APSY 510
Fall 2019 (Aug 22 version, check back for updates)
INTRODUCTION TO STATISTICS AND EXPERIMENTAL DESIGN

Time:	Place:
T-TH 10:15-12:25 (lecture)	SS134 (computer classroom)
T-Th 12:25-1:15 (help/tutorial/discussion)?	SS134? SS327

Professor: Bruce Dudek Office: SS 327 Phone: 442-4824

Office Hours: Tentatively W: 1-2:30. Tues: 3-4. Often available Mon and Fri: 11-2 and Th 3-4. 510 students should feel free to see me at any time during the week that I am in my office and free. Office hrs are just the predictable time.
Office hour adjustments would be posted on class web site.

Help Sessions: Help, and review sessions are scheduled when there is demand. Early in the semester, suggested practice exercises will be made available and help sessions to review them can be extremely helpful. Finding a common time for everyone is usually challenging. I suggest thinking about early Friday afternoons for this.

email: bruce dot dudek AT albany dot edu (Much more reliable than phoning me)
course home page-via personal web page (not blackboard):
http://www.albany.edu/psychology/bcd/dudekclass.html
The class web page is the official syllabus and will contain any updates to this doc.

TA: Arielle Wolinsky SS318 Email: awolinsky AT albany DOT edu
Hrs: TBA.

This is a four credit hour course. We are scheduled into the classroom from 10:15-1:05 on Tuesdays and Thursdays. We will establish a workable schedule that results in four class hours per week during this time frame. The remainder of the time in the classroom can be devoted to additional computer tutorials or help sessions on lecture material as you wish. *Please make certain to clear your schedules for this full 3 hour block of time each T-Th.* **Historically, this class has used Friday Afternoon times (often 2:30 pm) for help sessions. This can occur as demand warrants.**

A considerable amount of course material and communication will be distributed via the course web page, the shared department network drive, via email, and sometimes via dropbox. Students should make certain of their competence in accessing the course web page, the psych dept shared network drive, and UA email immediately (see computing document).

Course Philosophy and Objectives:

Philosophy:

The course is viewed as the first half of a year long, integrated sequence along with APSY511. As an Introductory course the topics covered are wide ranging but are generally limited to what are called univariate methods - one outcome variable (DV) at a time. The 511

course syllabus is available online so that the student can see the full range of topics for both semesters.

Statistics instruction is undergoing rapid and somewhat chaotic change. Use of statistical analysis in research is well established. However, emerging fields of "data science", " big data", "machine learning" are having an influence on all applications of statistics in the traditional research disciplines.

While basics of data summary/description, probability theory are not topics undergoing rapid change, statistical inference is evolving and is a challenging topic to teach/learn. This reflects the current climate of conversations about the value of different types of inference, alternatives to the traditional Null Hypothesis Signficance Testing (NHST), reproducibility of research results, and ethics in data analysis. Clear and comprehensively accepted alternatives to the traditional methods have not found consensus, nor have textbooks responded to the challenges. Fortunately, most of the material to be covered in the 510/511 courses is central to data analysis regardless of the choice of inference method. E.g., proper conceptualization of a multiple regression coefficient does not depend on how one "tests" it.

The course will continue to cover the standard NHST methods while taking great pains to present them in the proper framework which involves issues in logic, language of how they are presented, and their limitations. This treatment will be supported by readings in the voluminous literature on this topic (found in the "statistics toolkit" bibliography). The decision to continue to cover NHST methods is based on several factors, while recognizing that there are strong voices attempting to preclude use of these methods. These methods are still used and students need to understand them - it is important to understand a "religion" before rejecting it. Older literature is replete with these NHST methods so students will need to know how to interpret those contributions. Some statisticians still see the value in NHST methods in experimental science work and recognize that, when properly used/characterized, they offer a stable approach. The proper approaches involve use and understanding of confidence intervals and effect sizes as well as evaluation of assumptions of these tests. Some exposure to NHST alternatives/extensions in the form of Bayesian, robust, and re-sampling methods will occur.

One perspective that helps the student appreciate a way of viewing this time of controversy focuses on the question of what data analysis methods provide us and what they do not. No statistical inference is "proof" of a scientific hypothesis, or "disproof". Inferential methods/test provide evidence. There is a judgement of how strong or weak that evidence is - and this is where differing perspectives and historical practices often collide. It is helpful to recognize that no single research study can be viewed as definitive. Therefore, statistical analysis is an important tool in scientific decision making, but not a stand-alone arbiter of truth. We will often emphasize Tukey's distinction between decisions and conclusions.

The course follows an approach where the first 2/3 of the semester is an introduction to rudimentary/foundational principles. The final 1/3 is a broad introduction to linear modeling with quantitatively scaled variables. These methods in linear regression and correlation set the stage for elaboration in the second semester, especially using categorical IVs.

Statistics is best learned by doing. The student is expected constantly to practice the methods covered in class and the textbook by using suggested data sets and strategies outlined in lecture. Since the course is taught in a computer classroom, we will spend much time executing the data analytic methods being covered with a conceptual approach. The course emphasizes the logical-conceptual frame work of the methods, but execution is also important. Said another way, Skills are important, but knowing the "Why" is crucial.

An important analogy is that statistics courses are like language courses. One needs vocabulary, simple syntax, and complex grammar. Languages are only learned by repetition/rehearsal. Statistics is the same.

Finally, visualization is a central part of the course. This is true both for data analysis and presentation, but also for understanding central concepts. In the latter vein, the instructor uses and has created numerous "Shiny" apps available online. These dynamic/interactive web apps are a unique part of this course. For example the apps improve upon, and can replace, tables of probability distributions in the back of text books. Other apps approach logical-conceptual concepts more directly and facilitate understanding the equational approaches in textbooks. Use of analogous functions in R will also occur.

Objectives:

1. Efficient and Ethical Data Handling
2. Best practices in research design.
3. Efficiency in data visualization. An important component of the course that breaks these graphical approaches down into exploratory, presentation, and publication types of graphics.
4. Rudiments of inference.
    - Fisher/Neyman/Pearson tradition including Type I and II errors.
    - Understanding the *Modus Tollens* dilemma of NHST.
    - Maximum likelihood principles.
    - Prob(data|hypothesis) vs Prob (model|data).
    - Interval Estimation and its connection to inference
    - Effect sizes
5. Tukey's perspective on Decisions vs Conclusions, important for scientists.
6. Full development of skills to use software effectively for all methods we cover. SPSS syntax, R code and use of Rstudio are emphasized Some exposure to SAS and JASP will occur if time permits.
7. Research questions focusing on distribution location (means) are emphasized as the avenue to learn NHST and alternative methods.
8. Some treatment of categorical data analysis occurs both the basic treatment of probability concepts and in introductions to inference.
9. Extensive logical/conceptual, and mathematical foundations of bivariate correlation/regression, and the progression through partial correlation to multiple correlation and multiple regression.
10. Philosophy of Science in Psychology, particularly the interplay of experimental design, quasi-experimental methods and available approaches to inference.

Texts:

Required -

1. Howell. D. Statistical Methods for Psychology. 8th edition. Wadsworth/Cengage. 2012. will also be used for some sections of the 2nd semester course
2. Diez, D.M., Barr, C.D., and M. Cetinkaya-Rundel. (2019) OpenIntro Statistics. 4th Edition. http://www.openintro.org/stat/textbook.php

Recommended Statistical Software Guides (also see section below):

The basic SPSS USER manuals can be useful, but much of the material is in the electronic syntax guide available with the help function in the program (some sections will be on the course web page).

I recommend the following (DO NOT PURCHASE UNTIL WE DISCUSS IN CLASS):

1. Field, A. (2013) Discovering Statistics Using SPSS for Windows : . Sage Publications, 4th edition
2. Kabacoff, R. (2011). *R in action : data analysis and graphics with R.* Shelter Island, NY: Manning.

There are many other recommended books on R. I list a few here and can make them available if you see me.

Dalgaard. P. Introductory Statistics with R. 2nd edition. Springer. 2008

Wright and London (2009) Modern Regression Techniques Using R. Thousand Oaks, CA: Sage Publications.

Verzani, J. (2005). Using R for introductory statistics. Boca Raton: Chapman & Hall/CRC.

Muenchen, R. A. (2011). R for SAS and SPSS users (2nd ed.). New York: Springer.

Matloff, N. S. (2011). The art of R programming : tour of statistical software design. San Francisco: No Starch Press.

Rationale for textbook choice and Recommended Usage

The assigned textbooks were chosen with the following priorities in mind. First, texts should be good reference sources - books to be used for decades by the researcher. Second, the texts should cover most of the range of topics covered in lecture. Only third in the priority list is the "readability of the book" as an instructional textbook. The Howell text satisfies these requirements. However, students should familiarize themselves with other standard reference texts found in the "toolkit" bibliography. Some of them are listed below. The course will rely very heavily on materials prepared and distributed by the instructor. These materials will typically differ somewhat from the textbook approach and will align with classroom presentations. Texts will cover the range of topics presented in lecture, but not always in the same depth or with the same approach to development of the topic. They are to be used to expand and validate your understanding of lecture presentations. In this vein, any of the recommended alternative texts should be consulted at any point in time where you have difficulty with a topic.

The Diaz, et al., (2019) "OpenIntro Statistics" book is under continued development. It contains sections that approach subject matter in a manner very similar to the approach taken in this course and can be a nice supplement to the Howell text. Diaz, et al., also cover a set of topics of interest to our 510 course that are not covered in Howell and can supplement BCD

materials. More explicit guidance on usage of Diaz will be given as we move forward in the course.

Students are also urged to consult the "Statistics Toolkit" document found on the course web page. This is a constantly "in-progress" reading list of texts and articles which are viewed as the foundation literature for the appropriately trained data analyst in the Behavioral Sciences. PDF's of all the articles found in the toolkit are available on the department "O" drive.

Recommended Supplemental Texts - first-choice alternative texts are indicated with an asterisk.

*Cohen, Cohen, West and Aiken *Applied Multiple Regression/Correlation Analysis for the Behavioral Sciences*. 3rd Ed. Lawrence Erlbaum, 2003

Darlington, R.B. REGRESSION AND LINEAR MODELS. McGraw-Hill. 1990

Draper, N.R. and Smith, H. Applied Regression Analysis. J. Wiley, 3rd Ed. 1998

Fox, John. *Regression Diagnostics*. Thousand Oaks, CA: Sage University Press. Quantitative applications in the social sciences series #79, 1991.

Glass, G.V. and Hopkins, K.D. *Statistical Methods in Education and Psychology*. 3rd Ed. Needham Hts MA: Allyn and Bacon, 1996.

Hamilton, L. *Regression with Graphics*. Belmont, CA: Brooks/Cole, 1992.

*Hays, W.L. *Statistics*, 5th Ed. Holt, 1991.

Kerlinger, F.N. Foundations of Behavioral Research . Harcourt Brace. 3rd Ed., 1985

Kleinbaum, Kupper, Muller. APPLIED REGRESSION ANALYSIS AND OTHER MULTIVARIABLE METHODS. Duxbury Press, 3rd Ed. 1997.

Marascuilo, L.A. and Serlin, R.C. *Statistical Methods for the Social and Behavioral Sciences*. New York: W.H. Freeman, 1988.

Mendenhall, W., Beaver, R., & Beaver, B. (2012). Introduction to probability and statistics: Cengage Learning..

Minium, E.W., King, B.M. and Bear, G. *Statistical Reasoning in Psychology and Education* 3rd Ed. New York: J. Wiley, 1993

Pedhauzer, E. *Multiple Regression in Behavioral Research: Explanation and Prediction*. 3rd Ed. Harcourt Brace, 1997

Rosenthal, Robert and Ralph L. Rosnow . *Essentials of Behavioral Research : Methods and Data Analysis*. McGrawHill Series in Psychology. 1991.

Snedecor, G.W. and Cochran, W.G. STATISTICAL METHODS, 8th Ed. Iowa State Univ Press, 1989.

Exams and Grading :

This exam/grading outline is tentative at present, and will be finalized as we can assess our rate of progression through the material Examination material is heavily based on lecture presentations.

- Midterm I - Earliest possible time is first week in Oct (Probably after coverage of Sampling Distributions). **25%** of the course point total.
- Midterm II - Probably first week in Nov (after coverage of simple regression material). **25%** of the course point total.
- Final - Scheduled for Tues., Dec 17, 1-3 pm, **35%** of the course point total. Set by Univ regulations - Make your Holiday Plans accordingly

  Final exam will be cumulative, but with a progressive emphasis on more recent material.

Several ungraded (pass/fail) assignments (8-14) will contribute **5%** of the course point total and **must all be completed for a passing course grade**. Most of these be given out on a Thursday and due the following Tuesday, but shorter notice may also occur for a smaller number. Turning any of these in late will result in a diminution of the available course points from five to four. Two or more turned in late results in 0 of these 5 course points, but all must still be completed to pass the course.

Two graded assignments will probably focus on hand calculations of (1) a simple regression/correlation problem (due early Nov - 4% course point total), and (2) a multiple regression problem (due near the end of the semester - 6% course point total). Both must be completed on time for a passing grade in the course (B).

Several (probably at least five) computer assignments (to be specified later) are required, but do not count toward the course point total. Each will be graded on a +/- basis and all must be satisfactorily completed for a passing course grade (B). Unsatisfactory completion of computer assignments will result in redo's. Some of these computer assignments may be combined with ungraded assignments.

A strong expectation is that assignments will be due at the specified time/date.

Final course grade is determined from the distribution of point totals summed from all exams and assignments. Typically, cutpoints for grades are 90% of all possible points for an A-, and 75% for a B. The instructor prefers to not use the +/- grading option, but may use B+ and/or A- grades if the final point distribution does not have obvious break points.

During lecture, the instructor will regularly ask questions which will reflect the assigned reading. Assignment of final grades in the case of "borderline" point totals can produce grades that are influenced by willingness and accuracy in answering these questions.

Extra Lectures or Help Sessions may be scheduled upon demand (during the T-Th extra time period or at other times - usually Friday afternoons) in order to review material or work through

exercises provided in the texts. Individual tutoring/assistance is encouraged whenever a need arises. Don't be bashful about asking for help. The statistics material can only be well learned through active learning, and not simply passive attendance.

Computer Usage

The course will have a sizeable computing component. The goal of this component is the facilitation of rapid evaluation of data, rather than computing algorithms, per se. Some initial instruction in computing will occur in class and help sessions outside of class can be scheduled. Nonetheless, the onus is on the student to become proficient, not only in SPSS and R, but to be effective in the joint usage of these statistics packages with standard word processing, graphics, and spreadsheet software. Early in the semester, documents on the UA computing environment, on the R programming language, and on structure/creation of data sets will be assigned for mastery before we begin class work with computing. We will emphasize skills in SPSS, but R instruction will form an important component of the course since R is fast becoming the professional statistician's preferred tool. Some work in Excel will also occur early in the semester, but I generally do not see Excel as a statistical analysis tool - although good for data handling (Excel is bad for graphics).

Materials prepared by the professor will facilitate instruction of SPSS/R and much material is available online for this purpose as well. The Field text on SPSS usage is well-regarded for SPSS learning (not so much for its statistical concept development), but it is not required.

R is an expansive, open-source, programming environment. It is not a simple program to master, but we will use it in ways that facilitate our progression through the statistics material. The Kabakoff text very helpful and you can work through it as an elaboration of the treatment that we give R in class.

Early instruction in SPSS will be brief and the student is expected to elaborate on these basics by using materials provided. Additional help sessions can be scheduled to review/enhance SPSS skills.

Academic Integrity, Academic Honesty, and Plagiarism
(Very Important - Read Carefully)

All assignments for this course are given with the assumption that students will not collaborate with classmates or with any other colleagues on their completion. This includes computer assignments. For some assignments an exception to the collaboration rule may be instituted and will be explicitly stated (written) by the instructor.

Plagiarism can be defined as taking credit for someone else's work as one's own. This can be broadly construed, and students are not often aware of the nuances of expectations maintained by instructors. Education on this and other aspects of academic honesty are also viewed as an integral part of training in scientific disciplines. Therefore, as part of this course, you are required to read the University policy on Academic Standards/Integrity/Dishonesty/Plagiarism which can be found in the graduate bulletin/catalog. See:

http://www.albany.edu/graduatebulletin/requirements_degree.htm#standards_integrity
http://www.albany.edu/content_images/AcademicIntegrity.pdf

Plagiarism or academic dishonesty will result in automatic course failure.

APSY 510 Textbook Reading Schedule

(Subject to some adjustment as we go along - additional articles will be assigned)

Week of		Topic		Chapters in Howell
Aug.	26	Introduction & Design Issues		1
Sep.	2	Probability and Prob. Distributions		5
	11	Probability and Prob. Distributions		6.3-4
	16	Describing Data and Distributions		2
	23	Sampling Distributions, Normal Distribution		4,3
	30	Estimation and Hypothesis Testing		6,7
Oct.	7	Estimation and Hypothesis Testing		8
	14	Inferential Statistics, Chi-Squared and F distributions	(no class 15th)	
	21	Bivariate Linear Regression and Correlation		9
	28	Bivariate Linear Regression and Correlation		10
Nov.	4	Partial and Semi-partial correlation		15
	11	Multiple Regression		15
	18	" "		
	25	" " (no class 28th)		
Dec.	2	" " Dec 5 is our last lecture.		

Considerable supplemental reading will be assigned in the form of scanned chapters and articles. These will be provided as pdf's on the class web site.

NOTES:

1. The reading schedule is constructed under the assumption that a first reading of assigned material will be done prior to the lecture on the respective topic. Note that the amount of reading increases dramatically in later weeks of the semester. The best strategy is to get as far ahead in your reading as possible. Lectures are most beneficial when a first reading of the material is completed prior to the lecture. Second and third readings would then be used to reinforce, clarify and crystallize your understanding of the material after its lecture.
2. There is no attendance requirement. However, since exams are largely conceptual/verbal in nature, adequate performance usually presupposes the conceptual framework generated in the lectures - and assignments will be due at class.
3. Textbooks serve as reference and supplemental sources. Lecture material is NOT designed simply to rehearse the textbook style or framework. The core of the course will be found in a great many, very detailed set of lecture notes, and handouts.
4. Since the course is the first of a two semester sequence, we have some flexibility in determination of the "stopping" point for the Fall semester. We may be able to proceed farther than the above reading schedule indicates and more material on MR might be covered.

Behavioral Objectives for the Student

These practices will ensure adequate mastery of the material

1. A good rule of thumb is that each hour spent in lecture should be matched by a minimum of 2-3 hours work outside of class. This means that the course will likely be the source of the heaviest demand on your time of all your classes and research.
2. Give the textbook a once through quick read BEFORE class lecture on that topic in order to identify terms and concepts. After lecture, do a thorough reread of the text and the lecture notes using one to illuminate and counterbalance the other.
3. The lecture notes contain a very large fraction of all of the core material that is essential to the course. Make sure that you understand EVERYTHING in them. Use the textbook to reinforce the lecture perspective.
4. Print out lecture notes before class so that you can take your own notes on them.
5. Work ALL exercises in each chapter. Attend help sessions to go over answers to the even numbered exercises.
6. Get Ahead. Stay Ahead. Statistics courses are a slow build of foundation principles and elaboration into specific research design applications. This means that early concepts are crucial for development of correct understanding of later concepts. Getting Behind compounds the difficulty of later concepts. We will go relatively slowly early, but very rapidly by mid semester. Early material is simpler/easier. So, develop good study habits and over learn the early material so that you are accustomed to putting in the time when we get to the more rapid pace and more challenging topics later in the course.
7. Study in groups. Don't always keep the same group.
8. **Attend Help Sessions**. Ask for help sessions. Come for help from the Professor and/or TA at any time. Historically, we have found Friday afternoons a good time for help sessions. In addition to assignments, several "practice problem" sets will be recommended. Going over these in help sessions is tremendously helpful.