# STAT 801A: Statistical Methods in Research

**Instructor:** Dr. Erin Blankenship (she/her)

**email:** `erin.blankenship@unl.edu`

**Lecture:** 9:30-10:45 Tuesday/Thursday, 11 Newkirk Human Sciences Building

**Office Hours:** 10:00-11:00 Monday/Wednesday or by appointment; 343B Hardin Hall, North Wing

**Lab Instructor:** Dinuwanthi Liyanage (2:30 lab); Samitha Herath (4:30 lab)

**email:** `dliyanage2@huskers.unl.edu`; `sherath2@huskers.unl.edu`

**Required Materials:**

- *Introductory Statistics for the Life and Biomedical Sciences* (Vu and Harrington). Download for free at https://leanpub.com/biostat. Slide the cost to $0.
- We will be using two statistical software packages, R and SAS OnDemand. Both are free. R is a program that you need to install on your computer. The download link is in Canvas. SAS OnDemand is cloud-based and runs through your web browswer. Instructions on accessing SAS OnDemand are in Canvas.

**Prerequisites:** An introductory course in statistics and a good working knowledge of algebra.

**Course Description:** Statistical concepts and statistical methodology useful in descriptive, experimental, and analytical study of biological and other natural phenomena. The focus is on practical applications of statistics rather than on statistical theory.

**Course Goals:**

- understand the role statistics plays in the research process, and how a statistical investigation works.
- understand statistical evidence, and what conclusions may be drawn based on the evidence and study design.
- be able to make simple probability calculations, and be able to differentiate a few different probability distributions based on the scenario.
- understand that variablility is natural, and commonly used statistics such as the mean, variance, and others have their own probability distributions. Such a probability distribution is called a sampling distribution.
- understand the underlying logic behind commonly used statistical inference techniques (hypothesis tests and confidence intervals).
- realize that the most appropriate statistical inference method changes based on the explanatory variable(s), response variable, and goals of the study.
- be able to calculate and interpret statistical analyses for studies in which there is one (or fewer) explanatory variables.
- be able to sketch a skeleton ANOVA table from a description of the study.
- use statistical software appropriately.
- be able to clearly write up the results of an analysis.

**Grading:**

| Assignment(s) | Contribution to Final Grade |
|---|---|
| Exam 1 | 20% |
| Exam 2 | 20% |
| Comprehensive Final | 25% |
| Homework | 25% |
| Lab | 10% |

**Grading Scale:**

| Grade | Final Percentage Range |
|---|---|
| A | 94.0-100 |
| A- | 90.0-93.99 |
| B+ | 88.0-89.99 |
| B | 84.0-87.99 |
| B- | 80.0-83.99 |
| C+ | 78.0-79.99 |
| C | 74.0-77.99 |
| C- | 70.0-73.99 |
| D+ | 68.0-69.99 |
| D | 64.0-67.99 |
| D- | 60.0-63.99 |
| F | <60.0 |

**Course Expectations:** In this course, you are expected to have professional behavior. You are expected to attend all class meetings, be curious, ask questions, seek opportunities to learn, and be open and responsive to constructive feedback. In addition:

- Be an active participant–statistics is not a spectator sport!
- Be committed, take your work seriously
- Engage with the in-class activities and labs
- Help others–if you understand the material being discussed, practice your mentoring skills. This does not means sharing answers, but instead helping others understand the concepts.
- Complete any assigned readings.

You are also expected to exhibit a professional demeanor (language, attitude) toward others. Disagreement during discussions is welcome and often productive in developing a deeper understanding of the concepts being discussed. However, disagreement does not warrant yelling or disrespectful language or behavior. Unprofessional behavior will not be tolerated, and appropriate actions will be taken to prevent future occurrences.

**Recording of class-related activity:** I invite all of you to join me in actively creating and contributing to a positive, productive, and respectful classroom culture. Each student contributes to an environment that shapes the learning process. Any work and/or communication that you are privy to as a member of this course should be treated as the intellectual property of the speaker/creator, and is not to be shared outside the context of this course.

Students may not make or distribute screen captures, audio/video recordings of, or livestream, any class-related activity, including lectures and presentations, without express prior written consent from me or an approved accommodation from Services for Students with Disabilities. If you have (or think you may have) a disability such that you need to record or tape class-related activities, you should contact Services for Students with Disabilities. If you have an accommodation to record class-related activities, those recordings may not be shared with any other student, whether in this course or not, or with any other person or on any other platform.

**Labs:** All students must be registered for a lab section (section 251 or 252). Weekly labs will give you the opportunity to practice applying statistical software to the design and analysis concepts covered in class. **Lab attendance is required!** See the lab syllabus for details on how the lab grade will be calculated.

**Exams:** Two exams will be given: 2 October and 6 November. You will be allowed to use a calculator, but exams are closed notes. The exams will evaluate your understanding of the material, as well as your ability to synthesize and transfer that knowledge to other scenarios and situations; questions will assess conceptual understanding as opposed to mere memorization and mechanical calculation. You are expected to take exams at the scheduled times. If this is impossible due to extreme circumstances (illness, death in the family, previously scheduled activities vital to academic program), please notify me and provide appropriate documentation. No make-up exams will be given if I am not notified prior to the examination. You will be required to obtain a note from your physician or advisor explaining the nature of the conflict.

**Final Exam: Wednesday, 17 December 10:00-noon** Like Exams 1 and 2, the final exam is closed book and closed notes but you may use a calculator. This is the set time for the final exam, revise your travel plans accordingly.

**Homework:** Homework will be assigned approximately weekly, typically on Tuesdays and due on the following Wednesday (for example, Homework 1 will be assigned on Tuesday, 2 September and due on Wednesday, 10 September). This schedule may be altered around exam weeks. Most homework will require the use of R or SAS. Homework will be assigned and turned in through Canvas. Late homework submissions should be avoided if at all possible. If this policy is abused, it will be changed to "No late homeworks are accepted."

**Instructional Continuity:** If in-person classes are canceled, you will be notified of the instructional continuity plan for this class through Canvas.

**AI and Explainability Policy:** (adapted from Dr. Vanderplas)

- Any use of generative AI must be disclosed in an appendix to your submission - this includes brainstorming, editing, using AI as spell-check/grammar-check, and so on. You must document the following:
  - the version of the generative AI used
  - the full sequence of prompts and responses
  - any additional inputs you provided to the AI system
  - a "diff" between the AI responses and your submission, showing exactly what was generated by the AI system and what you changed.

It may be useful to leverage AI tools to ensure that your work conforms to grammar and style guidelines, but I very highly discourage the use of generative AI for content or code (I've seen it generate incorrect code too many times).

- You must be able to explain any work you turn in, including code. If you cannot explain the logic behind your approach as well as how it works in practice, then you will not receive credit for your submission.

**Department Grade Appeal Policy:** The Department of Statistics grade appeal policy

**Academic Integrity:** You are encouraged to work together on problems and exercises, but the work you turn in must be your own (unless the assignment specifically states otherwise). Work on exams must be your own. University policy will be followed in cases of academic dishonesty: In cases where an instructor finds that a student has committed any act of academic dishonesty, the instructor may in the exercise of his or her professional judgment impose an academic sanction as severe as giving the student a failing grade in the course. Before imposing an academic sanction the instructor shall first attempt to discuss the matter with the student. If deemed necessary by either the instructor or the student, the matter may be brought to the attention of the student's major advisor, the instructor's department chairperson or head, or the dean of the college in which the student is enrolled. For additional details see the department policy.

**Services for Students with Disabilities:** The University strives to make all learning experiences as accessible as possible. If you anticipate or experience barriers based on your disability (including mental health, chronic or temporary medical conditions), please let your instructor know immediately so that you can discuss options privately. To establish reasonable accommodations, your instructor may request that you register with Services for Students with Disabilities. If you are eligible for services and register with the office, make arrangements with your instructor as soon as possible to discuss your accommodations so they can be implemented in a timely manner. SSD is located in 117 Louise Pound Hall and can be reached at 402-472-3787.

**University Policies:** All university-wide policies.

**Tentative Course Outline**

| Week | Dates | Notes | Topics |
|---|---|---|---|
| 1 | 25-28 August | No Lab | Introduction to data and the scientific method |
| 2 | 1-4 September | No Lab | Probability basics |
| 3 | 8-11 September | HW 1 due | Probability basics; sampling distributions |
| 4 | 15-18 September | HW 2 due | Sampling distributions and foundations of inference |
| 5 | 22-25 September | HW 3 due | Foundations of inference |
| 6 | 19 Sept - 2 Oct | Exam 1 on 2 Oct | |
| 7 | 6-9 October | | 1 predictor variable with 2 levels |
| 8 | 13-16 October | HW 4 due | 1 predictor variable with 2 levels |
| 9 | 20-23 October | No lab, no class on 21 Oct; HW 5 due | 1 predictor variable, $> 2$ levels |
| 10 | 27-30 October | HW 6 due | 1 predictor variable, $> 2$ levels |
| 11 | 3-6 November | Exam 2 on 6 Nov | |
| 12 | 10-13 November | | Blocking |
| 13 | 17-20 November | HW 7 due | 1 predictdor variable (numeric): simple linear regression |
| 14 | 24-27 November | No class on 27 Nov; HW 8 due | 1 predictor variable (numeric): simple linear regression |
| 15 | 1-4 December | HW 9 due | Catch up |
| 16 | 8-11 December | | Catch up and review |
| Finals Week | | Final Exam | **Wednesday, 17 December at 10:00 am** |