Advanced Stat. & Research Design (830:400:01) Spring, 2012
Psychology majors only
Dr. R. Karlin

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Required Textbook:

1. Behavioral Statistics in Simple English, 6th edition. Book is in manuscript form and is posted, by chapter, with handouts and tables, on the 01:830:400:01 site on sakai (https://sakai.rutgers.edu). Although copyrighted, there is no charge for these materials.

2. Sprinthall, R. (2009). *SPSS from A to Z: A brief step-by-step manual*. Boston, MA: Pearson Education. This boring, but useful pamphlet/book is available on Amazon for $31 new.

Other good books to have on your shelf:

1. Rosenthal , R. & Rosnow, R. (2008). *Essentials of behavioral research: Methods and data analysis. 3rd edition.* New York:McGraw-Hill.
2. Cohen, J. (1988). *Statistical power analysis for the behavioral sciences. 2nd edition.* Hillsdale, NJ: Erlbaum. 3. Gamst, G., Meyers, L. & Guarino, A. (2008) *Analysis of variance designs: A conceptual and computational approach with SPSS and SAS.* New York: Cambridge University Press.

As advanced students you are becoming part of a conversation about things you care about. It is a rational conversation (most of the time) whose rules require that we put our ideas to an empirical test. Such tests generate data of a variety of kinds, usually data that can be expressed in numbers. Data almost always have a story to tell. They await the thoughtful analyst to understand and express their story.

Like any artisan, the data analyst requires tools. However, the possession of a hammer and saw does not make someone a carpenter. Similarly, the possession of a computer program like SPSS or SAS and knowledge of the appropriate statistical tests does not make someone a data analyst. Tools are necessary, but not sufficient, to discover the story in the data.

The text I wrote is largely about tools. It was written for the required undergraduate course in statistics. The vast majority of students taking that course will never analyze meaningful data. All of you will have taken that course or its equivalent. Of course, I will expect you to review those tools and understand when and how they can be used. However, more importantly, I will ask you to understand the (relatively simple) principles that underlie each statistical test. **This will allow you to invent each statistical test you learn simply from the logic of the situation.** Your midterm and final exams will examine your ability to do that.

A subsidiary goal is to give you a basic orientation to data analysis. To carefully analyze data, you have to know the numbers your research generates and how they go together. You have to see patterns, stabilize them, and use a statistical procedure that allows you to talk about the pattern. Remember, computers are great at crunching numbers, but lousy at pattern recognition. You on the other hand, are far worse than a computer at number crunching, but are great pattern recognizers. **But you won't recognize the patterns without getting your hands dirty with the data.**

Graphic presentations are often useful in forcing you to get your hands dirty. When we talk about correlation, I will often say “Plot the dots.” That means make a scattergram on t axes and look at the pattern. See what effects outliers are having on your data, and so on. This holds for all types of data analysis. Get as close to the raw numbers as possible. Then look at simple bivariate statistics (on which we will spend most of our time this semester), not multivariate computer printouts. For example, compute a correlation matrix and look at which variables go together without mathematical controls before you turn to multiple regression, factor analysis and/or SEM. Forget .05 while doing so; look for patterns. The computer can keep your hands quite clean. Don’t let it.

Final Grades: The course is graded A, B+, B and C. C is essentially a failing grade. Usually, here are about 25 students in this class. I would be very happy to be able to give 20 As and 5 B+ grades. Of course, I am willing to give 5 Bs and 20 Cs. If you are good at math, most of this course will be ridiculously easy. Try not to get too bored. Go to study group meetings and help anyone who is struggling. I learn something new every time I teach stat. Teaching each other will help you make the material your own. Further, along with exam grades and assignments, active participation will count in your favor.

Feedback and pacing: At the beginning of each class meeting, we will take a written anonymous vote on how fast we are going: too slow, too fast, or just about right. If one third or more of the class thinks we are going too fast, we will slow down. If we are to slow down, we will take another vote about whether to go on with the most recent assignment more slowly or go back over earlier work. Again, if more than 1/3 of the class wants to go back, we will do so.
We will also take a vote about workload: too light, too heavy or just about right. This vote will be treated as feedback and if not "just about right" we will talk about it.
As occurs in most math courses, if Chapter 4 is unclear, Chapter 5 will be more unclear and Chapter 6 will be mud. To prevent this happening to a number of students, we will proceed at the pace of the slower members of the class. So, don’t be afraid to vote “too fast” at the beginning of a class. Also, if you are having trouble with the concepts, please come to office hours. Right now I’m planning on being available before Thursdays class in Tillet 517. If you are one of the people who continually wants to slow down, both my office hours and study groups may help a good deal.

CPEs: In my manuscript there are a series of exercises called “Computational Practice Examples.” In the intro class they ensure students readiness for class. I have asked you to do a small number of them. From Chapter 5 on, setting up computational tables, while tedious, helps imprint the way the numbers go together in a statistical procedure. CPEs should be done by hand and be submitted at the beginning of class. They are worth 10 points each if handed in on time. Late = -5 each.

Study Groups: Study groups are not required, but are strongly recommended. We will attempt to form study groups at the first class.

Tutoring: For those applying to grad school, it would be nice to add "tutoring stat" to the rest of your accomplishments. I will be offering anyone who wants the job a chance to tutor intro stats students (for free, at mutual convenience). If we have requests for tutoring and you actually tutor, be sure to meet your student in a public venue (e.g., the student center) and find a place to work there. You are all aware of rules for student behavior and of concerns about sexual harrassment.

Computer assignments: There will be 10- 12 computer assignments from the Sprinthall book, worth 10 points each, 120 points in total. Please hand them in the class they are due. Late = -5 each.

***Midterm and final*:** The midterm will be held in class and will cover the material covered through related (repeated) measures Anova. The final will be cumulative. The midterm will be entirely an essay exam. There will be an hour and 20 minutes of essays on the why of the course (e.g. What are the conceptual and computational differences between the one and two way ANOVA? Why do the critical values of r get closer and closer to zero as degrees of freedom increase?) The midterm will be worth 200 points,
The final will be a full three hour essay exam. It will be just like the midterm, but more extensive. The final will be worth 400 points
Both exams are closed book.

The course schedule is tentative. As I noted above, this is a skills learning course, more analagous to a dissection lab than to a history course. You have come to this class with very different math backgrounds. The initial quiz will give me an idea of where you are at baseline. We will go at the pace of the slower (or more daring and honest) members of the class, so that everyone will learn a good deal. The class schedule below is a "best case" scenario. We all know about best case scenarios; anyone for a sub-prime mortgage? There probably will be a couple of classes devoted to catch up. If we seem to be getting through everything quickly, we will spend more time discussing research design.

Week Lecture and assignment

Week 1 Lecture: 1..An overview of what we are going to do 2.The basics, central tendency and variation.
Activity: Preliminary quiz (for info only)
Assigned: Read Ch. 1-3 Do Sprinthall (S) Problems A, B, C

Week 2 Lecture: 1.Freq. distributions: Empirical and theoretical 2.Scale scores, raw scores and percentiles 3.Symmetrical intervals around mu
Due: S – Probs. A-C
Assigned: Ch. 4. and the standard error and confidence
intervals supplement on Sakai. Do S -Prob D. Then redo Prob D by hand, using a CI to see whether the sample mean falls in the 95% CI around 80.00.

Week 3 Lecture: 1. The standard error of the mean, CIs with Z. 2. Estimating population parameters, df, t. 3. CIs using t. 4. Hypothesis testing with confidence intervals
Due: S- Prob D, computer and hand calculated versions
Assigned: Read Chapters 5-6. Do CPE 5.4 and 6.3.2;
S – Prob. F.

Week 4 Lecture: Bivariate Correlation and regression
Due : CPE 5.4 & 6.3.2; S-Prob. F
Assigned: Read Ch 7, CPE 7.4 & 7.5, S – Prob. H & P

Week 5 Lecture: 1. One way, unrelated groups ANOVA
2. Brief discussion: The t test as a specific case of the F test
Due: CPE 7.4 & 7.5, S – Prob. H & P
Assigned: Read Chapter 8, Do CPE 8.1 & 8.2.1 S-Prob. N & R

Week 6 Lecture: Decreasing error variance

1. Repeated measures ANOVA
2. Brief discussions Missing data: means, LOCF and BOCF; ANCOVA & empirically derived indices with unit weights
3. df_{MP}, the sphericity assumption, Mauchley's W, and Greenhouse-Geisser p levels
4. Brief discussion of the multivariate alternative when sphericity not found

Due: CPE 8.1 & 8.2.1 S-Prob. N&R
Assigned: Review for midterm

Week 7 **Midterm**: Tuesday: review for midterm.
Thursday: Exam -1 hour 15 minutes (essays)
Due: Nothing due in class.
Assigned: Read Chapter 9. Do CPE 9.1 – 9.2. Then compute the interaction using both the subtraction formula and the interaction table (definitional)
available on the course sakai site. S - Prob.I

Week 8 Lecture: 1. Factorial Anova
2. What the interaction really means per the computational table.
3 Graphing the interaction
Due: CPE 9.1 – 9.2. The computed interaction using both the subtraction formula and the interaction table. S - Prob.I.
Assigned: Read Ch. 10. Do CPE 10.1.1.A, 10.2.A, 10.3.1, 10.3.5, 10.4.1, 10..5.3, 10.6.3 S- Prob. D, E, M

Week 9 Lecture: 1. t tests: 1 & 2 groups,repeated (related) meas.
2. Post-hoc comparisons and experimentwise alpha, 3. ANOVA review
Due: CPE 10.1.1.A, 10.2.A, 10.3.1, 10.3.5, 10.4.1, 10..5.3, 10.6.3 S- Prob. D, E, M
Assigned: Read "Correlation 2 and reliability" short chapter from the sakai website. Do all CPEs.
S- Prob. S (S1, S2 & S3)

Week 10 Lecture: 1. Other aspects of correlation
2. Very brief discussion of factor analysis
Due: All CPEs from handout. S- Prob. S1, S2, S3
Assigned: Read Chapter 11 and p_{REP} comment on website.
CPE 11.1, 11.3.1, 11.5.2,l1.6.2. S - Prob. Z

Week 11 Lecture: 1. Power analysis: Sample size and what it means
2. What to do when the null is (almost) true
3. Meta-analysis
4. The bias toward exaggesrated effect sizes in published research
4. $p_{REP:}$ a statistic it is easy to misunderstand
Due: CPE 11.1, 11.3.1, 11.5.2,l1.6.2
Assigned: Read Ch. 12 & 13. CPE 13.2.1 S- Prob. J

Week 12 Lecture: 1. Assumptions of parametric stat 2. Chi square
3. Looking at it all as a whole
Due: CPE 13.2.1 S- Prob. J
Assigned: Review for final,

Week 13 Lecture: Review for final.

Final exam Cumulative. Same format as midterm but a full 3 hour exam.