Stat 2480 – **Statistics for the Life Sciences**   **Autumn 2022**

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Office Hours (see Canvas page for link to Carmen Zoom): 5–6pm W&F, 4:30–5:30pm T&Th

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Office Hours: 9:30am–10:30am T, 9:00am–10:00am Th

Course Description:
This course is a calculus-based introduction to the statistical analysis of data arising in biological and medical contexts. Topics include probability, common discrete and continuous probability distributions, experimental design and random sampling methods, significance testing and confidence interval estimation for one and two-sample settings, correlation and linear regression.

Prerequisites:
Math 1131, 1151 (152), 156, 1161.XX, or 1181H, or equivalent, or permission of instructor. This class is not open to students with credit for Stat 2450 (245) or 218.   This is a GE data analysis course.

Course materials:
- Required textbook: The Analysis of Biological Data, 3rd edition, by M.C. Whitlock and D. Schluter.   ISBN: 978139226299
- The textbook and the accompanying homework management system, **Achieve**, are provided by CarmenBooks. Through CarmenBooks students may obtain publisher materials electronically through CarmenCanvas. The fee for this material is included as part of your tuition, and is listed as a CarmenBooks fee on your Statement of Account. Materials should be available to you freely on or before the first day of class, so there is no need to wait for financial aid or scholarship money to purchase yoru book. In fact, unless you chose to opt out of the CarmenBooks program, you do not need to purchase any materials for this course. For more information about the CarmenBooks program, visit https://affordablelearning.osu.edu/carmenbooks/students .
- The textbook publisher's technical support team can be reached by phone, chat or email via the Student Support Community. To contact support, please open a service request by filling out the webform at https://macmillan.force.com/macmillanlearning/s/

Course delivery:

This course is completely online and mostly asynchronous.

- New material will be presented in recorded streamcast lectures broken into recordings that last from 10 to 30 minutes. You can expect about 90 minutes of new material to be posted each week to the Canvas page. You may watch these any time, as long as you keep up with this material and watch these lectures during the week in which they're posted.
- Each week several live, open office hours will be posted through CarmenZoom. Office hours are listed above. You do not have to attend these, but I hope you will. It's my hope that these office hours turn into interesting and lively discussions of class material.
- The only times you must be with me synchronously are for the three exam sessions. All students must take the midterm exams and final exam during the designated time slots, as indicated on the course schedule below.
- Assignments, labs and recorded class presentations will all be posted to the Canvas page.
- You will submit homework assignments and completed labs to the Canvas page under the appropriate submission box.
- Grades for assignments, labs and exams will also be posted to the Canvas page.

Course technology:

For help with your password, university email, Carmen, or any other technology issues, contact the OSU IT Service Desk. Standard support hours are available at https://ocio.osu.edu/help/hours . For urgent issues, help is available any time, including non-standard hours.

- Self Service and Chat Support: http://ocio.osu.edu/selfservice
- Phone: (614)688-HELP (4357)
- Email: 8help@osu.edu
- TDD: (614)688-8743

If you encounter difficulties navigating Carmen, you may find help here: https://resourcecenter.odee.osu.edu/canvas/

Necessary hardware: You need a computer with

- a high-speed internet connection
- either OS X (Mac) or Windows 10+ (PC) operating system
- a working webcam (Needed for the exams. This is non-negotiable.)
- a microphone (internal or external, also needed for exams.)

Necessary software:

- This class requires you to use the statistical software package R. You have flexibility in how you access tis software:
  - a.) You can download R to your laptop. This can be downloaded freely at http://www.r-project.org/ . If you do this, you may also choose to download the easier-to-use R interface called R-studio (http://rstudio.org). You need to install R first, then install R-studio. R-studio requires R to be installed.
  - b.) You can access R (actually R-studio) through the Ohio Supercomputer Center (OSC) through their webbrowser. You will need to set up an account through the OSC and log in to use R each time you need to work through a lab.
- Microsoft Office 365 ProPlus provides access to Word, Excel, PowerPoint, Outlook, and other programs depending on your platform. All OSU students are eligible for this package free of charge for installation on up to five machines (phones, computers, tablets). Students also receive 1 TB of cloud storage through ONEDrive for Business storage. You can install Office 365 within your BuckeyeMail account. Instructions for downloading can be found here: https://ocio.osu.edu/kb04733 .

Course learning outcomes:
This course satisfies the ***Mathematical and Quantitative Reasoning*** foundation component of the university's **General Education program**. Learning objectives attached to this foundation follow:

1.1 Use logical, mathematical and/or statistical concepts and methods to represent real-world situations.
1.2 Use diverse logical, mathematical and/or statistical approaches, technologies and tools to communicate about data symbolically, visually, numerically and verbally.
1.3 Draw appropriate inferences from data based on quantitative analysis and/or logical reasoning.
1.4 Make and evaluate important assumptions in estimation, modeling, logical argumentation and/or data analysis.
1.5 Evaluate social and ethical implications in mathematical and quantitative reasoning.

Students that successfully complete this course will obtain the following skills, which map to the learning objectives above as indicated ().

- Understand and discuss sound methods of data collection, and recognize problems that can occur when data is collected carelessly or problematically. In particular:
  - a. Be able to distinguish between simple random samples, cluster random samples, and stratified random samples, and be able to recognize advantages and disadvantages to each for various settings. (1.1, 1.2, 1.3)
  - b. Be able to explain how to correctly design an experiment, including understanding the roles of randomization, replication, blocking and blinding as appropriate. (1.1, 1.2)

c. Understand why observational studies are poor for determining cause-and-effect conclusions. (1.3)
d. Recognize different kinds of bias that can be introduced through poorly designed sampling plans or surveys. (1.4, 1.5)
e. Recognize how sources of bias in surveys can have problematic social and ethical implications on work they are intended to support. (1.5)

- Create and interpret graphical and numerical summaries of data. In particular:
  a. Recognize a graphical summary appropriate for a particular purpose, and be able to construct it; (1.2)
  b. Be able to interpret various graphical summaries commonly found in applications and in the literature; (1.2)
  c. Be able to numerically summarize various aspects of the distribution of a data; (1.2)
  d. Use correct terminology to describe data and distributions. (1.2)

- Make statistical inferences by analyzing data. In particular:
  a. Construct confidence intervals or carry out significance tests for a single mean or proportion, or for a difference between two means or between two proportions, or for the ratio of two proportions, or for an odds ratio. (1.1, 1.2, 1.3)
  b. Construct confidence intervals or significance tests for parameters in the simple linear regression setting; (1.1, 1.2, 1.3)
  c. Construct confidence intervals for the mean response or for a prediction in the simple linear regression setting; (1.1, 1.2, 1.3)
  d. Understand assumptions and conditions necessary for the validity and appropriateness of methods of statistical inference, and also how to check for whether these conditions and assumptions are reasonable in an application. (1.4)
  e. Understand the limitations and misuse of statistical inference methods. (1.4, 1.5)

- Understand probability and its link to statistical inference. In particular:
  a. Be able to apply set axiomatic rules of probability (unions, intersections, conditional probability, Bayes Rule, etc.) to solve probability problems and interpret answers in biostatistical contexts; (1.2)
  b. Recognize and apply common discrete distributions (binomial, hypergeometric, poisson) and continuous distributions (normal, uniform, t, chi-square) as models for probability and for statistical inference; (1.2)
  c. Understand what a sampling distribution is, and how they are foundational to statistical inference; (1.2, 1.3)
  d. Understand what the Central Limit Theorem tells us about the sampling distribution of a sample mean, and its role in foundational statistical inference. (1.2, 1.3)

Course Grades and Modes of Assessment:
Your total course average (TCA) will be computed according to the following weights:

Homework assignment average	20%
Lab Assignment average	15%
Discussion Assignments	5%
Exam 1	20%
Exam 2	20%
Final Exam	20%

Your course grade will depend on your total course average, according to the following scale:

93% ≤ TCA ≤ 100%	A	73% ≤ TCA < 77%	C
90% ≤ TCA < 93%	A–	70% ≤ TCA < 73%	C–
87% ≤ TCA < 90%	B+	67% ≤ TCA < 70%	D+
83% ≤ TCA < 87%	B	60% ≤ TCA < 67%	D
80% ≤ TCA < 83%	B–	TCA < 60%	E
77% ≤ TCA < 80%	C+		

Note: The instructor reserves the right to change this grade scale in a manner that raises student grades, but will not change it in a manner that lowers them. For example, if a student earns a TCA of 89.4%, a grade of at least B+ is guaranteed, but it might be improved to A–. This scale adjustment is not made on an individual level, but involves adjusting the scale in a manner that effects all students.

Homework assignments:
Homework problem sets will be assigned for each topic covered in the course. You will submit solutions to these assignments through the online platform **Achieve**, which you can access directly through the Canvas.   Periodically, recommended problems will also be posted for additional practice, but will not be collected or graded. Your lowest homework assignment score will be dropped with no questions asked. The average of your remaining assignment scores will count for 20% of your overall grade. Late homework assignment submissions will be accepted only with instructor approval, and a maximum of two times during the semester.

Lab Assignments:
Lab exercises using the R software package will be completed about once per week. These lab exercises will be submitted via Canvas quizzes. Your lowest lab assignment score will be dropped. The average of your remaining lab assignment scores will count for 15% of your overall grade.   Late lab assignment submissions will be accepted only with instructor approval, and a maximum of once during the semester.

Discussion Assignments:

Twice during the semester, you will be required to create a discussion board post that shows an improper use of statistics. This could be a graph, statistical hypothesis test, discussion of data, etc., that you find in a news article, blog post, or twitter thread, for example. Each post should be accompanied by a couple of sentences describing what is incorrect. You will also be required to comment on at least two of the other students' posts, to either agree, point out an additional problem, or argue that the posted information is actually correct. A rubric and due dates will be provided on the Canvas page. These two discussion assignments will count for 5% of your overall grade (2.5% for each assignment). No late discussion assignments will be accepted.

Exams:

There will be two midterms exams and a final exam. Dates and times of these exams are provided in the schedule below. You must be present in the Zoom session in order to take the exam, and you must do so with a live camera and microphone on.

More information about exams will come soon. You'll need a calculator (non-internet connected, so no phone, tablet or computer allowed). Statistical tables will be provided with the exam.

Makeup exams:

If you require a makeup exam, the following rules will apply:

(1) You will need to provide documentation demonstrating that you are unable to take the exam during the regularly scheduled time;

(2) You will need to take the makeup exam after but within one week of the regularly scheduled time – no early exams will be given;

(3) You will need to adhere to any request the instructor makes for verifying the validity of your reason for requesting the makeup;

(4) If you have documented need for missing a midterm exam but are also unable to take the makeup exam within a week of the regularly scheduled time, then the weight for the missed exam will be shifted equally to the other midterm exam and the final exam, so that the other midterm exam and final exam each weight for 30% instead of 20%;

(5) If you have documented need for missing the final exam, you will receive a course grade of Incomplete and will be required to complete the course in accordance with university policy;

(6) Finally, note that our exams are all scheduled in accordance with the official times scheduled for this class (3pm on MWF during the semester, and 12:00pm on F 12.9 for the final exam). Hence, requests for rescheduling an exam will only be considered for (a) illness or incapacitation; or (b) an official OSU conflict (e.g. you're traveling with an athletic team), and not for a personal or job-related conflict. Again, either reason will require documentation that the instructor can follow up on and validate.

Expected engagement:

This is an asynchronous class. You are expected to visit the Canvas page many times each week. Here is a list of things you should do regularly:

1. Listen and take notes from all posted lesson recordings. You may need to listen to lessons or parts of lessons more than once.
2. Read the textbook. Sections referencing lessons are provided with the class schedule below.
3. Work assignments. Do this after you learn the material through (1.) and (2.).
4. Complete lab assignments.
5. (Optional, but recommended) Attend some office hours.

For exams, you **must** take the exam at the designated exam times and spaces (Zoom).
This class requires regular and extensive engagement.

Communication:

Office hours and message boards will be the primary mode of student to instructor communication in this class. Of course, there will be times that questions will arise will need to be addressed over email. **In that case, please begin your email's subject with STAT 2480**. Remember that all course email correspondence must be conducted using your valid OSU name.# email account.

Announcements will regularly be posted to the Canvas page, containing course reminders about due dates, which videos you should be watching, and anyting you need to be keeping an eye on.

Technical questions related to R or Achieve access are best directed to 614–688–HELP. The instructor probably won't be able to resolve issues that are related to how your computer interfaces with the class software.

Conceptual questions related to class material should be posted to the discussion board whenever possible, so that all can benefit from a response. If you don't feel comfortable posting to the discussion board, you may send email. In all cases, expect a response within 24 hours, except some weekends.

Finally, you're strongly encouraged to attend office hours. A Zoom link for office hours is posted to the Canvas page.

All of us (students and instructors) must maintain a civil and polite tone with one another, always treating one another with respect and empathy. Let's all assume the best of intentions with one another. Remember that sarcasm is always obvious to its creator, but is often missed by its recipients.

Student academic Services:

Student academic services offered on the OSU main campus
http://advising.osu.edu/welcome.shtml.

Student support services:

Student support services offered on the OSU main campus http://ssc.osu.edu.

Academic integrity:

Policies for this online course

- **Homework**: Homework may be discussed with classmates or TAs but submitted homework assignments should represent your own effort.
- **Lab activities**: Lab activities may be completed in a "group setting" by collaborating with other students in the class. Help from sources outside of this class is not allowed.
- **Exams**: You must complete the exams yourself, without any help from or communication with any person other than the instructor. You must take the exam in the provided Zoom exam environment using a computer with a camera and microphone turned on, with the instructor able to observe you. During the exam you must adhere to all exam rules, such as not having access to an internet-connected device (tablet, phone).

Ohio State's Academic Integrity Policy

It is the responsibility of the Committee on Academic Misconduct to investigate or establish procedures for the investigation of all reported cases of student academic misconduct. The term "academic misconduct" includes all forms of student academic misconduct wherever committed; illustrated by, but not limited to, cases of plagiarism and dishonest practices in connection with examinations. Instructors shall report all instances of alleged academic misconduct to the committee (Faculty Rule 3335-5-487). For additional information, see the Code of Student Conduct http://studentlife.osu.edu/csc/.

Copyright disclaimer:

The materials used in connection with this course are subject to copyright protection and are only for the use of students officially enrolled in the course for the educational purposes associated with the course. Copyright law must be considered before copying, retaining, or disseminating materials outside of the course. **In particular, you do not have permission to distribute in any manner instructor-created recorded lessons, instructor-written notes, or instructor-written exams or solutions to these exams.**

Title IX disclaimer:

Title IX makes clear that acts of violence or harassment based on sex and gender are Civil Rights offenses, subject to the same kinds of accountability and the same kinds of support applied to offenses against other protected categories (e.g., race). If you or someone you know has been sexually harassed or assaulted, you may find the appropriate resources at http://titleix.osu.edu or by contacting the Ohio State Title IX Coordinator, Kellie Brennan, at titleix@osu.edu

Accessibility accommodations:

The university strives to make all learning experiences as accessible as possible. In light of the current pandemic, students seeking to request COVID-related accommodations may do so through the university's [request process](https://slds.osu.edu/covid-19-info/covid-related-accommodation-requests/) (https://slds.osu.edu/covid-19-info/covid-related-accommodation-requests/), managed by Student Life Disability Services. If you anticipate or experience academic barriers based on your disability (including mental health, chronic, or temporary medical conditions), please let the instructor know immediately so that we can privately discuss options. To establish reasonable accommodations, you may be requested to register with Student Life Disability Services. After registration, make arrangements with the instructor as soon as possible to discuss your accommodations so that they may be implemented in a timely fashion. SLDS contact information: slds@osu.edu; 614-292-3307; slds.osu.edu; 098 Baker Hall, 113 W. 12th Avenue.

Accessibility for course technology:

This online course requires use of Carmen (Ohio State's learning management system) and other online communication and multimedia tools. If you need additional services to use these technologies, please request accommodations with your instructor.

- [Carmen (Canvas) accessibility](#)
- Streaming audio and video
- Synchronous course tools

Mental health:

As a student you may experience a range of issues that cause barriers to learning, such as strained relationships, increased anxiety, alcohol/drug problems, feeling down, difficulty concentrating and/or lack of motivation. These mental health concerns or stressful events may lead to diminished academic performance or reduce a student's ability to participate in daily activities. The Ohio State University offers services to assist you with addressing these and other concerns you may be experiencing. If you or someone you know are suffering from any of the aforementioned conditions, you can learn more about the broad range of confidential mental health services available on campus via the Office of Student Life's Counseling and Consultation Service (CCS) by visiting ccs.osu.edu or calling 614- 292-5766. CCS is located on the 4th Floor of the Younkin Success Center and 10th Floor of Lincoln Tower. You can reach an on-call counselor when CCS is closed at 614-292-5766 and 24-hour emergency help is also available through the 24/7 National Suicide Prevention Hotline at 1-800-273- TALK or at suicidepreventionlifeline.org

Course Schedule (tentative)

Course materials will be posted to the Canvas page according to topics for the week. You can cover the material for a week any time during the week.

Week	Class No.	Date	Day	Topics	Reading
1	1	8/24/22	W	Introduction, methods for summarizing data	Ch. 1 - 3
	2	8/26/22	F	Lab 1: Intro to the R software	-
2	3	8/29/22	M	Probability	5.1 - 5.3
	4	8/31/22	W	Probability	5.5 - 5.6
	5	9/2/22	F	Lab 2: Exploratory data analysis in R	-
3	No Class	9/5/22	M	Labor Day	-
	6	9/7/22	W	Conditional probability, Law of total probability	5.7 - 5.9
	7	9/9/22	F	Lab 3: Random sampling activity	-
4	8	9/12/22	M	Bayes Theorem, Random Variables	5.4, 5.9
	9	9/14/22	W	Random variables	5.4, 7.1, 7.4
	10	9/16/22	F	Lab 4: Statistical distributions in R	-
5	11	9/19/22	M	Hypothesis testing, Binomial test	Ch. 6, 7.2
	12	9/22/22	W	Goodness-of-fit tests	8.1 - 8.3
	13	9/23/22	F	Lab 5: Hypothesis tests in R	-
6	14	9/26/22	M	Poisson distribution	8.4
	15	9/28/22	W	Analyzing proportions, odds ratios	9.1 - 9.3
	16	9/30/22	F	Exam #1, 3pm Zoom	Ch. 1-8
7	17	10/3/22	M	Contingency tables, Normal distribution	9.4, 10.1 - 10.4
	18	10/5/22	W	Normal Distribution	10.1-10.4
	19	10/7/22	F	Lab 6: Contingency tables in R	-
8	20	10/10/22	M	Central Limit Theorem	10.5 - 10.6
	21	10/12/22	W	Central Limit Theorem, t-distribution and confidence intervals	10.5 - 10.6, 11.1-11.2
	No Class	10/14/22	F	Fall Break	-

9	22	10/17/22	M	**t distribution and confidence intervals**	**11.1 - 11.2**
	23	10/19/22	W	**One-sample t-test**	**11.3 - 11.4**
	24	10/22/22	F	**Lab 7: Normal probability plots, t distribution**	**13.1, 13.3**
10	25	10/24/22	M	**Comparing two means, unpaired test**	**12.1, 12.3**
	26	10/26/22	W	**Comparing two means, paired test & sign test**	**12: 2,4 -7; 13.4**
	27	10/28/22	F	**Lab 8: Inference for the population mean in R**	**-**
11	28	10/31/22	M	**Experimental and observational studies**	**Ch. 14**
	29	11/2/22	W	**Experimental and observational studies**	**Ch. 14**
	30	11/4/22	F	**Exam #2, 3pm Zoom**	**Ch. 9 - 13**
12	31	11/8/22	M	**Case Study**	**-**
	32	11/9/22	W	**ANOVA**	**15.1 - 15.2**
	33	11/11/22	F	**Lab 9: Power of hypothesis tests, NP tests**	**-**
13	34	11/14/22	M	**ANOVA**	**15.3 - 15.4**
	35	11/16/22	W	**Correlation**	**Ch 16**
	36	11/18/22	F	**Lab 10: ANOVA in R**	**-**
14	37	11/21/22	M	**Regression**	**17.1 - 17.5**
	No Class	11/23/22	W	**Thanksgiving Break**	**-**
	No Class	11/25/22	F	**Thanksgiving Break**	**-**
15	38	11/28/22	M	**Regression**	**17.1 - 17.5**
	39	11/30/22	W	**Regression**	**17.1 - 17.5**
	40	12/2/22	F	**Lab 11: Regression in R**	**-**
16	41	12/5/22	M	**Logistic Regression**	**17.6 - 17.9**
	42	12/7/22	W	**Review Day**	**-**
	43	12/9/22	F	**Final Exam (12:00pm–1:45pm)**	**Cumulative**