BIOL 827: Biological Statistics

Term: Fall 2024
Course Credits: 3
Course Delivery: Online - Asynchronous

Instructor: Dr. Gregory J. Pec
Office: 319 Bruner
Email: pecg@unk.edu
Phone: 308.865.8410

Office hours (link to schedule appointments on Canvas homepage): Wednesdays 10 AM – 12 PM and Thursdays 10 AM – 12 PM Central Time, or by appointment. Please take advantage of office hours to check-in, ask questions, or follow-up on anything you would like to understand better. Email should be used judiciously to address questions pertaining to course administration/scheduling or urgent matters. I respond to messages as quickly as I can, generally within 24-48 hours. Direct issues related to the course content should be posted to the Canvas forum described below.

Course Description: This class is divided into two main areas. The first is biological statistics: the collection and analysis of scientific data. The second area is experimental design: how an experimental hypothesis is built and what are the pieces and procedures needed to conduct a successful experiment. The class is not mathematically intensive and relies on the power of computers beyond a few examples done by hand. The class includes both parametric and non-parametric statistics with continuous and categorical variables.

Course Learning Objectives: At the completion of the course, you will be able to:

1. Identify best practices for data management, including creation of metadata, to ensure longevity of datasets.
2. Construct testable hypotheses about biological systems and identify appropriate experimental designs to statistically test those hypotheses.
3. Calculate descriptive statistics to examine the character of a dataset and evaluate statistical power using statistical software.
4. Use statistical software to conduct standard statistical tests as appropriate for different experimental designs and datasets.
5. Interpret results of standard statistical tests.
6. Apply statistical concepts in critically evaluating research conducted by others.
7. Communicate research results that are accurately and concisely supported by statistics

Required Texts and Materials

- Whitlock, M.C., Schluter, D. The Analysis of Biological Data. Freeman- Macmillan, New York. 2015 Second edition or 2020 Third edition
- Other: Some required and optional reading materials may be provided via the Library Reserves or require accessing via Library citation finder. Any other course readings, website, and interactives (required or optional) will be posted for download or linked on the Learning Content pages in Canvas.

Required Technology

- As an online course, access to an **up-to-date computer** and Canvas several times a week is required (checking in daily is encouraged). Use of an obsolete computer operating system may hinder functionality of both Canvas, JASP and/or RStudio.

- You will need to be able to download and install software from the internet on the computer you use for this course. See more about JASP, R, and RStudio below.
- All quizzes should be completed from a computer browser. Issues may arise if using the Canvas mobile app or browser on a mobile device to complete quizzes.
- Application of concepts via statistical software is central to current research practice and eases the need for you to complete complex computations manually. Familiarity with statistical computing is also seen as a valuable skill by many employers in the biological sciences. In this course, we will use one of the most common programs, the R program, as it is implemented using R Studio. With that said, we are also piloting the use of JASP, runs R programming in the background, however compared to R is much more user friendly and provides a GUI interface without the need to write code. Both are free and available for Windows, Mac, and Linux operating systems. **Please install both software programs** prior to beginning Module 1. No prior knowledge of or experience with either software is needed at the beginning of the course – we will start from the beginning and build skills incrementally during the semester. Although current builds of RStudio and JASP are designed for 64-bit computers, you can download and install an older build of RStudio or JASP compatible with 32-bit computers.
- For issues installing JASP, R or RStudio, please contact the instructor as soon as possible.
- An updated PDF reader will also be needed to read course materials.
- You may need to use software, such as Microsoft Word, Excel, or another equivalent.
- Microsoft365 software is available to UNK students for free download.
- Ability to use search engines (for example, Google Scholar or the Calvin Library search engine) to locate scholarly works is expected of graduate students. If you are not already comfortable with this, I encourage you to reach out to me or the Natural Sciences Librarian at Calvin Library for assistance.
- For issues with Canvas or other technologies associated with your university account, please contact the University technology help desk.

Course Organization

Canvas

For this class we will use an online course management system called Canvas. Course information, updates, and related information, etc. will be posted here. I have also created a forum in Canvas for asking/answering questions about course information. There are 16 content modules over 16 weeks prior to Finals Week.

Participation

The more students are engaged in a course, the more they tend to get out of it. I encourage you to spend at least a little time each day with course material or activities though I recognize this is not always possible.

Communication

Please check course announcements in Canvas frequently. This the primary way I will communicate. Please feel free to reach out to me at any time via Canvas messages, email, or office phone. I will respond as quickly as possible, usually within 24-48 hours. Emails sent after 3 pm (CST) on Fridays will be answered by the following Monday. If sending an email or leaving a voicemail, please be sure to include BIOL 827 in the subject (email) or message (voicemail) so I can prioritize responding to it.

Course Structure and Assessment

All work is due by 11:59 PM Central Time on the date listed in Canvas and on the course schedule, unless otherwise indicated. This course consists of recorded information sessions, reading assignments, and online discussion boards. All materials for each week will be posted on Canvas.

This is not a self-paced course. You will be expected to keep up with the pace of the course, and the course structure is designed to help with this. If this is your first distance class, you will find that these classes can be fast paced. Understandably, everyone in this class has several commitments other than this class. Nonetheless, as a student who has registered for this class, it is your full responsibility to ensure that you can meet the requirements and commit the needed time for this course. Students are responsible for all material covered, even for assignments that are missed. If you start to fall behind, it may be difficult to catch up. Please do not hesitate to contact me.

Information Sessions: Audio/video information sessions, accompanying presentations, and supplementary resources will be posted on Tuesdays to Canvas.

Assignments:
Problem Sets (PS): Each week will have a 15-point problem set except during weeks with an exam. Problem sets will provide students practice applying concepts relevant to each module, handling data, conducting analyses, and interpreting results in the context of a biological question and hypothesis. There will be a total of 12 graded problem sets, with the lowest 2 scores being dropped. A file with detailed instructions and any datafiles will be provided for each problem set in Canvas. Students are expected to read and follow these instructions. Students may work through problem sets collaboratively, but each student must submit their own unique work and will be responsible for all material on exams. Most problem sets will be submitted by entering responses in a Canvas quiz page. If there is a discrepancy between the instructions document and the Canvas quiz form, the instructions document takes precedence. When entering problem set responses into a Canvas quiz form, students will not have a time limit in which to complete the assignment or be limited in the number of attempts submitted prior to the due date/time. The last submission will be graded.

Quizzes (Q): There will be a 15-point quiz each week related to the learning objectives of the module(s) covered except in weeks with an exam. Students may work through quizzes collaboratively, but each student must submit their own unique work and will be responsible for all material on exams. Quizzes may require students to refer to tables in the text or other materials provided in the module and may include simple calculations requiring a calculator or spreadsheet. Quizzes are open book/note (no proctor needed). Students will have **two attempts** to take each quiz; the highest score will be graded. Of the 13 weekly quizzes, the lowest 3 scores will be dropped.

Exams: Will assess your progress toward reaching the course learning objectives. You are responsible for all material covered for exams, even for assignments that are missed or for which the score is dropped. There are two-unit exams (UE) (90 points each) and a comprehensive final exam (FE) (180 points). Exams have the following components:

1. quiz over concepts,
2. problem set over application of concepts,
3. [final only] paper critique.

Quiz and problem set components are to be completed by you independently and without collaboration or outside assistance. All quiz portions are open note/open book (proctor not required). You will have one attempt to take the exam. Specific instructions and expectations for exam problem sets will be provided in Canvas one week prior to their due date.

Basis for final grade

Assessment	**Points**
Quizzes (13 @ 15 points each; 3 drops)	150
Problem Sets (12 @ 15 points each; 2 drops)	150
Unit Exams (2 @ 90 points/each)	180

Exams (1 @ 180 points)	180
Total	660

Grades will be assigned using the standard grading scale for the Department of Biology, as follows: A (93-100%), A- (90-92%), B+ (88-89%), B (83-87%), B- (80-82%), C+ (78-79%), C (73-77%), C- (70-72%), D+ (68-69%), D (63-67%), D- (60-62%), and F (below 60%).

Course Policies and Resources
I take my role as your instructor very seriously; I care about how well you do in this course and that you have a challenging and rewarding experience. It is my commitment to you to respond individually to the work you submit in this class and to return your work promptly.

Grading Policy
Scores for each assignment will be posted on the course Canvas page. If you think there was a grading error or do not understand the feedback you receive on graded work, please contact me as soon as possible. If you would like me to regrade your work, requests should be made within three days after the graded work has been returned to you. Regrade requests may result in a lower grade.

Late Work Policy
As a student enrolled in this course, one of your responsibilities is to submit course work on time. With that said, I recognize there may be times when you are unable to complete or submit these tasks by their due dates. To accommodate this, late assignments will be accepted up to 3 days late. If more than 3 days late, the submission will not be accepted and a grade of 0 (zero) will be recorded for that assignment. Course work will not be accepted late unless prior arrangements have been made due to documented professional or extenuating personal circumstances (e.g., family emergency, participation in university-sanctioned activities, religious observation, etc.). Please contact me as soon as possible to discuss alternative arrangements.

All students at the University of Nebraska Kearney should be aware of the following university-wide course policies and resources.

Attendance Policy
Your instructor may have indicated on their syllabus an attendance policy specific to their class. If so, that is the policy with which you must comply. If no other policy is stated, the University-wide attendance policy will apply.
Undergraduate Student Attendance Policy
Graduate Student Attendance Policy

Academic Honesty Policy
Academic honesty is essential to the existence and integrity of an institution of higher education. The responsibility for maintaining that integrity is shared by all members of the academic community. To further serve this end, the University of Nebraska at Kearney has a policy relating to academic integrity.
Undergraduate Academic Integrity Policy
Graduate Academic Integrity Policy

Finals Week Policy
The final exam will be administered in the time period scheduled during finals week in accordance with University policy (Final Exam Schedule). More information about UNK's Finals Week Policy, including when it is appropriate to ask for special accommodations to move a course's final exam, can be found here: Finals Week Policy.

Mental Wellness
The UNK Counseling Center provides mental health services to support the academic success of students. The Counseling Center provides a full range of short-term professional mental health services. Getting help is a smart and courageous thing to do. Contact the UNK Counseling Center at 308-865-8248 or visit their website for more information: https://www.unk.edu/offices/counseling_healthcare/counseling_care/index.php

Military and Veteran Services
Military and Veteran Services assist veterans, service members, and their dependents with education benefits and academic and supporting resources. They serve as a liaison between students and the Veterans Administration and branches of the military. Contact the UNK Military and Veteran Services office at 308-865-8677 or visit their website for more information: https://www.unk.edu/offices/financial_aid/veterans_services/index.php

Reporting Student Sexual Harassment, Sexual Violence or Sexual Assault
Reporting allegations of rape, domestic violence, dating violence, sexual assault, sexual harassment, and stalking enables the University to promptly provide support to the impacted student(s), and to take appropriate action to prevent a recurrence of such sexual misconduct and protect the campus community. Confidentiality will be respected to the greatest degree possible. Any student who believes they may be the victim of sexual misconduct is encouraged to report to one or more of the following resources:

- **Local Domestic Violence, Sexual Assault Advocacy Agency** 308-237-2599
- **Campus Police (or Security)** 308-865-8911
- **Title IX Coordinator** 308-865-8655

Retaliation against the student making the report, whether by students or University employees, will not be tolerated.

Students with Disabilities
It is the policy of the University of Nebraska at Kearney to provide flexible and individualized reasonable accommodation to students with documented disabilities. To receive accommodation services for a disability, students must be registered with the UNK Disabilities Services for Students (DSS) office, 175 Memorial Student Affairs Building, 308-865-8214 or by email unkdso@unk.edu

Students Who are Pregnant
It is the policy of the University of Nebraska at Kearney to provide flexible and individualized reasonable accommodation to students who are pregnant. To receive accommodation services due to pregnancy, students must contact the Student Health office at 308.865.8218. The following links provide information for students and faculty regarding pregnancy rights. https://thepregnantscholar.org/title-ix-basics/
https://nwlc.org/resource/faq-pregnant-and-parenting-college-graduate-students-rights/

UNK Policy for Inclusive Excellence
At UNK, inclusive excellence is rooted in our values.

- **People matter.** The diversity of our students, faculty and staff is essential to our educational mission. Our backgrounds, identities, and lived experiences enrich our learning community.
- **The learning environment matters.** We are committed to an inclusive and equitable student-centered learning environment. In our classrooms we exchange ideas and opinions with respect for one another.
- **Learning matters.** Preparing students to value critical thinking, mutual respect, and open communication is essential for lifelong learning. We are building a community that protects and fosters intellectual inquiry and embraces diverse perspectives.

The following link provides information for students regarding UNK's commitment to inclusive excellence and procedures for improving classroom experience with inclusion and belonging: https://www.unk.edu/about/dei/inclusive-excellence-in-the-classroom.php.

Distribution of course materials: The materials on the course website are only for the use of students enrolled in this course for purposes associated with this course and may not be retained or further disseminated. The materials on the course website may be protected by copyright, and any further use of this material maybe in violation of Federal copyright law.

Disclaimer: Any typographical errors in this Course Outline are subject to change and will be announced on the course Canvas page.

Tentative Fall 2024 Course Schedule

All work due by 11:59PM Central Time unless otherwise indicated. Required content not listed here may be provided in Canvas.

Week	Topics	Readings	Assessment
1	Introduction to Statistics	Ch. 1	Q1; PS1
2	Data management		Q2; PS2
3	Describing and visualizing data	Ch. 2, 3	Q3; PS3
4	Uncertainty and probability	Ch. 4, 5	Q4; PS4
5	Hypothesis testing	Ch. 6	UE1
6	Experimental design	Ch. 14	Q5; PS5
7	Binomial distribution	Ch. 7	Q6; PS6
8	Ch-square distribution	Ch. 8, 9	Q7; PS7
9	Fall Semester Break		
10	Normal distribution	Ch. 10, 13	Q8; PS8
11	One-sample and paired t-tests	Ch. 11, 12, 13	Q9; PS9
12	Two-sample t-tests	Ch. 12, 13	UE2
13	One-way ANOVA	Ch. 15	Q10; PS10
14	Thanksgiving Break		
15	Complex ANOVA	Ch. 18	Q11; PS11
16	Correlation and regression	Ch. 16, 17	Q12; Q13; PS12
17	Finals Week		FE1