirements in every respect
C–	1.667	
D+	1.333	
D	1.000	Represents achievement that is worthy of credit even though it fails to meet fully the course requirements
S		Represents achievement that is satisfactory, which is equivalent to a C– or better
F/N		Represents failure (or no credit) and signifies that the work was either (1) completed but at a level of achievement that is not worthy of credit or (2) was not completed and there was no agreement between the instructor and the student that the student would be awarded an I (see also I).
I	Incomplete	Assigned at the discretion of the instructor when, due to extraordinary circumstances, e.g., hospitalization, a student is prevented from completing the work of the course on time. Requires a written agreement between instructor and student.



## **Senate Academic Workload Policy**

One conventional credit is hereby defined as equivalent to three hours of learning effort per week, averaged over an appropriate time interval, necessary for an average student taking that course to achieve an average grade in that course. It is expected that the academic work required of graduate and professional students will exceed three hours per credit per week or 45 hours per semester.

## **Scholastic Dishonesty**

You are expected to do your own academic work and cite sources as necessary. Failing to do so is scholastic dishonesty. Scholastic dishonesty means plagiarizing; cheating on assignments or examinations; engaging in unauthorized collaboration on academic work; taking, acquiring, or using test materials without faculty permission; submitting false or incomplete records of academic achievement; acting alone or in cooperation with another to falsify records or to obtain dishonestly grades, honors, awards, or professional endorsement; altering, forging, or misusing a University academic record; or fabricating or falsifying data, research procedures, or data analysis. (Student Conduct Code: [http://www1.umn.edu/regents/policies/academic/Student\\_Conduct\\_Code.html](http://www1.umn.edu/regents/policies/academic/Student_Conduct_Code.html)) If it is determined that a student has cheated, he or she may be given an “F” or an “N” for the course, and may face additional sanctions from the University. For additional information, please see: <http://policy.umn.edu/Policies/Education/Education/INSTRUCTORRESP.html>.

The Office for Student Conduct and Academic Integrity has compiled a useful list of Frequently Asked Questions pertaining to scholastic dishonesty: <http://www1.umn.edu/oscai/integrity/student/index.html>. If you have additional questions, please clarify with your instructor for the course. Your instructor can respond to your specific questions regarding what would constitute scholastic dishonesty in the context of a particular class—e.g., whether collaboration on assignments is permitted, requirements and methods for citing sources, if electronic aids are permitted or prohibited during an exam.

## **Student Conduct Code**

The University seeks an environment that promotes academic achievement and integrity, that is protective of free inquiry, and that serves the educational mission of the University. Similarly, the University seeks a community that is free from violence, threats, and intimidation; that is respectful of the rights, opportunities, and welfare of students, faculty, staff, and guests of the University; and that does not threaten the physical or mental health or safety of members of the University community.

As a student at the University you are expected adhere to Board of Regents Policy: Student Conduct Code. To review the Student Conduct Code, please see: [http://www1.umn.edu/regents/policies/academic/Student\\_Conduct\\_Code.html](http://www1.umn.edu/regents/policies/academic/Student_Conduct_Code.html). Note that the conduct code specifically addresses disruptive classroom conduct,



which means “engaging in behavior that substantially or repeatedly interrupts either the instructor’s ability to teach or student learning. The classroom extends to any setting where a student is engaged in work toward academic credit or satisfaction of program-based requirements or related activities.”

### **Appropriate Student Use of Class Notes and Course Materials**

Taking notes is a means of recording information but more importantly of personally absorbing and integrating the educational experience. However, broadly disseminating class notes beyond the classroom community or accepting compensation for taking and distributing classroom notes undermines instructor interests in their intellectual work product while not substantially furthering instructor and student interests in effective learning. Such actions violate shared norms and standards of the academic community. For additional information, please see: <http://policy.umn.edu/Policies/Education/Education/CLASSNOTESSTUDENTS.html>.

### **Sexual Harassment**

“Sexual harassment” means unwelcome sexual advances, requests for sexual favors, and/or other verbal or physical conduct of a sexual nature. Such conduct has the purpose or effect of unreasonably interfering with an individual’s work or academic performance or creating an intimidating, hostile, or offensive working or academic environment in any University activity or program. Such behavior is not acceptable in the University setting. For additional information, please consult Board of Regents Policy: <http://www1.umn.edu/regents/policies/humanresources/SexHarassment.html>.

### **Equity, Diversity, Equal Opportunity, and Affirmative Action**

The University will provide equal access to and opportunity in its programs and facilities, without regard to race, color, creed, religion, national origin, gender, age, marital status, disability, public assistance status, veteran status, sexual orientation, gender identity, or gender expression. For more information, please consult Board of Regents Policy: [http://www1.umn.edu/regents/policies/administrative/Equity\\_Diversity\\_EO\\_AA.html](http://www1.umn.edu/regents/policies/administrative/Equity_Diversity_EO_AA.html).

### **Disability Accommodations**

The University is committed to providing quality education to all students regardless of ability. Determining appropriate disability accommodations is a collaborative process. You as a student must register with Disability Services and provide documentation of your disability. The course instructor must provide information regarding a course’s content, methods, and essential components. The combination of this information will be used by Disability Services to determine appropriate



accommodations for a particular student in a particular course. For more information, please reference Disability Services: <http://ds.umn.edu/Students/index.html>.

### **Mental Health Services**

As a student you may experience a range of issues that can cause barriers to learning, such as strained relationships, increased anxiety, alcohol/drug problems, feeling down, difficulty concentrating and/or lack of motivation. These mental health concerns or stressful events may lead to diminished academic performance and may reduce your ability to participate in daily activities. University of Minnesota services are available to assist you. You can learn more about the broad range of confidential mental health services available on campus via the Student Mental Health Website: <http://www.mentalhealth.umn.edu>.

### **Academic Freedom and Responsibility**

Academic freedom is a cornerstone of the University. Within the scope and content of the course as defined by the instructor, it includes the freedom to discuss relevant matters in the classroom. Along with this freedom comes responsibility. Students are encouraged to develop the capacity for critical judgment and to engage in a sustained and independent search for truth. Students are free to take reasoned exception to the views offered in any course of study and to reserve judgment about matters of opinion, but they are responsible for learning the content of any course of study for which they are enrolled.\*

Reports of concerns about academic freedom are taken seriously, and there are individuals and offices available for help. Contact the instructor, the Department Chair (Susan Hupp; [shupp@umn.edu](mailto:shupp@umn.edu)), your adviser, the associate dean of the college (Kenneth R. Bartlett; [bartlett@umn.edu](mailto:bartlett@umn.edu)), or the Vice Provost for Faculty and Academic Affairs in the Office of the Provost (Arlene Carney; [carne005@umn.edu](mailto:carne005@umn.edu)).

*\*Language adapted from the American Association of University Professors "Joint Statement on Rights and Freedoms of Students".*

This publication/material is available in alternative formats upon request. Please contact the Educational Psychology Department, 250 Education Sciences Building, 612-624-6083.