BIOST/STAT 571: Advanced Regression Methods For Dependent Data

Land Acknowledgment: *The University of Washington acknowledges the Coast Salish people of this land, the land which touches the shared waters of all tribes and bands within the Duwamish, Suquamish, Tulalip and Muckleshoot nations.*

Instructor

- Michael Wu (he/him)
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Teaching Assistants

- Trinity Fan (she/her) (Stat), fansx@uw.edu
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Lectures

- Wed. January 6 through Fri. March 15, 2025
- Lectures: Mon/Wed/Fri, 1:30-2:20 PM (except 1/20, 2/17)
  Lectures will typically be held at GLD 322; (In the event of instructor illness/unavailability or pandemic surge, we may move to hybrid)

Office Hours

- Instructor: Monday 12PM -1PM (HRC 347) OR by Appt.
- TAs:
  - Trinity: Thursday 11AM-12PM OR by Appt.
  - Taek: Tuesday 11AM-12PM OR by Appt.
  - Office Hours Zoom Link for all TAs: https://washington.zoom.us/s/92814067294

Course Webpage (Canvas):

- `https://canvas.uw.edu/courses/1785813`

Recommended Texts

- Diggle, Heagerty, Liang and Zeger (2002). *Analysis of Longitudinal Data*, Oxford University Press.
- Verbeke, G. and Molenberghs, G. (2000). *Linear Mixed Models for Longitudinal Data*, Springer.

Other useful texts:

- Wakefield, J. (2014). *Bayesian and Frequentist Regression Analysis*, Springer.
- McCullagh, P. and Nelder, P.(1989). *Generalized Linear Models*, Chapman & Hall/CRC
- Rencher, A. C. (2002). *Methods for Multivariate Analysis*. 2nd Edition. Wiley.
- Johnson, R.A., and Wichern, D.W. (2002). *Applied Multivariate Statistical Analysis*, 5th ed. Prentice-Hall, Upper Saddle River, NJ
- Verbeke, G. and Mollenberghs, G. (2005). *Models for Discrete Longitudinal Data*, Springer.
- Hastie, T., Tibshirani, R. and Friedman, D. (2001). *The Elements of Statistical Learning*, Springer.

Prerequisite

- Biost/Stat 570
- Familiarity with: generalized linear models, quasi-likelihood, linear algebra, non-measure theoretic probability.

Grading

- 60% HW, 40% Final Project.

BIOST/STAT 571: COURSE POLICIES

Homework Assignments

- Posted and handed in on Canvas.
- At the instructor's discretion, not all homework problems may be graded.
- You are allowed and even encouraged to discuss with peers, but write your own work.
- Students may request regrades for homework assignments: see regrade policy below.
- Clarity of exposition and presentation is important and a part of your training. Accordingly, proofs and technical writing are expected to be presented legibly with clarity and ease in following your exposition part of your grade, in addition to correctness.
- Assignments are expected to take the full time provided. Do NOT start at the last minute.
- Late Policy: **No late HW will be accepted.**

Assignment Extensions

- In general: requests for extensions will usually be DENIED.
- Exceptions (at instructor's discretion): e.g. major illness, loss in immediate family, other exceptions as required by UW.

Final

- *Group Project/Term Paper*: 40% of grade.
  - Groups of approx. 4-5 students (Assigned by instructor)
  - Further details will be provided when the project is assigned in Late January or Early February.

Regrade Policy

- Students that perceive that a problem on any assignment has been incorrectly graded must submit for a full regrade of the entire assignment per the regrade procedure
- Regrade Procedure:
  1. Entire assignment must be submitted for regrade within 1 week of the assignment's return.
  2. For each potential grading error, students must write a full paragraph (4-5 sentences) clearly detailing why they believe their solution is correct/deserves additional credit.

3. Regrades will be conducted with regard to the entire assignment, i.e. all problems will be reconsidered

- Regrades may result in higher, unchanged, OR **lower** scores (grading errors can occur in both directions).
- Regraded scores are final.
- Mistakes in adding up points do not require full regrade.

Communication Skills

Communication through writing and speaking is an important transferable skill for all career pathways. Establishing a strong foundation in communication skills will help you be successful throughout your future course work and career. Therefore, this course includes assignments with the goal to help you identify areas of strength and improvement in your communication. If you feel that you could benefit from additional opportunities to improve your writing skills in particular, a list of resources at the UW and others accessible online can be found on the SPH website at
https://sph.washington.edu/sites/default/files/inline-files/Writing-Resources-4.3.19.pdf.

Academic Integrity

Students at the University of Washington (UW) are expected to maintain the highest standards of academic conduct, professional honesty, and personal integrity. The UW School of Public Health (SPH) is committed to upholding standards of academic integrity consistent with the academic and professional communities of which it is a part. Plagiarism, cheating, and other misconduct are serious violations of the University of Washington Student Conduct Code (WAC 478-121). We expect you to know and follow the university's policies on cheating and plagiarism, and the SPH Academic Integrity Policy. Any suspected cases of academic misconduct will be handled according to University of Washington regulations. For more information, see the University of Washington Community Standards and Student Conduct.

- https://sph.washington.edu/students/academic-integrity-policy
- Faculty are responsible for reporting *suspected* violations.
- Please don't cheat. If it's questionable, then talk to the instructor first.

Use of Generative AI

Generative artificial intelligence (AI) represents an important new resource for learners. Students are encouraged to utilize generative AI tools such as ChatGPT as they think appropriate. Some assignments will also necessitate the use of generative AI tools. However, students should also be aware that such tools are NOT perfect. All material that they generate and create are based on imperfect algorithms not tailored towards the tasks at hand. The training data for these algorithms also can reflect highly problematic biases (e.g. racial, gender, scientific, etc.) that

persist in online resources. Furthermore, material generated by these tools may not provide sufficient detail or depth required for this high level graduate course. Accordingly, while students are encouraged to use these tools, incorrect or inadequate materials resulting from their use will still be evaluated as such. Since AI is another resource/tool, appropriate citations should be made (especially if copied).

Illness Protocol

If you feel ill or exhibit respiratory or other symptoms, do not come to class. Seek medical attention if necessary and notify your instructor(s) as soon as possible by email. UW Environmental Health & Safety recommends that you wear a well-fitting mask while you are symptomatic.

Additional recommendations include getting your annual flu shot and getting boosted with the updated COVID vaccines (available at clinics and pharmacies, as well as through UW Medicine and local health agencies).

Please check your email and CANVAS announcements daily BEFORE coming to class. If we need to conduct class remotely because the instructor is unable to attend in person, we will send all registered students an email and/or post a CANVAS announcement with a Zoom link for remote instruction or a plan for making up the class.

Access and Accommodations

Your experience in this class is important to me. It is the policy and practice of the University of Washington to create inclusive and accessible learning environments consistent with federal and state law. If you have already established accommodations with Disability Resources for Students (DRS), please activate your accommodations via myDRS so we can discuss how they will be implemented in this course.

If you have not yet established services through DRS, but have a temporary health condition or permanent disability that requires accommodations (conditions include but not limited to; mental health, attention-related, learning, vision, hearing, physical or health impacts), contact DRS directly to set up an Access Plan. DRS facilitates the interactive process that establishes reasonable accommodations. Contact DRS at disability.uw.edu.

Religious Accommodations

Washington state law requires that UW develop a policy for accommodation of student absences or significant hardship due to reasons of faith or conscience, or for organized religious activities. The UW's policy, including more information about how to request an accommodation, is available at Religious Accommodations Policy (https://registrar.washington.edu/staffandfaculty/religious-accommodations-policy/). Accommodations must be requested within the first two weeks of this course using the Religious Accommodations Request form (https://registrar.washington.edu/students/religious-accommodations-request/).

Inclusion & Diversity

Diverse backgrounds, embodiments and experiences are essential to the critical thinking endeavor at the heart of University education. In SPH, we are expected:

1. To respect individual differences, which may include, but are not limited to, age, cultural background, disability, ethnicity, family status, gender, immigration status, national origin, race, religion, sex, sexual orientation, socioeconomic status and veteran status.
2. To engage respectfully in the discussion of diverse worldviews and ideologies embedded in course readings, presentations and artifacts, including those course materials that are at odds with personal beliefs and values.
3. To encourage students with concerns about classroom climate to talk to their instructor, adviser, a member of the departmental or SPH EDI Committee, the Assistant Dean for EDI, or the program's director.

If you have any concerns, please let me know as soon as possible.

Classroom Climate

We are co-creators of our learning environment. It is our collective responsibility to develop a supportive learning environment for everyone. Listening with respect and an open mind, striving to understand others' views, and articulating your own point of view will help foster the creation of this environment. We engage our differences with the intent to build community, not to put down the other and distance our self from the other. Being mindful to not monopolize discussion and/or interrupt others will also help foster a dialogic environment.

The following guidelines can add to the richness of our discussion:

- We assume that persons are always doing the best that they can, including the persons in this learning environment.
- We acknowledge that systematic oppression exists based on privileged positions and specific to race, gender, class, religion, sexual orientation, and other social variables and identities.
- We posit that assigning blame to persons in socially marginal positions is counter-productive to our practice. We can learn much about the dominant culture by looking at how it constructs the lives of those on its social margins.
- While we may question or take issue with another class member's ideology, we will not demean, devalue, or attempt to humiliate another person based on her/his experiences, value system, or construction of meaning.
- We have a professional obligation to actively challenge myths and stereotypes about our own groups and other groups so we can break down the walls that prohibit group cooperation and growth. [Adapted from Lynn Weber Cannon (1990). Fostering positive race, class and gender dynamics in the classroom. Women Studies Quarterly, 1 & 2, 126-134.]

We are a learning community. As such, we are expected to engage with difference. Part of functioning as a learning community is to engage in dialogue in respectful ways that supports learning for all of us and that holds us accountable to each other. Our learning community asks us to trust and take risks in being vulnerable. Here are some guidelines that we try to use in our learning process:

- LISTEN WELL and be present to each member of our group and class.
- Assume that I might miss things others see and see things others miss.
- Raise my views in such a way that I encourage others to raise theirs.
- Inquire into others' views while inviting them to inquire into mine.
- Extend the same listening to others I would wish them to extend to me.
- Surface my feelings in such a way that I make it easier for others to surface theirs.
- Regard my views as a perspective onto the world, not the world itself.
- Beware of either-or thinking.
- Beware of my assumptions of others and their motivations.
- Test my assumptions about how and why people say or do things.
- Be authentic in my engagement with all members of our class.

Pronouns

We share our pronouns because we strive to cultivate an inclusive environment where people of all genders feel safe and respected. We cannot assume we know someone's gender just by looking at them. So we invite everyone to share their pronouns.

Bias Concerns

The Office of the Dean has a student concern policy, a faculty concern policy and standard HR procedures for staff concerns. Our 2018 climate survey states that most people in SPH do not report bias incidents because they do not know where to go. Students are encouraged to report any incidents of bias to someone they feel comfortable with, including instructors, advisers or department staff. They can email dcinfo@uw.edu for immediate follow up. Bias concerns can be anonymously and confidentially reported at this link https://sph.washington.edu/about/diversity/bias-concerns. Data is collected by the Assistant Dean for EDI and the Director of Program Operations for Student and Academic Services and tracked for resolution and areas are identified for further training.

Sexual Harassment

Sexual harassment is a form of harassment based on the recipient's sex that is characterized by:

1. Unwelcome sexual advances, requests for sexual favors, or other verbal or physical conduct of a sexual nature by a person who has authority over the recipient when:
    - Submission to such conduct is an implicit or explicit condition of the individual's employment, academic status, or ability to use University facilities and services, or
    - Submission to or rejection of the conduct affects tangible aspects of the individual's employment, academic status, or use of University facilities.
2. Unwelcome and unsolicited language or conduct that creates an intimidating, hostile, or offensive working or learning environment, or has the purpose or effect of unreasonably interfering with an individual's academic or work performance.

If you believe that you are being harassed, or have observed harassment, you can report it to SPH using the bias concerns link. The University also has designated offices to help you: SafeCampus; Office of the Ombud; Title IX Investigation Office; and University Complaint Investigation and Resolution Office.

Class or TA Concerns

If you have any concerns about the class or your TA, please see the TA about these concerns as soon as possible. If you are not comfortable talking with the TA or not satisfied with the response that you receive, you may contact the Department of Biostatistics Associate Director of Academic Affairs (biostgp@uw.edu). If you are still not satisfied with the response that you receive, you may contact the Department of Biostatistics Chair (bchair@uw.edu). You may also contact the Graduate School at G-1 Communications Building, by phone at 206-543-5139 or by email at raan@uw.edu.

Biost/Stat 571: Primary Learning Objective

At the completion of this course, students are expected to be able to:

- Major: Recommend and defend appropriate choices of methods to analyze longitudinal, clustered, and other non-independent outcome data.
- Minor: Have the ability to develop, adapt, or extend statistical approaches for analyzing non-independent outcome data.

Biost/Stat 571: Lecture Topics (approximate)

1. Introduction
2. Linear Mixed Models for Correlated Data

   LMM; MLEs; Fixed effects; Random effects; BLUPs; EM; Restricted MLEs (REMLs); Variance components; Variance/covariance modeling.
3. Generalized Estimating Equations

   GEE, Hypothesis Testing in GEE, GEE2
4. Generalized Linear Mixed Models

   Relationship between GEEs and GLMMs; Likelihood; Approximate inference; MLEs; EM; Conditional inference
5. Modeling Longitudinal Data with Dropouts

   Missing mechanisms (MCAR, MAR and NMAR); Likelihood-based approaches (selection models and pattern-mixture models); Weighted GEEs.
6. Classical and Multivariate Analysis

   Multivariate normal regression and tests; Principle Components; Factor Analysis; Discriminant Analysis, Classification; Cluster Analysis;

   Kernel machine methods and connections with mixed models

   Measures of multivariate association (ρV statistics, HSIC, etc.)