



# University of Maryland School of Public Health

## EPIB 650: Biostatistics I

**Semester:** Fall 2016  
**Section:** 0101  
**Classroom and Time:** 0302 SPH Building / Tuesday 4:00 PM – 6:45 PM  
**Course Webpage:** <https://umd.instructure.com/courses/1200742>  
**Instructor:** Xin He, Ph.D.  
**Office:** 2234H SPH Building  
**Office Hours:** Monday 2:00 PM – 4:00 PM or by appointment  
**Phone:** 301-405-2551  
**Email:** xinhe@umd.edu  
**Teaching Assistant:** Jared Fisher  
**Office:** 1226 SPH Building  
**Office Hours:** Tuesday 1:00 PM – 4:00 PM  
**Email:** jafisher@umd.edu

### Course Description:

This course is intended to provide students with comprehensive introduction to basic statistical concepts and procedures used in public health research. The course focuses on applications, hands-on experience, and interpretations of statistical findings.

### Course Prerequisite:

EPIB 300; or equivalent undergraduate statistics or biostatistics course with a grade of C- or higher; or a score of 70% or higher on EPIB placement exam.

### Course Learning Objectives:

Upon completing this course, the student will be able to:

1. Gain an understanding of the role of statistics in biomedical research and public health.
2. Become familiar with the basic concepts of probability, random variation and commonly used probability distributions (e.g. normal, Poisson, binomial).
3. Learn how to explore data to describe and summarize common types of variables (e.g. continuous, discrete, categorical) using graphs and summary statistics. The goal is to gain insights into distributions of scientific interest, and get hands-on computer-based experience in doing so.
4. Gain an understanding of the fundamental ideas behind using statistical methods to formally quantify evidence regarding scientific hypotheses and parameter values, and learn how to properly interpret the results of statistical analyses found in publications. Students will become familiar with commonly-used statistical methods for inference, including both estimation and significance testing.
5. Conduct power calculations and perform a power analysis to determine sample size for a study.
6. Learn how to calculate point and interval estimates for risk and odds ratios and interpret the results of these procedures.

### Program Competencies Addressed in this Course:

The following competencies for the *Master of Public Health with concentration in Biostatistics* are addressed in this course:

1. Describe the role biostatistics serves in the discipline of public health.
2. Describe basic concepts of probability, random variables, and commonly used statistical probability distributions.
3. Distinguish among the different measurement scales or types of variables and select appropriate descriptive statistical methods for summarizing public health data.
4. Select appropriate inferential statistical methods to answer research questions relevant to public health research.
5. Conduct descriptive and inferential statistical analyses that are appropriate to different basic study designs used in public health research.
6. Interpret results of statistical analyses found in public health studies.
7. Critically review and summarize statistical analyses presented in public health literature.
8. Perform appropriate sample size and power calculations to ensure that the study is sufficiently powered to achieve the scientific aims.
9. Use a basic software package to describe, explore, and summarize data as well as perform the basic conventional statistical procedures.
10. Communicate results of statistical analyses to lay and professional audiences.

### **Required Texts and Other Readings:**

#### Required:

- Pagano, M. and Gauvreau, K. (2000). *Principle of Biostatistics*, 2nd Edition. Pacific Grove, CA: Duxbury. [ISBN: 0-534-22902-6]

#### Recommended:

- Rosner, B. (2005). *Fundamentals of Biostatistics*, 6th Edition. Belmont, CA: Duxbury. [ISBN: 0-534-41820-1]
- Delwiche, L. D. and Slaughter, S. J. (2003). *The Little SAS Book: A Primer*, 3rd Edition. Cary, NC: SAS Institute. [ISBN: 1-59047-333-7]

### **Course Requirements and Expectations:**

#### Homework:

There will be eight homework assignments in this class, and each of them will be due at the beginning of the due date class. **Late homework will NOT be accepted without a reasonable and advance notice.**

#### Exams:

Exams will be in class, closed book and closed note. The content of the exam will be cumulative, but the emphasis will be on the materials not covered in the previous exams. For the midterm exam #1, you are allowed to bring one page of letter-size formula sheet; for the midterm exam #2, you are allowed to bring two pages of letter-size formula sheet; for the final exam, you are allowed to bring a maximum of three pages of letter-size formula sheet. You also need to bring a calculator to facilitate the computation.

**As a general rule, make-up exams and advance exams will NOT be given.** Exceptions to this rule are evaluated on a case-by-case basis. Students must submit the request before the exam takes place with valid supporting document. No post-exam request will be considered except the student is hospitalized during the exam period.

### Course Webpage:

Course announcements, lecture notes, data sets, homework assignments, and homework solutions will be distributed on the course webpage (<https://umd.instructure.com/courses/1200742>). Please check it on a regular basis. Lecture notes will be posted before class. You may wish to print these notes prior to each lecture and use them as an outline for taking notes during the class.

### **Course Policies:**

#### Email – The Official University Correspondence:

**Verify your email address** by going to [www.my.umd.edu](http://www.my.umd.edu).

All enrolled students are provided access to the University's email system and an email account. *All official University email communication will be sent to this email address* (or an alternate address if provided by the student). Email has been adopted as the primary means for sending official communications to students, so email must be checked on a regular basis. Academic advisors, faculty, and campus administrative offices use email to communicate important and time-sensitive notices.

**Students are responsible for keeping their email address up to date or for redirecting or forwarding email to another address. Failure to check email, errors in forwarding email, and returned email (from "full mailbox" or "unknown user" errors for example), will not excuse a student from missing University announcement, messages, deadlines, etc.** Email addresses can be quickly and easily updated at <http://www.my.umd.edu> or in-person at the Student Service Counter on the first floor of the Mitchell Building.

For technical support for University email: [www.helpdesk.umd.edu](http://www.helpdesk.umd.edu) or call 301-405-1400.

#### Absence Policy:

In accordance with University policy if you are absent for a single (1) lecture due to illness or some form of personal or family emergency, this absence will be considered "excused" and the instructor will accept a note from you attesting to the date of the illness/incident, along with an acknowledgement that the information is true. Whenever feasible, you should try to contact the instructor in advance.

Multiple or prolonged absences, and absences that prevent attendance at a major scheduled grading event (like an exam or test) will require written documentation from an appropriate health care provider/organization.

A link to pull information on the new policy covering absences from class can be found at <http://www.president.umd.edu/policies/v100q.html>.

#### Course Evaluations:

The University, the School of Public Health, and the Department of Epidemiology and Statistics are committed to the use of student course evaluations for improving the student experience, course and curriculum delivery, and faculty instruction. Your evaluations help instructors improve their courses; help deans and department chairs decide on merit pay for faculty, renewal of contracts, and support tenure and promotion decisions; and help current and future students decide on classes. Your participation in the evaluation of courses through CourseEvalUM is a responsibility you

hold as a student member of our academic community. Your feedback is confidential and important to the improvement of teaching and learning at the University as well as to the tenure and promotion process. CourseEvalUM will be open for you to complete your evaluations starting about two weeks prior to the last day of the term before exams begin. Please go directly to the website ([www.CourseEvalUM.umd.edu](http://www.CourseEvalUM.umd.edu)) to complete your evaluations. By completing all of your evaluations each semester, you will have the privilege of accessing online evaluation reports for the thousands of courses for which 70% or more students submitted their evaluations. You can access results at [www.CourseEvalUM.umd.edu](http://www.CourseEvalUM.umd.edu), the same link you use to submit your evaluations. Click View Past Results instead.

**Grading Procedures:**

Grade of this course will be determined as follows:

- Homework: 30%
- Midterm Exam #1: 20%
- Midterm Exam #2: 20%
- Final Exam: 30%

**Course Outline / Course Calendar:**

<b>Tentative Course Outline *</b>			
<b>Session Number</b>	<b>Date</b>	<b>Topic</b>	<b>Assignments</b>
1	08/30/2016	Overview; Types of Numerical Data; Data Presentation; Introduction to SAS	Reading: Chapters 1, 2 & 3 (omit Section 3.4) and Sections 6.1 & 6.2
2	09/06/2016	Numerical Summary; Introduction to Probability	Reading: Sections 6.1, 6.2, 6.3 & 6.4 Homework 1 (Due date: 09/13/2016)
3	09/13/2016	Probability Laws; Bayes' Theorem and Applications; Application to Diagnostic Tests	Reading: Sections 7.1, 7.2, 7.3 & 7.4 Homework 2 (Due date: 09/20/2016)
4	09/20/2016	ROC Curves; Random Variable; Probability Distributions; Discrete Random Variables; Reading Binomial Probability Table	Reading: Sections 7.1, 7.2, 7.3 & 7.4 Homework 3 (Optional)
5	09/27/2016	Midterm Exam #1	

6	10/04/2016	Reading Poisson Probability Table; Continuous Random Variables; Reading Normal Probability Table	Reading: Sections 14.1, 8.1, 8.2 & 8.3 Homework 4 (Due date: 10/18/2016)
7	10/11/2016	Normal Approximation to Binomial Distribution; Population and Sample; Sampling Distributions; Central Limit Theorem	Reading: Sections 9.1, 9.2 & 9.3
8	10/18/2016	Basics for Statistical Inference; Point and Interval Estimation; Sample Size Determination based on Interval Estimation; Student's $t$ Distribution; Reading Student's $t$ Distribution Table	Reading: Sections 10.1, 10.2 & 10.3 Homework 5 (Due date: 10/25/2016)
9	10/25/2016	Hypothesis Testing Framework; Types of Errors; $P$ -values; Decision Rule; One-Sample Z Test	Reading: Sections 10.3, 10.4, 10.5, 10.6, 11.1 & 11.2 Homework 6 (Optional)
10	11/01/2016	Midterm Exam #2	
11	11/08/2016	One-Sample $t$ Test; Relationship with Confidence Intervals; Power	Reading: Sections 10.6, 10.7, 11.1, 11.2 & 11.3 Homework 7 (Due date: 11/15/2016)
12	11/15/2016	Sample Size Determination via Power; Comparison of Two Means for Paired Samples and Independent Samples	Reading: Section 12.1 Homework 8 (Due date: 11/29/2016)
13	11/22/2016	Analysis of Variance; SAS Examples	Reading: 15.1 & 15.3
14	11/29/2016	Contingency Tables; Odds Ratio	Reading: 18.1 & 18.2
15	12/06/2016	Simple Linear Regression; Review for Final Exam	
16	12/20/2016	Final Exam	

\* This is a tentative schedule, and the actual materials covered in each lecture might not be exactly the same.

<b>Session Outline</b>	
<b>Session 1</b>	<b>08/30/2016</b>
<p>Topic: Overview; Types of Numerical Data; Data Presentation; Introduction to SAS</p> <p>Learning Objectives for Session 1</p> <ul style="list-style-type: none"> <li>- Apply appropriate descriptive statistical methods for summarizing public health data.</li> <li>- Use computer software such as SAS to conduct data analysis.</li> </ul> <p>Reading: Chapters 1, 2 &amp; 3 (omit Section 3.4) and Sections 6.1 &amp; 6.2</p>	
<b>Session 2</b>	<b>09/06/2016</b>
<p>Topic: Numerical Summary; Introduction to Probability</p> <p>Learning Objectives for Session 2</p> <ul style="list-style-type: none"> <li>- Describe basic concepts of probability, random variation, and commonly used statistical probability distributions.</li> <li>- Apply appropriate descriptive statistical methods for summarizing public health data.</li> <li>- Use computer software such as SAS to conduct data analysis.</li> </ul> <p>Reading: Sections 6.1, 6.2, 6.3 &amp; 6.4</p> <p>Homework 1 (Due date: 09/13/2016)</p>	
<b>Session 3</b>	<b>09/13/2016</b>
<p>Topic: Probability Laws; Bayes' Theorem and Applications; Application to Diagnostic Tests</p> <p>Learning Objectives for Session 3</p> <ul style="list-style-type: none"> <li>- Describe basic concepts of probability, random variation, and commonly used statistical probability distributions.</li> <li>- Apply appropriate descriptive statistical methods for summarizing public health data.</li> <li>- Conduct descriptive and inferential statistical methods that are appropriate to the different study designs used in public health research.</li> </ul> <p>Reading: Sections 7.1, 7.2, 7.3 &amp; 7.4</p> <p>Homework 2 (Due date: 09/20/2016)</p>	
<b>Session 4</b>	<b>09/20/2016</b>
<p>Topic: ROC Curves; Random Variable; Probability Distributions; Discrete Random Variables; Reading Binomial Probability Table</p> <p>Learning Objectives for Session 4</p> <ul style="list-style-type: none"> <li>- Describe basic concepts of probability, random variation, and commonly used statistical probability distributions.</li> <li>- Conduct descriptive and inferential statistical methods that are appropriate to the different study designs used in public health research.</li> </ul> <p>Reading: Sections 7.1, 7.2, 7.3 &amp; 7.4</p> <p>Homework 3 (Optional)</p>	
<b>Session 5</b>	<b>09/27/2016</b>
Midterm Exam #1	
<b>Session 6</b>	<b>10/04/2016</b>
<p>Topic: Reading Poisson Probability Table; Continuous Random Variables; Reading Normal Probability Table</p> <p>Learning Objectives for Session 6</p> <ul style="list-style-type: none"> <li>- Describe basic concepts of probability, random variation, and commonly used statistical</li> </ul>	

<p>probability distributions.</p> <ul style="list-style-type: none"> <li>- Conduct descriptive and inferential statistical methods that are appropriate to the different study designs used in public health research.</li> </ul> <p>Reading: Sections 14.1, 8.1, 8.2 &amp; 8.3</p> <p>Homework 4 (Due date: 10/18/2016)</p>	
<b>Session 7</b>	<b>10/11/2016</b>
<p>Topic: Normal Approximation to Binomial Distribution; Population and Sample; Sampling Distributions; Central Limit Theorem</p> <p>Learning Objectives for Session 7</p> <ul style="list-style-type: none"> <li>- Describe basic concepts of probability, random variation, and commonly used statistical probability distributions.</li> <li>- Conduct descriptive and inferential statistical methods that are appropriate to the different study designs used in public health research.</li> </ul> <p>Reading: Sections 9.1, 9.2 &amp; 9.3</p>	
<b>Session 8</b>	<b>10/18/2016</b>
<p>Topic: Basics for Statistical Inference; Point and Interval Estimation; Sample Size Determination based on Interval Estimation; Student's <math>t</math> Distribution; Reading Student's <math>t</math> Distribution Table</p> <p>Learning Objectives for Session 8</p> <ul style="list-style-type: none"> <li>- Describe basic concepts of probability, random variation, and commonly used statistical probability distributions.</li> <li>- Apply appropriate descriptive statistical methods for summarizing public health data.</li> <li>- Conduct descriptive and inferential statistical methods that are appropriate to the different study designs used in public health research.</li> </ul> <p>Reading: Sections 10.1, 10.2 &amp; 10.3</p> <p>Homework 5 (Due date: 10/25/2016)</p>	
<b>Session 9</b>	<b>10/25/2016</b>
<p>Topic: Hypothesis Testing Framework; Types of Errors; <math>P</math>-values; Decision Rule; One-Sample Z Test</p> <p>Learning Objectives for Session 9</p> <ul style="list-style-type: none"> <li>- Conduct descriptive and inferential statistical methods that are appropriate to the different study designs used in public health research.</li> <li>- Critically review and summarize statistical analyses presented in public health literature.</li> <li>- Draw appropriate inferences based on statistical analyses used in public health research.</li> </ul> <p>Reading: Sections 10.3, 10.4, 10.5, 10.6, 11.1 &amp; 11.2</p> <p>Homework 6 (Optional)</p>	
<b>Session 10</b>	<b>11/01/2016</b>
Midterm Exam #2	
<b>Session 11</b>	<b>11/08/2016</b>
<p>Topic: One-Sample <math>t</math> Test; Relationship with Confidence Intervals; Power</p> <p>Learning Objectives for Session 11</p> <ul style="list-style-type: none"> <li>- Conduct descriptive and inferential statistical methods that are appropriate to the different study designs used in public health research.</li> <li>- Critically review and summarize statistical analyses presented in public health literature.</li> <li>- Draw appropriate inferences based on statistical analyses used in public health research.</li> </ul>	

Reading: Sections 10.6, 10.7, 11.1, 11.2 & 11.3	
Homework 7 (Due date: 11/15/2016)	
<b>Session 12</b>	<b>11/15/2016</b>
Topic: Sample Size Determination via Power; Comparison of Two Means for Paired Samples and Independent Samples	
Learning Objectives for Session 12	
<ul style="list-style-type: none"> <li>- Conduct descriptive and inferential statistical methods that are appropriate to the different study designs used in public health research.</li> <li>- Critically review and summarize statistical analyses presented in public health literature.</li> <li>- Draw appropriate inferences based on statistical analyses used in public health research.</li> </ul>	
Reading: Section 12.1	
Homework 8 (Due date:11/29/2016)	
<b>Session 13</b>	<b>11/22/2016</b>
Topic: Analysis of Variance; SAS Examples	
Learning Objective for Session 13 [Relevant Program Competencies: #4, #5, #6, #9, #10]	
<ul style="list-style-type: none"> <li>- Gain an understanding of the fundamental ideas behind using statistical methods to formally quantify evidence regarding scientific hypotheses and parameter values, and learn how to properly interpret the results of statistical analyses found in publications. Students will become familiar with commonly-used statistical methods for inference, including both estimation and significance testing.</li> </ul>	
Reading: Sections 15.1 & 15.3	
<b>Session 14</b>	<b>11/29/2016</b>
Topic: Contingency Tables; Odds Ratio	
Learning Objective for Session 14 [Relevant Program Competencies: #4, #5, #6, #7, #10]	
<ul style="list-style-type: none"> <li>- Gain an understanding of the fundamental ideas behind using statistical methods to formally quantify evidence regarding scientific hypotheses and parameter values, and learn how to properly interpret the results of statistical analyses found in publications. Students will become familiar with commonly-used statistical methods for inference, including both estimation and significance testing.</li> <li>- Learn how to calculate point and interval estimates for risk and odds ratios and interpret the results of these procedures.</li> </ul>	
Reading: Sections 18.1 & 18.2	
<b>Session 15</b>	<b>12/06/2016</b>
Topic: Simple Linear Regression; Review for Final Exam	
Learning Objectives for Session 15 [Relevant Program Competencies: #5, #6, #7, #10]	
<ul style="list-style-type: none"> <li>- Gain an understanding of the fundamental ideas behind using statistical methods to formally quantify evidence regarding scientific hypotheses and parameter values, and learn how to properly interpret the results of statistical analyses found in publications. Students will become familiar with commonly-used statistical methods for inference, including both estimation and significance testing.</li> </ul>	
<b>Session 16</b>	<b>12/20/2016</b>
Final Exam	

Assessment Activity	Learning Objectives Assessed with the Activity	Relevant Program Competencies
Homework 1	#2, #3	#2, #3, #9, #10
Homework 2	#2, #3	#1, #2, #5
Homework 3	#2, #3	#2, #4, #5
Midterm Exam #1	#1, #2, #3	#1, #2, #3, #4, #5
Homework 4	#2, #3, #4	#2, #4, #5, #6
Homework 5	#2, #4, #5	#2, #4, #5, #6, #8
Homework 6	#4	#4, #5, #6
Midterm Exam #2	#2, #3, #4, #5	#2, #4, #5, #6, #8, #10
Homework 7	#4, #5	#4, #5, #6, #8
Homework 8	#4, #5	#4, #5, #6, #7, #8, #10
Final Exam	#2, #3, #4, #5, #6	#2, #3, #4, #5, #6, #8, #10

### Critical University Policies:

#### Religious Observances:

The University System of Maryland policy provides that students should not be penalized because of observances of their religious beliefs; students shall be given an opportunity, whenever feasible, to make up within a reasonable time any academic assignment that is missed due to individual participation in religious observances. **It is the student's responsibility to inform the instructor in advance of any intended absences for religious observance.**

#### Special Accommodations / Disability Support Services:

If you have a documented disability and wish to discuss academic accommodations for test taking or other needs, you will need documentation from Disability Support Service (301-314-7682). If you are ill or encountering personal difficulties, please let the instructor know as soon as possible. You can also contact Learning Assistance Services (301-314-7693) and/or the Counseling Center (301-314-7651) for assistance.

#### Academic Integrity:

The University's code of academic integrity is designed to ensure that the principle of academic honesty is upheld. Any of the following acts, when committed by a student, constitutes academic dishonesty:

- CHEATING: intentionally using or attempting to use unauthorized materials, information, or study aids in an academic exercise.
- FABRICATION: intentional and unauthorized falsification or invention of any information or citation in an academic exercise.
- FACILITATING ACADEMIC DISHONESTY: intentionally or knowingly helping or attempting to help another to violate any provision of this code.
- PLAGIARISM: intentionally or knowingly representing the words or ideas of another as one's own in any academic exercise.

For more information see: <http://www.shc.umd.edu/code.html>.

The Honor Pledge is a statement undergraduate and graduate students should be asked to write by hand and sign on examinations, papers, or other academic assignments. The Pledge reads:

*I pledge on my honor that I have not given or received any unauthorized assistance on this assignment/examination.*

The University of Maryland, College Park has a nationally recognized Code of Academic Integrity, administered by the Student Honor Council. This Code sets standards for academic integrity at Maryland for all undergraduate and graduate students. As a student you are responsible for upholding these standards for this course. It is very important for you to be aware of the consequences of cheating, fabrication, facilitation, and plagiarism. For more information on the Code of Academic Integrity or the Student Honor Council, please visit <http://www.shc.umd.edu>.

Inclement Weather / University Closings:

In the event that the University is closed for an emergency or extended period of time, the instructor will communicate to students regarding schedule adjustments, including rescheduling of examinations and assignments due to inclement weather and campus emergencies. Official closures and delays are announced on the campus website (<http://www.umd.edu>) and snow phone line (301-405-SNOW), as well as local radio and TV stations.