Northeastern University

PHTH5210 Biostatistics in Public Health

Credit Hours: 4
Format: Online
Term: Spring 2017

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Course Prerequisites: Enrollment in the MPH program, or permission of the instructor.

Course Description: This course for public health students is intended to introduce the fundamental concepts and methods of biostatistics as applied to health disciplines. Topics include descriptive statistics; sampling; estimation and hypothesis testing; sample size and power; correlation and regression methods. In order to understand the concepts behind hypothesis testing, we must discuss basic probability and certain distributions. Examples and readings will be drawn from public health practice. Use of Stata as statistical software package will be introduced.

Course Outcomes: By the end of this course you will be able to:
- Interpret health data using both numeric and graphic techniques
- Quantify the uncertainty surrounding assumptions about data by creating, testing, and interpreting statistical hypotheses.
- Appropriately design studies by calculating necessary sample sizes
- Infer associations between variables through linear regression modeling
- Evaluate statistical measures reported in medical literature through research and use of course vocabulary
- Use Stata to summarize, analyze, and display data

Course Summary: Biostatistics is the study the uncertainties surrounding data collected from a variety of fields such as Biology, Epidemiology, Medicine, Public Health, and Pharmaceutical Sciences. As studies in these fields often involve data collected from living subjects, one must know how to account for the natural variation between people, plants, animals, and other organisms. Studying, interpreting, and correctly using data analysis methods to understand these particular types of data is the main role of a Biostatistician.

We will begin this course with a discussion of how to understand and communicate effectively about data that has been collected. We will then discuss how to use data that has been collected to help us estimate a potentially unknown quantity. Next we will learn how to evaluate our estimate, as well as previous assumptions that were made regarding the data, prior to data collection. We will

focus on attempting to give people the correct answer to questions they have asked, but also respecting the fact that we may be wrong. Along with our answers, we will provide information about how confident we are in our answers, as well as probabilities that we have made an incorrect decision.

Course Topics:
This course will cover the following topics:

1.0 Appropriate summarizations health data:
    1.1 Types of data
    1.2 Data visualization
    1.3 Measures of center and spread
2.0 Basic concepts of probability:
    2.1 General mathematical properties of probabilities and random variables
    2.2 Bayes' rule and diagnostic testing
    2.3 Distributions of random variables
    2.4 The sampling distribution of the mean
    2.5 The Central Limit Theorem
3.0 Formulations, testing, and interpretation of hypothesis tests:
    3.1 Confidence intervals
    3.2 Z-tests, t-tests, tests of proportions
    3.3 P-values, Type-1 errors, Type-2 errors
    3.4 Power and sample size
4.0 Linear regression modeling
    4.1 Assumptions
    4.2 Correlation
    4.3 Hypothesis testing
    4.4 Interpretations of model parameters
5.0 Use of the Stata statistical software package

Course Format & Methodology: This course runs for a total of 15 weeks beginning January 9th, 2017, and ending on May 3rd, 2015 and is delivered online via the NU Online Blackboard (Bb) system accessible at: nuonline.neu.edu. Each or module contains one or more lessons. Lessons are organized around specific course topics, and contain readings and multimedia presentations, practice activities that you complete individually or in small groups (online), and assessments. **Please note that all due dates and times are specified according to the Eastern Standard Time zone (EST);** plan to complete and submit all assignments accordingly.

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Required Textbook & Materials:
Principles of Biostatistics
Pagano and Gauvreau
2000
ISBN-13: 978-0534229023
You can order textbooks from Northeastern University Bookstore by phone at (617) 373-3182 or (617) 373-2286, [online](#), or purchase in person at the main campus bookstore. This book is also available at amazon.com, and there is a copy on reserve at Snell Library. Any version of the "Second Edition" of this book will suffice (the cover of our textbook will be purple, not red).

Participation and Engagement: Because this is course is online, your presence in peer-to-peer activities, and your performance on assignments, serve as indicators of your level of engagement and effort throughout the course. Frequent and varied (e.g., synchronous/ asynchronous/face-to-face) opportunities to receive feedback, help, and/or clarification on course material from the instructor are provided throughout the term. Those students who struggle with the material, but take advantage of self-checks and opportunities provided for instructor help and/or peer-to-peer mentoring, can be successful in this course.

Communication/Submission of Work: Guidelines for completing and submitting each assignment are posted along with the assignment in Blackboard. Please note that if you are unable to complete an examination within the period it is assigned, a documented compelling excuse (such as hospitalization) is required. Make-up exams will be given during the final examination week.

Course Activities and Assignments: This course includes the following required activities and assignments:

- **Module reading and lessons:** Readings and multimedia presentations provide the background knowledge, terminology, and practical examples you need in order to understand and correctly apply fundamental course concepts. You are responsible for completing the assigned textbook and other readings and for viewing the presentations and demonstrations included in the lessons. All materials should be completed in the order in which they are presented, and by the due dates specified, within the weekly module.
- **Self-checks:** Each module, you complete required self-checks within the lessons aimed at enhancing your current understanding, and/or ability to correctly apply, concepts covered in weekly readings and presentations. These self-checks include feedback with suggested areas for review. A self-check is considered completed, and you are awarded full credit, once you achieve a score of at least 80%. You may attempt each self-check as many times as necessary or desired.
- **Discussions:** There are two types:
    - Optional Discussions: These optional discussions are every week. They are not graded, but are available for you to post questions on materials or homework. If you have the answer to a classmates' question, feel free to respond. The instructor will be monitoring the discussion as well and will answer any outstanding questions.
    - Required Discussions: In some modules, you will be required to actively

participate in discussions. These will be open discussion topics based on reading assignments. You are required to participate in this discussion with an initial post and at least two follow up posts. More information will be provided in Blackboard.

- **Homework:** Most modules include a homework based on the lessons and readings. Students may be able to complete some portions of the homework in Blackboard, and the remainder will be homework uploaded to Blackboard. Homework assignments received one day late will receive a 10 percent deduction. Homework assignments will not be accepted more than one day late.

- **Exams:** There will be two exams in this course, a midterm and a final. The concepts in this course are interrelated and often build on each other. At these two points during the term, you will be assessed on your cumulative understanding of course topics. Exams will be administered both electronically, via Blackboard, and there will also be a take home portion. You will be provided with detailed guidelines that describe the examination protocol.

Course Grading Criteria:

Self-checks - 10%
Homework (10)- 30%
Discussions (13)- 10%
Exam 1 covering Modules 1-4 – 25%
Exam 2 covering Modules 5-13 – 25%

Grading/Evaluation Standards:

A 94+; A- 90 to 93; B+ 87 to 89; B 84 to 86; B- 80 to 83; C+ 76 to 79; C 72-75; C- 68 to 71; F less than 68

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Class Schedule / Topical Outline:

Please note: for more information about specific assignments and due dates, see instructions within your course site.

Module	Topics	Readings	Assignments
Section 1: Introduction to Data and Probability			
1 Introduction to Data 1/9/17- 1/15/17	Introduction to Stata Data Summarization Measures of Center Measures of Spread	P&G: 7-48, 52-54	Install Stata Introduction to Stata assignment Discussion Homework 1
2 – Probability and Diagnostic Testing 1/16/17- 1/22/17	Events and Operations on Events Probability Conditional Probability Diagnostic Testing	P&G: 125-155	Discussion Homework 2
3 Discrete Random Variables 1/23/17- 1/29/17	Sampling Probability Distributions Bernoulli Random Variables Binomial Random Variables	P&G: 162-175	Discussion Homework 3
4 Continuous Random Variables 1/30/17 – 2/5/17	Normal Distributions Standardization Central Limit Theorem	P&G: 176-191, 196-210	Discussion Homework 4
2/6/17- 2/12/17	Review and Midterm		Discussion Midterm Exam
Section 2: Estimation and Hypothesis Testing			
5 – Confidence Intervals 2/13/17– 2/19/17	Confidence Intervals T-distribution	P&G: 214-227	Discussion Homework 5
6 – Hypothesis Testing 2/20/17–	Hypothesis Testing Power and Sample Size	P&G: 232-254	Discussion Homework 6

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2/26/17			
7– Two-Sample Testing 2/27/17–3/5/17	Two Sample Testing Comparing Two Means ANOVA	P&G: 259-278, 285-298	Discussion Homework 7
Spring Break 3/6/17-3/12/17			
8 – Inference on Proportions 3/13/17–3/19/17	Normal Approximation to the Binomial One and Two Sample Tests of Proportions Odds Ratio	P&G: 323-335	Discussion Homework 8
9 – Nonparametrics 3/20/17 – 3/23/17	Nonparametric Statistics	P&G: 302-312	Discussion Homework 9-begin Read "Can you bias a coin?" article
Section 3: Linear Regression			
10- Correlation 3/24/17 3/26/17	Correlation	P&G: 398-407	Discussion Homework 9-due
11 – Linear Regression 3/27/17–4/2/17	Introduction to Linear Regression Simple linear Regression	P&G: 415-428	Discussion Homework 10-begin
12 – Regression Diagnostics 4/3/17-4/9/17	Regression Diagnostics	P&G: 432-434	Discussion Homework 10
13 – Multiple Regression 4/10/17-4/16/17	Multiple Regression	P&G:, 449-460	Discussion Homework 10-due

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Special Accommodations: If you have specific physical, psychiatric or learning disabilities that may require accommodations for this course, please contact Northeastern's Disabilities Resource Center (DRC) at (617) 373-2675. The DRC can provide you with information and assistance to help manage any challenges that could affect your performance in the course. The University requires that you provide documentation of your disabilities to the DRC so that they may identify what accommodations are required, and arrange with the instructor to provide those on your behalf, as needed.

Honor Code: All students must adhere to the Northeastern University honor code available on the Northeastern web site
(see http://www.northeastern.edu/osccr/academicintegrity/index.html) and the graduate student handbook.

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