BIO 5040/7045: BIOMETRY
FALL SEMESTER 2020
SYLLABUS

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

LECTURES
Tuesday and Thursday 1:00 pm-2:15 pm
Lectures will be synchronous and held online using Zoom

LAB LOCATION/TIME
309 Shapero Hall
Monday 10:00 am-11:50 am
Labs will be in-person at the start of the semester but may transition to online once students have attained proficiency using the R statistical platform.

OFFICE HOURS
There are no in-person office hours. General questions can be sent to me via email (or Canvas messaging). If you would like a "face to face" meeting, I can also schedule online Zoom meetings 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.
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 will be in-person at the start of the semester but may transition to online once students have attained proficiency using the R statistical platform. 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.

LAB SAFETY
Students are expected to observe standard safety precautions for the prevention of pathogen transmission when in the computer lab. These include completion of the WSU daily screening questionnaire prior to coming to the lab, proper social distancing when in the lab and wearing a face mask that covers both mouth and nose when in the lab. Sanitizing solution will be provided in the lab for sanitizing desk surfaces and computer keyboards in addition to hand sanitizer.

GRADING
Your grade will be based on points earned from exams and lab assignments. The exam with your lowest grade will count towards fewer points:

Exam with your highest grade	260
Exam with your 2nd highest grade	260
Exam with your 3rd highest grade	260
Exam with your lowest grade	100
In-lab exercises (12)	120
Total points possible:	*1000*

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	$\leq 59.4\%$

EXAM FORMAT AND DATES

Four exams will be given during the semester (see the lecture-exam schedule for dates and topics covered). <u>There is no final exam</u>. All exams will be administered online in Canvas. Exams are open-book/open-notes and will be a mix of multiple choice and written questions. You must work alone on the exams, and you may not communicate with your peers (or anybody else) during the exam period (this is considered cheating). The exam will be available from 8am to 10pm on the schedule exam date. You will have 2 hours to complete the exam. Once you start the exam you will have 120 minutes to complete it. Note that after 10pm you will no longer be able to access the exam (so if you start it after 8:00pm, you will not get your full 120 minutes). Multiple attempts are not permitted. Thus, once you submit the exam in Canvas, you cannot reopen it (even if you had time left in your 120 minutes).

All students are expected to take the exams on the scheduled dates. 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 stationery.

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 (<u>all analyses must be performed using R</u>); 4) a short discussion section (2-3 paragraphs) interpreting your results and assessing your hypotheses (in light of the results) and 5) an appendix containing R code and statistical output from your analyses and results of tests of the assumptions of your statistical models (including diagnostic figures).

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 **Tuesday, October 13** 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 (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 **Tuesday, November 3** 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 **Tuesday, December 1** by the beginning of class.

If I feel that your final draft is below a C- effort, I will request a revision (due **Thursday, December 17 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 a make-up exam may be scheduled at the instructor's discretion.

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

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
September 15 is the last day you can drop classes and get your tuition refunded. From September 15 until the last withdraw date (November 15), 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 Academica, and the system will contact me. Failure to withdraw before the deadline will result in the student receiving the grade earned in the course. See https:// https://wayne.edu/registrar/registration/calendar20-21/ 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 Newsline (313) 577-5345 *
      2. WSU Homepage (www.wayne.edu) *
      3. WSU Academica portal (academica.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, FALL SEMESTER 2020
LECTURE, LAB, READING AND EXAM SCHEDULE
(Unless otherwise noted, chapters refer to the Quinn and Keough Textbook)

DATE	LECTURE AND LAB TOPICS	READING
Tues, Sept. 1	1. Introduction: Why do we need statistics?	Ch. 1(1.1-1.3; 1.5)
Thurs, Sept . 3	2. Estimation and Descriptive Statistics	Ch. 2 (2.1-2.3)
Mon, Sept. 7	**Holiday (no lab)**	
Tues, Sept. 8	3. Hypothesis testing; t-tests	Ch. 3 (3.1-3.4)
Thurs, Sept. 10	4. Hypothesis testing continued; assumptions and graphical exploration	Ch. 4
Mon, Sept. 14	**Lab 1:** getting started in R; Descriptive stats; t-tests	
Tues, Sept. 15	5. Basics of experimental design	Ch. 7; Hurlbert 1984 paper
Thurs, Sept. 17	6. Correlation and linear regression	Ch. 5 (5.1-5.3.11; 5.5)
Mon, Sept. 21	**Lab 2:** t-tests, testing assumptions, correlation, graphical exploration of data (In-lab exercise #1)	
Tues, Sept. 22	7. Linear regression	Ch. 5 (5.1-5.3.11; 5.5)
Thurs, Sept. 24	**EXAM 1 (COVERS LECTURES 1-7, LABS 1-2)**	
Mon, Sept. 28	**Lab 3:** linear regression (In-lab exercise #2)	
Tues, Sept. 29	8. Multiple linear regression; model selection	Ch. 6 (6.1-6.1.10; 6.1.15)
Thurs, Oct. 1	9. Nonlinearity	Ch. 6 (6.1.13; 6.4)
Mon, Oct. 5	**Lab 4:** Multiple linear regression, model selection (In-lab exercise #3)	
Tues, Oct. 6	10. Single factor ANOVA	Ch. 8
Thurs, Oct. 8	11. Single factor ANOVA	
Mon, Oct. 12	**Lab 5:** polynomial regression, nonlinear regression, one-way ANOVA (In-lab exercise #4)	
Tues, Oct. 13	**BIO 7045 Paper Topic Proposal Due**	
Tues, Oct. 13	12. Multifactor ANOVA	Ch. 9
Thurs, Oct. 15	**EXAM 2 (COVERS LECTURES 8-12, LABS 3-5)**	
Mon, Oct. 19	**Lab 6:** nested ANOVA; post hoc tests (In-lab exercise #5)	
Tues, Oct. 20	13. Multifactor ANOVA	
Thurs, Oct. 22	14. Blocked designs: RCB and simple repeated measures	Ch. 10 (10.1-10.4, 10.11, 10.12)
Mon, Oct. 26	**Lab 7:** Factorial ANOVA (In-lab exercise #6)	

Tues, Oct. 27	15. Blocked designs: Latin square; split plot	Ch. 11 (11.1-11.3, 11.8)
Thurs, Oct. 29	16. Blocked designs: split plot; repeated measures	Ch. 11
Mon, Nov. 2	**Lab 8:** RCB, simple repeated measures (In-lab exercise #7)	
Tues, Nov. 3	**BIO 7045 First Draft of Intro and Methods Due**	
Tues, Nov. 3	17. ANCOVA	Ch. 12
Thurs, Nov. 5	18. GLM (Binary and proportion data)	Ch. 13
Mon, Nov. 9	**Lab 9:** Split-plot and repeated measures (In-lab exercise #8)	
Tues, Nov. 10	**EXAM 3 (COVERS LECTURE 13-18, LABS 6-8)**	
Thurs, Nov. 12	19. GLM (Count data)	TBA
Mon, Nov. 16	**Lab 10:** ANCOVA and GLM (In-lab exercise #9)	
Tues, Nov. 17	20. Contingency tables	Ch. 14
Thurs, Nov. 19	21. Zero-inflated data; Mixed effects models (GLMM)	TBA
Mon, Nov. 23	**Lab 11:** GLM (In-lab exercise #10)	
Tues, Nov. 24	22. Multivariate data analysis	Ch. 15, 17 (17.1-17.2)
Thurs, Nov. 26	**Thanksgiving Holiday (no lecture)**	
Mon, Nov. 30	**Lab 12:** GLM, multivariate analysis (In-lab exercise #11)	
Tues, Dec. 1	23. Multivariate data analysis	Ch. 18
Tues, Dec. 1	**BIO 7045 Final Draft of Paper Due**	
Thurs, Dec. 3	24. Multivariate data analysis	Ch.16
Mon, Dec. 7	**Lab 13:** Multivariate analysis (In-lab exercise #12)	
Tues, Dec.8	25. TBD	
Thurs, Dec. 10	**EXAM 4 (COVERS LECTURES 19-25, LABS 9-13)**	
Thurs, Dec. 17	**BIO 7045 Revisions of Paper Due (if needed)**	