Biostatistics

BIOL 50123, Spring 2024

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Meeting Time & Office Hours:

Class Meetings: TR 11:00AM-11:50AM WIN 407
Lab meetings: T 14:00PM-15:50PM WIN 423

Office Hours: TR 11:50AM-12:50PM WIN 426
*Individual appointments are available for students needing to discuss private matters (email me for 3 potential meeting time at least one week in advance)

General Course Information:

***Course Description*:** approximate 2 hours lecture and 2 hours computer lab per week. Prerequisites: BIOL 30403 & 30603 or permission of instructor. ** A grade C or above of BIOL 30403, 30603 is expected to enroll in this course.*

This course introduces basic statistics, and the applied examples of statistics in biology. Students will gain knowledge and understanding about how to apply basic statistical methods for biological studies. This course will introduce probability, distribution, common statistics, hypothesis testing, coding for statistical test and interpretation of statistical results.

***Course Goals*:** Students should come out of this course with an increased understanding of basic statistics, coding skills and applied mindset to solve biological questions via statistical knowledge. Moreover, students should gain experience in forming logical and rigorous scientific hypotheses, application across disciplines and group collaborations.

Student Learning Outcomes/Objectives:

- Students will be able to understand basic statistical tests
- Students will be able to understand in what biological areas different statistical analyses should be applied
- Students will be able to perform R coding to perform basic statistical analyses.
- Students will be able to understand how to interpret statistical results in biological context.

Learning Environment:

This class will rely mostly on lectures and group learning (both in class, lab and online), and also involve calculations in class and homework. Lecture slides will be presented as a starting point, but the goal is to spark questions and discussion of application of statistics we learn to your interested biological areas.

Course Communications:

I will communicate with you via the D2L and by individual TCU email (when appropriate). Please actively check your D2L or your TCU email regularly. Course slides will be posted on D2L before each class and your grade will also be posted on D2L.

Course Materials:

TCU students are prohibited from sharing any portion of course materials (including videos, PowerPoint slides, assignments, or notes) with others, including on social media, without written permission by the course instructor. Accessing, copying, transporting (to another person or location), modifying, or destroying programs, records, or data belonging to TCU or another user without authorization, whether such data is in transit or storage, is prohibited. The full policy can be found at: https://security.tcu.edu/polproc/usage-policy/. Violating this policy is considered a violation of Section 3.2.15 of the Student Code of Conduct (this policy may be found in the Student Handbook at https://tcu.codes/code/index/), and may also constitute Academic Misconduct or Disruptive Classroom Behavior (these policies may be found in the undergraduate catalog at https://tcu.smartcatalogiq.com/current/Undergraduate-Catalog/Student-Policies/Academic-Conduct-Policy-Details). TCU encourages student debate and discourse; accordingly, TCU generally interprets and applies its policies, including the policies referenced above, consistent with the values of free expression and First Amendment principles.

How to Be Successful in This Course:

Student's Responsibility

- Be prepared for all classes: e.g., pre- and post-class learning by self and group
- Be respectful of others and engage an effective learning environment
- Actively contribute to the learning activities in and outside of class – especially asking or answering questions and actively access online materials
- Abide by the TCU Honor Code
- If you do badly on an assessment, revisit the topic and figure out what you missed and why
- Think positively and stay motivated! If you feel a lack of motivation, attend office hours or seek positive environment or strategies to keep your head in the game.

Instructor's Responsibility

- Be prepared for all classes
- Evaluate all fairly and equally to the best of my abilities
- Be respectful of all students
- Create and facilitate meaningful learning activities
- Behave according to TCU codes of conduct

Texts/Resources/Materials:

Suggested: The Analysis of Biological Data by Whitlock & Schluter
Statistics for Biology by Susan Holmes & Wolfgang Huber

Required Equipment:

Regular calculation tools: e.g., R language and Rstudio

Course Requirements, Assessments, and Evaluations:

Attendance Policy: Attendance is expected and active participation in course discussions is required. I will not be willing to use email/office hours to purely go over everything we covered in class just because you weren't there. Please try to come or find a classmate to share notes with you.

Social Media Policy: Laptop or phone is not allowed during my lecture; can only be used for class-related topics if allowed in some circumstances (e.g., search for some coding scripts).

Grading System:

In-class quizzes (25%: 5 quizzes are accounted – lower grades are dropped; 5% each)

Midterm exam (15%)
Homework (35%: 7 homeworks are accounted – lower grades are dropped; 5% each)
Final exam (20%: Graduate students will have one more question in Final than undergraduate students)
Attendance (5%: 10 attendance checks will be counted; 0.5 each)

Grade Weighting: The course will not have weighted grades unless we get to the second-to-last week of the semester and more than half of you have earned less than a 70%, in which case, clearly our communication methods have been failing and we will discuss together in class what to do about it/how to rescale appropriately.

Anticipated Grade Scales:

Undergraduate:
A: 95-100
A-: 90-94.99
B+: 85-89.99
B: 80-84.55
B-: 75-79.99
C+: 70-74.99
C: 65-69.99
C-: 60-64.99
D: 55-59.99
F: 0-54.99

Graduate:
A: 95-100
A-: 90-94.99
B+: 85-89.99
B: 80-84.55
B-: 75-79.99
C+: 70-74.99
C: 65-69.99
C-: 60-64.99
F: 0-59.99

Assignments and Exams

- There will homework from lab sections every week, occasionally there will also be in-class quizzes during lecture sections
    - **i.** Homework will be released at the last slide of the lab presentation for that week, R code writing is required for homework. You will have ONE week to finish your homework and upload your answer to D2L system (preferred) before the lab section of next week. Only 7 homework scores will be counted towards your final grade (i.e., I will drop those with lower scores).
    - **ii.** For in-class quizzes, time will be controlled and blank papers can be provided with requests
    - **iii.** Quizzes need to be done solely by yourself, homework can be discussed within group members, but **you must write your answers independently and in your own words.**
    - **iv.** Only 5 in-class quizzes' scores will be counted towards your final grade (i.e., I will drop those quizzes with lower scores).
    - **v.** 10 times attendance check will be counted towards your final grade. **Note**: I will not tell you which date I will do attendance check, so you'd better to come to every class to avoid class

missing. Also, if you miss >= 30 mins of the lecture or lab, you will be counted as missing the class even you show up.

- There will be in-class Midterm and Final Exams. See Course Outline below for the date. It will be given at the beginning of the lecture class at either T or R, you need to finish the exams and submit to me at the end of the class period. Makeup exams need to follow TCU makeup policies.
- Weekly homework assignment:
    i. Homework is mainly about programming in R language.
    ii. Homework questions will be released during the lab sections.
    iii. You have one week to work on the homework questions.
    iv. You need to submit your answers to homework before the next lab session.

Course Feedback:

Feedback will be given mostly via assessment of performance on quizzes, exams, and in-class activities.

Course Policies:

Academic Integrity:

As stated in the TCU Official Student Handbook, "Each student is expected to be fully acquainted with all published policies, rules, and regulations of the University and will be held responsible for compliance with them." You are expected to maintain high standards of personal and scholarly conduct. You are also expected to review "Syllabus Disclosures" portion of the syllabus.

Accommodations:
Texas Christian University affords students with disabilities reasonable accommodations in accordance with the Americans with Disabilities Act and Section 504 of the Rehabilitation Act. To be eligible for disability-related academic accommodations, students are required to register with the TCU Office of Student Access and Accommodation and have their requested accommodations evaluated. Students are required to provide instructors an official TCU notification of accommodation approved through Student Access and Accommodation. More information on how to apply for accommodations can be found at https://www.tcu.edu/access-accommodation/ or by calling Student Access and Accommodation at (817) 257-6567. Accommodations are not retroactive and require advance notice to implement. Students granted extended time for quizzes and exams must provide notice to the course instructor at ≥ 5 days in advance of the assessment so that suitable arrangements can be made.

Academic misconduct:
Cheating, plagiarism, collusion, etc. are not acceptable. Students cheating may be subject to a variety of sanctions at the discretion of the course instructor, including disenrollment from the course and a failing course grade. Unauthorized recording and/or distribution of lectures and class meetings violates course policy and may represent academic dishonesty. Student engaged in academic conduct will be reported to the appropriate administrators. Pre-health students are reminded that the course instructor is a member of HPAC and provides comments for inclusion in letters of evaluation. Be aware that engaging in academic misconduct may prevent you from being accepted to professional schools. Simply put, cheating is NOT worth it. A subpar grade is far less detrimental to your future than a record demonstrating a lack of integrity. Information regarding academic misconduct appears in the "Syllabus Disclosures" portion of the syllabus.

Assistance outside of class:
There will be up to 8 hours* available each week for students to seek help with course material. Students are strongly encouraged to attend office hours and/or tutoring to seek help as soon as questions related to

course content arise as it is best to seek clarification of concepts soon after lectures are posted, rather than waiting until just before an exam. Questions regarding course material will only receive responses if they are no later than 11am, one day prior to exam dates. As such, office hours and tutoring sessions scheduled after 11am one day before exams or on the day of exams will not be held. *Note that office hours and tutoring hours may change due to illness, emergencies, etc.

Email Etiquette and Expectations:
When you send an email to the course instructor, please remember to be professional and respectful. All emails should include: 1) a descriptive subject line, 2) brief, yet descriptive text describing the purpose of your email, 3) your full name. You can expect a response within 48 hours for emails sent Sunday to Thursday and within 72 hours for emails sent Friday-Saturday.

Important Dates:
Drop date: April. 9, 2024. P/NC date: April. 22, 2024. Final Exam Date: May 6-10, 2024

Late and make-up work:
Make-up exams, quizzes, and in-class activities are given only for University-approved absences. Requests for University-absences are evaluated by Campus Life and typically cover only absences for athletics and other University-sanctioned events, but generally do not cover illness, family emergencies, vacations, flat tires, oversleeping, etc. Class activities, assignments, quizzes or exams that have clear due date must submit by the due date. Otherwise, you will have score penalty (20% off your final grade of the delayed materials) for each day delay. Late submissions over one week pass the due date will not be accepted.

Syllabus Disclosures:

Please use this **link** or scan the QR code with a mobile device camera to access TCU policies and resources including support for TCU students, student access and accommodation, anti-discrimination and Title IX information, and other important information.

Course Outline and Schedule:

These are rough estimates – I expect some topics will take longer, others will be shorter. We may zoom ahead or slow down, as interest and discussion dictate throughout the semester.

1/16, 18– Introduction to Biostatistics
Course Introduction, Go over Syllabus Together, Reviewing Expectations

1/16 – Homework #1 released: **due 11am on 1/23**
Topics: Basic introduction to R language and RStudio

1/23, 25 – Describe Data in Biology
Topics: Mean, Median, Mode and Variance

1/23 – Homework #2 released: **due 11am on 1/30**

1/30, 2/1– Distribution and Z score
Topics: Normal Distribution, student-t distribution, Z score, Confidence Interval

1/30 – Homework #3 released: **due 11am on 2/6**

2/6, 8 – Hypothesis Testing—section 1

Topic: Null & Alternative Hypotheses, conduct a hypothesis testing, understanding errors

2/13, 15– Hypothesis Testing—Section 2
Topics: interpret no-significant results, one- or two-tailed tests, Difference between Hypothesis Testing vs. Confidence Interval

2/13 – Homework #4 released: **due 11am on 2/20**

2/20, 22 – Effect size and power of a test
Topic: calculation of effect size, meta-analysis, how to calculate and increase the power of a statistical test

2/20 – Homework #5 released: **due 11am on 2/27**

2/27, 29 – Dependent sample t test
Topic: sample mean, equal variance of populations

2/27 – Homework #6 released: **due 11am on 3/5**

3/5, 7 – Independent sample t test & Review of Midterm
Topic: sample mean, variance of populations

3/5 – lab is open but NO homework

Spring Break

3/19 – Midterm

3/19 – lab is open but NO homework

3/21, 26 – One-way ANOVA
Topic: similarity & difference between ANOVA vs. t test

3/26 – Homework #7 released: **due 11am on 4/2**

3/28, 4/2 – Two-way ANOVA
Topic: difference between One-way vs. Two-way ANOVA

4/2 – Homework #8 released: **due 11am on 4/9**

4/4, 9 – Correlation and Regression

4/9 – Homework #9 released: **due 11am on 4/16**

4/11, 16 – Chi-square test

4/16 – Homework #10 released: **due 11am on 4/23**

4/18, 23 – Non-parametric tests

4/23 – Homework #11 released: **due 11am on 4/30**

4/25, 30 – Advanced statistics & Review for Final

4/30 – lab is open but NO homework

5/7 – Final

Four Very Important Disclaimers for Entire Course:

If these things will bother you, you might want to switch to a different course

Distractions: I will go off-topic on purpose (e.g., introducing some new methodology). We will get distracted by conversations.

Class Slides: Some slides can be short and incomplete. They are not meant to capture everything we will talk about, nor be a complete list of concepts. They are there to get the conversation started. If you miss class, please get someone's notes.

Being Right: For some questions, I think it's much more important to be able to make good arguments than to get the right answer. An unsupported, poorly supported, or incorrectly supported "right answer" will be graded as wrong in this course.

Evidence-based Rationale: In this course, you will be expected to make logical, evidence-based arguments based upon current scientific principles and data. Arguments rooted outside of scientific evidence are beyond the scope of this course.

The instructor reserves the right to revise, alter or amend this syllabus as necessary. Students will be notified in writing / email of any such changes.