



BSC 504.01B 85522 : Advanced

Biostatistics – Fall 2026

Instructor Information:

Bjorn Schmidt

Office: STC 212

Email: bjorn.schmidt@tamuc.edu

Preferred contact: email

Virtual office hours: TR 1:00-3:00 pm, by appointment – zoom meetings available

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 the 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.

More information about R and computer requirements for downloading and using (section 2.2) can be found here: [R FAQ \(r-project.org\)](https://r-faq.r-project.org/)

R is a free program that is user-sourced, continuously updated, and can perform pretty much any statistical procedure through the downloading of program packages continuously developed and updated by other end users. Basic R, which we will use in the course, 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. After completion of the course, you can put knowledge of analysis in R on a resume or CV.

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 5 quizzes that will go over the material for that week (sometimes will also include previous week – will be noted what material is covered for each quiz).

Assignments: There will be 9 worksheet assignments throughout the semester, which will require using the statistical program R and working with online datasets. Each assignment will cover specific analyses/tests as indicated in the course outline.

Term paper: There will be a semester long statistical methods/results critique assignment (expected total length ~10 pages). For this paper, students will need to find manuscripts from the primary scientific literature in biology related topics (peer-reviewed journals) that use statistical methods covered in the class.

Statistical tests for the semester will be broken up into two groups based on similarity/complexity of the tests. Within each group, students will need to find three papers that use two different statistical tests in that group (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 for this test, and main results of their statistics – further details will be made available in d2l. Students should both review these topics and critique the methods where appropriate based on the textbook and knowledge from the class.

Statistical test groupings (each paper selected should use one of these tests; do not duplicate tests in the critique please; do six different tests spread across these two groups):

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

- Binomial test
- 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 (three papers covering different tests from this group):

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

Multiple linear regression analysis
Principle component analysis
Non-metric Multidimensional Scaling 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 – 75 points (15 points each; 5 quizzes)	(~17% of total)
Assignments – 180 points (20 points each; 9 assignments)	(~41% of total)
Statistical critique paper – 80 points	(~18 % of total)
Final Exam – 100 points	(~23% of total)

Total points = 435 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 powerpoint slides for the corresponding week's topics will be published on d2l under the content tab, on Mondays. For weeks with worksheet assignments, there will also be short tutorial videos for implementing codes for that week in the program R.

-quizzes and assignments will also be posted on Mondays, and both will be due in general a week after posting in d2l (usually the following Monday at 11:59 pm). Quizzes are open book/open notes, but are **timed**, so students should be familiar with the material before starting the quiz.

*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. 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.*

Course AI Statement: AI writing tools, including predictive text generators like ChatGPT, are not allowed in this course. Students are responsible for their own work in the course, and are subject to requirements and consequences of the TAMUC academic dishonesty policy and the student code of conduct:

<http://www.tamuc.edu/aboutUs/policiesProceduresStandardsStatements/rulesProcedures/13students/graduate/13.99.99.R0.10GraduateStudentAcademicDishonesty.pdf>

<https://www.tamuc.edu/student-life/division-of-student-affairs/office-of-student-rights-and-responsibilities/student-code-of-conduct/>

Tentative Course Schedule:

week 1 (01/13) – Introduction to Statistics, histograms & frequency distributions, descriptive statistics

Textbook sections: Ch 1, Ch 2.2, Ch 3

Quiz one – due Tue Jan. 21

week 2 (01/20) – Introduction to R, working with R

*note Monday (Jan. 20), **school is closed for MLK, Jr. holiday**

Textbook readings: none

Worksheet one: Introduction to R - due Mon. Jan 27

week 3 (01/27) – quantifying uncertainty; sampling distributions, hypothesis testing

Textbook readings: Ch 4, Ch 6

Quiz two – due Mon. Feb. 3

week 4 (02/03) – probability

Textbook readings: Ch 5

Quiz three – due Mon. Feb. 10

week 5 (02/10) – binomial test

Textbook readings: Ch 7

Worksheet two: binomial test – due Mon. Feb. 17

week 6 (02/17) – chi-square goodness of fit & chi-square contingency tests

Textbook readings: Ch 8, Ch 9

Worksheet three: chi-square tests – due Mon. Feb.24

week 7 (02/24) – normal distributions, one-sample t-tests

Textbook readings: Ch 10, Ch 11

Quiz four – due Mon. Feb. 10

week 8 (03/03) – two sample t-tests

Textbook readings: Ch 12

Worksheet four: t-tests – due Mon. Mar. 17

Spring Break (03/10)

No classes between 03/10 – 03/14

week 9 (03/17) – checking normality, data transformations, non-parametric t-tests

Textbook readings: Ch 13

Worksheet five: normality; non-parametric tests – due Mon. Mar. 24

week 10 (03/24) – One-way ANOVA

Textbook readings: Ch 15

Worksheet six: One-way ANOVA – due Mon. Mar. 31

week 11 (03/31) – Linear Correlations

Textbook readings: Ch 16

Quiz five – due Mon. Apr. 7

week 12 (04/07) – Linear Regression

Textbook readings: Ch 17

Worksheet seven: Linear Correlation and Bivariate Linear Regression

week 13 (04/14) – Multiple Linear Regression

Textbook readings: none

Worksheet eight: Multiple Linear Regression

week 14 (04/21) – Principle Component Analysis; ordination

Textbook readings: none

Worksheet nine: PCA; ordinations

week 15 (04/28) – no new material

work on term paper, study for final

Term paper due Mon. May 5

Finals week (05/05)

Final exam – multiple choice and short answer; located under content-quizzes tab in d2l, available from 05/05 to 05/09; Questions on statistics theory/comparison of different tests; also will have some data analysis questions to be done in R (can use notepad file: “R script for final” codes as starting point for code manipulation during test) – **due Fri. May 9th**

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

R information and support

The statistical program that we will use in the course is called R. R is an open-sourced free program that in general can perform any statistical procedure. Statistical packages used in R are

continually developed and updated by users. Specific instructions for downloading and setting up R will be presented in the course. More information about R, computer requirements, and user manuals can be obtained at <https://cran.r-project.org/>

Communication and Support

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

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>

Interaction with Instructor Statement

Response time to any questions sent by email regarding the course will be answered within 72 hours. However, students are encouraged to interact with the instructor directly during the class time and office hours, if necessary. Exceptions such as widespread internet outage apply.

Counseling Services Statement

The Counseling Center at A&M-Commerce, located in the Halladay Building, Room 203, offers counseling services, educational programming, and connection to community resources for students. Students have 24/7 access to the Counseling Center's crisis assessment services by calling 903-886-5145. For more information regarding Counseling Center events and confidential services, please visit www.tamuc.edu/counsel

Course and University Procedures/Policies:

Course Specific Procedures/Policies:

You are expected to check your TAMUC email and d2l every day to check for any announcements. Additional information about all course assessment components is provided under "Course Evaluations". Please do not attend class if feeling ill, if an illness occurs during a course assessment, please see the "General Makeup Policy" section above for guidance.

University Specific Procedures:

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 [Student Guidebook](http://www.tamuc.edu/Admissions/oneStopShop/undergraduateAdmissions/studentGuidebook.aspx).
<http://www.tamuc.edu/Admissions/oneStopShop/undergraduateAdmissions/studentGuidebook.aspx>

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)
<http://www.albion.com/netiquette/corerules.html>

TAMUC Attendance

For more information about the attendance policy please visit the [Attendance](#) webpage and [Procedure 13.99.99.R0.01](#).

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

<http://www.tamuc.edu/aboutUs/policiesProceduresStandardsStatements/rulesProcedures/13students/academic/13.99.99.R0.01.pdf>

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. For more details and the definition of academic dishonesty see the following procedures:

[Undergraduate Academic Dishonesty 13.99.99.R0.03](#)

<http://www.tamuc.edu/aboutUs/policiesProceduresStandardsStatements/rulesProcedures/13students/undergraduates/13.99.99.R0.03UndergraduateAcademicDishonesty.pdf>

[Graduate Student Academic Dishonesty 13.99.99.R0.10](#)

<http://www.tamuc.edu/aboutUs/policiesProceduresStandardsStatements/rulesProcedures/13students/graduate/13.99.99.R0.10GraduateStudentAcademicDishonesty.pdf>

AI Statement

Texas A&M University-Commerce acknowledges that there are legitimate uses of Artificial Intelligence, ChatBots, or other software that has the capacity to generate text, or suggest replacements for text beyond individual words, as determined by the instructor of the course.

Any use of such software must be documented. Any undocumented use of such software constitutes an instance of academic dishonesty (plagiarism).

Individual instructors may disallow entirely the use of such software for individual assignments or for the entire course. Students should be aware of such requirements and follow their instructors' guidelines. If no instructions are provided the student should assume that the use of such software is disallowed.

In any case, students are fully responsible for the content of any assignment they submit, regardless of whether they used an AI, in any way. This specifically includes cases in which the AI plagiarized another text or misrepresented sources.

13.99.99.R0.03 Undergraduate Academic Dishonesty

<https://inside.tamuc.edu/aboutus/policiesproceduresstandardsstatements/rulesprocedures/13students/undergraduates/13.99.99.R0.03UndergraduateAcademicDishonesty.pdf>

Students with Disabilities – ADA Statement

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/)

<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.

Campus Concealed Carry Statement

Texas Senate Bill - 11 (Government Code 411.2031, et al.) authorizes the carrying of a concealed handgun in Texas A&M University-Commerce buildings only by persons who have been issued and are in possession of a Texas License to Carry a Handgun. Qualified law enforcement officers or those who are otherwise authorized to carry a concealed handgun in the State of Texas are also permitted to do so. Pursuant to Penal Code (PC) 46.035 and A&MCommerce Rule 34.06.02.R1, license holders may not carry a concealed handgun in restricted locations.

For a list of locations, please refer to the [Carrying Concealed Handguns On Campus](#) document and/or consult your event organizer.

Web url:

<http://www.tamuc.edu/aboutUs/policiesProceduresStandardsStatements/rulesProcedures/34SafetyOfEmployeesAndStudents/34.06.02.R1.pdf>

Pursuant to PC 46.035, the open carrying of handguns is prohibited on all A&M-Commerce campuses. Report violations to the University Police Department at 903-886-5868 or 9-1-1. at 903-886-5868 or 9-1-1.