



THE OHIO STATE UNIVERSITY

COLLEGE OF ARTS AND SCIENCES

SYLLABUS: STAT 2480 **STATISTICS FOR THE LIFE SCIENCES** **SPRING 2023**

Course overview:

An introduction to statistical methods commonly used in the life sciences

Instructor

Name: Dr. Laura Kubatko ("Dr. K")

Email: kubatko.2@osu.edu

In-Person Office Location: 219 Cockins Hall

Office hours:

Zoom: Mondays and Wednesdays 11:30am – 12:30pm

The office hour link is provided on Carmen's Syllabus page.

Teaching Assistant

Name: Zherui Zheng

Email: zheng.1571@osu.edu

Tutoring hours: TBA

Math/Stat Learning Center (MSLC)

Tutoring is available starting the second week of school in room CH132 and via zoom at various days and times throughout the week. Use the Office Hours link on the Syllabus page on Carmen to see a list of the days, times and relevant zoom links.

Course Description

Statistical methods play an important role in the analysis of data collected in the biological sciences. This course will provide an introduction to the analysis of biological data in a statistical framework. The topics covered include the definition of probability and manipulation of probabilistic quantities; the common discrete and continuous distributions used in modeling biological phenomena; experimental design; and statistical methods for testing hypotheses.

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

The following goals will be achieved by detailed study utilizing example data from the life sciences.

This course satisfies the General Education foundation requirement in *Mathematical and Quantitative Reasoning or Data Analysis* which has the following goals and expected learning outcomes:

Goals: Successful students will be able to apply quantitative or logical reasoning and/or mathematical/ statistical methods to understand and solve problems and will be able to communicate their results.

Expected Learning Outcomes (ELOs): Successful students are able to:

- 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.

This course also satisfies the Legacy General Education requirement in *Data Analysis* which has the following goals and expected learning outcomes:

Goals: Students develop skills in drawing conclusions and critically evaluating results based on data.

Expected Learning Outcomes (ELOs):

1. Students understand basic concepts of statistics and probability.
2. Students comprehend methods needed to analyze and critically evaluate statistical arguments.
3. Students recognize the importance of statistical ideas.

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**, 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 necessary for online courses

- 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 8+) with high-speed internet connection OR tablet with web-browser capabilities and high-speed internet connection

- CarmenZoom text, audio, and video chat. If you need technical assistance, either call 614-688-HELP, or refer to the online instructions: <https://resourcecenter.odde.osu.edu/carmenzoom>

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

The course will be delivered in a mix of synchronous and asynchronous formats. The scheduled course hours will be used for synchronous exams and office hours. Each week several lecture videos, totaling approximately 110 minutes of lecture, will be posted on the course website. You are responsible for watching the videos and studying the material that is assigned each week. In addition to the lecture videos, weekly assignments, including a laboratory activity using the R statistical software, will be posted on the class website. You will be given ample time to complete the assignments.

The instructor will hold weekly office hours via CarmenZoom during Monday's and Wednesday's scheduled class time. Additional information 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

Assignment or category	Percentage
Homework	25%
Lab assignments	20%
Discussion Assignments	5%
Exam #1	15%
Exam #2	15%
Final exam	20%
Total	100%

Assignment Information

Homework: Required homework problems will be assigned for each topic covered in the course, and solutions will be submitted and graded via Achieve or Carmen. Your lowest score in this category will be dropped. 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 in order to perform well in the class. Homework is worth 25% of your overall grade.

Labs: 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 and will, altogether, account for 20% of the overall grade. Your lowest score in this category will be dropped.

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 actually correct. A rubric and due dates will be provided on Carmen. Each post and set of comments are worth 2.5% of your grade.

Exams: There will be two in-class midterms exams and a final exam. Statistical tables will be provided as needed. Please note the dates of all exams as given on the syllabus (below).

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	Percentage (%)
A	93 - 100
A-	90 - 92.99
B+	87 – 89.99
B	83 – 86.99
B-	80 – 82.99
C+	77 -79.99
C	73 – 76.99
C-	70 – 72.99
D+	67 – 69.99
D	60 – 66.99
E	Below 60

Communication

Office hours and tutoring hours 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.

At the beginning of each week's module, there will be a page with announcements. Other announcements and reminders will be made in class and/or via Carmen announcements.

Staff feedback and response time

We are 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.)

Canvas Conversations/Email

A course instructor or teaching assistant will reply to messages sent via Canvas Conversations or email within **24 hours on school days (Monday – Friday, excluding university holidays; list of holidays at <http://registrar.osu.edu/staff/bigcal.asp>)**.

Discussion board

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

Office hours

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

Communication guidelines

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

- **Writing style:** While there is no need to communicate 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.
- **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

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 online 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.

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, Kellie Brennan, 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](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 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; slds.osu.edu; 098 Baker Hall, 113 W. 12th Avenue.

Accessibility of 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

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

See course schedule on next page.

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 9	M	Introduction, methods for summarizing data	Ch. 1 - 3	-
	2	Jan 11	W	Probability	5.1-5.3	-
	3	Jan 13	F	Lab 1: Intro to the R software	-	Lab 1 Quiz
2	No Class	Jan 16	M	Martin Luther King Jr. Day	-	-
	4	Jan 18	W	Probability	5.5-5.6	-
	5	Jan 20	F	Lab 2: Exploratory data analysis in R	-	Lab 2 Quiz HW: Ch. 1, 2, and 3
3	6	Jan 23	M	Conditional probability, Law of total probability	5.7-5.9	-
	7	Jan 25	W	Bayes Theorem, Random Variables	5.4, 5.9	-
	8	Jan 27	F	Lab 3: Random sampling activity	-	Lab 3 Quiz HW: Ch. 5
4	9	Jan 30	M	Random variables	5.4, 7.1, 7.4	-
	10	Feb 1	W	Hypothesis testing, Binomial test	Ch. 6, 7.2	-
	11	Feb 3	F	Lab 4: Statistical distributions in R	-	Lab 4 Quiz HW: Ch. 5 extra
5	12	Feb 6	M	Goodness-of-fit tests	8.1-8.3	-
	13	Feb 8	W	Poisson distribution	8.4	-
	14	Feb 10	F	Lab 5: Hypothesis tests in R	-	Lab 5 Quiz HW: Ch. 7, 8
6	15	Feb 13	M	Analyzing proportions, odds ratios	9.1-9.3	-
	16	Feb 15	W	Exam 1	Ch. 1-8	Exam 1
	17	Feb 17	F	Contingency tables, Normal distribution	9.4, 10.1-10.4	-
7	18	Feb 20	M	Normal Distribution	10.1-10.4	-
	19	Feb 22	W	Central Limit Theorem	10.5-10.6	-
	20	Feb 24	F	Lab 6: Contingency tables in R	-	Lab 6 Quiz HW: Ch. 9
8	21	Feb 27	M	Central Limit Theorem, t-distribution and confidence intervals	10.5-10.6, 11.1-11.2	-
	22	Mar 1	W	t distribution and confidence intervals	11.1-11.2	-

	23	Mar 3	F	Lab 7: Normal probability plots, t distribution	11.3-11.4	Lab 7 Quiz HW: Ch. 10
9	24	Mar 6	M	One-sample t-test	13.1, 13.3	-
	25	Mar 8	W	Comparing two means, unpaired test	12.1, 12.3	-
	26	Mar 10	F	Lab 8: Inference for the population mean in R	12.2, 12.4-7, 13.4	Lab 8 Quiz Discussion Assign. 1 HW: Ch. 11
10	No Class	Mar 13	M	Spring Break	-	-
	No Class	Mar 15	W	Spring Break	-	-
	No Class	Mar 17	F	Spring Break	-	-
11	27	Mar 20	M	Comparing two means, paired test & sign test	12.2, 12.4-7, 13.4	-
	28	Mar 22	W	Experimental and observational studies	Ch. 14	-
	29	Mar 24	F	Lab 9: Power of hypothesis tests, NP tests	-	Lab 9 Quiz HW: Ch. 12, 13
12	30	Mar 27	M	Experimental and observational studies	Ch. 14	-
	31	Mar 29	W	Exam 2	Ch. 9-13	Exam 2
	32	Mar 31	F	Case Study	-	-
13	33	Apr 3	M	ANOVA	15.1-15.2	-
	34	Apr 5	W	ANOVA	15.3-15.4	-
	35	Apr 7	F	Lab 10: ANOVA in R	-	Lab 10 Quiz HW: Ch. 14, 15
14	36	Apr 10	M	Correlation	Ch. 16	-
	37	Apr 12	W	Regression	17.1-17.5	-
	38	Apr 14	F	Regression	17.1-17.5	HW: Ch. 16 Discussion Assign. 2
15	39	Apr 17	M	Regression	17.1-17.5	-
	40	Apr 19	W	Logistic Regression	17.6-17.9	-
	41	Apr 21	F	Lab 11: Regression in R	-	Lab 11 Quiz HW: Ch. 17
16	42	Apr 24	M	Review/Catch-Up Day	-	-
	-			-	-	-
	-	Apr 28	F	Final Exam, 12:00 – 1:45pm	Cumulative	Final Exam