Entomological Techniques and Data Analysis: Syllabus

ENTOMOLOGY 6707, AUTUMN 2025

Course Information

Course times and location: Tuesdays and Thursdays, 1:30 – 2:50 PM (synchronous online via Zoom)
Credit hours: 3
Mode of delivery: Distance Learning
Zoom link: https://osu.zoom.us/j/94355799506?pwd=0tSOc1lqGh7lbLbkw9cNo5yUByhnXL.1

Instructors

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Office hours: By appointment.

Name: Dr. Samuel F Ward, Ph.D., Assistant Professor, Department of Entomology
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Phone Number: 614-292-3286
Office location: 408C Kottman Hall
Office hours: By appointment.

Preferred means of communication:

- Our preferred method of communication for questions is **email.**
- Class-wide communications will be sent through the Announcements tool in CarmenCanvas. Please check your notification preferences (go.osu.edu/canvas-notifications) to be sure you receive these messages.

Course Prerequisites/Co-Requisites

None

Course Description

Students will be introduced to the design and analysis of simple experiments and studies frequently used in entomology. This hands-on course will cover analysis of data generated from commonly-used entomological techniques and observational approaches. Throughout, students will use and analyze data using statistical and version control software programs commonly used in the scientific community (i.e., Excel, R, RStudio, Git, and GitHub).

Learning Goals and Outcomes

Goal 1: Students will engage in statistical analyses as applied in entomology and use this knowledge to design and interpret results from their own experiments.

Learning objectives for Goal 1

Students will:

- Demonstrate proficiency in conducting and interpreting analyses of data generated from entomological techniques.
- Design simple experiments and distinguish between observational vs. experimental approaches.

Goal 2: Students will understand best practices in data management and become good communicators of statistical results within their discipline.

Learning objectives for Goal 2

Students will:

- Design a laboratory/field logbook and digital repository to keep track of important activities related to an experiment and analysis.
- Use common software to graph and analyze data sets.
- Determine the type(s) of data, such as continuous and categorical, generated from entomological techniques, and develop knowledge of how to choose appropriate statistical tests based on data type.
- Produce informative, quantitative summaries in tables and figures that would be suitable for peer-reviewed publications.

How This Course Works

Mode of delivery: Online lectures will be synchronous and thus students are expected to attend virtually during the scheduled meeting times. To that end, reliable internet access through a desktop or laptop computer is required along with a webcam.

The syllabus will be posted to CarmenCanvas, whereas lectures, assignment descriptions, and other class resources will be posted to the course GitHub page. Students will submit assignments for grading via CarmenCanvas.

Credit hours and work expectations: This is a 3 credit-hour course. According to Ohio State bylaws on instruction (go.osu.edu/credithours), students should expect around 3 hours per week of time spent on direct instruction (instructor content and CarmenCanvas activities, for example) in addition to 6 hours of homework (reading and assignment preparation, for example) to receive a grade of [C] average.

Attendance and participation requirements: Research shows regular participation is one of the highest predictors of success. With that in mind, we have the following expectations for everyone's participation:

- **Attendance of online synchronous classes**: **twice a week**
  You are expected to attend class each week during the scheduled meeting sessions. If you have a situation that might cause you to miss an entire week of class, discuss it with us *as soon as possible.* Attendance will not be recorded per se, but there are weekly, in-class activities that students will be required to submit before the end of the lecture in which they are assigned (please see "In-class Activities" in the Grading and Faculty Response section for more details).

Course Materials and Technologies

Required Materials and/or Technologies

- Textbook not required.
- Course readings are listed in this syllabus and will be posted to the course GitHub.

Required Equipment

- **Computer:** current Mac (MacOS) or PC (Windows 10) with high-speed internet connection.
- **Webcam:** built-in or external webcam, fully installed and tested
- **Microphone:** built-in laptop or tablet mic or external microphone
- **Other:** a mobile device (smartphone or tablet) to use for BuckeyePass authentication

If you do not have access to the technology you need to succeed in this class, review options for technology and internet access (go.osu.edu/student-tech-access).

Required Software

Microsoft Office 365: All Ohio State students are now eligible for free Microsoft Office 365. Visit the installing Office 365 (go.osu.edu/office365help) help article for full instructions.

R Software: Freely available for download at https://www.r-project.org/

RStudio Software: Freely available for download at https://posit.co/downloads/

Git Software: Freely available for download at https://git-scm.com/

GitHub Desktop: Freely available for download at https://desktop.github.com/

GitHub Account: Go to https://github.com/ to sign up for a free account.

CarmenCanvas Access

You will need to use BuckeyePass (buckeyepass.osu.edu) multi-factor authentication to access your courses in CarmenCanvas. To ensure that you are able to connect to CarmenCanvas at all times, it is recommended that you do each of the following:

- Register multiple devices in case something happens to your primary device. Visit the BuckeyePass - Adding a Device (go.osu.edu/add-device) help article for step-by-step instructions.
- Request passcodes to keep as a backup authentication option. When you see the Duo login screen on your computer, click **Enter a Passcode** and then click the **Text me new codes** button that appears. This will text you ten passcodes, good for 365 days, that can each be used once.

- Install the Duo Mobile application (go.osu.edu/install-duo) on all of your registered devices for the ability to generate one-time codes in the event that you lose cell, data, or Wi-Fi service.

If none of these options will meet the needs of your situation, you can contact the IT Service Desk at 614-688-4357 (HELP) and IT support staff will work out a solution with you.

Technology Skills Needed for This Course

- Basic computer and web-browsing skills
- Navigating CarmenCanvas (go.osu.edu/canvasstudent)
- CarmenZoom virtual meetings (go.osu.edu/zoom-meetings)

Technology Support

For help with your password, university email, CarmenCanvas, or any other technology issues, questions or requests, contact the IT Service Desk, which offers 24-hour support, seven days a week.

- **Self Service and Chat**: go.osu.edu/it
- **Phone:** 614-688-4357 (HELP)
- **Email:** servicedesk@osu.edu

Grading and Faculty Response

How Your Grade is Calculated

Assignment Category	Points
Canvas Check-Ins (*N*=12 worth 2 points each)	**24**
R Activities (*N*=11 worth 4 points each; drop the lowest score)	**40**
Semester Project	**36**
Letter of Intent	4
Preliminary Data Analysis	10
Presentation	10
Final Write Up	12
Total	**100**

Descriptions of Major Course Assignments

Canvas Check-Ins

Description: There will be 15 weekly Canvas Check-Ins, **twelve** of which must be completed for full credit. These will involve short answer writing prompts, coding problems (e.g., making a simple graph), identifying an appropriate statistical analysis given some data, and interpreting R output, among others. You will be given sufficient time in class to complete such activities, and each activity will need to be submitted via CarmenCanvas by the end of the lecture in which it was assigned.

R/GitHub Assignments

Description: The assignments will typically involve the use of GitHub and R (both of which are free to use and download) and will be provided at regularly scheduled class meeting times. The first few lectures will introduce students to software, and no prior experience with R/GitHub is expected. A laptop with moderate computing power will be necessary to complete course assignments.

You will be assigned 11 problem sets each worth 4 points (the lowest score will be dropped). The first two problem sets are only graded for completeness (i.e., evaluating whether a genuine attempt was made on each question) so that you can get a sense of the minimum amount of information required for full credit before being formally assessed. Problems sets 3-11 will be evaluated for clarity as well as correctness. Problem sets emphasize understanding, synthesis, and application and are designed to equip students with a quantitative skillset so that they feel comfortable organizing, analyzing, interpreting, and presenting data long after they have completed the course.

For each problem set, you will be required to submit an organized answer sheet – generated via R quarto (or markdown) within Rstudio – to the CarmenCanvas course webpage. When applicable, answers should include the code you used, the relevant output, and any required written response(s). Problem sets will be posted on Tuesdays and due the following Thursday by 5:00pm. Specific due dates will be posted on CarmenCanvas. Please submit all assignments through CarmenCanvas.

Academic integrity and collaboration: Students should make frequent use of Google and/or the several textbooks available (some freely) to R users. This course is meant to reflect the "real world" and you should use the resources available to you, including your peers (group work is encouraged!). However, we expect each of you to submit your own work for these assignments.

Semester Project

Description: This is a tiered project with multiple assignments due throughout the semester. This is an extremely flexible project in which each student will propose, complete, and present a statistical analysis on a data set of their choosing. The goal is to gain hands-on experience with data analysis and written/oral presentation of quantitative information. Students are welcomed to source data from thesis/dissertation work (please clear this option with adviser(s)), previously published datasets (e.g., from a lab mate, adviser, or elsewhere in the primary literature), or open-source options (e.g., NSF National Ecological Observation Network (NEON) data, NSF Long Term Ecological Research Network (LTER) data). Regardless of the data source, the analysis should be entirely novel. Each student is expected to create a GitHub repository for their project and provide collaborator access to the instructors. All project assignment submissions should be completed through CarmenCanvas.

Note on references: Be sure to cite your sources. Reporting of citations and references should be formatted as appropriate for submission to a peer reviewed journal (e.g., https://academic.oup.com/jee/pages/Manuscript_Preparation#References).

Letter of Intent (0.5 pages) Letters should propose the research question and outline planned efforts. Please include a brief description of the data source, structure of the data set, and potential analyses to be conducted. The objective of this assignment is to ensure that projects are of an appropriate scope.

Preliminary data analysis (~0.5 page + tables/figures) Provide a description of the data, including but not limited to the source (e.g., thesis data, published data), any data wrangling undertaken to prepare the data for analysis, summary statistics for relevant variables, response and predictor variable types (e.g., categorical vs. continuous), potential challenges in analysis (e.g., violations of normality; pseudoreplication), and pertinent graphical depictions. If using a published database or data from a publication, please provide a complete citation and explain how your analyses build upon any existing analyses of those data. Create and include the link to a public GitHub repository for your project.

Presentation Each student will deliver a presentation (~10-15 minutes, depending on course enrollment) on their final project to include a description of the research question, its relevance to the field/society, the structure of the data, the statistical analyses and potential challenges therein, results, and broader implications of the findings. The slide deck will be submitted through CarmenCanvas, and both scientific content and presentation style (including slide design) will be graded following the rubric used in the Student 10-minute Paper Competition at the Entomological Society of America (https://www.entsoc.org/events/annual-meeting/student-competition/ten-minute-paper).

Final Write Up (~1 page, single spaced + tables/figures/references) This report should include a statement of objectives (i.e., clarify the goal of your analyses) as well as Materials and Methods and Results sections ***that are focused on the statistical analyses and conclusions*** (i.e., methods underlying the data collection do not need an in depth description). Please include sections for References and Tables/Figures as appropriate.

Late Assignments

Please refer to the course schedule in the syllabus or CarmenCanvas for due dates. Due dates are set to help you stay on pace and to allow timely feedback that will help you complete subsequent assignments.

An assignment that is submitted late will be reduced in value 5% per day that it is late. In the case of an emergency or illness, contact the instructors as soon as possible to discuss potential accommodations that will be determined on a case-by-case basis.

Instructor 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 614-688-4357 (HELP) at any time if you have a technical problem.

- **Preferred contact method:** If you have a question, please contact us first through our Ohio State email addresses. We will reply to emails within **24 hours on days when class is in session at the university**.

- **Class announcements:** We will send all important class-wide messages through the Announcements tool in CarmenCanvas. Please check your notification preferences (go.osu.edu/canvas-notifications) to ensure you receive these messages.
- **Grading and feedback:** For assignments submitted before the due date, we will try to provide feedback and grades within **seven days**. Assignments submitted after the due date may have reduced feedback and grades may take longer to be posted.

Grading Scale

93–100: A
90–92.9: A-
87–89.9: B+
83–86.9: B
80–82.9: B-
77–79.9: C+
73–76.9: C
70–72.9: C-
67–69.9: D+
60–66.9: D
Below 60: E

Other Course Policies and Information

https://ugeducation.osu.edu/academics/standard-syllabus/standard-syllabus-statements
https://ugeducation.osu.edu/academics/standard-syllabus/optional-syllabus-statements

Course Schedule

Refer to the CarmenCanvas course for up-to-date due dates.

Week	Date	Topic	Lead K=K.Perry S=S.Ward	Asgmt Posted	Due	Reading
1	26-Aug	Class introduction, discussion of syllabus	K,S			
	28-Aug	Intro to R/R studio Part 1	K,S	1		Beckerman & Childs (Ch. 1)
2	2-Sep	Intro to R/R studio Part 2	K,S			Broman & Woo (2018)
	4-Sep	Data entry, logbook curation, backing up data; GitHub; Open Science	K		1	Borer et al. (2009)
3	9-Sep	Using basic statistical designs; importance of appropriate replication	S	2		Hurlbert (1984)
	11-Sep	Sampling, variables, and distributions				
4	16-Sep	Data wrangling; tidyverse	S	3		
	18-Sep	Data visualization; ggplot2			2	Weissgerber et al. (2015)
5	23-Sep	Analyzing and presenting insect feeding data (t-tests; nonparametrics)	Manoj Pandey	4		
	25-Sep				3	

6	30-Sep	Randomized complete block designs (ANOVA)	S	5	Letter of Intent	
	2-Oct				4	
7	7-Oct	Randomized complete block designs (ANOVA)	S			
	9-Oct				5	
8	14-Oct	Analyzing and presenting insect growth data (Simple linear regression)	K	6		
	16-Oct	Autumn Break - No Class				
9	21-Oct	Observational studies in entomology and open source data (Multiple linear regression)	K	7		
	23-Oct				6	
10	28-Oct	Dealing with repeated measurements (Mixed-effects models)	Manoj Pandey	8	Preliminary data analysis	Harrison et al. (2018)
	30-Oct				7	
11	4-Nov	Analyzing and presenting insect survival and trapping data (GLMMs)	S	9		Bolker et al. (2009)
	6-Nov				8	
12	11-Nov	ESA				

	13-Nov	ESA				
13	18-Nov	Analyzing and presenting insect biodiversity surveys (biodiversity metrics)	K	10		Scheiner et al. (2025)
	20-Nov				9	
14	25-Nov	Analyzing and presenting insect biodiversity surveys (PCA, NMDS)	K	11		
	27-Nov	Thanksgiving Break - No Class				
15	2-Dec	Presentations	K,S		Final Project	
	4-Dec	Presentations			10	
16	9-Dec	Presentations (Last day of class)				
	11-Dec	No class			11	

References for assigned readings:

Beckerman, A. P., and D. Z. Childs. 2017. Getting started with R: an introduction for biologists.

Bolker, B. M., M. E. Brooks, C. J. Clark, S. W. Geange, J. R. Poulsen, M. H. H. Stevens, and J.-S. S. White. 2009. Generalized linear mixed models: a practical guide for ecology and evolution. Trends in Ecology & Evolution. 24: 127–135.

Borer, E. T., E. W. Seabloom, M. B. Jones, and M. Schildhauer. 2009. Some simple guidelines for effective data management. Bulletin of the Ecological Society of America. 90: 205–214.

Broman, K. W., and K. H. Woo. 2018. Data organization in spreadsheets. American Statistician. 72: 2–10.

Harrison, X. A., L. Donaldson, M. E. Correa-Cano, J. Evans, D. N. Fisher, C. E. D. Goodwin, B. S. Robinson, D. J. Hodgson, and R. Inger. 2018. A brief introduction to mixed effects modelling and multi-model inference in ecology. PeerJ. 6: e4794.

Hurlbert, S. H. 1984. Pseudoreplication and the design of ecological field experiments. Ecological Monographs. 54: 187–211.

Johnson, J. B., and K. S. Omland. 2004. Model selection in ecology and evolution. Trends in Ecology & Evolution. 19: 101–108.

Makin, T. R., and J.-J. Orban de Xivry. 2019. Ten common statistical mistakes to watch out for when writing or reviewing a manuscript. eLife. 8: e48175.

Scheiner, Samuel M., Evsey Kosman, Steven J. Presley, and Michael R. Willig. 2025. “ The Units of Biodiversity.” *Ecological Monographs* 95(2): e70019. https://doi.org/10.1002/ecm.70019

Spurgeon, D. W. 2019. Common Statistical Mistakes in Entomology: Pseudoreplication. American Entomologist. 65: 16–18.

Weissgerber, T. L., N. M. Milic, S. J. Winham, and V. D. Garovic. 2015. Beyond bar and line graphs: time for a new data presentation paradigm. PLOS Biology. 13: e1002128.