BSC 504: Advanced Quantitative Biology – Fall 2022

Web Based Course

Instructor Information:
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Preferred contact: email
Virtual office hours: available 9-5, M-F, scheduled by appointment through email

Required Textbooks and Materials

1) The Analysis of Biological Data, 3rd ed. 2020. Whitlock, M.C. & Schluter, D. ISBN: 978-1319226237

Access to a computer and d2l (myleo online) is required; all course materials will be uploaded through d2l

You will need to have access to a computer that can run the statistical program R. Generally, this will require a system that runs either Windows or Mac family operating systems (to my knowledge, phone and tablet systems and/or Chromebooks do not run R as needed for the course and are not recommended for assignment purposes). If you have access to TAMUC campus, computers in classroom STC 210 are available with R loaded on them and can be used for class assignments when the classroom is available and not being used for class purposes.

R is a free program that is user-sourced, continuously updated, and can perform pretty much any statistical procedure through the downloading of programming packages developed by other users. R uses command line implementation with basic programming language, which will require some training for specifics in the R programming language. Specific instructions for downloading, setting up, and tutorials for R use will be presented in the first part of the course. More information about R and computer requirements (section 2.2) can be found here: R FAQ (r-project.org)

Course Description

The objective of this course is to provide students with the knowledge and understanding of the methods of statistical analysis applicable to biological research. Emphasis will be placed on the concepts and practical application of different tests in the R statistical program. Students should also be able to apply learned knowledge in evaluating statistical methods in the scientific literature. The statistical tests covered in the class will include both univariate and multivariate methods including: chi-squared tests and t-tests, analysis of variance, correlation, regression, general linear models, principle components analysis, correspondence analysis, non-metric multi-dimensional scaling, and canonical correspondence analysis.

Student Learning Outcomes

- Students will be able to use the R software program to perform basic and intermediate statistical analysis
- Students will be able to understand, interpret, and critique statistical methods used in primary scientific literature
- Students will understand the theory behind statistical analysis and hypothesis testing
- Students will interpret and present descriptive statistics of data, manipulate data sets and code in R, and be able to select appropriate statistical tests for different data sets or research objectives

Course Materials and Online Presentation

All course materials will be presented through d2l. The class format will be asynchronous, following the schedule that appears later in the syllabus. Lecture & R tutorial videos and corresponding powerpoint slides will be uploaded to d2l each week. Students will need to read along in the textbook for chapters as indicated in the schedule. Virtual office hours for the course are available by appointment through email. Questions will also be responded to promptly through email (generally within 24 hours).

Course Evaluations

Quizzes: There will be 14 short quizzes (roughly every week) that will go over the material/test for that week.

Assignments: There will be 12 assignments throughout the semester, which will require using the statistical program R and working with a dataset given in d2l. Each assignment will cover specific analyses/tests as indicated in the course outline.

Statistical critique paper: There will be a semester long statistical methods/results critique paper (expected length ~5-10 pages). For this paper, students will need to find manuscripts from the primary scientific literature in biology (peer-reviewed journals) that use statistical methods covered in the class. Statistical tests for the semester will be broken up into three groups based on similarity of the tests. With each group, students will need to find two papers that use different statistical tests (six total papers covering six total statistical tests). Then students will need to critique and summarize several components of the statistical aspects of

the paper – including why the authors chose this test for the data, specific aspects of what the authors did in the paper, and main results of their statistics. The three major groupings for the statistical tests follow a linear order in the class, so students can begin this assignment earlier in the semester, once all tests have been covered in each group. This paper replaces a traditional "final exam" for the course. More specific instructions for this paper will be posted in d2l.

Statistical test groupings:

Group One (two papers covering different tests from this group):

- Chi-squared goodness of fit
- Chi-squared contingency
- One sample t-test
- Paired t-test
- Two-sample t-test (also Welch's version)
- Sign test
- Wilcoxon-Rank sum test

Group Two (two papers covering different tests from this group):

- One-way ANOVA (with or without posthoc tests)
- Kruskal-Wallis test
- Pearson correlation analysis
- Spearman correlation analysis
- Linear regression analysis

Group Three (two papers covering different tests from this group):

- General linear models
- Principle Components Analysis
- Correspondence Analysis
- Nonmetric Multidimensional Scaling
- Canonical Correspondence Analysis

Grading

A: 89.96-100%
B: 79.96-89.95%
C: 69.96-79.95%
D: 59.96-69.95%
F: <59.96%

Evaluation Points

Quizzes – 210 points (15 points each; 14 quizzes)	(~34% of total)
Assignments – 300 points (25 points each; 12 assignments)	(~50% of total)
Statistical critique paper – 100 points	(~16 % of total)

Total points = 610 points

General Makeup Policy: The student is responsible for requesting a makeup when they are unable to submit the regularly scheduled assessment and must schedule the makeup within **3 days** after the due date. If the assessment is not made-up, the student will receive a zero for that item.

General Course Outline

-Lecture videos and slides for the corresponding week's topics will be published on d2l under the content tab, generally on Mondays.

-quizzes and assignments will be posted on Wednesdays, and both will be due in general a week after posting in d2l (usually before the following Tuesday at 11:59 pm)

> *All students are expected to submit their own course materials and work on their own on quizzes and assignments; plagiarism on assignments/papers and cheating on online quizzes are acts of serious academic misconduct (see the academic misconduct section later in syllabus). Examples of cheating include copying another student's quiz or assignment, or collaborating with other students to provide advance knowledge of specific quiz questions. A first offence of cheating or plagiarism will result in a score of zero for the assignment. A second offense will result in an F for the course or potentially other disciplinary actions.*

-Virtual office hours can be scheduled by appointment for 9am - 5pm M-F by email request; other specific questions or concerns can be answered by email, within 24 hours.

Tentative Course Schedule:

week 1 – 08/29

Introduction to Statistics, histograms & frequency distributions, descriptive statistics

> Textbook readings: Ch 1, Ch 2 (only section 2.2), Ch 3
>
> Quiz one posted (W)

week 2 – 09/05

Mon – Labor day holiday; (lecture materials posted on Tuesday of this week)

Introduction to R, working with R

- Assignment one posted (W): downloading and using R, histograms and descriptive statistics
- Quiz two posted (W)

week 3 – 09/12

quantifying uncertainty & sampling distributions, hypothesis testing

- Textbook readings: Ch 4, Ch 6
- Quiz three posted (W)

week 4 – 09/19

categorical data analyses: chi-square goodness of fit & chi-square contingency tests

- Textbook readings: Ch 8, Ch 9
- Assignment two posted (W): chi-square tests
- Quiz four posted (W)

week 5 – 09/26

normal distributions, one-sample t-tests

- Textbook readings: Ch 10, Ch 11
- Assignment three posted (W): one-sample t-tests
- Quiz five posted (W)

week 6 – 10/03

two sample t-tests

Textbook readings: Ch 12

Assignment four posted (W): two-sample t-tests

Quiz six posted (W)

week 7 – 10/10

checking normality, data transformations, non-parametric t-tests

Textbook readings: Ch 13

Assignment five posted (W): normality, transformations, non-parametric versions of t-tests

Quiz seven posted (W)

week 8 – 10/17

ANOVA

Textbook readings: Ch 15

Assignment six posted (W): ANOVA

Quiz eight posted (W)

week 9 – 10/24

Correlation analysis

Textbook readings: Ch 15

Assignment seven posted (W): correlations

Quiz nine posted (W)

week 10 – 10/31

Regression analysis

Textbook readings: Ch 15

Assignment eight posted (W): regression

Quiz ten posted (W)

week 11 – 11/07

experiments with more than one factor, general linear models

Textbook readings: Ch 14 (14.4 only), Ch 15

Assignment nine posted (W): GLM

Quiz eleven posted (W)

week 12 – 11/14

Unconstrained ordination: Principle Component Analysis

Assignment ten posted (W): PCA

Quiz twelve posted (W)

week 13 – 11/21

no class this week – Thanksgiving break

week 14 – 11/28

Unconstrained ordination: Correspondence Analysis; Nonmetric Multidimensional Scaling

Assignment eleven posted (W): CA, NMDS

Quiz thirteen posted (W)

week 15 – 12/05

Constrained ordination: Canonical Correspondence Analysis

Assignment twelve posted (W): CCA

Quiz fourteen posted (W)

week 16 – 12/12

Statistical methods paper due 12/16 at 11:59 pm

Technology Requirements

LMS

All course sections offered by Texas A&M University-Commerce have a corresponding course shell in the myLeo Online Learning Management System (LMS). Below are technical requirements

LMS Requirements:

https://community.brightspace.com/s/article/Brightspace-Platform-Requirements

LMS Browser Support:
https://documentation.brightspace.com/EN/brightspace/requirements/all/browser_support.htm

Access and Navigation

You will need your campus-wide ID (CWID) and password to log into the course. If you do not know your CWID or have forgotten your password, contact the Center for IT Excellence (CITE) at 903.468.6000 or helpdesk@tamuc.edu.

Communication and Support

If you have any questions or are having difficulties with the course material, please contact your Instructor by email.

Technical Support

If you are having technical difficulty with any part of Brightspace, please contact Brightspace Technical Support at 1-877-325-7778. Other support options can be found here:

https://community.brightspace.com/support/s/contactsupport

Syllabus Change Policy

The syllabus is a guide. Circumstances and events, such as student progress, may make it necessary for the instructor to modify the syllabus during the semester. Any changes made to the syllabus will be announced.

University Specific Procedures

More details about the following procedures can be located in the graduate student handbook: Office of Student Rights & Responsibilities (tamuc.edu)

Student Conduct

All students enrolled at the University shall follow the tenets of common decency and acceptable behavior conducive to a positive learning environment. The Code of Student Conduct is described in detail in the graduate student handbook: Office of Student Rights & Responsibilities (tamuc.edu)

Students should also consult the Rules of Netiquette for more information regarding how to interact with students in an online forum: Netiquette
http://www.albion.com/netiquette/corerules.html

TAMUC Attendance

For more information about the attendance policy please visit the school's Attendance webpage.

http://www.tamuc.edu/admissions/registrar/generalInformation/attendance.aspx

Academic Integrity

Students at Texas A&M University-Commerce are expected to maintain high standards of integrity and honesty in all of their scholastic work, including specifically cheating in online exams and acts of plagiarism in assignments and papers. For more details and the definition of academic dishonesty, please see the following:

Graduate Student Academic Honesty - Texas A&M University-Commerce (tamuc.edu)

ADA Statement

Students with Disabilities

The Americans with Disabilities Act (ADA) is a federal anti-discrimination statute that provides comprehensive civil rights protection for persons with disabilities. Among other things, this legislation requires that all students with disabilities be guaranteed a learning environment that

provides for reasonable accommodation of their disabilities. If you have a disability requiring an accommodation, please contact:

Office of Student Disability Resources and Services
Texas A&M University-Commerce
Gee Library- Room 162
Phone (903) 886-5150 or (903) 886-5835
Fax (903) 468-8148
Email: studentdisabilityservices@tamuc.edu
Website: Office of Student Disability Resources and Services
http://www.tamuc.edu/campusLife/campusServices/studentDisabilityResourcesAndServices/

Nondiscrimination Notice
Texas A&M University-Commerce will comply in the classroom, and in online courses, with all federal and state laws prohibiting discrimination and related retaliation on the basis of race, color, religion, sex, national origin, disability, age, genetic information or veteran status. Further, an environment free from discrimination on the basis of sexual orientation, gender identity, or gender expression will be maintained.