

BIO 5040/7045: BIOMETRY
WINTER SEMESTER 2020
SYLLABUS

Instructor: Dr. Chris Steiner
Biological Sciences Building, Office #3121
email: csteiner@wayne.edu

LECTURE LOCATION/TIME

0159 Old Main
Monday and Wednesday 10:00 am-11:15 am

LAB LOCATION/TIME

309 Shapero Hall
Thursday 12:00 pm-1:50 pm

OFFICE HOURS

Monday 2:00-3:00 pm, Wednesday 11:30-12:30 pm (or by appointment)

COURSE PREREQUISITES

([BIO 3070 with a minimum grade of C-] OR [BIO 4130 with a minimum grade of C-]) AND
([MAT 1800 with a minimum grade of C-])

COURSE DESCRIPTION & OBJECTIVES

This course will provide practical tools for the design of experiments, data exploration and statistical analysis of data. My intent with this course is to provide you a toolbox with which you can begin to design scientific studies and experiments, critically evaluate your data and test hypotheses via data analysis. While the course will delve into some underlying statistical theory, a major emphasis will be providing exposure to and hands-on experience with basic approaches to the analysis of univariate and multivariate data.

Learning objectives for both 5040 and 7045 students:

1. Students will gain working proficiency with the R statistical platform (including hands-on experience with data management, data manipulation, statistical analyses and data visualization).
2. Students will gain exposure to the design of experiments and observational studies.
3. Students will understand the models underlying basic statistical analyses
4. Students will be able to distinguish among different types of univariate and multivariate data produced by different study/experimental designs and the statistical analyses that can be applied to those data.
5. Students will be able to interpret the results of basic univariate and multivariate statistical analyses.
6. Students will know the assumptions that underlie statistical tests and be able to test those assumptions.

REQUIRED COURSE MATERIALS

Experimental Design and Data Analysis for Biologists. Gerry P. Quinn, Michael J. Keough.

The book is on reserve at the Undergraduate Library (UGL). Additional supplemental readings may be assigned for certain lectures/labs and will be made available on Canvas. The degree to which lectures use materials directly from the textbook will vary greatly, with some lectures drawing more heavily from outside sources. Thus, it is vital that you attend lectures/labs and take notes to do well in this class. **Material that is covered in the textbook but is not covered in lecture or lab will not be on the exams.**

LAB SECTION

Labs meet every Thursday. Most of the lab time will focus on using the R platform to perform data exploration and analysis. There will also be an in-lab assignment during most labs which is to be completed by the end of the lab session and submitted in Canvas. Lab assignments are graded and count towards your course grade.

GRADING

Your grade will be based on points earned from the exams and exercises completed in the lab section. The midterm exam with your lowest grade will count towards fewer points:

| | |
|--|-------------|
| Midterm Exam with your highest grade | 200 |
| Midterm Exam with your 2 nd highest grade | 200 |
| Midterm Exam with your lowest grade | 120 |
| Final exam | 300 |
| <u>In-lab exercises (12)</u> | <u>180</u> |
| <i>Total points possible:</i> | <i>1000</i> |

In addition to the above, those seeking graduate level credit (BIO 7045) must also complete and pass a writing assignment and data analysis project due the last week of class (a detailed description is provided below, and important due dates are provided in the course schedule). You will not be allowed to pass the course unless a passing grade of C- or higher is attained on the writing assignment. If a passing grade is attained on the writing assignment, your grade for the course will then be based on the grading scheme provided above. Students who fail to attain a C- or higher after revision of their assignment will be given an incomplete (I) for the course and a due date for further revision will be established for the following semester.

You will be graded based on the following scale.

| | | | |
|----|--------------|----|--------------|
| A | 93.5 – 100% | C | 72.5 – 75.4% |
| A- | 89.5 – 93.4% | C- | 69.5 – 72.4% |
| B+ | 85.5 – 89.4% | D+ | 65.5 – 69.4% |
| B | 82.5 – 85.4% | D | 62.5 – 65.4% |
| B- | 79.5 – 82.4% | D- | 59.5 – 62.4% |
| C+ | 75.5 – 79.4% | F | ≤ 59.4% |

EXAM FORMAT AND DATES

You must bring your student ID (Onecard) to all exams. All exams are closed-book and will be a mix of multiple choice and written questions. Three midterm examinations (scheduled for **February 5,**

February 26, and March 25) will be given during the lecture period. A two-hour final will be given during the scheduled final exam period (**Monday, April 27, 8:00 am – 10:00 am**). The final exam will be cumulative. All students are expected to take the exams at these times. Reasonable exceptions will be granted in cases of illness, which will require notification prior to the exam (via email) and must be followed up with an original signed note from a physician on official stationary. Exams will be closed book and held in class. No electronic devices of any kind (including watches) will be allowed and cell phones must be turned off. Anyone who leaves the exam room will not be allowed back in. Late-arriving students should know that admittance into the exam room will not be allowed after the first student has left the room.

ADDITIONAL REQUIREMENTS FOR BIO 7045 STUDENTS

Students seeking graduate level credit (BIO 7045) will be required to submit a writing assignment and data analysis project in the second half of the semester (see the class schedule for due dates). The assignment will take the form of a short peer-reviewed style research paper on a research topic of the student's choice. In detail, the elements of the paper will include: 1) an introduction (a short 3-4 paragraph section providing background on the research topic - including synthesis of relevant primary literature – and hypothesis formation regarding the research question); 2) a methods section describing the research methods (i.e. the form of the experimental/study design and data collection that will be used to address your predictions, including a clear description of specific outcomes that will either support or not support your hypotheses) and a detailed description of the statistical methods that will be used to analyze your data; 3) a results section which will include description plus graphical displays of your results and description of the results of your statistical analyses (this must also include tests of the assumptions of your statistical models) and 4) a short discussion section (2-3 paragraphs) interpreting your results and assessing your hypotheses (in light of the results).

The research topic can be any scientific topic that is amenable to the study/experimental design principles presented in lecture and may include topics related to your own research projects.

Data for your paper can come from two sources: 1) your own data from past research projects, or 2) data that I will generate for you following the experimental/study design you outline in your methods section.

Approval of research topics and general analytical framework is due Monday, February 24 by the beginning of class. This should take the form a short paragraph describing the topic, the study design and the types of statistical analyses you will use. This is the final due date for approval; you should discuss with me beforehand (either in person or via email) your ideas and seek feedback before submitting your paragraph description.

A first draft of the introduction and methods section of your paper is due Monday, March 16 by the beginning of class. The introduction should include synthesis of literature related to your research topic (at least three primary literature sources). Include in your draft a reference list. For those students who require data generation by me, the methods should be detailed enough for me to produce a suitable data set for your analysis. I will provide your data for analysis within one week.

A final draft of your paper, including the results (statistical analysis plus figures) and discussion section is due Monday, April 13 by the beginning of class.

If I feel that your final draft is below a C- effort, I will request a revision (due Monday, April 27 by 5:00pm). Students who fail to attain a C- or higher after revision of their paper will be given an incomplete (I) for the course and a due date for further revision will be established for the following semester.

MAKE-UP EXAM POLICY

If the student's absence from an exam is a legitimate documented emergency, then the student's score on the cumulative portion of the Final Exam may (at the discretion of the instructor) be pro-rated to cover the missed exam.

EXAM GRADE DISPUTES / CHALLENGE OPTION

Students will have one (1) week after the return of an exam to challenge a grade for any question. Failure to challenge the grade within this period indicates a willingness to accept the grade as is. The challenge should consist of a written description of why the answer is correct based on other published material that you cite.

CHEATING

Cheating is covered in detail in the Wayne State University Code of Conduct, found at <https://doso.wayne.edu/conduct>

Students found to be cheating during an exam (using a "cheat sheet" in physical or electronic form, looking at another's paper, or allowing another to look at yours), will receive a zero for that test with no opportunity to drop or replace that score. A second episode of cheating will result in a grade of F for the course and may also result in initiation of university disciplinary action.

No electronic devices (cell phones, tablets, computers, smart watches, cameras, calculators, etc.) are to be present at an exam. Those present will be confiscated until the exam is completed, and students using such devices to cheat on an exam will receive a zero on the exam.

POSTING OF EXAM GRADES

Exam grades will be posted on Canvas as soon as possible after the exam has been administered.

SPECIAL CONSIDERATIONS FOR INDIVIDUALS WITH DISABILITIES

If you have a documented disability that requires accommodations, you will need to register with Student Disability Services for coordination of your academic accommodations. The Student Disability Services (SDS) office is located at 1600 David Adamany Undergraduate Library in the Student Academic Success Services department. The SDS telephone number is 313-577-1851 or 313-202-4216 for videophone use. Once you have met with your disability specialist, I will be glad to meet with you privately during my office hours to discuss your accommodations. Student Disability Services' mission is to assist the university in creating an accessible community where students with disabilities have an equal opportunity to fully participate in their educational experience at Wayne State University. You can learn more about the disability office at www.studentdisability.wayne.edu.

RELIGIOUS HOLIDAY CONFLICTS

If you have a conflict with any of the scheduled class or exam times due to religious reasons, you must notify Dr. Steiner via email at least two weeks in advance of the date of conflict.

ADD/DROP POLICY

January 17 is the last day you can drop classes and get your tuition refunded. From January 18 until the last withdraw date (March 22), if you withdraw from the course you will receive a WN on your transcript if you never completed any exams; a WP if you have greater than 60% of the points possible at the time of your request on exams; or a WF if you have less than 60% of the points possible at the time of your request. No exams are dropped or replaced in this calculation. You can initiate a withdrawal request in Academics, and the system will contact me. I will respond within five business days. Failure to withdraw before the deadline will result in the student receiving the grade earned in the course. See <https://wayne.edu/registrar/registration/calendar19-20> for more important dates.

UNEXPECTED UNIVERSITY CLOSURES

If the University is officially closed on an exam day, the exam will be held on the next regularly scheduled class day. Closure of the University is announced by the following mechanisms:

1. the University Newline (313) 577-5345 *
2. WSU Homepage (www.wayne.edu) *
3. WSU Academics portal (academics.aws.wayne.edu) *
4. WDET-FM (Public Radio 101.9)
5. by other local radio and television stations

* Note: The information on closures and class cancellations is likely to be found at these locations before it is broadcast by local radio and television stations

Any specific issue not covered by this syllabus will be resolved using University policies. Disputes that cannot be resolved following the guidelines present in this syllabus will be resolved by following the guidelines of the University "Student Due Process".

BIO 5040/7045, WINTER SEMESTER 2020
LECTURE, LAB, READING AND EXAM SCHEDULE
(Unless otherwise noted, chapters refer to the Quinn and Keough Textbook)

| <u>DATE</u> | <u>LECTURE AND LAB TOPICS</u> | <u>READING</u> |
|---------------------|--|----------------------------------|
| Mon, Jan. 6 | 1. Introduction: Why do we need statistics? | Ch. 1(1.1-1.3; 1.5) |
| Wed, Jan. 8 | 2. Estimation and Descriptive Statistics | Ch. 2 (2.1-2.3) |
| Thurs, Jan. 9 | Lab: getting started in R; Descriptive stats | |
| Mon, Jan. 13 | 3. Hypothesis testing; t-tests | Ch. 3 (3.1-3.4) |
| Wed, Jan. 15 | 4. Hypothesis testing continued; assumptions and graphical exploration | Ch. 4 |
| Thurs, Jan. 16 | Lab: t-tests, testing assumptions, graphical exploration of data (In-lab exercise #1) | |
| Mon, Jan. 20 | Holiday - No Class | |
| Wed, Jan. 22 | 5. Basics of experimental design | Ch. 7; Hurlbert 1984 paper |
| Thurs, Jan. 23 | No Lab | |
| Mon, Jan. 27 | 6. Correlation and linear regression | Ch. 5 (5.1-5.3.11; 5.5) |
| Wed, Jan. 29 | 7. Linear regression | Ch. 5 (5.1-5.3.11; 5.5) |
| Thurs, Jan. 30 | Lab: correlation, linear regression (In-lab exercise #2) | |
| Mon, Feb. 3 | 8. Multiple linear regression; model selection | Ch. 6 (6.1-6.1.10; 6.1.15) |
| Wed, Feb. 5 | <u>EXAM 1 (COVERS LECTURES 1-7)</u> | |
| Thurs, Feb. 6 | Lab: linear regression; model selection (In-lab exercise #3) | |
| Mon, Feb. 10 | 9. Nonlinearity | Ch. 6 (6.1.13; 6.4) |
| Wed, Feb. 12 | 10. Single factor ANOVA | Ch. 8 |
| Thurs, Feb. 13 | Lab: Nonlinear models; ANOVA (In-lab exercise #4) | |
| Mon, Feb. 17 | 11. Single factor ANOVA | |
| Wed, Feb. 19 | 12. Multifactor ANOVA | Ch. 9 |
| Thurs, Feb. 20 | Lab: ANOVA; post hoc tests (In-lab exercise #5) | |
| Mon, Feb. 24 | 13. Multi-factor ANOVA | |
| Mon, Feb. 24 | <u>BIO 7045 Paper Proposals Due</u> | |
| Wed, Feb. 26 | <u>EXAM 2 (COVERS LECTURES 8-12)</u> | |
| Thurs, Feb. 27 | Lab: Multi-factor ANOVA (In-lab exercise #6) | |
| Mon, Mar. 2 | 14. Blocked designs: RCB and simple repeated measures | Ch. 10 (10.1-10.4, 10.11, 10.12) |
| Wed, Mar. 4 | 15. Blocked designs: Latin square; split plot | Ch. 11 (11.1-11.3, 11.8) |

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| Thurs, Mar. 5 | Lab: Factorial ANOVA; RCB (In-lab exercise #7) | |
| March 9-13 | Spring Break – No Classes | |
| Mon, Mar. 16 | BIO 7045 First Draft of Intro and Methods Due | |
| Mon, Mar. 16 | 16. Blocked designs: split plot; repeated measures | Ch. 11 |
| Wed, Mar. 18 | 17. ANCOVA | Ch. 12 |
| Thurs, Mar. 19 | Lab: Split-plot and repeated measures analysis (In-lab exercise #8) | |
| Mon, Mar. 23 | 18. GLM (Binary data) | Ch. 13 |
| Wed, Mar. 25 | EXAM 3 (COVERS LECTURES 13-17) | |
| Thurs, Mar. 26 | Lab: ANCOVA and GLM (Binary Data) (In-lab exercise #9) | |
| Mon, Mar. 30 | 19. GLM (Proportions) | Crawley Ch. 16 |
| Wed, Apr. 1 | 20. GLM (Count data) | Crawley Ch. 13-14 |
| Thurs, Apr. 2 | Lab: GLM (In-lab exercise #10) | |
| Mon, Apr. 6 | 21. Analyzing frequencies | Ch. 14 |
| Wed, Apr. 8 | 22. Multivariate data: Ordination | Ch. 15, 17 (17.1-17.2) |
| Thurs, Apr. 9 | Lab: Analyzing Frequencies (In-lab exercise #11) | |
| Mon, Apr. 13 | 23. Multivariate data: Ordination, MDS | Ch. 18 |
| Mon, Apr. 13 | BIO 7045 Final Draft of Paper Due | |
| Wed, Apr. 15 | 24. Multivariate data: MANOVA, PERMANOVA | Ch.16; McCune & Grace Ch. 21 |
| Thurs, Apr. 16 | Lab: Multivariate analyses (In-lab exercise #12) | |
| Mon, Apr. 20 | 24. Multivariate data: MANOVA, PERMANOVA | Ch.16; McCune & Grace Ch. 21 |
| Mon. Apr. 27 | BIO 7045 REVISIONS OF PAPER DUE (IF NEEDED) | |
| Mon, Apr. 27 | FINAL EXAM, 8:00AM-12:00PM | |