THE OHIO STATE UNIVERSITY

COLLEGE OF ARTS AND SCIENCES

# SYLLABUS: STAT 2480
## STATISTICS FOR THE LIFE SCIENCES
## SPRING 2022

# Course overview

## Instructor

Instructor: Justin Long
Email address: long.1787@osu.edu
Office hours:

- Wednesday: 12:30 pm – 1:30 pm
- Thursday: 4:30 pm – 5:30 pm
- Friday: 12:30 pm – 1:30 pm

Office Location: Office hours will be held on Zoom. Links are posted on Carmen.

## Teaching Assistants

Name: Yi Tang Chen
Email: chen.8414@osu.edu
Tutoring hours: TBD

Name: Nikki Schnitzler
Email: schnitzler.6@osu.edu

## Course description

Calculus-based introduction to the statistical analysis of biological data, including probability, common discrete and continuous distributions, experimental design, hypothesis testing, linear regression, and correlation. Prerequisites: Math 1131, 1151 (152), 1156, 1161.XX, or 1181H, or equivalent, or permission of instructor. Not open to students with credit for 2450 (245) or 218. GE data analysis course.

## Course learning outcomes

By the end of this course, students should successfully be able to:

- Understand and discuss methods of collecting data
    - By providing examples of methods of random sampling
    - By explaining correct procedures for designing experiments and observational studies
    - By explaining uses and misuses of sample surveys
- Use statistical tools for presentation of data and to understand presentations of data
    - By discussing when different types of graphical displays are appropriate and explaining proper methods of constructing graphical displays
    - By using appropriate summary statistics to describe the distribution of data
    - By introducing statistical terminology used to describe data and distributions
- Analyze data
    - By constructing and interpreting confidence intervals
    - By conducting and interpreting hypothesis tests
    - By using simple linear regression for bivariate data
- Understand basic probability and statistical concepts
    - By presenting and applying rules of probability
    - By study of the common discrete and continuous distribution used to model biological data
    - By discussing sampling distributions and the use of the Central Limit Theorem as the foundation of inference
- Evaluate statistical procedures and summaries
    - By discussing assumptions and conditions for analysis procedures
    - By identifying sources of bias in sampling, experiment, and survey methods
    - By discussing appropriate nature and scope of conclusions for analysis procedures
    - By discussing case studies in the life sciences

## GE Course Information

- This course satisfies the GEC Data Analysis requirement
- The expected learning outcomes are:
    - ELO1: Students understand basic concepts of statistics and probability.
    - ELO2: Students comprehend methods needed to analyze and critically evaluate statistical arguments.
    - ELO3: Students recognize the importance of statistical ideas.
- These goals will be achieved by detailed study utilizing example data from the life sciences.

# Course materials

- Required Textbook: *The Analysis of Biological Data*, by M. C. Whitlock and D. Schluter, 3rd ed., ISBN: 9781319226299.
- The textbook and the accompanying homework management system, **Achieve,** are for this course is being provided via CarmenBooks. Through CarmenBooks, students obtain publisher materials electronically through CarmenCanvas, saving them up to 80% per title. The fee for this material is included as part of tuition and is listed as CarmenBooks fee on your Statement of Account. In addition to cost-savings, materials provided through CarmenBooks are available immediately on or before the first day of class. There is no need to wait for financial aid or scholarship money to purchase your textbook. Unless you choose to opt-out of the program, you do NOT need to purchase any materials for this course at the bookstore. For more information on the program or information on how to opt out, please visit the CarmenBooks website, https://affordablelearning.osu.edu/carmenbooks/students
- Need help with the textbook? The publisher's technical support team can be reached by phone, chat, or by 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/contactsupport (Privacy notice: https://store.macmillanlearning.com/us/privacy-notice)

# Course technology

For help with your password, university e-mail, Carmen, or any other technology issues, questions, or requests, contact the OSU IT Service Desk. Standard support hours are available at https://ocio.osu.edu/help/hours, and support for urgent issues is available 24x7.

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

## Baseline technical skills

- Basic computer and web-browsing skills
- Navigating Carmen; the following website may help you if you encounter difficulties with Carmen: https://resourcecenter.odee.osu.edu/canvas/ .

## Necessary equipment

- Computer: current Mac (OS X) or PC (Windows 10+) with high-speed internet connection
- Webcam: built-in or external webcam, fully installed
- Microphone: built-in laptop or tablet mic or external microphone

### Necessary software

- This class requires you to use the statistical software package called R (The R Project for Statistical Computing; http://www.r-project.org/). Students will be given instructions for using the open-source R statistical software at the Ohio Supercomputer Center (OSC) through their web browser. This software will be accessible on either a laptop or a tablet.
- This software package is also available as Free Software if a student chooses to download it to a personal computer instead of accessing it through OSC.
    - You can download R for Windows, Mac, and Linux, from the CRAN archive at https://cran.r-project.org.
    - An easier to use interface to R is available in the software package RStudio. This package is available for Windows, Mac, and Linux and can be downloaded for free from http://rstudio.org. **Note that RStudio requires R to be installed.**
- Microsoft Office 365 ProPlus All Ohio State students are now eligible for free Microsoft Office 365 ProPlus through Microsoft's Student Advantage program. Each student can install Office on five PCs or Macs, five tablets (Windows, iPad® and Android™) and five phones.
    - Students are able to access Word, Excel, PowerPoint, Outlook and other programs, depending on platform. Users will also receive 1 TB of OneDrive for Business storage.
    - Office 365 is installed within your BuckeyeMail account. Full instructions for downloading and installation can be found https://ocio.osu.edu/kb04733.

## Course delivery

This course will meet in-person MWF from 10:20 am – 11:15 am in Hitchcock Hall 324. **You are expected to attend all lectures.**

The instructor will hold weekly office hours. The dates and times will be announced later and posted on the Carmen website. The instructor and teaching assistants will initiate and manage active discussion boards, also via Carmen. Additionally, information about how and when students can access free tutoring from the Mathematics and Statistics Learning Center (MSLC) will be provided.

# Grading and Assignments

## Grades

| Category | Points | Percentage |
|---|---|---|
| **Homework** | **250** | **25%** |
| **Lab Quizzes** | **200** | **20%** |
| **Discussion Assignments** | **50** | **5%** |
| **Exam #1** | **150** | **15%** |
| **Exam #2** | **150** | **15%** |
| **Final exam** | **200** | **20%** |
| | | |
| **Total** | **1000** | **100%** |

*See course schedule, below, for due dates.*

## Assignment information

You can earn up to 1000 points in this course. The breakdown of these points is outlined below, along with descriptions of each assignment category.

**Homework:** This category consists of a syllabus quiz and ten homework assignments. Each is worth 25 points. *Your lowest score in this category will be dropped*. Homework will be assigned for each topic covered in this course, and solutions will be submitted and graded via Achieve or Carmen. Periodically, recommended problems will also be posted for additional practice, but will not be collected or graded. *You need to work through homework problems on your own in a timely manner to perform well in the class.*

**Labs:** This category consists of eleven lab quizzes, each worth 20 points. *Your lowest score in this category will be dropped*. Lab exercises using the R software will be carried out once per week in place of a formal lecture. These lab exercises will be submitted via Carmen quizzes.

**Discussion Assignments:** At two points 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 correct. A rubric will be provided on Carmen. Each post and set of comments are worth 25 points.

**Exams:** There will be two midterm exams and a final exam. Each midterm is worth 150 points and the final exam is worth 200 points. Statistical tables will be provided as needed. Please note the dates of all exams as given on the syllabus (below). All exams will be administered in-person during the scheduled class time.

**Makeup exams:** If you absolutely need a makeup exam and have a valid excuse, please see your instructor for the necessary arrangements. However, you must notify the instructor in advance in such a situation. A make-up exam should be taken within a week of the missed exam. Exceptions to this policy will be permitted on a case-by-case basis and only in extreme situations.

## Late assignments

Late assignments **are not** accepted without **prior** permission from the instructor.

## Grading scale

| Grade | Points (out of 1000) | Percentage (%) |
|---|---|---|
| A | 930 – 1000 | 93 - 100 |
| A- | 900 – 929.99 | 90 - 92.99 |
| B+ | 870 – 899.99 | 87 – 89.99 |
| B | 830 – 869.99 | 83 – 86.99 |
| B- | 800 – 829.99 | 80 – 82.99 |
| C+ | 770 – 799.99 | 77 -79.99 |
| C | 730 – 769.99 | 73 – 76.99 |
| C- | 700 – 729.99 | 70 – 72.99 |
| D+ | 670 – 699.99 | 67 – 69.99 |
| D | 600 – 669.99 | 60 – 66.99 |
| E | Below 60 | Below 60 |

# Communication

## Instructor feedback and response time

I am providing the following list to give you an idea of our intended availability throughout the course. (Remember that you can call **614-688-HELP** at any time if you have a technical problem.)

### Grading and feedback

For large weekly assignments, you can generally expect feedback within **7 days**.

### E-mail

We will reply to e-mails within **24 hours on school days**.

### Discussion board

We will check and reply to messages in the discussion boards as appropriate every **24 hours on school days**.

### Office hours

Three office hours will be offered each week. The dates, times, and location of these will be communicated clearly and well in advance. An announcement will also be posted on the class website.

# Attendance, participation, and discussions

## Student participation requirements

The following is a summary of everyone's expected participation:

- **Lecture**

  Formal attendance records will not be kept on Mondays and Wednesdays; however, students are responsible for all material covered in class. Office hours should not be used for instruction on material that has already been covered in class. *Attendance at labs will be required to receive credit and Top Hat will be used to track attendance.*
- **Office hours:**
  All office hours are optional.
- **Participating in discussion forums**:

  There will be discussion boards for each assignment and for other general course questions. Participation on these boards is heavily encouraged but not required.

## Discussion and communication guidelines

The following are my expectations for how we should communicate as a class. Above all, please remember to be respectful and thoughtful.

- **Email:** If you email a question that is appropriate for the discussion board, we will copy it verbatim to the board and include our reply there. 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.
- **Writing style**: While there is no need to participate in class discussions as if you were writing a research paper, you should remember to write using good grammar, spelling, and punctuation. Informality (including an occasional emoticon) is fine for non-academic topics.
- **Tone and civility**: Let's maintain a supportive learning community where everyone feels safe and where people can disagree amicably. Remember that sarcasm doesn't always come across online.
- **Citing your sources**: When we have academic discussions, please cite your sources to back up what you say. (For the textbook or other course materials, list at least the title and page numbers. For online sources, include a link.)
- **Backing up your work**: Consider composing your academic posts in a word processor, where you can save your work, and then copying into the Carmen discussion.

# Other course policies

## Health and safety

For the latest information about COVID-19 as well as guidance for students, faculty and staff, please see https://safeandhealthy.osu.edu/.

## 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 policy

### Policies for this course

- **Homework**: Homework may be discussed with classmates or TAs but submitted homework assignments should represent your own efforts.
- **Lab activities**: can 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 external help or communication.
- **Written assignments**: Your written assignments, including discussion posts, should be your own original work. You are encouraged to ask a trusted person to proofread your assignments before you turn them in--but no one else should revise or rewrite your work.
- **Collaboration and informal peer-review**: While study groups are encouraged, remember that comparing answers on a quiz or assignment is not permitted. If you're unsure about a particular situation, please feel free just to ask ahead of time.

### 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 may be 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.

# Statement on title IX

Title IX makes it clear that violence and 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 at titleix@osu.edu.

## Accessibility accommodations for students with disabilities

**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, 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 me know immediately so that we can privately discuss options. To establish reasonable accommodations, I may request that you register with Student Life Disability Services. After registration, make arrangements with me 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; http://slds.osu.edu; 098 Baker Hall, 113 W. 12th Avenue.**

### Accessibility of course technology

This 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

## Your mental health

As a student you may experience a range of issues that can 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

## Disclaimer

This syllabus should be taken as a fairly reliable guide for the course content. However, you cannot claim any rights from it, and we reserve the right to change due dates or the methods of grading and/or assessment if necessary. Any changes will be communicated to you through official course announcements.

# Course Schedule (tentative)

| Week | Class # | Date | Day | Topic | Reading | Assignments (All Due at 5pm) |
|---|---|---|---|---|---|---|
| 1 | 1 | Jan 10 | M | Introduction, methods for summarizing data | Ch. 1 - 3 | - |
| | 2 | Jan 12 | W | Probability | 5.1-5.3 | - |
| | 3 | Jan 14 | F | Lab 1: Intro to the R software | - | Lab 1 Quiz<br>Syllabus Quiz |
| 2 | No Class | Jan 17 | M | Martin Luther King Jr. Day | - | - |
| | 4 | Jan 19 | W | Probability | 5.5-5.6 | - |
| | 5 | Jan 21 | F | Lab 2: Exploratory data analysis in R | - | Lab 2 Quiz<br>Homework 1 |
| 3 | 6 | Jan 24 | M | Conditional probability, Law of total probability | 5.7-5.9 | - |
| | 7 | Jan 26 | W | Bayes Theorem, Random Variables | 5.4, 5.9 | - |
| | 8 | Jan 28 | F | Lab 3: Random sampling activity | - | Lab 3 Quiz<br>Homework 2 |
| 4 | 9 | Jan 31 | M | Random variables | 5.4, 7.1, 7.4 | - |
| | 10 | Feb 2 | W | Hypothesis testing, Binomial test | Ch. 6, 7.2 | - |
| | 11 | Feb 4 | F | Lab 4: Statistical distributions in R | - | Lab 4 Quiz<br>Homework 3 |
| 5 | 12 | Feb 7 | M | Goodness-of-fit tests | 8.1-8.3 | - |
| | 13 | Feb 9 | W | Poisson distribution | 8.4 | - |
| | 14 | Feb 11 | F | Lab 5: Hypothesis tests in R | - | Lab 5 Quiz<br>Homework 4 |
| 6 | 15 | Feb 14 | M | Analyzing proportions, odds ratios | 9.1-9.3 | - |
| | 16 | Feb 16 | W | Contingency tables, Normal distribution | 9.4, 10.1-10.4 | - |
| | 17 | Feb 18 | F | Exam 1 | Ch. 1-8 | Exam 1 |
| 7 | 18 | Feb 21 | M | Normal Distribution | 10.1-10.4 | - |
| | 19 | Feb 23 | W | Central Limit Theorem | 10.5-10.6 | - |
| | 20 | Feb 25 | F | Lab 6: Contingency tables in R | - | Lab 6 Quiz<br>Homework 5 |
| 8 | 21 | Feb 28 | M | Central Limit Theorem, t-distribution and confidence intervals | 10.5-10.6, 11.1-11.2 | - |
| | 22 | Mar 2 | W | t distribution and confidence intervals | 11.1-11.2 | - |

| | | | | | | |
|---|---|---|---|---|---|---|
| | 23 | Mar 4 | F | Lab 7: Normal probability plots, t distribution | 11.3-11.4 | Lab 7 Quiz Homework 6 |
| 9 | 24 | Mar 7 | M | One-sample t-test | 13.1, 13.3 | - |
| | 25 | Mar 9 | W | Comparing two means, unpaired test | 12.1, 12.3 | - |
| | 26 | Mar 11 | F | Lab 8: Inference for the population mean in R | 12.2, 12.4-7, 13.4 | Lab 8 Quiz Discussion Assign. 1 |
| 10 | No Class | Mar 14 | M | Spring Break | - | - |
| | No Class | Mar 16 | W | Spring Break | - | - |
| | No Class | Mar 18 | F | Spring Break | - | - |
| 11 | 27 | Mar 21 | M | Comparing two means, paired test & sign test | 12.2, 12.4-7, 13.4 | - |
| | 28 | Mar 23 | W | Experimental and observational studies | Ch. 14 | - |
| | 29 | Mar 25 | F | Lab 9: Power of hypothesis tests, NP tests | - | Lab 9 Quiz Homework 7 |
| 12 | 30 | Mar 28 | M | Experimental and observational studies | Ch. 14 | - |
| | 31 | Mar 20 | W | Case Study | - | - |
| | 32 | Apr 1 | F | Exam 2 | Ch. 9-13 | Exam 2 |
| 13 | 33 | Apr 4 | M | ANOVA | 15.1-15.2 | - |
| | 34 | Apr 6 | W | ANOVA | 15.3-15.4 | - |
| | 35 | Apr 8 | F | Lab 10: ANOVA in R | - | Lab 10 Quiz Homework 8 |
| 14 | 36 | Apr 11 | M | Correlation | Ch. 16 | - |
| | 37 | Apr 13 | W | Regression | 17.1-17.5 | - |
| | 38 | Apr 15 | F | Regression | 17.1-17.5 | Homework 9 Discussion Assign. 2 |
| 15 | 39 | Apr 18 | M | Regression | 17.1-17.5 | - |
| | 40 | Apr 20 | W | Logistic Regression | 17.6-17.9 | - |
| | 41 | Apr 22 | F | Lab 11: Regression in R | - | Lab 11 Quiz Homework 10 |
| 16 | 42 | Apr 25 | M | Review/Catch-Up Day | - | - |
| | - | Apr 27 | W | - | - | - |
| | - | Apr 28 | Th | Final Exam, 10:00 am – 11:45 am | Cumulative | Final Exam |