STAT 5413 - Biostatistical Analysis Applications in R and SPSS
Course Syllabus – Spring 2023

Instructor
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                 Tue, Thu | 9:30-11:30 & 2:00-4:00 | FH 204 (and virtual)
                 Alternate arrangements can always be made via e-mail or text. I also have "Open Door Office Hours".
                 Feel free to come in anytime you see me in my office.

Teaching Assistants (Both have "open door office hours" as well)

Name:	Kelsey Wogan (SPSS focus)	Rosemary Ketring (R focus)
Office:	WSB 215	RAS 141C (in Meat Market Retail Space)
Office Hours:	Tue, Wed, Thu 4:00-5:00 (or by appt)	Tue 8-9:30; Wed 1-2 (or by appt)
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Course Description
An advanced course in statistical concepts and models applied to agricultural and biological systems. Emphasis will be placed on data analysis and interpretation using computer statistical applications. The course applies all null hypotheses significance testing (NHST) procedures taught in STAT 5412, first in Program SPSS, then in Program R after the thorough overview of R programming. NHST theory for these advanced scenarios will also be introduced and applied in R; Generalized Linear Models (GLMs) including Poisson regression, dichotomous variables, binomial distribution, and proportion testing and logistic regression: Generalized Linear Mixed Models (GLMMs); and circular distributions.

Enhanced Course Description
H. G. Wells argued that "statistical thinking will one day be as necessary for efficient citizenship as the ability to read and write." Due to its importance to the everyday person, some (a.g. Arthur Benjamin) are currently advocating for courses in statistics to replace algebra courses in high school.

Statistical proficiency is even more important to the scientist, as good science employs statistical knowledge in *every* step of the scientific method. Statistics is *the* tool used to discern truth from fiction, and science is all about finding the truth. Statistics is so fundamental to sound science, that Karl Pearson described statistics as the "grammar of science." Whether you go on to be a technician, a researcher, a manager, or a professor, the knowledge you gain in this course will be critical to your success.

In the short term, statistical knowledge will inform most decision you make in every stage of your graduate research, and will in large part affect the success of your research. Then you will be going to job interviews, where a chief complaint from hiring managers of new hires concerns their lack of statistical ability. So please take this course very seriously. Your graduate committee and future employers *will* want to know if you know your statistics!

Let's be frank. Statistics can be an intimidating subject. My promise is to *walk with you every step of the way*. I have been teaching graduate statistics and helping students with their research at Sul Ross since 2015. Prior to coming to Sul Ross, I had 20-years of experience applying statistical principles as an aerospace engineer at NASA for our nation's human spaceflight programs. Life then brought me to West Texas, and I couldn't be happier. I LOVE teaching statistics, and plan to help each of you become statistically competent by the end of this semester.

Now, let's go delve in and tackle some statistics!

Objectives

Student Learning Objectives for the M.S. in Range and Wildlife Management

The graduating student will demonstrate that he/she is able to:
1. Apply statistical concepts and procedures to research.
2. Evaluate literature and references to substantiate the applied research project.
3. Justify and defend research questions and design.

Student Learning Objectives for the M.S. in Biology

The graduating student will demonstrate that he/she is able to:
1. Understand and implement scientific methodology.
2. Utilize field techniques toward addressing scientific questions.
3. Utilize statistics toward the analysis of data within the discipline.
4. Effectively disseminate scientific findings using both written and oral communication.

Student Learning Objectives for the M.S. in Animal Science

The graduating student will demonstrate that he/she is able to:
1. Demonstrate the basic skills of interpreting research data gathered in an agricultural context,
2. Apply critical thinking skills to mitigate potential challenges in diverse animal sciences and related agricultural industries,
3. Develop problem solving skills, and
4. Demonstrate the ability to communicate through written, spoken, and graphical methods.

Marketable Skills for M.S. in Range and Wildlife Management

Students will acquire these marketable skills:
1. Students will be able to communicate scientific research results to a wide variety of audiences.
2. Students will be able to analyze a data set with a wide variety of statistics.
3. Students will demonstrate competence in scientific writing – also includes appropriate literature review.

Marketable Skills for M.S. in Biology

Students will acquire these marketable skills:
1. Students will be able to organize, analyze, and interpret data.
2. Students will be proficient at using presentation software.
3. Students will acquire experience in managing time and meeting deadlines.
4. Students will gain the ability to speak effectively and write concisely about scientific topics.
5. Students will acquire experience and guidance in the development of professional email correspondence.

Marketable Skills for M.S. in Animal Science

Students will acquire these marketable skills:
1. Students will develop data collection and analysis skills using Excel, R, and SAS programs.
2. Students will be proficient in analytical lab procedures, project organization, and scientific writing.
3. Students will disseminate information to a variety of target audiences using oral and written methods.

Course Objectives

This course addresses the Student Learning Objectives and Marketable Skills highlighted above. Specific Course Objectives include the following:
1. Assess and review experimental designs, paired-sample hypotheses, multi-sample hypotheses, multiple comparisons, factorial and nested ANOVA, data transformations, linear regression, correlation, multiple regression and correlation, polynomial regression, and the binomial distribution.
2. Understand and interpret advanced statistical analyses in published research literature.
3. Interpretation and application of analytical results to research projects.
4. Application and interpretation of statistical data analysis using SPSS and R software.

Course Outline

SPSS Track (Names are of sections in Laerd Statistics {unless *ed}, parenthetical numbers are the associated chapters in the Zar textbook from NRM 5412 – Biostatistical Analysis Theory)

1. Getting Started (Basics)
2. Types of Variables (Zar Ch 1)
3. Charts & Graphs
4. Descriptive Statistics (Zar Ch 3&4)
5. Testing for Normality
6. Transforming Data (Zar Ch 13)
7. Chi-square Goodness of Fit Test (Zar Ch 22)
8. Chi-square Test of Independence (Zar Ch 23)
9. One-sample t-Test (Zar Ch 7)
10. Independent-samples t-Test (Zar Ch 8)
11. Mann-Whitney U-Test (Zar Ch 8)
12. Paired-samples t-Test (Zar Ch 9)
13. One-way ANOVA (Zar Ch 10, 11)
14. Kruskal Wallis H Test (Zar Ch 10)
15. Two-way ANOVA (Zar Ch 12)
16. One-way Repeated Measures ANOVA (Zar Ch 12)
17. *Randomized Block ANOVA (Zar Ch 12)
18. Three-way ANOVA (Zar Ch 14)
19. *Nested ANOVA (Zar Ch 15)
20. One-way MANOVA (Zar Ch 16)
21. Linear Regression (Zar Ch 17)
22. Pearson's Correlation (Zar Ch 19)
23. Standard Multiple Regression (Zar Ch 20, 21)
24. *Dichotomous Variables (Zar Ch 24)
25. Logistic Regression (Zar Ch 24)
26. Poisson Regression
27. *Model Selection and AIC

R Track (Numbers given are the associated chapters in the Davies textbook)

1. Getting Started
2. Numerics, Arithmetic, Assignment, and Vectors
3. Matrices and Arrays
4. Non-Numeric Values
5. Lists and Data Frames
6. Special Values, Classes, and Coercion
7. Basic Plotting
8. Reading and Writing Files
9. Calling Functions
10. Conditions and Loops
11. Writing Functions
12. Exceptions, Timings, and Visibility
13. Elementary Statistics
14. Basic Data Visualization
15. Probability
16. Common Probability Distributions
17. Sampling Distributions and Confidence
18. Hypothesis Testing
19. Analysis of Variance
20. Simple Linear Regression
21. Multiple Linear Regression
22. Linear Model Selection and Diagnostics

Logistics / Materials / Grading Information / Course Policies

Class Meeting Time/Place
Times: Monday, Wednesday, Friday 10:00 am -11:50 am (with a ten-minute break from 10:50-11:00)
Place: RAS 126 (face-to-face) and Blackboard Collaborate Ultra (online)

Text and Supplies
1. Davies, T. M. 2016. *The Book of R, A First Course in Programming and Statistics*. No Starch Press. San Francisco, CA. (***Required***) (ISBN 978-1593276515)
2. Subscription to Laerd Statistics (https://statistics.laerd.com/) (***Required***).
   NOTE: Each student is required to purchase their own, individual subscription to Laerd Statistics before our fourth class day. In doing so, all students must agree to the Laerd Statistics Terms & Conditions. All students MUST subscribe individually and sign a statement of agreement to the Terms & Conditions; **failure to subscribe and sign the statement of agreement will result in a grade of "F" for this class**. Both the instructor and Laerd will verify your subscription. NOTE: from Laerd Statistics FAQ: "We do not allow the downloading or printing of any Laerd Statistics material (Premium or otherwise). This is to prevent any unauthorized spreading of the content to non-paying members."

Course Grade
Homework   25%
Exam I   25%
Exam II   25%
Exam III   25%

Grade Assignment
<60 = F, 60-69 = D, 70-79 = C, 80-89 =B, 90-100 = A.

Late Work and Extensions Policy
All graded work is expected to be on-time. **No due dates for ANY graded work will be extended without PRIOR e-mail arrangements** initiated by the student, and only for valid reasons. **Before an accommodation (e.g. extended due date) can be granted for a COVID-related reason, students are required to first submit the SR COVID-19 Self Report form found at https://srinfo.sulross.edu/covid-19/self-report/.** Late work may be accepted at the instructor's discretion, with a **10% penalty per day late** (i.e. 10% for 0-24 hours late, 20% for 24-48 hours late, etc.) Late assignments are not accepted after 7 days.

Readings
The course and its material are organized by chapter. Each chapter has a reading assignment that explains the material. ***The assigned readings are essential; completing 100% of the assigned readings is expected***.

Exams
Three take-home examinations will be given during the semester:
- Exams will consist of a variety of questions, including multiple-choice, fill-in-the-blank, short-answer, and essay.
- No make-up exams will be given for an unexcused absence. You must notify me of an excused absence from an exam ***PRIOR*** to the start day and time of the exam you will miss; i.e. arrangements for make-up exams must be made BEFORE the exam is given.
- Exams will be completed outside of class, online in Blackboard, ***using a strict honor code***. The following statement must be e-mailed to your instructor *after* you submit *each* exam for you to earn a grade other than zero:

"I have neither given nor received any unauthorized aid on this exam."

Participation
- I expect a high level of engagement to enhance everyone's learning. This includes interacting with the instructor and other students, asking questions during class, posting in the Blackboard discussion forums, attending office hours (in-person and/or online), completing outside of class assignments and readings, and being prepared to participate in class discussions.
- Online participation: Any time you attend class online (via Blackboard Collaborate Ultra), you are required to be properly dressed, avoid video distractions, and keep your microphone muted except to ask questions or request clarification. **Anyone causing distractions may be muted, have their video shut off, and/or removed from the session without warning, at the instructor's discretion.**

Academic Integrity
Students in this class are expected to demonstrate scholarly behavior and academic honesty in the use of intellectual property. A scholar is expected to be punctual, prepared, and focused; meaningful and pertinent participation is appreciated. Examples of academic dishonesty include but are not limited to: Turning in work as original that was used in whole or part for another course and/or professor; turning in another person's work as one's own; copying from professional works or internet sites without citation; collaborating on a course assignment, examination, or quiz when collaboration is forbidden. In addition, please note that plagiarism detection software will be used in this class for written assignments, as well as monitoring software for any online exams. **Any student shown to violate academic integrity will receive no credit (0) for work done and/or may be penalized in accordance with published University Rules**.

On all work submitted for credit by students at the university, the following pledge is either required or implied: "**On my honor, I have neither given nor received unauthorized aid in doing this assignment.**"

Classroom Climate of Respect
Importantly, this class will foster free expression, critical investigation, and the open discussion of ideas. This means that all of us must help create and sustain an atmosphere of tolerance, civility, and respect for the viewpoints of others. Similarly, we must all learn how to probe, oppose and disagree without resorting to tactics of intimidation, harassment, or personal attack. No one is entitled to harass, belittle, or discriminate against another on the basis of race, religion, ethnicity, age, gender, national origin, or sexual preference. Still we will not be silenced by the difficulty of fruitfully discussing politically sensitive issues.

Communication
You are required to check your *Sul Ross e-mail* and *Blackboard* announcements *several times per week*. I do not use the personal or preferred e-mail addresses that you may have on record with the University.

Attendance
- Students are expected to make every effort to attend class live (as it happens) either online OR in person (when available and if comfortable doing so). All lectures will be recorded and posted in Blackboard. If live class must be missed, the student is expected to watch the recorded lecture as soon as practical.
- Roll will be taken every lecture for the face-to-face students, attendance will be automatically recorded for those joining live lecture online, and viewing of recorded lectures will also be automatically recorded by Blackboard.
- It is policy of this class to **drop a student with a grade of ``F'' if 9 hours or more of class are missed**. Any time class is missed, for any reason, it will be recorded as an absence. Any time class is missed, for any reason, it will be recorded as an absence, unless an absence can be shown to be due to a college-related event.
- Students are expected to arrive to class on time. If a student is perpetually late, they will be asked to not attend class unless they can arrive on time. If tardiness becomes a problem for the class as a whole, people who arrive late will not be permitted to enter the class. If this stricter policy becomes necessary, there will be an announcement made in class.

Electronics in the Classroom
The use of personal laptops, cell phones, iPads, and other electronic devices can create distractions for learning, both for yourself and others. However, such devices can also be great tools to aid learning. Therefore, using electronic

devices for class purposes (e.g. taking notes, working out problems, searching the internet) is allowed in silent mode. If you choose to use electronic devices in class, do so in a professional manner that does not impede others' learning. **The use of internet-capable devices (e.g. smartphones) is not allowed for exams. Headphones/earbuds will not be allowed in class for any reason.**

General Expectations
Statistics can be a very intimidating subject. However, you cannot survive in the biological sciences without knowing statistics. To maximize learning in this course, we should have some expectations of each other.

I expect from you:
- ASK whenever something is unclear. Preferably in class, as it is likely that others have the same question. **THIS IS YOUR MOST IMPORTANT JOB!**
- ATTEND lecture; be on time as a courtesy to others.
- PARTICIPATE in class.
- READ the required sections from the text. If you come to me with a question and it is clear that you haven't read the book or the lecture notes, I will direct you to the reading first.
- DO all assignments, do them in a timely manner, and ensure I can read them! Parts of assignments that I can't read will not be graded. If you are late with assignments, it prevents me from returning others' assignments until I have yours in-hand.
- BE HONEST in all of your work.

What you can expect from me:
- GIVE 100% effort in teaching you the best I can.
- Make myself AVAILABLE to help outside of class.
- ANSWER all of your questions to the best of my knowledge, and if I don't know the answer I will find out.
- Be FAIR in all grading.
- Provide you with timely, constructive FEEDBACK regarding your work.

Resources and Assistance

SRSU Online Bookstore
The Sul Ross State University Online Bookstore, powered by TextbookX, operates completely online and can be visited at http://sulross.textbookx.com. Created in partnership with Akademos, Inc., and powered by TextbookX, SRSU's Online Bookstore simplifies the textbook process for students while providing them with a variety of course materials, and physical and digital textbook formats. Students log into the bookstore using their LoboID login, select their materials, checkout, and their materials will be delivered to them via email or shipped via USPS, FedEx, or UPS. Information about the on-campus bookstore can be found at https://www.sulrossbookstore.com/home.

SRSU Library Services
The Bryan Wildenthal Memorial Library in Alpine. Offers FREE resources and services to the entire SRSU community. Access and borrow books, articles, and more by visiting the library's website, library.sulross.edu. Off-campus access requires logging in with your LobolD and password. Librarians are a tremendous resource for your coursework and can be reached in person, by email (srsulibrary@sulross.edu), or phone (432-837-8123).

Tutoring
SRSU tutoring will be available shortly after the semester starts. Contact Anita Banegas (432-837-8992, abanegas@sulross.edu) or Mabel Garcia 432-837-8629, mag15bf@sulross.edu) to get information or to request an appointment.

Blackboard's Support Desk
If you have any technical issues with Blackboard itself, e.g. if you are having issues submitting a document, getting videos to play, or you are dealing with a technical error in the course, then the Blackboard Support Desk is ready to help you. The support desk is open 24 hours a day, 7 days a week. You can reach the support desk by calling **888-837-6055**, emailing **blackboardsupport@sulross.edu**, using resources from the Technology Support tab within Blackboard, or clicking the Support Desk graphic on the course homepage. As always, academic questions about course assignments, due dates, and general course questions should be directed to your instructor.

SRSU Disability Services
Sul Ross State University (SRSU) is committed to equal access in compliance with Americans with Disabilities Act of 1973. It is SRSU policy to provide reasonable accommodations to students with documented disabilities. It is the student's responsibility to initiate a request each semester for each class. Alpine students seeking accessibility/accommodations services must contact Mary Schwartze Grisham, M.Ed., LPC, SRSU's Accessibility Services Coordinator at 432-837-8203, or email mschwartze@sulross.edu. The office is located on the first floor of Ferguson Hall – room 112, and the mailing address is P.O. Box C-122, SuI Ross State University, Alpine. Texas, 79832.

Learning Environment and Life
I aim to create a learning environment for my students that supports a diversity of thoughts, perspectives and experiences, and honors your identities (including race, gender, class, sexuality, religion, ability, socioeconomic class, age, nationality, etc.). I also understand that the crisis of COVID, economic disparity, and health concerns, or even unexpected life events could impact the conditions necessary for you to succeed. My commitment is to be there for you and help you meet the learning objectives of this course. I do this to demonstrate my commitment to you and to the mission of Sul Ross State University to create an inclusive environment and care for the whole student as part of the Sul Ross Familia. **If you feel like your performance in the class is being impacted by your experiences outside of class, please don't hesitate to come and talk with me.** I want to be a resource for you.

Tentative Course Schedule (Subject to Change)

Week	Dates	Zar/SPSS (Laerd) Topic(s) Laerd Topic Titles {unless *} (Zar Chapters)	R Topic(s) Chapters from Davies
1	01/18-01/20	Getting Started (Basics) Types of Variables (Ch 1)	Course Introduction Ch 1. Getting Started
2	01/23-01/27	Charts & Graphs Descriptive Statistics (Chs 3&4) Testing for Normality Transforming Data (Ch 13)	Ch 1. Getting Started Ch 2. Numerics, Arithmetic, Assignment, and Vectors
3	01/30-02/03	Chi-square Goodness of Fit Test (Ch 22) Chi-square Test of Independence (Ch 23) One-sample t-Test (Ch 7)	Ch 2. Numerics, Arithmetic, Assignment, and Vectors Ch 3. Matrices and Arrays
4	02/06-02/10	Independent-samples t-Test (Ch 8) Mann-Whitney U-Test (Ch 8) Paired-samples t-Test (Ch 9) Wilcoxon Signed-Rank Test (Ch 9)	Ch 4. Non-Numeric Values Ch 5. Lists and Data Frames
5	02/13-02/17	One-way ANOVA (Ch 10, 11) Post-Hoc Testing (Ch 11) Multiple Comparisons (Scheffé Test) (Ch 11) Kruskal Wallis H Test (Ch 10)	Ch 6. Special Values, Classes, and Coercion Ch 7. Basic Plotting
6	02/20-02/24	Two-way ANOVA (Ch 12) Two-way mixed ANOVA (Ch 12)	Ch 7. Basic Plotting Ch 8. Reading and Writing Files
7	02/27-03/03	Randomized Block ANOVA (Ch 12) One-way Repeated Measures ANOVA (Ch 12)	Ch 9. Calling Functions
8	03/06-03/10	Three-way ANOVA (Ch 14) Nested ANOVA* (Ch 15)	Ch 10. Conditions and Loops
9	03/13-03/17	SPRING BREAK HOLIDAY WEEK	
10	03/20-03/24	One-way MANOVA (Ch 16)	Ch 11. Writing Functions Ch 12. Exceptions, Timings, and Visibility
11	03/27-03/31	Simple Linear Regression (SLR) (Ch 17) SLR with Replication (Ch 17) Pearson's Correlation (Ch 19)	Ch 13. Elementary Statistics Ch 14. Basic Data Visualization Ch 15. Probability Ch 16. Common Probability Distributions
12	04/03-04/07	Standard Multiple Linear Regression (Ch 20) Multiple Regression Model Selection (Ch 20) Polynomial Regression (Ch 21)	Ch 16. Common Probability Distributions Ch 17. Sampling Distributions and Confidence
13	04/10-04/14	Model Selection & AIC (Burnham & Anderson) Sequential Multiple Regression (not in book)	Ch 18. Hypothesis Testing Ch 19. Analysis of Variance
14	04/17-04/21	Dichotomous Variables (Ch 24) Binomial Distribution and GOF (Ch 24) General GLMMs (not in book)	Ch 19. Analysis of Variance Ch 20. Simple Linear Regression
15	04/24-04/28	Poisson Regression (not in book) Binomial Logistic Regression (Ch 24)	Ch 21. Multiple Linear Regression Ch 22. Linear Model Selection and Diagnostics
16	05/01-05/05	Multinomial Logistic Regression (not in book) Ordinal Logistic Regression (not in book)	Ch 22. Linear Model Selection and Diagnostics App B. Working with RStudio
17	05/08-05/10	Catchup/Wrap-Up	Catchup/Wrap-Up

Holidays

Mon-Fri	03/13-17	Spring Break (no classes)
Fri	04/07	Good Friday Holiday (no classes)

Exam Schedule

Exam I Due (Blue Content)	Sunday, February 26 (tentative)
Exam II Due (Orange Content)	Sunday, April 02 (tentative)
Exam III Due (Green Content)	Wednesday, May 17 (**FIRM!!!**)