OEHS 7000 Occupational Biostatistics II

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Course Description

Advanced Biostatistics in SAS explores the use of statistical modeling for analysis of health and medical data. This course focuses on the analysis of data using a variety of regression and analysis of variance techniques, including: linear regression, logistic regression, proportional hazards regression, Poisson regression, generalized linear models, and causal inference. Examples and exercises throughout the course will utilize R and SAS. The primary emphases of the course will be on the theoretical basis for each modeling technique, the commands to run these tests using R and SAS, appropriate interpretation of the results, and techniques for building multivariable models.

Course Outcomes
At the conclusion of the course students will be expected to be able to do the following:
- Explain the fundamental concepts and arrange the assumptions underlying multiple regression models.
- Classify and relate different types of regression analyses.
- Diagnose model fit issues and discriminate between different violation of assumptions.
- Propose and document corrective measures for assumption violations in multiple regression.
- Explain the applications of logistic regression in occupational health.
- Identify and communicate the foundational assumptions of logistic regression.
- Execute binary, ordinal, and multinomial logistic regression analyses.
- Interpret and evaluate the model fit and coefficients in logistic regression models.
- Categorize data structures as nested within hierarchical linear models.
- Distinguish between random intercepts and random slopes in multi-level models.
- Implement growth curve modeling within the multi-level modeling framework.
- Employ SAS to analyze hierarchical data structures.
- Construct basic structural equation models including path analysis.
- Estimate and verify model identification parameters.
- Critique structural equation models for fit and theoretical consistency.
- Design models that incorporate mediation and moderation within the SEM framework.

- o Compute and interpret polynomial regression models.
- o Analyze curvilinearity in occupational health data and perform transformations.
- o Describe the principles of analyzing repeated measures data.
- o Apply growth modeling techniques to longitudinal data.
- o Integrate trajectory analysis with time-varying covariates in longitudinal studies.
- o Experiment with models to test and refine analysis strategies.
- o Select and justify appropriate model selection criteria.
- o Execute validation techniques like cross-validation and bootstrapping to test model robustness.
- o Investigate and report on non-parametric regression techniques.
- o Explore survival analysis methodologies and their application in occupational health studies.
- o Synthesize biostatistical techniques to produce comprehensive analysis of occupational health data.
- o Evaluate and defend analytical decisions and interpret the results in a formal presentation.

Teaching and Learning Methods
The teaching and learning method for this course is experiential learning.

Course Policies
All work by the student should be submitted to the instructor through the course Canvas site, including the student evaluation form, journal entries and final practicum paper.

The mentor can submit his or her completed evaluation of the student's performance to the instructor via email, fax, or mail.

Late submissions are not accepted.

Assignments

Quizzes (Total: 20% of final grade)

- Quiz 1: Module 3 (after Multiple Regression Part II) - 4%
- Quiz 2: Module 5 (after Logistic Regression Part II) - 4%
- Quiz 3: Module 8 (after Multi-level Modeling Part II) - 4%
- Quiz 4: Module 11 (after Curvilinear Regression) - 4%
- Quiz 5: Module 13 (after Longitudinal Multi-stage Analysis Part II) - 4%

Note: Each quiz should cover materials taught in the modules leading up to the quiz.

Midterm Exam (25% of final grade)

- Midterm: Module 7 (Cumulative from Modules 1 to 6)

Project (25% of final grade)

- Project Assigned: Module 9
- Project Milestone Check/Progress Report: Module 12
- Project Presentation and Submission: Module 16

The project should be a significant piece of work that allows students to apply the methods and techniques they have learned to real-world data. It will involve data analysis, method development, and an extensive literature review.

Final Exam (30% of final grade)

- Final Exam: Module 16 (Cumulative from Modules 1 to 15)

Grading Breakdown Summary:

- Quizzes: 20% (Each quiz: 4%)
- Midterm Exam: 25%
- Project: 25%
- Final Exam: 30%

Grading Policy (Evaluation Methods & Criteria)
Quizzes are online and cover the previous material covered since the prior lecture(s). They are open book/note and have a time limit. Late submissions will not be accepted. Students are not allowed to retake any quizzes.

The Statistical Analysis Project is an opportunity for you to demonstrate your application of the biostatistical methodologies learned in this course by analyzing data for a project of interest to you. There are several parts, with graded elements most weeks. You are required to post and respond in discussions as well as submit a final element of your statistical analysis project throughout the course.

The Midterm and Final exams are comprehensive and are administered online.

Determination of Grades

A	93-100%
A-	90-92%
B+	87-89%
B	83-86%
B-	80-82%

Course Schedule

Module 1: Introduction to Advanced Biostatistics

- The importance of advanced techniques in occupational health
- Review of foundational biostatistics concepts

Module 2: Multiple Regression (Part I)

- Basics and assumptions
- Introduction to model building

Module 3: Multiple Regression (Part II)

- Assessing models
- Diagnostics and remedies for violation of assumptions

Module 4: Logistic Regression (Part I)

- Introduction and applications in occupational health
- Assumptions and diagnostics

Module 5: Logistic Regression (Part II)

- Binary, ordinal, and multinomial logistic regression
- Model fit and interpretation

Module 6: Meta-Analyses

- Introduction to meta-analysis
- Basics of meta-analysis in occupational health

Module 7: Midterm Examination

- Comprehensive assessment covering Modules 1-6

Module 8: Multi-level Modeling (Part I)

- Understanding nested data structures
- Introduction to random intercepts and slopes

Module 9: Multi-level Modeling (Part II)

- Growth curve modeling
- Application in SAS

Module 10: Structural Equation Modeling (Part I)

- Basics of path analysis and confirmatory factor analysis
- Model identification and estimation

Module 11: Structural Equation Modeling (Part II)

- Model fit
- Mediation and moderation concepts

Module 12: Curvilinear Regression

- Polynomial regression foundations
- Detection of curvilinearity and transformations

Module 13: Longitudinal Multi-stage Analysis (Part I)

- Introduction to repeated measures data
- Introduction to growth modeling

Module 14: Longitudinal Multi-stage Analysis (Part II)

- Trajectory analysis
- Delving into time-varying covariates

Module 15: Model Selection and Validation

- Criteria for optimal model selection
- Techniques such as cross-validation and bootstrapping

Module 16: Final Examination & Project Presentation

- Comprehensive assessment covering Modules 1-15
- Hand in final projects by students

Finals Week

All materials from the student are due the last day of classes.

Note: This syllabus is meant to serve as an outline and guide for our course. Please note that I may modify it with reasonable notice to you. I may also modify the Course Schedule to accommodate the needs of our class. Any changes will be announced in class and posted on Canvas under Announcements.

University Policies

1. ***The Americans with Disabilities Act***. The University of Utah seeks to provide equal access to its programs, services, and activities for people with disabilities. If you will need accommodations in this class, reasonable prior notice needs to be given to the Center for Disability & Access, 162 Olpin Union Building, (801) 581-5020. CDS will work with you and the instructor to make arrangements for accommodations. All written information in this course can be made available in an alternative format with prior notification to the Center for Disability & Access.

   o ***If in-class attendance is a necessary component of the course for pedagogical reasons (e.g., laboratories, studios, or artistic training), state it explicitly.***

      Use this standard language: "*Given the nature of this course, attendance is required and adjustments cannot be granted to allow non-attendance. However, if you need to seek an ADA accommodation to request an exception to this attendance policy due to a disability, please contact the Center for Disability and Access (CDA). CDA will work with us to determine what, if any, ADA accommodations are reasonable and appropriate*

2. ***University Safety Statement.*** The University of Utah values the safety of all campus community members. To report suspicious activity or to request a courtesy escort, call campus police at 801-585-COPS (801-585-2677). You will receive important emergency alerts and safety messages regarding campus safety via text message. For more information regarding safety and to view available training resources, including helpful videos, visit https://safeu.utah.edu

3. ***Addressing Sexual Misconduct***. Title IX makes it clear that violence and harassment based on sex and gender (which Includes sexual orientation and gender identity/expression) is a civil rights offense subject to the same kinds of accountability and the same kinds of support applied to offenses against other protected categories such as race, national origin, color, religion, age, status as a person with a disability, veteran's status or genetic information. If you or someone you know has been harassed or assaulted, you are encouraged to report it to the Title IX Coordinator in the Office of Equal Opportunity and Affirmative Action, 135 Park Building, 801-581-8365, or the Office of the Dean of Students, 270 Union Building, 801-581-7066. For support and confidential consultation, contact the Center for Student Wellness, 426 SSB, 801-581-7776. To report to the police, contact the Department of Public Safety, 801-585-2677(COPS).

4. ***Academic Misconduct Statement.*** It is expected that students adhere to University of Utah policies regarding academic honesty, including but not limited to refraining from cheating, plagiarizing, misrepresenting one's work, and/or inappropriately collaborating. This includes the use of generative artificial intelligence (AI) tools without citation, documentation, or authorization. Students are expected to adhere

to the prescribed professional and ethical standards of the profession/discipline for which they are preparing. Any student who engages in academic dishonesty or who violates the professional and ethical standards for their profession/discipline may be subject to academic sanctions as per the University of Utah's Student Code: https://regulations.utah.edu/academics/6-410.php