SYLLABUS & COURSE INFORMATION

SCHOOL OF PUBLIC HEALTH
UNIVERSITY OF MINNESOTA

PUBH 6450, SECTION 320

Biostatistics I
Fall 2019

COURSE & CONTACT INFORMATION

Credits: 4 credits
Meeting Day(s), Time, and Place: This course is entirely web-based, delivered via Canvas at http://canvas.umn.edu.

Contact Type	Contact Information	Role	When to Contact
Instructor	Laura Le free0312@umn.edu	Instructor for this course	Your instructors is your first line of contact. Feel free to email them about • Questions or concerns about the class, material, assignments, deadlines, etc. • Arranging a meeting (via phone call or video chat).
Teaching Assistants	Jiawei Liu liu00731@umn.edu Karan Shah shah0515@umn.edu Solvejg Wastvedt wastv004@umn.edu	Monitor collaborative keys and grade quizzes	Your TAs are your second line of contact. Feel free to email them about • Questions about concepts.
Technical Support	Technical support options are available on the SPH website. https://z.umn.edu/sphquickhelp	Troubleshoots technical issues related to the course site or course content.	Technical issues with the course site, media, quizzes or assignments.

Please save this contact information to your computer or print it. That way, you can still contact us in the event that you have difficulty connecting to the Internet or accessing the syllabus.

Communication in Online Courses

Communication is especially important in an online course. The course site announcement forums/discussions and email will be used to communicate with students. You are responsible for reading all course-related emails sent to your University email account and contacting us in a timely manner with any questions you may have. We strongly recommend that you check your U of M email daily. [My/our] goal is to respond to emails within [24 hours] [days of week].

COURSE DESCRIPTION

In this course, we will explore the basic concepts of exploratory data analysis and statistical inference, including: descriptive statistics, random variables and their distributions, point/interval estimation for means, proportions, and odds/risk, hypothesis testing, ANOVA, simple regression/correlation, multiple regression, and nonparametric methods (if possible). We will focus on health science applications using output from statistical packages.

COURSE PREREQUISITES

College Algebra (e.g. Math 1031), health science grad student, or instructor permission.

COURSE GOALS & OBJECTIVES

By the end of the course, students should have a basic understanding of the fundamentals of biostatistical methods. This includes:

- Summarizing data with numerical measures and graphs

- Basic concepts of randomness and data distributions
- Point/Interval estimation for categorical and continuous outcomes
- Hypothesis testing for categorical and continuous outcomes
- Simple and multiple linear regression
- Basic SAS and/or R programming language skills

METHODS OF INSTRUCTION AND WORK EXPECTATIONS

Course Workload Expectations
PubH 6450: Biostatistics I is a 4-credit course. The University expects that for each credit, you will spend a minimum of three hours per week attending class, reading, studying, and completing assignments, etc. over the course of a 15-week term. Thus, this course requires approximately 180 hours of effort spread over the course of the term in order to earn an average grade.

Methods of Instruction
This course is entirely online. Therefore, time you would otherwise be in class will be incorporated into work for the course in the form of online discussions, lectures, etc.

NOTE: **The online section is not self-paced.** This course covers a large amount of material in a short time. The group and class activities depend on the active and timely participation of all students. Therefore, **late assignments or quizzes will not be accepted**.

Here is the breakdown of the weekly work expectations:

- **Preceding weekend / early part of the week**: Students will be expected to prepare for the week by reading the textbook and viewing several short (10-30 minute) online presentations. Students will be also expected to work through the software lessons to learn how to use your chosen statistical software.

- **During the week / later part of the week**: The week will be devoted to working collaboratively to explore and apply the concepts and computing. Weekly learning activities will focus on exploring the concepts and practice analyzing the data via your chosen software. Your learning experience is thus dependent–to some extent–on your classmates and vice versa. Because of this, it is essential that you not only participate in the activities and discussions, but that you show up prepared, having completed the preparation material (concepts and computing). The Problem Sets are best carried out with a partner or study group in real time, either in person or via teleconference, chat, Skype, FaceTime, Google Hangouts, or similar means, but you may also work independently if you prefer. Plan to spend 2 – 3 hours per week working on the Problem Sets, alone or with your study group. We will also work collaboratively as a class to create the answer key for Problem Set. Each student is expected to contribute at least once to the key each week. Your contribution to the collaborative key is **due each Sunday by 11:55pm.**

- **At the end of the week**: An online quiz or written homework assignment covering the material of the week, as well as concepts from earlier weeks, will be **due each Sunday by 11:55pm**. Students are expected to complete the quizzes and homework assignments independently.

Software Lessons & Computing
You will learn how to analyze data via your chosen software (SAS or R) in the software lesson documents. Within each document, there will be *Guided Questions* that ask you to interpret the output from the code in the document. In addition, there will be *Challenge* questions that try to push you in your coding abilities. Both of these are provided to guide your learning and neither will be collected. Feel free to discuss the answers to these in the Question and Answer forums. Additional online resources will also be provided on each topic, if you need further instruction.

The course includes examples of data analysis from SAS and R. You will need access to SAS or R to complete your assignments.

Projects
There will be two projects within the semester that assess your ability to analyze data via your chosen software and interpret the results. Students are expected to complete these projects independently, **except** where the instructors specifically note collaboration is acceptable.

Technology
You will use the following technology tools in this course. Please make yourself familiar with them.
- Google Docs for the activity collaborative keys. Training is available via OIT.
- Zoom or Google Hangout for any group meetings. Information on using Google Hangout can be found here, and information using Zoom can be found here.

Learning Community
School of Public Health courses ask students to discuss frameworks, theory, policy, and more, often in the context of past and current events and policy debates. Many of our courses also ask students to work in teams or discussion groups. We do not come to our courses with identical backgrounds and experiences and building on what we already know about collaborating, listening, and engaging is critical to successful professional, academic, and scientific engagement with topics.

In this course, students are expected to engage with each other in respectful and thoughtful ways.

In group work, this can mean:

- Setting expectations with your groups about communication and response time during the first week of the semester (or as soon as groups are assigned) and contacting the TA or instructor if scheduling problems cannot be overcome.
- Setting clear deadlines and holding yourself and each other accountable.
- Determining the roles group members need to fulfill to successfully complete the project on time.
- Developing a rapport prior to beginning the project (what prior experience are you bringing to the project, what are your strengths as they apply to the project, what do you like to work on?)

In group discussion, this can mean:

- Respecting the identities and experiences of your classmates.
- Avoid broad statements and generalizations. Group discussions are another form of academic communication and responses to instructor questions in a group discussion are evaluated. Apply the same rigor to crafting discussion posts as you would for a paper.
- Consider your tone and language, especially when communicating in text format, as the lack of other cues can lead to misinterpretation.

Like other work in the course, all student to student communication is covered by the Student Conduct Code (https://z.umn.edu/studentconduct).

COURSE TEXT & READINGS

The required textbook for the course is **Diez, Barr, Cetinkaya-Rundel. (2019). *OpenIntro Statistics* (4th ed. or 3rd ed.).**

- This book is free for download or available for a very low cost through the site https://www.openintro.org.

Note: The 4th edition of this book was recently released. As a result, we will provide chapter references for the two most recent editions, the 3rd and 4th editions, for the fall term.

Other resources:

Sullivan. (2018). Essentials of Biostatistics in Public Health (3rd ed., Jones & Bartlett Learning).
Various online resources

The chapters or sections will be listed in a particular week and are available free to download through the University Library system, up to 60 pages, or to check out (eBook) for a short period of time.

This course might use journal articles, which are available via the University Libraries' E-Reserves and will be linked from the course site. It is good practice to use a citation manager to keep track of your readings. More information about citation managers is available at https://www.lib.umn.edu/pim/citation.

COURSE OUTLINE/WEEKLY SCHEDULE

This course has specific deadlines. All coursework must be submitted via the course site before the date and time specified on the site. **Note: assignments are due by 11:55pm CST unless indicated otherwise.**

Week	Topic	Lecture & Readings	Activities/Assignments
Week 1 **Sept. 3–8**	• **INTRODUCTION & DATA SUMMARIES**	**Online Lectures** **Textbook Reading:** • OpenIntro Statistics (OIS) ○ Chapters for 4th edition: ▪ 1.1: Case Study: Using Stents to Prevent Strokes ▪ 1.2: Data Basics ▪ 2.1: Examining Numerical Data ▪ 2.2: Considering Categorical Data ▪ 2.3: Case study: Malaria Vaccine (OPTIONAL) ○ Chapters for 3rd edition: ▪ 1.1: Case Study: Using Stents to Prevent Strokes ▪ 1.2: Data Basics ▪ 1.6: Examining Numerical Data ▪ 1.7: Considering Categorical Data • 1.8: Case Study: Gender Discrimination (OPTIONAL)	• Software Lessons • Homework (due **Friday, Sept. 6)** • Problem Set activity • Contribution to Project Set collaborative key (due Sunday, Sept. 8) • Quiz (due Sunday, Sept. 8)
Week 2 **Sept. 9–15**	• **SAMPLING, RANDOM VARIABLES, & POPULATION DISTRIBUTIONS**	**Online Lectures** **Textbook Reading:** • OIS ○ Chapters for 4th edition: ▪ 1.3: Sampling Principles and Strategies (**except 1.3.4)** ▪ 3.5: Continuous Distributions ▪ 4.1: Normal Distribution ▪ 4.3: Binomial Distribution ○ Chapters for 3rd edition: ▪ 1.3: Overview of Data Collection Principles ▪ 1.4.2: Four Sampling Methods ▪ 2.5: Continuous Distributions • 3: Distributions of Random Variables **(except 3.3.2 & 3.5)**	• Software Lesson • Problem Set activity • Contribution to Project Set collaborative key (due Sunday, Sept. 15) • Quiz (due Sunday, Sept. 15)
Week 3 **Sept. 16–22**	• **CONFIDENCE INTERVALS FOR A PROPORTION**	**Online Lectures** **Textbook Reading:** • OIS: ○ Chapters for 4th edition: ▪ 5.1: Point Estimates and Sampling Variability ▪ 5.2: Confidence Intervals for a Sample Proportion	• Software Lesson • Problem Set activity • Contribution to Project Set collaborative key (due Sunday, Sept. 22)

		▪ 6.1: Inference for a Single Proportion ○ Chapters for 3rd edition: ▪ 4.1: Variability in Estimates ▪ 4.2: Confidence Intervals ▪ 6.1: Inference for a Single Proportion (**except 6.1.3 & 6.1.4**) **Online Resources:** • https://www.spss-tutorials.com/sampling-distribution-what-is-it/	• Quiz (due Sunday, Sept. 22)
Week 4 Sept. 23–29	• **CONFIDENCE INTERVALS FOR A MEAN**	**Online Lectures** **Textbook Reading:** ● OIS ○ Chapter for 4th edition: ▪ 7.1: One-Sample Means with the *t*-distribution (**except 7.1.5)** ○ Chapter for 3rd edition: ▪ 5.1: One-Sample Means with the *t*-distribution (**except 5.1.5)** **Online Resources:** ○ http://my.ilstu.edu/~wjschne/138/Psychology138Lab10.html • https://courses.lumenlearning.com/boundless-statistics/chapter/sampling-distributions/	• Software Lesson • Problem Set activity • Contribution to Project Set collaborative key (due Sunday, Sept. 29) • Homework (due Sunday, Sept. 29)
Week 5 Sept. 30– Oct. 6	• **INTRODUCTION TO HYPOTHESIS TESTING**	**Online Lectures** **Textbook Reading:** ● OIS ○ Chapters for 4th edition: ▪ 5.3: Hypothesis Testing for a Proportion ▪ 7.1.5: One Sample t-tests ▪ 7.2: Paired Data ○ Chapters for 3rd edition: ▪ 4.3: Hypothesis Testing ▪ 4.5: Inference for Other Estimators ▪ 5.1.5: One Sample t-tests • 5.2: Paired Data	• Software Lesson • Problem Set activity • Contribution to Project Set collaborative key (due Sunday, Oct. 6) • Quiz (due Sunday, Oct. 6)
Week 6 Oct. 7–13	• **INFERENTIAL METHODS FOR COMPARING MEANS**	**Online Lectures** **Textbook Reading:** ● OIS ○ Chapter for 4th edition: ▪ 7.3: Difference of Two Means ○ Chapter for 3rd edition: • 5.3: Difference of Two Means	• Software Lesson • Problem Set activity • Contribution to Project Set collaborative key (due Sunday, Oct. 13) • Homework (due Sunday, Oct. 13)

Week 7 **Oct. 14–20**	• **STUDY DESIGN & MORE SAMPLING**	**Online Lectures** **Textbook Readings:** ● OIS ○ Chapters for 4th edition: ▪ 1.3.4: Observational Studies ▪ 1.4: Experiments ▪ 7.4: Power Calculations for a Difference of Means ○ Chapters for 3rd edition: ▪ 1.4.1: Observational Studies ▪ 1.5: Experiments ▪ 5.4: Power Calculations for a Difference of Means ● Essentials of Biostatistics in Public Health (EBPH) • Chapter 8.1: Issues in Estimating Sample Size for CI Estimates	• Software Lesson • Problem Set activity • Contribution to Project Set collaborative key (due Sunday, Oct. 20) • Quiz (due Sunday, Oct. 20)
Week 8 **Oct. 21–27**	• **PROJECT 1**	•	• Project 1 (due Sunday, Oct. 27)
Week 9 **Oct. 28–Nov. 3**	• **ANOVA**	**Online Lectures** **Textbook Reading:** ● OIS ○ Chapter for 4th edition: ▪ 7.5: Comparing Many Means with ANOVA ○ Chapter for 3rd edition: • 5.5: Comparing Many Means with ANOVA	• Software Lesson • Problem Set activity • Contribution to Project Set collaborative key (due Sunday, Nov. 3) • Quiz (due Sunday, Nov. 3)
Week 10 **Nov. 4–10**	• **COMPARING CATEGORICAL DATA IN 2x2 TABLES: ODDS RATIOS AND RELATIVE RISKS**	**Online Lectures** **Textbook Reading:** ● EBPH ○ Chapter 3.4: Comparing the Extent of Disease Between Groups ○ Chapter 6.6: Confidence Intervals for Two Independent Samples, Dichotomous Outcome **Article Reading:** ● Andrade. (2015). Understanding Relative Risk, Odds Ratios, and Related Terms: As Simple as It Can Get. J Clin Psychiatry 76(7):e857-861 •	• Software Lesson • Problem Set activity • Contribution to Project Set collaborative key (due Sunday, Nov. 10) • Quiz (due Sunday, Nov. 10)
Week 11 **Nov. 11–17**	• **HYPOTHESIS TESTING FOR COMPARING TWO OR MORE CATEGORIES**	**Online Lectures** **Textbook Readings:** ● OIS ○ Chapters for 4th edition:	• Software Lesson • Problem Set activity • Contribution to Project Set collaborative key (due Sunday, Nov. 17)

		▪ 6.3: Testing for Goodness of Fit using Chi-square: Observational Studies ▪ 6.4: Testing for Independence in Two-way Tables ○ Chapters for 3rd edition: ▪ 6.3: Testing for Goodness of Fit using Chi-square ▪ 6.4: Testing for Independence in Two-way Tables ● EBPH ○ Chapter 7.7: Tests with Two Independent Samples, Dichotomous Outcome ○ Chapter 7.9: Tests for Two or More Independent Samples, Categorical & Ordinal Outcomes •	• Homework (due Sunday, Nov. 17)
Week 12 Nov. 18–24	• **CORRELATION & SIMPLE LINEAR REGRESSION**	**Online Lectures** **Textbook Reading:** ● OIS ○ Chapters for 4th edition: ▪ 8.1: Fitting a Line, Residuals, and Correlation ▪ 8.2: Least Squares Regression (**except 8.2.3**) ○ Chapters for 3rd edition: ▪ 7.1: Line Fitting, Residuals, and Correlation • 7.2: Fitting a Line by Least Squares Regression (**except 7.2.2)**	• Software Lesson • Problem Set activity • Contribution to Project Set collaborative key (due Sunday, Nov. 24) • Quiz (due Sunday, Nov. 24)
Week 13 Nov. 25– Dec. 1	• **INFERENCE FOR SIMPLE LINEAR REGRESSION**	**Online Lectures** **Textbook Reading:** ● OIS ○ Chapters for 4th edition: ▪ 8.2.3: Conditions for the Least Squares Line ▪ 8.3: Types of Outliers in Linear Regression ▪ 8.4: Inference for Linear Regression ○ Chapters for 3rd edition: ▪ 7.2.2: Conditions for the Least Squares Line ▪ 7.3: Types of Outliers in Linear Regression • 7.4: Inference for Linear Regression	• Software Lesson • Problem Set activity • Contribution to Project Set collaborative key (due Sunday, Dec. 1) • Homework (due Sunday, Dec. 1)
Week 14 Dec. 2–8	• **MULTIPLE LINEAR REGRESSION**	**Online Lectures** **Textbook Reading:** ● OIS ○ Chapter for 4th edition: ▪ 9: Multiple & Logistic Regression **(except 9.2.2, 9.2.3, & 9.5)** ○ Chapter for 3rd edition: • 8: Multiple & Logistic Regression **(except 8.2.2, 8.2.3, & 8.4)**	• Software Lesson • Problem Set activity • Contribution to Project Set collaborative key (due Sunday, Dec. 8) • Quiz (due Sunday, Dec. 8)
Week 15	**PROJECT 2**	•	• Project 2 (due Sunday, Dec. 15)

Dec. 9–15	•		

SPH AND UNIVERSITY POLICIES & RESOURCES

The School of Public Health maintains up-to-date information about resources available to students, as well as formal course policies, on our website at www.sph.umn.edu/student-policies/. Students are expected to read and understand all policy information available at this link and are encouraged to make use of the resources available.

The University of Minnesota has official policies, including but not limited to the following:

- Grade definitions
- Scholastic dishonesty
- Makeup work for legitimate absences
- Student conduct code
- Sexual harassment, sexual assault, stalking and relationship violence
- Equity, diversity, equal employment opportunity, and affirmative action
- Disability services
- Academic freedom and responsibility

Resources available for students include:

- Confidential mental health services
- Disability accommodations
- Housing and financial instability resources
- Technology help
- Academic support

EVALUATION & GRADING

Grading is determined by:

- **Weekly work** (Total: 245 points, ~60%)
    - Set-up Homework (Total: 10 points, ~2%)
    - Active and timely participation in the 13 Problem Set Collaborative Keys (7 points each, Total: 91 points, ~16%)
    - 9 Quizzes (~15 points each, Total: ~135 points, ~24%)
    - 4 Homeworks (25 points each, Total: 100 points, 18%)
- **Projects** (Total: 40%)
    - Project 1 (Total: 100 points, 18%)
    - Project 2 (Total: 120 points, 22%)

Grading Scale
The University uses plus and minus grading on a 4.000 cumulative grade point scale in accordance with the following, and you can expect the grade lines to be drawn as follows:

% In Class	Grade	GPA
93 - 100%	A	4.000
90 - 92%	A-	3.667
87 - 89%	B+	3.333
83 - 86%	B	3.000
80 - 82%	B-	2.667
77 - 79%	C+	2.333
73 - 76%	C	2.000
70 - 72%	C-	1.667
67 - 69%	D+	1.333
63 - 66%	D	1.000

< 62%	F	

- A = achievement that is outstanding relative to the level necessary to meet course requirements.
- B = achievement that is significantly above the level necessary to meet course requirements.
- C = achievement that meets the course requirements in every respect.
- D = achievement that is worthy of credit even though it fails to meet fully the course requirements.
- F = failure because work was either (1) completed but at a level of achievement that is not worthy of credit or (2) was not completed and there was no agreement between the instructor and the student that the student would be awarded an I (Incomplete).
- S = achievement that is satisfactory, which is equivalent to a C- or better
- N = achievement that is not satisfactory and signifies that the work was either 1) completed but at a level that is not worthy of credit, or 2) not completed and there was no agreement between the instructor and student that the student would receive an I (Incomplete).

Evaluation/Grading Policy	Evaluation/Grading Policy Description
Scholastic Dishonesty, Plagiarism, Cheating, etc.	The goal of this course is to enable students to read and interpret statistical results in the primary literature. We expect that students will complete all end-of-week quizzes INDEPENDENTLY, without assistance from any other people. If we have any reason to suspect that a student gave assistance on an end-of-week quiz to another student or received assistance on an end-of-week quiz from another student or a person outside the class, all students involved will receive a score of zero on that quiz. If we believe that scholastic dishonesty has occurred, we are required by the University to report the incident to the Office of Community Standards (https://communitystandards.umn.edu/). You are expected to do your own academic work and cite sources as necessary. Failing to do so is scholastic dishonesty. Scholastic dishonesty means plagiarizing; cheating on assignments or examinations; engaging in unauthorized collaboration on academic work; taking, acquiring, or using test materials without faculty permission; submitting false or incomplete records of academic achievement; acting alone or in cooperation with another to falsify records or to obtain dishonestly grades, honors, awards, or professional endorsement; altering, forging, or misusing a University academic record; or fabricating or falsifying data, research procedures, or data analysis (As defined in the Student Conduct Code). For additional information, please see https://z.umn.edu/dishonesty The Office for Student Conduct and Academic Integrity has compiled a useful list of Frequently Asked Questions pertaining to scholastic dishonesty: https://z.umn.edu/integrity. If you have additional questions, please clarify with your instructor. Your instructor can respond to your specific questions regarding what would constitute scholastic dishonesty in the context of a particular class-e.g., whether collaboration on assignments is permitted, requirements and methods for citing sources, if electronic aids are permitted or prohibited during an exam. Indiana University offers a clear description of plagiarism and an online quiz to check your understanding (http://z.umn.edu/iuplagiarism).
Late Assignments	This course covers a large amount of material in a short time. The group and class activities depend on the active and timely participation of all students. Therefore late assignments or quizzes will not be accepted. For every day the Project assignment is late, you will be docked 20% of the grade.

CEPH COMPETENCIES

Competency	Learning Objectives	Assessment Strategies* (*see Assessment Descriptions below this table)
Analyze quantitative and qualitative data using biostatistics, informatics, computer-based programming and software, as appropriate.	**Descriptive and Graphical Summaries** • Create summary statistics, tables, and graphs are appropriate for each variable type (e.g., categorical variable(s): bar plot, count, proportion, 2x2 table, risk, odds, odds ratio, relative risk, difference in proportions; continuous variable(s): histogram, boxplot, mean, median, SD, IQR, difference in means) via your chosen software. • Calculate any of screening test summary statistics from a table of cell counts, or the equivalent information in words (e.g. in an article) (e.g., prevalence, sensitivity, specificity, false positive, false negative, PPV, NPV). **Confidence Intervals** • Calculate a confidence interval for a population parameter (e.g., mean(s), relative risk, odds ratio) from data or summary statistics via your chosen software. **Hypothesis Testing** • Identify situations when a particular statistical test would be used (e.g., one, paired, and two-sample t-test; Chi-squared test; Fisher's exact test; McNemar's test; ANOVA) and carry out the tests via your chosen software. • Be aware of some of the statistical analysis options that exist if your sample is from a severely non-normal population and carry out the analyses via your chosen software. **Regression** • Create a scatterplot via your chosen software to assess the relationship between variables. • Identify situations when a particular statistical regression method would be used (e.g., simple linear regression, multiple linear regression, logistic regression, proportional hazards regression). • Calculate the correlation or the fitted regression coefficients to obtain slope values (for simple or multiple regression) for each predictor via your chosen software. • Create diagnostic plots via your chosen software to assess how well the model fits the data.	• Homeworks • Projects
Interpret results of data analysis for public health research, policy or practice.	**Descriptive and Graphical Summaries** • Recognize the variable type, categorical or continuous. • Distinguish between the standard deviation (SD or s) and the standard error of the mean (SE or SEM).	• Weekly quizzes

	• Interpret summary statistics, tables, and graphs for each variable type (e.g., categorical variable(s): bar plot, count, proportion, 2x2 table, risk, odds, odds ratio, relative risk; continuous variable(s): histogram, boxplot, mean, median, SD, IQR, difference in means). • State the limitations of the commonly-used measures of center and spread. • Interpret a Z-score value. • Define screening test summary statistics (e.g., prevalence, sensitivity, specificity, false positive, false negative, PPV, NPV) and correctly interpret them. • Explain how the screening test summary statistics are related to each other. **Confidence Intervals** • Explain the purpose of a confidence interval and meaning of the confidence level. • Make a conclusion about the significance of a result, based off of the confidence interval (e.g., for a mean, for a proportion, for a difference in means, for an OR, for a RR, for a slope). **Hypothesis testing** • Know the terminology of hypothesis testing (e.g., null hypothesis, alternative hypothesis, test statistic, sampling distribution of the test statistic, *p*-value, false positive result, false negative result, Type I error, Type II error, power). • For a particular statistical test, state the appropriate null and alternative hypotheses (e.g., one, paired, and two-sample t-test; Chi-squared test; Fisher's exact test; McNemar's test; ANOVA). • For a particular statistical test, make a conclusion based off of the p-value and a significance level (e.g., one, paired, and two-sample t-test; log-rank test; Chi-squared test; Fisher's exact test; McNemar's test; ANOVA). • Recognize situations in which multiple comparisons may be an issue. • Explain the consequences of failing to properly account for multiple comparisons. • Explain the purpose of post-hoc tests following ANOVA and interpret the results. • Explain the difference between statistical significance and clinical/practical significance. **Regression** • Know what it means to say that two variables are "associated". • Interpret statistics (correlation or fitted coefficients) from regression methods and make a conclusion from its confidence interval or *p*-value (e.g., simple linear regression, multiple linear regression). • Write down the equation for a regression model and describe what each parameter means (e.g., simple linear regression, multiple linear regression).	

	• Interpret both the diagnostic plots and the model R^2 value.	
Communicate audience-appropriate public health content, both in writing and through oral presentation	• Complete a data analysis project by analyzing data via their chosen software and interpreting the results.	• Homeworks • Projects

Assessment Descriptions	
Weekly quizzes	The weekly quizzes are intended to assess what the students have learned both from the readings and lectures and from the activities and discussions as outlined in the unit learning objectives. The questions are both multiple-choice and short essay format. During the quizzes, students are encouraged to consult the textbook and the course materials, particularly the completed activity worksheets and any notes you may have made on lectures or other content, but they may not consult with other people during the individual attempt on the quiz. The group attempt on the same quiz occurs the first class period after the due date of the quiz. The group quiz is intended to further solidify the concepts by forcing students to discuss the questions and come to a consensus on the answers. Students are encouraged to check all of the forums and collaborative keys for any comments or clarifications from the instructor *before* beginning the quizzes.
Homeworks	The homeworks are intended to assess students' ability to analyze the data via their chosen software and interpret the results via a short report. The homeworks are more comprehensive than quizzes in that they assess students' ability to integrate the concepts and programming from multiple weeks, apply their knowledge to a new scenario, and evaluate the results based on the output from the software. The homeworks allow students to practice application of the material prior to the high-stake assessment of the projects. Students are given questions with minimal direction on the type of summary or inferential method to assess their ability to identify and use the concepts and programming learned in the course. The homeworks must be completed independently.
Projects	The projects are intended to assess students' ability to analyze the data via their chosen software and interpret the results via a two- to three-page report. The projects are the most comprehensive assessment in the course in that they assess students' ability to integrate the concepts and programming from half of the semester, apply their knowledge to a new scenario, and evaluate the results based on the output from the software. Students are given questions with minimal direction on the type of summary or inferential method to assess their ability to identify and use the concepts and programming learned in the course. The projects must be completed independently, **except** where the instructors specifically note collaboration is acceptable.