Syllabus

BST 467: Applied Statistics in the Biomedical Sciences
Spring 2018
Monday and Wednesday, 10:30 – 11:45
Helen Wood Hall (HWH): 1W-502 Collins & Wilson Classroom

Instructor(s): Xueya Cai, Ph.D.
Office Hours: Wednesday 11:45 – 12:45 pm or by appointment
TA office hours:
Luoying Yang, Thursday 9:50-10:50 am, SRB 4.165D
William Consagra-Francis, Tuesday 12:40-1:40, SRB 4121
Course website, course email list: Blackboard
Prerequisites: One semester of undergraduate statistics is required. Students with insufficient statistics
preparation are expected to remedy the deficiency on their own.

Instructor and Teaching Assistants
Instructor: Xueya Cai, PhD
Research Associate Professor
Department of Biostatistics and Computational Biology
University of Rochester School of Medicine and Dentistry
601 Elmwood Avenue, Saunders Research Building 4208
Rochester, NY, 14642
(Phone): 585-275-2162
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Teaching Assistants:
Luoying Yang, William Consagra-Francis
PhD students
Department of Biostatistics and Computational Biology
(Email):
Luoying_yang@urmc.rochester.edu
William_ConsagraFrancis@URMC.Rochester.edu

Course Description
BST 467 is an introductory level biostatistics course designed for PhD students in the biomedical
sciences. This course will cover the topics on probability and probability distributions, sampling
distributions, statistical inferences from small and large samples, analysis of categorical data, analysis of
variance, correlation and simple linear and non-linear regression analysis. All analytical topics will be
illustrated using examples from biomedical sciences areas.

Course Aims and Objectives
The primary objectives of this course are to:
• Provide a basic foundation of probability and probability distributions
• Provide instruction on how to formulate an appropriate hypothesis and make relevant
  inferences from quantitative and qualitative data
• Provide instruction on how to apply modeling to real life data in order to identify the associated
  significant predictors to response variables.

Upon completion of the course, students will understand and be able to apply basic techniques in
inferential statistics.

Course Policies and Expectations
Students are required to attend the class. Students are encouraged to participate in discussions on
course materials and homework assignments but the final solutions to homework assignments are
expected to be written independently by each student.

Materials and Access


Assignments and Grading Procedures
Class materials and homework assignments will be posted on Blackboard and homework will be
collected in class the following week. No late homework will be accepted. JMP output without highlights
or without relevant interpretation will not be given credit. The final homework grade will be based on
the best 10 homework assignments. Make-up examinations will be given only in extraordinary situations
(such as serious illness) and can be arranged after receiving prior consent from the instructor. The class
has an open book in-class midterm exam and an open book in-class final exam. Students are also
required to present and discuss papers as teams during the journal club sessions. The final course grade
will be determined using the following weighing scheme:

<table>
<thead>
<tr>
<th>Component</th>
<th>Weight</th>
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<tbody>
<tr>
<td>Homework</td>
<td>25%</td>
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<tr>
<td>Midterm Exam</td>
<td>25%</td>
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<tr>
<td>Final exam</td>
<td>30%</td>
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<tr>
<td>Journal club participation</td>
<td>20%</td>
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</tbody>
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Exam 2 will test all the material covered in this class although the emphasis will be on the contents
after Exam 1. Letter grades will be assigned based on the distribution of the total score.

Academic Integrity
Academic integrity is a core value of the University of Rochester. Students who violate the University of
Rochester University Policy on Academic Honesty are subject to disciplinary penalties, including the
possibility of failure in the course and/or dismissal from the University. Since academic dishonesty
harms the individual, other students, and the integrity of the University, policies on academic dishonesty
are strictly enforced. For further information on the University of Rochester Policy on Academic
Honesty, please visit the following website:
http://www.rochester.edu/college/honesty/docs/Academic_Honesty.pdf
Accommodations for Students with Disabilities
Students needing academic adjustments or accommodations because of a documented disability must contact the Disability Resource Coordinator for the school in which they are enrolled:
http://www.rochester.edu/eoc/DisabilityCoordinators.html

Course Schedule
Lecture 1. (Wednesday, January 17)
Class and course introduction
Chapter 2. Data Presentation. 2.1 Type of data, 2.2 Frequency tables, 2.4 Graphs

Lecture 2. (Monday, January 22)
Chapter 2 Data Presentation. 2.3 Graphs
Chapter 3 Numerical Summary Measures. 3.1 Measures of central tendency, 3.2 Measures of dispersion
Homework #1 is assigned (Chapters 2, 3, 6)

Lecture 3. (Wednesday, January 24)
Chapter 6 Probability: 6.1 Basic idea of probability, 6.2 Conditional probability, 6.7 Exercises
Lab

Lecture 4. (Monday, January 29)
Chapter 6 Probability: 6.3 Bayes’ theorem, 6.4 Diagnostic tests 6.5 The relative risk and the odds ratio
Homework #2 is assigned (Chapter 6, 7)
Homework #1 is due

Lecture 5. (Wednesday, January 31)
Chapter 7. Theoretical Probability Distributions: 7.2 Binomial, 7.3. The Poisson distribution, 7.4 Normal
Chapter 8. Sampling Distribution of the Mean: 8.1 Normal distribution of the sample mean

Lecture 6. (Monday, February 5)
Chapter 8. Sampling Distribution of the Mean: 8.2 Central limit theorem, 8.4 Application of the central limit theorem, problems solving), 9.3 Student’s t distribution
Discussion on Homework #1
Homework #3 is assigned (Chapters 8, 9, 10)
Homework #2 is due

Lecture 7. (Wednesday, February 7)
Chapter 10. Hypothesis Testing: 10.1 General concepts 10.2 Two-sided tests of hypotheses, 10.3 One-sided and two-sided tests of hypotheses
Lecture 8. (Monday, February 12)
Chapter 10. Hypothesis Testing: 10.4 Types of error, 10.5 Power, 10.6 Sample size calculation
Lecture notes: Study design
Lab
Discussion on Homework #2
Homework #4 is assigned (Chapter 10, 11)
Homework #3 is due

Lecture 9. (Wednesday, February 14)
Journal club reading (15 min for each team)


Lecture 10. (Monday, February 19)
Chapter 9. Confidence Intervals of a Single Mean: 9.1 Two-sided confidence intervals, 9.2 One-sided confidence intervals, Confidence Intervals of a Single Mean
Discussion on Homework #3
Homework #5 is assigned (Chapter 9)
Homework #4 is due

Lecture 11. (Wednesday, February 21)
Chapter 11. Comparison of Two Means: 11.1 Paired samples 11.2 Independent samples
Chapter 9 Confidence interval on difference of two means
Lab

Lecture 12. (Monday, February 26)
Chapter 12. Analysis of Variance: 12.1 One-way analysis of variance
Discussion on Homework #4
Homework #6 is assigned (Chapter 12)
Homework #5 is due

Lecture 13. (Wednesday, February 28)
Chapter 12. Analysis of Variance: 12.2 Multiple comparisons procedures, ANOVA with interaction
Lab
Lecture 14. (Monday, March 5)
Homework #7 is assigned (Chapter 13, 14)
Homework #6 is due
Lab

Lecture 15. (Wednesday, March 7)
Journal club reading


Additional reading
Discussion on Homework 5 and 6

Spring Break: March 10 – March 18
No Class

Monday, March 19
Midterm examination

Lecture 16. (Wednesday, March 21)

Lecture 17. (Monday, March 26)
Chapter 14. Inference on Proportions: 14.3 Confidence intervals, 14.4 Hypothesis testing, 14.5 Sample size estimation, 14.6 Comparison of two proportions
Lab
Homework #8 is assigned (Chapter 14)
Homework #7 is due

Lecture 18. (Wednesday, March 28)
Real data example

Lecture 19. (Monday, April 2)
Journal club reading


And it’s correction:

Lecture 20. (Wednesday, April 4)
Chapter 15. Contingency Tables: 15.1 Chi-Square test for 2 × 2 tables, 15.2 McNemar’s test
Homework #9 is assigned (Chapter 15, 17)
Homework #8 is due
Discussion on Homework 7

Lecture 21. (Monday, April 9)
Chapter 15. Contingency Tables: 15.1 Chi-Square test for r × c tables
Lecture notes: Multiple proportions and comparisons

Lecture 22. (Wednesday, April 11)
Chapter 17. Correlation: 17.1 The two-way scatter plot, 17.2 Pearson’s correlation coefficient
Lab

Lecture 23. (Monday, April 16)
Chapter 18. Simple Linear Regression: 18.1 Linear regression concepts, 18.2 Fittings of a regression line by the method of least squares, 18.4 Some applications
Homework # 10 is assigned (Chapters 18, 19)
Homework # 9 is due
Discussion of Homework #8

Lecture 24. (Wednesday, April 18)
Chapter 19: Multiple regression

Lecture 25. (Monday, April 23)
Chapter 20: Logistic Regression: 20.1 The model, 20.2 Multiple Logistic regression, 20.3 Indicator variables
Homework # 11 is assigned (Chapter 20)
Homework # 10 is due
Discussion of Homework #9
Lecture 26. (Wednesday, April 25) SRB 1412
Non-linear Regression Models (Lecture notes)

Lecture 27. (Monday, April 30)
Journal club reading


Additional reading:

5/6 – 5/13 final exam