Course Description:
This course is intended to provide students with comprehensive introduction to basic statistical concepts and procedures used in public health research, and their applications through SAS (and a little bit R) software. Through this course, students will be exposed to a variety of techniques to develop an understanding of how to appropriately approach data to answer public health research questions. The course focuses on applications and interpretations of statistical findings.

Course Prerequisites:
Minimum grade of C- in EPIB301.
Restriction: Must be in Public Health Science major or Behavioral and Community Health major.

Course Learning Objectives:
Upon completing this course, the student will be able to:
1. Apply basic vocabulary to summarize biomedical readings and communicate about real world biostatistics.
2. Apply the properties of random variables and probability, and understand probability distributions (including Binomial and Normal Distributions).
3. Conduct statistical inference including point and interval estimations and one-sample, two sample, and multiple sample comparisons.
4. Conduct simple / multiple linear regression and interpret them.
5. Conduct data analysis using statistical software SAS.
Program Competencies Addressed in this Course:
The following competencies for the Public Health Science Program, in part or whole, are addressed in this course:

1. Identify and describe core scientific concepts underlying disease prevention, environmental protection, and health promotion.
2. Synthesize scientific knowledge to formulate solutions to public health problems.
3. Identify and define public health problems from an interdisciplinary perspective.

Texts:

Recommended:

References:

Required Technology and Other Materials:
- Scientific calculator
- Colored pencils/pens
- A loose-leaf binder
- Blank sheets of paper
- Clicker

Course Communication:
The instructor will communicate with students via e-mail regarding class cancellation, room change, or other timely announcements. 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 or call 301-405-1400.

Student Feedback for Improving the Course:
We are interested in your feedback as we proceed through the semester! You are welcome to communicate feedback regarding the course in person or over email to the instructor and/or TA. Thank you in advance for sharing your thoughts!

Course Requirements and Expectations:

1. Attendance and Participation: Attending lectures and discussion sections is necessary in order to do well. Exams and quizzes are based on lecture notes and exercises, discussion sessions and assigned reading. Every student is expected to attend every lecture and assigned discussion session. If you must miss a lecture or section, please let the instructor or teaching assistant know in advance.
know in advance (afterwards notice does not work). Participation is important to learning, and I encourage active participation; if you have a question, it’s likely that other students do as well. Please attend office hours or schedule an appointment with the instructor or Teaching Assistant if you are having trouble with the concepts and/or assignments.

2. **Course Website:** Course announcements, syllabus, lecture notes, data sets, and other course materials will be distributed on the ELMS (Enterprise Learning Management System). 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 but keep in mind the professor might keep improving the class material until the last minute before class. You can access the website by following these directions:

- Direct your URL to [https://myelms.umd.edu/login](https://myelms.umd.edu/login).
- Enter your Directory ID and Password.
- Click “Courses” on the ELMS home tab.
- Click “EPIB300(315)-0101, 0102, 0103, 0104, 0105, 0108, 0201, 0202: Biostatistics for Public Health Practice – Spring2019”.

3. **Reading Assignment:** Students are encouraged to complete the reading assignments before attending classes / discussion sessions.

4. **Homework Questions:** Please consult your TAs for homework questions. The instructor will not reply emails on homework questions, but students are welcome to come to the instructor’s office hours for homework questions.

5. **Clickers:** We will need clickers for pop quizzes. A clicker device or a licensed “Virtual clicker” using mobile device (which uses TurningPoint Mobile Response software) is needed. Students are responsible to ensure their clickers work before the 2nd week of the semester.

**Major Graded Assignments:**

1. **Homework (35%):** There will be eight homework assignments in this class, and the one with the lowest score will not affect the final grade. Homework questions will be posted at least one week before the due date and should be submitted via Canvas before midnight on the specified due date (Course Outline / Course Calendar). Late homework will get an automatic 20% point penalty. Submissions that are more than two days late will not be accepted.

2. **Tests and Exam (45%):** Two in-class tests and one final examination will be given, worth a total of 45 points. Tests and Exam will be in class, closed book and closed note. The final exam will be cumulative. For the test, you are allowed to bring one page of letter-size formula sheet; for the final exam, you are allowed to bring two pages of letter-size formula sheet. You also need to bring a calculator [not your phone] to facilitate the computation. As a general rule, make-up exams and advance exams will NOT be given. If you arrive late, you must complete the test or exam during the time allotted.

   - Test 1: March 12th (10%)
   - Test 2: April 30th (10%)
   - Comprehensive Final Exam: Scheduled by the University (25%)
3. **Pop Quizzes (5%)**: There will be multiple pop quizzes (open book and open notes) throughout the semester. They will be administered in class **without notice** and will be based on lecture notes. 2.5% will be graded based on participation and 2.5% will be graded based on accuracy. **The one with the lowest score will not affect the final grade.**

4. **Discussion Section Participation (5%)**: Section participation will be based on contributions to group discussions and exercises.

5. **Discussion Section Case Study using SAS (10%)**: Students will work on a case study and produce a report. The report will be judged on organization, clarity of writing, appropriateness of statistical methods used to address the questions, and skill in interpretations.

6. **Extra Credits via Two Stats Activities (2%)**: 1% on top of the final grade for each of the two activities. Students will read the assigned documents, discuss with their group members about the questions, and share their thoughts with the whole class.

**University Course Related Policies:**

All University of Maryland-approved course policies are provided at the following website: [http://www.ugst.umd.edu/courselatedpolicies.html](http://www.ugst.umd.edu/courselatedpolicies.html)

Policy descriptions, resources, and links to official policy documents are provided for:

- **Academic Integrity**: What is cheating? What is plagiarism? What is the Honor Pledge?
- **Code of Student Conduct**: What behavior is prohibited?
- **Sexual Misconduct**: What to do in case of sexual harassment or sexual assault.
- **Discrimination**: Procedures to prohibit discrimination, complaints about discrimination, harassment, and retaliation.
- **Accessibility**: Information about disability support services (DSS) and accommodations.
- **Attendance, Absences, or Missed Assignments**: The student must notify the instructor in a timely manner (typically first week of class). Read this prior to Schedule Adjustment date.
- **Student Rights Regarding Undergraduate Courses**: What should I find in the course syllabus? Am I allowed to see my exams after they are graded?
- **Official UMD Communication**: Use of email, communication with faculty, communication about cancelled class meetings, and weather-related or other urgent notifications.
- **Mid-Term Grades**: Provided for 100 and 200 level courses, and all student athletes.
- **Complaints About Course Final Grades**: Questions about course grades should first be addressed to the course instructor.
- **Copyright and Intellectual Property**: Who owns the work that I produce in class?
- **Final Exams**: Final exams are scheduled by the University.
- **Course Evaluations**: The School of Public Health is committed to the use of student course evaluations for improving the student experience, course and curriculum delivery, and faculty instruction.
- **Campus Resources**: ELMS, counseling, learning workshops, tutoring, writing help, questions about graduation, adding or dropping classes, withdrawing from the semester, etc.
• **Course Etiquette:** You are expected to take notes on paper. A student version of slides will be posted online in the course website. The student version will be incomplete, with the expectation that you supplement with your class notes. For documentation on why taking notes longhand is better for your grades than on laptop, see this article at [http://www.scientificamerican.com/article/a-learning-secret-don-t-take-notes-with-a-laptop/](http://www.scientificamerican.com/article/a-learning-secret-don-t-take-notes-with-a-laptop/) outlining research on this issue. Please turn off your cell phone during class time as it can be disruptive to the class and your learning. Texting during class time is not allowed unless it is an emergency.

• **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 contact the instructor in advance. Multiple or prolonged absences, and absences that prevent attendance at a major scheduled grading event (like an exam, test or quiz) 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/v100g.html](http://www.president.umd.edu/policies/v100g.html).

• **Late Homework and assignments:** Extensions for homework and assignments will only be accepted in the case of personal emergency (e.g., illness) and will require doctor’s documentation. If you find yourself in this position, please contact the instructor or TA before the deadline to discuss alternative arrangements.

• **Missed exams:** There are no makeups for tests or exams, with the exception of documented medical excuses or personal emergencies to be discussed in advance with the Instructor. Otherwise, no accommodation will be made, to be fair to all students.

• **Inclement Weather / University Closings / Emergency Procedures:** In the event that the University has a delayed opening or 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.

• **Course Evaluations:** The University, the School of Public Health, and the Department of Epidemiology and Biostatistics 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: 35%
- Tests: 20%
- Final Exam: 25%
- Pop quizzes: 5%
- Section Participation: 5%
- Case Study using SAS: 10%

**Grading Rubric:** There Are No Deviations From this. Please Do Not Ask For Any Exceptions.

<table>
<thead>
<tr>
<th>Grades</th>
<th>Lower Cut Off</th>
<th>Upper Cut Off</th>
</tr>
</thead>
<tbody>
<tr>
<td>A+</td>
<td>96</td>
<td>100</td>
</tr>
<tr>
<td>A</td>
<td>92</td>
<td>95.99</td>
</tr>
<tr>
<td>A-</td>
<td>89</td>
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<tr>
<td>B</td>
<td>82</td>
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</tr>
<tr>
<td>B-</td>
<td>79</td>
<td>81.99</td>
</tr>
<tr>
<td>C+</td>
<td>76</td>
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<tr>
<td>C</td>
<td>72</td>
<td>75.99</td>
</tr>
<tr>
<td>C-</td>
<td>69</td>
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<tr>
<td>D+</td>
<td>65</td>
<td>68.99</td>
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</tr>
</tbody>
</table>

Points of 59.99 and below will earn you an “F” in the course.

**Course Outline / Course Calendar:**

<table>
<thead>
<tr>
<th>Week</th>
<th>Session</th>
<th>Date</th>
<th>Topic</th>
<th>Assignments</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td># 1</td>
<td>01/29</td>
<td>Course overview &amp; Introduction of Biostatistics</td>
<td>HW1 (#1-#2) due on 2/05</td>
</tr>
<tr>
<td></td>
<td># 2</td>
<td>01/31</td>
<td>Frequency Distributions</td>
<td></td>
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<tr>
<td>2</td>
<td># 3</td>
<td>02/05</td>
<td>Summary Statistics (Central Tendency &amp; Spread), Part I</td>
<td>HW2 (#3-#4) due on 2/12</td>
</tr>
<tr>
<td></td>
<td># 4</td>
<td>02/07</td>
<td>Summary Statistics (Central Tendency &amp; Spread), Part II</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td># 5</td>
<td>02/12</td>
<td>Probability Concepts &amp; Properties of Probability</td>
<td>HW3 (#5-#7) due on 2/26</td>
</tr>
<tr>
<td></td>
<td># 6</td>
<td>02/14</td>
<td>Bayes’ Theorem &amp; Diagnostic Tests</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td># 7</td>
<td>02/19</td>
<td>Binomial Probability Distribution</td>
<td></td>
</tr>
<tr>
<td></td>
<td># 8</td>
<td>02/21</td>
<td>Normal Probability Distribution, Part I</td>
<td>HW4 (#8-#11) due on 03/07</td>
</tr>
<tr>
<td>5</td>
<td># 9</td>
<td>02/26</td>
<td>Normal Probability Distribution, Part II</td>
<td></td>
</tr>
<tr>
<td></td>
<td># 10</td>
<td>02/28</td>
<td>Introduction to Statistical Inference, Part I</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td># 11</td>
<td>03/05</td>
<td>Introduction to Statistical Inference, Part II</td>
<td></td>
</tr>
</tbody>
</table>
# 12 03/07  Review for Test 1 (#1-#11)
7
# 13 03/12  Test 1 (#1-#11)
# 14 03/14  Activity: Stats Critique
8
# 15 03/19  Spring Break
# 16 03/21  Spring Break
9
# 17 03/26  Basics of Hypothesis Testing, Part I
# 18 03/28  Basics of Hypothesis Testing, Part II
10
# 19 04/02  Estimation and Confidence Intervals
# 20 04/04  Inference about a mean, Part I
# 21 04/09  Inference about a mean, Part II
# 22 04/11  Comparing two population means, Part I
# 23 04/16  Comparing two population means, Part II
# 24 04/18  One-Way Analysis of Variance, Part I
# 25 04/23  One-Way Analysis of Variance, Part II
# 26 04/25  Review for Test 2 (#17-#25)
14
# 27 04/30  Test 2 (#17-#25)
# 28 05/02  Scatter Plot & Correlation
15
# 29 05/07  Simple Linear Regression & Multiple Linear Regression
# 30 05/09  Activity: Stats Debate
16
# 31 05/14  Course Conclusions & Review for final exam

**NOTE:** Statistical software SAS will be used in discussion sessions for all statistical techniques covered in this course.

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

Note: Numbers in brackets after learning objectives show linkage between material covered in each session and the numbered program competencies shown on page 1 of this syllabus.

## Required Session Outline

**Session 1**

**01/29**

**Topic:** Course overview & Introduction of Biostatistics

**Learning Objectives for Session 1 [Competencies 1, 2, 3]**
- Understand the structure of scheduling for this course
- Understand what is Biostatistics and its role in public health
- Understand cutting-edge public health issues
- Learn types of data and data structure
- SAS university installation

**Required and recommended readings:** Chapter 1

**Session 2**

**01/31**

**Topic:** Frequency Distributions

**Learning Objectives for Session 2 [Competencies 1, 2]**
- Tell how often various values appear in a batch of numbers
- Explore visually the shape, location, and spread of each variable’s distribution
- Learn stemplot and frequency tables
- SAS codes

Required and recommended readings: Chapter 3

**Assignment – Homework 1 due on 2/05**

**Sessions 3 & 4 02/05 & 02/07**

Topic: Summary Statistics, Central Tendency & Spread

Learning Objectives for Sessions 3 & 4 [*Competencies 1, 2, 3*]
- Understand the measures of central tendency
- Compare the Mean, Median and Mode
- Learn Quantiles, IQR and Boxplots
- Learn variance and Standard Deviation
- SAS codes

Required and recommended readings: Chapter 4

**Assignment – Homework 2 due on 2/12**

**Sessions 5 & 6 02/12 & 02/14**

Topic: Probability Concepts & Bayes’ Theorem

Learning Objectives for Sessions 5 & 6 [*Competencies 1, 2, 3*]
- Learn basic operation on events and laws of operation
- Learn basic concept of probability, conditional probability, and total probability
- Differentiate independent events and disjoint events
- Learn Bayes’ Theorem
- Apply Bayes’ Theorem to diagnostic tests
- SAS codes

Required and recommended readings: Chapter 5

**Sessions 7 02/19**

Topic: Binomial Probability Distributions

Learning Objectives for Session [*Competencies 1, 2, 3*]
- Learn Binomial Random Variable
- Learn Binomial Distribution
- Learn how to calculate binomial probability
- Learn how to calculate cumulative probabilities for Binomial random variable
- Learn expected value and variance of a Binomial Random Variable
- SAS codes

Required and recommended readings: Chapter 6

**Assignments – Homework 3 due on 2/26**

**Sessions 8 & 9 02/21 & 02/26**

Topic: Normal Probability Distribution, Parts I & II

Learning Objectives for Session [*Competencies 1, 2, 3*]
- Learn Normal distribution and standard Normal Distribution
- Learn 68-95-99.7 Rule
- Learn how to read the Normal cumulative probability table
- Assess departures from normality using statistical figures
- SAS codes

Required and recommended readings: Chapter 7

**Sessions 10 & 11**
02/28 & 03/05

Topic: Introduction to Statistical Inference, Parts I & II

Learning Objectives for Session [Competencies 1, 2, 3]
- Learn Basic Statistical Inference
- Compare population versus sample, and parameter versus statistics
- Learn the sampling distribution of the sample mean
- Learn central limit theorem
- SAS codes

Required and recommended readings: Chapter 8

**Assignment – Homework 4 due on 03/07**

**Sessions 12 & 13: Review for Test 1 & Test 1**
03/07 & 03/12

**Session 14: Activity – Stats Critique**
03/14

**Sessions 17 & 18**
03/26 & 03/28

Topic: Basics of Hypothesis Testing, Parts I & II

Learning Objectives for Session [Competencies 1, 2, 3]
- Be able to conduct hypothesis testing using the 5 step procedures
- Differentiable the null and alternative hypotheses
- Understand type I and type II error
- Understand and be able to calculate $p$ -value
- Make conclusion based on $p$ -value and interpret the results
- R codes

Required and recommended readings: Chapter 9

**Assignments – Homework 5 due on 04/09**

**Sessions 19**
04/02

Topic: Estimation and Confidence Intervals, Parts I & II

Learning Objectives for Session [Competencies 1, 2, 3]
- Learn basic statistical estimation
- Learn confidence intervals when population standard deviation known
- Understand the relationship between hypothesis testing and confidence intervals
- R codes

Required and recommended readings: Chapter 10

**Session 20 & 21**
04/04 & 04/09

Topic: Inference about a mean, Parts I & II
Learning Objectives for Session \([\text{Competencies 1, 2, 3}]\)
- Calculate estimated standard error of the mean
- Learn student’s \(t\) distribution
- Learn One-sample \(t\)-test
- Learn how to read student’s \(t\) table
- Calculate power and sample size
- SAS codes

Required and recommended readings: Chapter 11

**Assignments – Homework 6 due on 04/16**

<table>
<thead>
<tr>
<th>Session 22 &amp; 23</th>
<th>04/11 &amp; 04/16</th>
</tr>
</thead>
<tbody>
<tr>
<td>Topic: Comparing two population means, Parts I &amp; II</td>
<td></td>
</tr>
</tbody>
</table>

Learning Objectives for Session \([\text{Competencies 1, 2, 3}]\)
- Compare two independent samples for equal variance scenario
- Understand when to use two sample \(Z\) test and two sample \(t\) test, and learn their differences
- Carry out \(Z\) test and \(t\) test
- SAS codes

Required and recommended readings: Chapter 12

**Assignments – Homework 7 due on 04/25**

<table>
<thead>
<tr>
<th>Sessions 26 &amp; 27: Review for Test 2 &amp; Test 2</th>
<th>04/25 &amp; 04/30</th>
</tr>
</thead>
<tbody>
<tr>
<td>Session 28</td>
<td>05/02</td>
</tr>
<tr>
<td>Topic: Scatter plot &amp; Correlation</td>
<td></td>
</tr>
</tbody>
</table>

Learning Objectives for Session \([\text{Competencies 1, 2}]\)
- Understand the explanatory and response variables
- Learn scatter plot
- Learn how to calculate correlation coefficient
- Understand the direction and strength of correlation
- Learn coefficient of determination
- SAS codes

Required and recommended readings: Chapter 14

**Session 29 | 05/07**

| Topic: Simple Linear Regression & Multiple Linear Regression |
Learning Objectives for Session [Competencies 1, 2, 3]
- Learn how to conduct simple linear regression
- Understand least squares estimation
- Understand the general idea of multiple linear regression
- Learn categorical explanatory variables in regression models
- Learn how to interpret the intercept and slope
- SAS codes

Required and recommended readings: Chapters 14 & 15

Session 30: Activity – Stats Debate 05/09
Session 31 05/14

Topic: Course Conclusions & Review for final exam

Learning Objectives for Session [Competencies 1, 2, 3]
- Review and conclude all materials learnt in this class

Assignments – Homework 8 due on 05/14

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