BIOSTATISTICS 6612
Biostatistical Methods II
Spring Semester 2019

Instructor:	John Rice
Email:	john.rice@ucdenver.edu
Office:	Room 338, CU Medicine bldg. (old UPI bldg.)
Office hours:	TBD based on students' preferences
Teaching Assistant:	TBD
Lecture Time:	Tuesday and Thursday, 2:30-4:00pm
Location:	Ed 2 South, Room 2201
Course Website:	CU Denver Canvas

COURSE DESCRIPTION:
A mathematical presentation of linear models, logistic regression, and methods for correlated data are covered. Matrix algebra and the R statistical computing environment will be used extensively.

COURSE GOALS:
This course builds on the material covered in BIOS 6611. An introduction to statistical methods for the analysis of correlated data will also be presented. We will explore estimation, hypothesis testing, and interpretation for these models as well as model diagnostics. The development of statistical thinking and an understanding of the relationship between scientific inquiry and statistical methods will be the primary goals. The material presented will be illustrated through the use of examples in the fields of medicine, biology, epidemiology, and public health. The written presentation and interpretation of analytic results by the student will be emphasized. Calculus, matrix algebra, and the SAS/R statistical packages will be utilized. This course is required for students in the MS-Biostatistics and the PhD-Epidemiology Programs. *PREREQUISITES*: BIOS 6611, Calculus 1&2. PREFERRED: Linear Algebra

RECOMMENDED TEXTBOOKS (NOT REQUIRED):
- Vittinghoff, Glidden, Shiboski, McCulloch. Regression Methods in Biostatistics. 1st Edition. 2005. [Vittinghoff]
- Agresti. Categorical Data Analysis. 2nd Edition. 2002. [Agresti]
- Kleinbaum DG, Kupper LL, Nizam A, Muller KE. *Applied Regression Analysis and Other Multivariable Methods, 4th Edition*. Duxbury Press, 2008. [KKMN]

STATISITICAL SOFTWARE:
All examples and solutions will be provided in either SAS or R. Students are free to use whatever package they choose to complete assignments, but assistance will only be provided in SAS or R depending on the assignment and the corresponding lecture examples.

COURSE CREDIT HOURS: 3

STUDENT EVALUATION:

- Assignments 50%
- Midterm 25%
- Final 25%

ASSIGNMENTS:

In order to receive credit, assignments should be typed whenever possible, neat, and well organized; use of R Markdown (e.g.) is encouraged. Raw computer output from a statistical package is not acceptable. Numerical output should be incorporated into text or tables, and plots should be electronically or manually integrated into the pages to be turned in. Plots should be labeled, including axis labels. Late homework is not accepted without prior permission from the instructor.

Students are encouraged to work together on the assignments; however, the assignment handed in must represent the student's own work and may NOT be identical for multiple students.

ACADEMIC INTEGRITY:

All graduate educational programs and courses taught at the CSPH are conducted under the honor system. All students should have developed the qualities of honesty and integrity, and each student should apply these principles to his or her academic and subsequent professional career. All students are expected to have achieved a level of maturity, which is reflected in appropriate conduct at all times. Related to academic honesty, all work done on exams or other assignments is to be done independently, unless specific instruction to the contrary is provided by the course instructor.

The following statement will appear on each exam:

I understand that my participation in this examination and in all academic and professional activities as a UC Anschutz Medical Campus student is bound by the provisions of the UC AMC Honor Code. I understand that work on this exam and other assignments are to be done independently unless specific instruction to the contrary is provided.

Students requesting accommodations for a disability must contact:

Sherry Holden | Coordinator
University of Colorado Anschutz Medical Campus Disability Resources & Services | Bldg. 500, Room Q20-EG 305A
Phone: (303) 724-5640, Fax (303) 724-5641
Part-time: Monday, Tuesday and Thursday
sherry.holden@ucdenver.edu

Selim Özi | Assistive technology Specialist, Accommodation Coordinator
University of Colorado Anschutz Medical Campus Disability Resources & Services | Mail Stop A010, Building 500, Room Q20-EG 306
Phone: (303) 724-8428, Fax: (303) 724-5641
selim.ozi@ucdenver.edu

Be aware that the determination of accommodations can take a long period of time. No accommodations will be made for the course until written documentation is provided by the Disability resources and services office to the course directors. It is the student's responsibility to coordinate approved accommodations with the Disability resources and services office in advance.

Further general Information regarding disability resources and services can be found at: http://www.ucdenver.edu/student-services/resources/disability-resources-services/accommodations/Pages/accommodations.aspx

Students can set up an appointment at: http://www.ucdenver.edu/student-services/resources/disability-resources-services/about-office/contact-us-CUAnschutz/Pages/form.aspx

MS Biostatistics Competencies

All or part of the following competencies are addressed in this course:

- Map study aims to testable statistical hypotheses.
- Identify the strengths and weaknesses of various clinical trial and observational study designs and the data collection methods that go with these designs.
- Use probability and statistical theory to develop appropriate data analysis plans for study hypotheses.
- Use summary and graphical methods to carry out exploratory data analyses for data examination.
- Use probability and statistical theory to identify appropriate modeling and analysis methods to address study hypotheses.
- Determine and check modeling assumptions, and verify validity of proposed analyses.
- Carry out valid and efficient modeling, estimation and inference to address study hypotheses, using standard statistical methods including basic one- and two-sample methods, general linear models including regression and ANOVA, logistic regression, and clustered and longitudinal analysis.
- Communicate orally and in writing simple and complex statistical ideas and methods to collaborators in non-technical terms including preparation of analysis section of grant proposals and methods and results sections of manuscripts.

Spring 2019 Course Schedule (Subject to Additional Change)

Lecture	Date	Topic	HW Due
1	1/22	Model Selection: AIC, BIC, Adjusted R Squared	
1	1/24	Model Selection: Collinearity, Outliers	
2	1/29	Logistic Regression (LR): Introduction	Hw1 (L1)
3	1/31	LR: Maximum Likelihood Estimation	
4	2/5	LR: Wald, Score, & Likelihood Ratio Tests	
5	2/7	LR: Comparing Models & Interactions	
6	2/12	LR: Confounders	
7	2/14	LR: Model Fit	Hw2 (L2-5)
8	2/19	LR: Deviance	
9	2/21	LR: Categorical Outcomes	
10	2/26	Linear Models (LM): Forms	
11	2/28	LM: Estimation	Hw3 (L2-9)
12	3/5	LM: Hypothesis Tests	
13	3/7	Linear Mixed Models (LMM): Introduction	Hw4 (L10-12)
Review	3/12	Review for midterm	
Midterm	**3/14**	**Midterm exam** (during class)	
Spring recess	3/19, 3/21	(no class)	
14	3/26	LMM: Repeated Measures ANOVA	
15	3/28	LMM: Random Intercept & Slope Models	Hw5 (L13)
15	4/2	LMM: Random Intercept & Slope Models	
16	4/4	LMM: Covariance Structures	
16	4/9	LMM: Covariance Structures	
17	4/11	LMM: Random Intercept & RMANOVA	Hw6 (L13-15)
18	4/16	LMM: Notation and Models	
19	4/18	LMM: Inference for Fixed Effects	
20	4/23	LMM: Inference for Variance Components	
21	4/25	LMM: Modeling Random Effects	Hw7 (L17-19)
22	4/30	LMM: Modeling Covariance Structures	
23	5/2	TBD	Hw8 (L17-21)
Review	5/7, 5/9	Review for final	
Final	**5/14**	**Final exam** (during class)	