EPsy 8261: Probability & Inference

Instructor and Teaching Assistants

Andrew S. Zieffler, Ph.D.
Educational Psychology
Office: Educational Sciences Building 167
Office Hours: Monday 11:00 a.m.–1:00 p.m.; and by appointment
Email: zief0002@umn.edu

Rebekah Isaak
Office Hours: Tuesday 8:00 a.m.–11:00 a.m. (Peik Hall 325); and by appointment
Email: isaak009@umn.edu

Jiyoon Park
Office Hours: Tuesday 8:00 a.m.–10:00 a.m. (Educational Sciences Building 197); and by appointment
Email: parkx666@umn.edu

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. Topics will include exploratory data analysis, probability distributions used in hypothesis testing, one- and two-sample hypothesis testing and confidence intervals, one- and two-factor, between-subjects analysis of variance for fixed effects models, post hoc contrast testing, and a priori power and sample size calculations. The course will emphasize the conceptual framework underlying these methods along with their application to education related research. The use of statistical software will be emphasized throughout the course.

The course is applied, meaning the focus is on conceptual issues important in applied research. A consequence of this focus is that the mathematical bases of the methods will not be stressed (e.g. no mathematical proofs will be given in the course). The student wishing more mathematical rigor is referred to the masters' level or Ph.D. level sequence in the Department of Statistics.

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 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.

Course Philosophy and Content

Most of our time — both inside and outside of class — will be spent learning how to do data analysis. 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.

We will devote considerable time to illustrating how to present results in words, tables and figures. 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.

Instead of formal textbook readings, each unit is supported by lectures and course notes. I will place each set of notes on the course website at least one day before the first class session in which they will be covered. It is your responsibility to download and print the notes in advance of the relevant classes and bring them with you to class meetings.

Class participation is an important part of learning, even in a relatively large lecture course like EPsy 8261. 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.

Course Website

Supplemental notes, lab assignments, data files, etc. are available on the course website (http://www.tc.umn.edu/~zief0002/8261.htm). There are some important things to note about using the website. First, the website works best with a recent version of Mozilla Firefox or Safari. Second, 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. If all else fails, the materials can be downloaded and printed in the *Educational Psychology Computer Lab* (see section below).

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) or your systems administrator (if you have one).

Many students bring laptops to class. I expect professional behavior — that means no e-mail, web surfing, instant messaging, or any other electronic activity during class. It is not only rude it is distracting to your classmates.

Lab Assignments

I believe that the only way to learn how to conduct statistical analysis is to conduct statistical analysis. To help you develop your skills, you will complete six lab assignments. Each lab is a carefully constructed exercise consisting of a research question, a dataset, and a sequenced set of questions that guide you through a complete statistical analysis. As part of each assignment, you will need to write and run an `R` program. You will also interpret the output and summarize your results in prose, tables and figures.

Students are encouraged to work in groups and consult with one another on the lab assignments. The lab assignments and data sets will be available from the course website. The lab assignments are guided, but general help with `R` is available from both myself and the TA. *We can only help you produce the output. We will not help you answer the lab questions.*

I will grade each lab using a holistic approach — I am interested in not only whether you get the "right answer" but also in your reasoning and presentation. Your writing should be clear and concise, integrating substance and statistics. To help focus your energies, I will indicate page limits for each lab. Further information on how I grade assignments can be found on the `Evaluation of Student Labs` document available on the course website.

There will be a penalty for late labs. Because I strive to read and return your assignments quickly, all labs must be turned in on time. *Late assignments will not be graded and will contribute 0 to your course grade.* Extensions will be granted only in the case of personal emergency (e.g., illness, death in the family). If you find yourself in this position, please contact me before the assignment deadline to discuss alternative arrangements.

No labs will be accepted via e-mail or turned in to the instructor's or TA's mailbox without prior instructor approval. Any lab submitted in either of these manners without prior approval will be thrown away or deleted, and will be considered to have been not submitted with the appropriate penalties applied. If approval is granted to turn in a lab via e-mail, the only acceptable format is a PDF file.

Grading

Each lab will be given a holistic grade and feedback by the instructor. This grade will be then given a score as follows,

Points	Grade	Points	Grade	Points	Grade
6	A	3	B	0	C or Below
5	A–	2	B–		
4	B+	1	C+		

You will be evaluated on the basis of your performance on the lab assignments only. While I use arithmetic computations to arrive at a first approximation of your course grade, in the end, I will look at your whole portfolio of work when assigning course grades. Grades will be assigned using the following criteria as a guideline:

Average	Grade	Average	Grade
5.3 or Above	A	2.8–3.7	B
4.7–5.2	A–	2.0–2.7	B–
3.8–5.1	B+	1.9 or Below	C

Shortly after the course, you may access your final grade online at `http://www.onestop.umn.edu`. To access your grade via telephone, call the Gopher Student Line at 612-624-5200. Uncollected labs will be retained for one semester after the course, and then discarded.

Questions regarding grading are to be directed *only to the instructor*. Please do not contact the TA regarding grading. The TA will grade all assignments under the instructor's strict parameters and thus the instructor is responsible for all issues regarding grading.

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.

Incompletes for this course will be given on a case-by-case basis. 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.

Calendar

The calendar below lists the tentative dates of the lecture topics and the due dates for the labs and the exams.

Session	Date	Topic	Reading
1	June 14	Introduction/Introduction to R *Install R on your computer*	[A6]
2	June 16	EDA *Lab 1 Due (Not Graded)*	
3	June 21	EDA	[A7]
4	June 23	Randomization & Permutation Test *Lab #2 Due*	[A4]
5	June 28	Independent Samples t-Test	
6	June 30	Parametric Bootstrap Test *Lab #3 Due*	
7	July 7	Nonparametric Bootstrap Test	
8	July 12	Interval Estimates & Effect Size	[A5]
9	July 14	Statistical Power	[A2]
10	July 19	Dependent Samples Test *Lab #4 Due*	[A1]
11	July 21	One-Factor Between-Subjects ANOVA	
12	July 26	One-Factor Between-Subjects ANOVA	[A8]
		Post Hoc Contrast Testing	
13	July 28	Factorial ANOVA *Lab #5 Due*	
14	Aug 2	Factorial ANOVA	[A3]
15	Aug 4	TBA *Lab #6 Due*	

Readings

There are several articles, papers and technical reports that you will need to read during the semester. Most of the articles themselves are accessible through the University of Minnesota library website (`http://www.lib.umn.edu`). In order to access the full text of some of the articles, you will need to log in using your University x500 username and password.

[A1] Dimitrov, D. M., & Rumrill, Jr., P. D. (2003). Pretest-posttest designs and measurement of change. *Work, 20(2),* 159–165.

[A2] Faul, F., Erdfelder, E., Lang, A.-G., & Buchner, A. (2007). G*power 3: A flexible statistical power analysis program for the social, behavioral,and biomedical sciences. *Behavior Research Methods, 39(2),* 175–191(17).

[A3] Gelman, A., Pasarica, C., & Dodhia, R. (2002). *Let's practice what we preach: Turning tables into graphs The American Statistician. 56(2),* 121–130.

[A4] Gossett, W. S. (1908). On the probable error of a mean. *Biometrika, 6,* 1–24.

[A5] Kelley, K. (2007). Confidence intervals for standardized effect sizes: Theory, application, and implementation. *Journal of Statistical Software, 20(8),* 1–24.

[A6] Kelley, K., Lai, K., & Wu, P-J. (2008). Using R for data analysis: A best practice for research. In J. Osbourne (Ed.), *Best practices in quantitative methods* (pp. 535–572). Newbury Park, CA: Sage.

[A7] Wainer, H. (1984). How to display data badly. *The American Statistician, 38(2),* 137–147.

[A8] Wilkinson, L., & Task Force on Statistical Inference, APA Board of Scientific Affairs. (1999). Statistical methods in psychology journals: Guidelines and explanations. *American Psychologist, 54(8),* 594–604.

Textbook

No textbooks are required. The instructor's website contains many supplemental resources. Students should be able to master the material by attending classes, studying the accompanying lecture notes, working (collaboratively) on the assignments, attending office hours (as they wish) and using other online resources.

That said, many students report that they would like to have a textbook for use both during the semester (to provide a different perspective on a topic being covered in class) and/or for future reference. To provide this perspective, I have ordered:

- Dalgaard, P. (2004). *Introductory statistics with R.* New York: Springer.

For students who really want to develop their statistical programming skills (which can be very helpful on the job market), you can purchase the following book:

- Gentleman, R. (2009). *R Programming for Bioinformatics.* Boca Raton, FL: Chapman & Hall/CRC.

Lastly, as you will soon see, EPsy 8262 is very writing intensive. I highly recommend the following books to help with the writing process:

- American Psychological Association. (2010). *Publication manual of the American Psychological Association (sixth edition).* Washington, DC: Author.
- Barass, R. (2002). *Scientists Must Write: A Guide to Better Writing for Scientists, Engineers and Students.* London: Routledge.
- Higham, N. J. (1998). *Handbook of Writing for the Mathematical Sciences.* Philadelphia, PA: SIAM: Society for Industrial and Applied Mathematics.

Scholastic Dishonesty

Please read the university's policy on "scholastic dishonesty". Attention to this policy is particularly important in a course like EPsy 8262, in which collaboration with other students is encouraged and the writing component is intensive. Make sure that you give appropriate credit and citations as necessary. This helps avoid the natural questions that arise when textual similarities are detected during grading. I cannot overemphasize the need for all students to monitor their own behavior. The consequences for plagiarism — an F for the course — are appropriately severe.

Educational Psychology Computer Lab

The Peik Hall Computer Labs (Peik Hall 325 and Peik Hall 355) will have some open times during the week, including all day on Fridays. 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 Office of Information Technology (OIT) website to locate these computer labs.

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.