



PUBH 6414, SECTION 001

Biostatistical Literacy
Fall 2020

COURSE & CONTACT INFORMATION

Credits: 3
Meeting Day(s): Tuesdays and Thursdays
Meeting Time: 9:45a–11:00a
Meeting Place: Remote via Zoom

Instructor: Mark Fiecas
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Office Hours: By appointment

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COURSE DESCRIPTION

PubH 6414: Biostatistical Literacy will cover the fundamental concepts of

- study design,
- descriptive statistics,
- hypothesis testing,
- confidence intervals,
- odds ratios,
- relative risks,
- adjusted models in multiple linear,
- logistic and proportional hazards regression, and
- survival analysis.

The focus will be when to use a given method and how to interpret the results, not the actual computation or computer programming to obtain results from raw data.

This course will involve minimal calculation and offer no formal training in any statistical programming software.

COURSE PREREQUISITES

The course presupposes a basic knowledge of mathematics (including algebra). A Math Refresher website has been created by the University of Minnesota School of Public Health to help you review these concepts (<http://www.sph.umn.edu/current/resources/>). It is entirely up to you whether you utilize the review site. However, it's there to help you feel confident of the basic mathematical operations that may be referred to in the course.

COURSE GOALS & OBJECTIVES

PubH 6414: Biostatistical Literacy has the primary goal of developing student ability to read and interpret statistical results in the primary literature of their specific scientific field of interest.

METHODS OF INSTRUCTION AND WORK EXPECTATIONS

Course Workload Expectations

PubH 6414: Biostatistical Literacy is a 3-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 135 hours of effort spread over the course of the term in order to earn an average grade.

The primary method of instruction uses a flipped classroom model. You may be wondering, “*what is a flipped classroom?*” In a flipped classroom, learning takes place both in and out of the classroom. Before class, you will be required to gain necessary knowledge through reading the textbook and watching or reading recorded lectures. Then, in class, you will work collaboratively on learning activities that explore statistical concepts and apply them to reading the research literature. You will be reading and critically analyzing at least one article from the medical or public health literature each week.

Here is the breakdown of the weekly work expectations for class:

- **Preceding weekend:** Students are expected to prepare for each class meeting by reading several selections from the textbook and viewing several short (10-20 minute) online presentations. An online readiness quiz covering the readings and lecture material will be **due each Tuesday before class (by 9:45am)**.
- **In class:** Time will be devoted in class to working collaboratively in small and large groups to explore and apply the concepts. 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 attend class each day and participate in the activities and discussions, but that you show up prepared having completed the before-class tasks.
- **At the end of the week:** An online end-of-unit quiz covering the concept and literature activities of the week, as well as concepts from earlier weeks, will be **due each Sunday (by 11:55pm)**.

Throughout the semester, you will complete two major components to demonstrate your ability to read and interpret statistical results in your scientific field of interest:

1. **Article Review:** The goal of this major component is to use your knowledge of statistical concepts to critically evaluate your chosen article.
2. **Literature Project:** The goal of this major component is to use your knowledge of statistical concepts to create a learning activity. This “learn by teaching” approach will help synthesize your understanding of the statistical material.

You have the choice of working individually or small groups to complete the tasks. The culmination of the Project will be sharing your Literature Project with your peers during the last week of the semester.

Technology

You will use the following technology tools in this course. Please make yourself familiar with them.

- Our class meetings will take place via Zoom. Information on using Zoom can be found [here](#),
- Zoom, WebEx, or Google Hangout may be useful for group meetings. Information for Google Hangout can be found [here](#), and information using WebEx 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

There is a required textbook for the course:

Harvey Motulsky's *Intuitive Biostatistics: A Nonmathematical Guide to Statistical Thinking* (Oxford University Press, 3rd edition, 2014, or 4th edition, 2018).

The book is available through the University of Minnesota bookstore.

The activities and literature articles used in this course are available on the course website.

This course uses 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

PubH 6414: Biostatistical Literacy has specific deadlines. All coursework must be submitted via the Canvas course site before the date and time specified on the site. **Note: assignments are due by 11:55pm CST unless indicated otherwise.**

Week	Topic	Readings	Activities/Assignments
Week 1 Sept. 8–13	Unit 1: INTRODUCTION TO BIOSTATISTICS	<p>Textbook Readings:</p> <ul style="list-style-type: none"> Ch 1. Statistics and Probability are not Intuitive Ch 2. The Complexities of Probability Ch 3. From Sample to Population <p>Online Lectures:</p> <ul style="list-style-type: none"> Biostatistical Literacy Cycle of Research Sampling Methods Study Designs 	<ul style="list-style-type: none"> Readiness Quiz (due THURSDAY, Sept. 10 by 9:45a) Welcome Activity & Literature Activity End-of-Unit Quiz (due Sunday, Sept. 13 by 11:55p)
Week 2 Sept. 14–20	Unit 2: INTRODUCTION TO SURVIVAL DATA	<p>Textbook Reading:</p> <ul style="list-style-type: none"> Ch 5. Confidence Interval of Survival Data <p>Online Lecture:</p> <ul style="list-style-type: none"> Survival Data 	<ul style="list-style-type: none"> Readiness Quiz (due TUESDAY, Sept. 15 by 9:45a) Concept & Literature Activities End-of-Unit Quiz (due Sunday, Sept. 20 by 11:55p)
Week 3 Sept. 21–27	Unit 3: CONFIDENCE INTERVAL FOR A PROPORTION	<p>Textbook Reading:</p> <ul style="list-style-type: none"> Ch 4. Confidence Interval of a Proportion <p>Online Lectures:</p> <ul style="list-style-type: none"> Types of Variables Confidence Interval for Proportion 	<ul style="list-style-type: none"> Readiness Quiz (due Tuesday, Sept. 22 by 9:45a) Concept & Literature Activities End-of-Unit Quiz (due Sunday, Sept. 27 by 11:55p)
Week 4 Sept. 28–Oct. 4	Unit 4: SUMMARIZING CONTINUOUS VARIABLES	<p>Textbook Readings:</p> <ul style="list-style-type: none"> Ch 7. Graphing Continuous Data Ch 9. Quantifying Scatter <p>Online Lecture:</p> <ul style="list-style-type: none"> Summarizing Continuous Data 	<ul style="list-style-type: none"> Readiness Quiz (due Tuesday, Sept. 29 by 9:45a) Concept & Literature Activities Project: Submit article selection (due Sunday, Oct. 4 by 11:55p; Instructor will approve the article by the end of Monday, Oct. 5.) End-of-Unit Quiz (due Sunday, Oct. 4 by 11:55p)

Week 5 Oct. 5–11	Unit 5: CONFIDENCE INTERVAL FOR A MEAN	Textbook Readings: <ul style="list-style-type: none"> • Ch 10. The Gaussian (Normal) Distribution • Ch 12. Confidence Interval of a Mean • Ch 14. Error Bars Online Lecture: <ul style="list-style-type: none"> • Confidence Interval For a Mean 	<ul style="list-style-type: none"> • Readiness Quiz (due Tuesday, Oct. 6 by 9:45a) • Concept & Literature Activities • End-of-Unit Quiz (due Sunday, Oct. 11 by 11:55p)
Week 6 Oct. 12–18	Unit 6: HYPOTHESIS TESTING	Textbook Readings: <ul style="list-style-type: none"> • Ch 15. Introducing P-values • Ch 16. Statistical Significance and Hypothesis Testing • Ch 17. Relationship Between Confidence Intervals and Statistical Significance • Ch 18. Interpreting a Result that is Statistically Significant • Ch 19. Interpreting a Result that is not Statistically Significant Online Lecture: <ul style="list-style-type: none"> • Hypothesis Testing 	<ul style="list-style-type: none"> • Readiness Quiz (due Tuesday, Oct. 13 by 9:45a) • Concept & Literature Activities • Project: Submit Research Guidelines Table (due Sunday, Oct. 18 by 11:55p) • End-of-Unit Quiz (due Sunday, Oct. 18 by 11:55p)
Week 7 Oct. 19–25	Unit 7: CHALLENGES IN STATISTICS	Textbook Readings: <ul style="list-style-type: none"> • Ch 20. Statistical Power • Ch 22. Multiple Comparisons Concepts • Ch 23. The Ubiquity of Multiple Comparisons • Ch 24. Normality Tests • Ch 25. Outliers • Ch 26. Choosing a Sample Size Online Lectures: <ul style="list-style-type: none"> • Multiple Comparisons • Normality • Outliers • Sample Size 	<ul style="list-style-type: none"> • Readiness Quiz (due Tuesday, Oct. 20 by 9:45a) • Concept & Literature Activities • End-of-Unit Quiz (due Sunday, Oct. 25 by 11:55p)
Week 8 Oct. 26–Nov. 1	Unit 8: STATISTICAL TESTS, PART 1	Textbook Readings: <ul style="list-style-type: none"> • Ch 27. Comparing Proportions • Ch 28. Case-Control studies Online Lectures: <ul style="list-style-type: none"> • Comparing Proportions: Odds • Comparing Proportions: Risks 	<ul style="list-style-type: none"> • Readiness Quiz (due Tuesday, Oct. 27 by 9:45a) • Concept & Literature Activities • End-of-Unit Quiz (due Sunday, Nov. 1 by 11:55p)
Week 9 Nov. 2-8	Unit 9: STATISTICAL TESTS, PART 2	Textbook Readings: <ul style="list-style-type: none"> • Ch 29: Comparing Survival Curves 	<ul style="list-style-type: none"> • Readiness Quiz (due Tuesday, Nov. 3 by 9:45a)

		<ul style="list-style-type: none"> Ch 30. Comparing Two Means: Unpaired T-Test Ch 31. Comparing Two Paired Groups <p>Online Lectures:</p> <ul style="list-style-type: none"> Comparing Survival Curves Comparing Two Means Comparing Paired Groups 	<ul style="list-style-type: none"> Concept & Literature Activities Project: Submit Article Review (due Sunday, Nov. 8 by 11:55p) End-of-Unit Quiz (due Sunday, Nov. 8 by 11:55p)
Week 10 Nov. 9-15	Unit 10: COMMUNICATING RISK	<p>Textbook Readings:</p> <ul style="list-style-type: none"> (Lecture) Communicating Risk: Absolute, Relative, Natural Frequencies Ch 42. Sensitivity, specificity and ROC curves. <p>Online Lecture:</p> <ul style="list-style-type: none"> Screening Tests 	<ul style="list-style-type: none"> Readiness Quiz (due Tuesday, Nov. 10 by 9:45a) Concept & Literature Activities End-of-Unit Quiz (due Sunday Nov. 15 by 11:55p)
Week 11 Nov. 16-22	Unit 11: ANOVA	<p>Textbook Readings:</p> <ul style="list-style-type: none"> Ch 39. Analysis of Variance. Ch 40. Multiple Comparisons Tests after ANOVA <p>Online Lecture:</p> <ul style="list-style-type: none"> Analysis of Variance (ANOVA) 	<ul style="list-style-type: none"> Readiness Quiz (due Tuesday, Nov. 17 by 9:45a) Concept & Literature Activities End-of-Unit Quiz (due Sunday, Nov. 22 by 11:55p)
Week 12 Nov. 23-29	Unit 12: CORRELATION AND REGRESSION	<p>Textbook Readings:</p> <ul style="list-style-type: none"> Ch 32. Correlation Ch 33. Simple Linear Regression <p>Online Lectures:</p> <ul style="list-style-type: none"> Correlation Simple Linear Regression 	<ul style="list-style-type: none"> Readiness Quiz (due Tuesday, Nov. 24 by 9:45a) Concept & Literature Activities End-of-Unit Quiz (due Sunday, Nov. 29 by 11:55p)
Week 13 Nov. 30-Dec. 6	Unit 13: MULTIPLE LINEAR REGRESSION	<p>Textbook Readings:</p> <ul style="list-style-type: none"> Ch 34. Introducing Models Ch 35. Comparing Models Ch 37. Multiple Regression <p>Online Lecture:</p> <ul style="list-style-type: none"> Multiple Regression 	<ul style="list-style-type: none"> Readiness Quiz (due Tuesday, Dec. 1 by 9:45a) Concept & Literature Activities End-of-Unit Quiz (due Sunday, Dec. 6 by 11:55p)
Week 14 Dec. 7-13	Unit 14: LOGISTIC REGRESSION AND PROPORTIONAL HAZARDS REGRESSION	<p>Textbook Reading:</p> <ul style="list-style-type: none"> Ch 38. Logistic and Proportional Hazards Regression <p>Online Lectures:</p>	<ul style="list-style-type: none"> Readiness Quiz (due Tuesday, Dec. 8 by 9:45a) Concept & Literature Activities

		<ul style="list-style-type: none"> • Logistic Regression • Proportional Hazards Regression 	<ul style="list-style-type: none"> • Project: Submit Literature Project (due Sunday, Dec. 13 by 11:55p) • End-of-Unit Quiz (due Sunday, Dec. 13 by 11:55p)
Week 15 Dec. 14-20	Unit 15	Literature Project Articles	<ul style="list-style-type: none"> • Project <ul style="list-style-type: none"> • Active participation in literature project questions and answers • Peer- and Self-Evaluations • Reflection Statement • All activities above due Sunday, Dec. 20 by 11:55p • End-of-Semester Quiz (due Sunday, Dec. 20 by 11:55p)

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: 80%)
 - Readiness quizzes (20%)
 - Active and timely participation in class activities, discussions, and developing the collaborative answer key during class (20%)
 - End-of-Unit quizzes (40%)
- **Project** (20%)

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
<p>Scholastic Dishonesty, Plagiarism, Cheating, etc.</p>	<p>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-unit quizzes INDEPENDENTLY, without assistance from any other people. If we have any reason to suspect that a student gave assistance on an end-of-unit quiz to another student or received assistance on an end-of-unit 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/).</p> <p>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</p> <p>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.</p> <p>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.</p> <p>Indiana University offers a clear description of plagiarism and an online quiz to check your understanding (http://z.umn.edu/iuplagiarism).</p>
<p>Late Assignments</p>	<p>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.</p>
<p>Attendance Requirements</p>	<p>Class: You can have two absences from class before you will be penalized for participation. For each day missed thereafter, your weekly class participation grade will be reduced 1% (up to 10%).</p>

CEPH COMPETENCIES

Competency	Learning Objectives	Assessment Strategies* (*see Assessment Descriptions below this table)
<p>Analyze quantitative and qualitative data using biostatistics, informatics, computer-based programming and software, as appropriate.</p>	<p>Descriptive and Graphical Summaries</p> <ul style="list-style-type: none"> State which 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; continuous variable(s): histogram, boxplot, mean, median, SD, IQR, difference in means; time-to-event variable(s): Kaplan-Meier curve, 5-year survival time, median survival, hazard, hazard ratio). Normalize a continuous measurement (i.e., calculate a Z-score). 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). <p>Confidence Intervals</p> <ul style="list-style-type: none"> State what information you need to calculate a confidence interval and how those factors affect the width of the confidence interval. Calculate a confidence interval from a margin of error and vice versa. <p>Hypothesis Testing</p> <ul style="list-style-type: none"> Identify situations when a particular statistical test would be used (e.g., one, paired, and two-sample t-test; log-rank test; Chi-squared test; Fisher's exact test; McNemar's test; ANOVA). Be aware of the common approaches for accounting for multiple comparisons. Be aware of some of the statistical analysis options that exist if your sample is from a severely non-normal population. <p>Regression</p> <ul style="list-style-type: none"> Understand why the first step in correlation or regression analysis is to graph the data. Identify situations when a particular statistical regression method would be used (e.g., simple linear regression, multiple linear regression, logistic regression, proportional hazards regression). Use the fitted regression coefficients to obtain slope values (for simple or multiple regression), odds ratios (for logistic regression) or hazard ratios (for proportional hazards regression) for each predictor. Know what kind of a plot is used to assess how well a multiple linear regression model fits the data. 	<ul style="list-style-type: none"> Weekly Readiness quizzes Weekly End-of-Unit quizzes

Interpret results of data analysis for public health research, policy or practice.

Descriptive and Graphical Summaries

- Recognize the variable type, including categorical, continuous, and time-to-event variables.
- Distinguish between the standard deviation (SD or s) and the standard error of the mean (SE or SEM).
- 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; time-to-event variable(s): Kaplan-Meier curve, 5-year survival time, median survival, hazard, hazard ratio).
- 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 when found in a journal article or other material, 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.

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).
- Given a journal article involving a particular statistical test, state the appropriate null and alternative hypotheses (e.g., one, paired, and two-sample t-test; log-rank 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

- Weekly Readiness quizzes
- Weekly End-of-Unit quizzes

	<ul style="list-style-type: none"> • 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, logistic regression, proportional hazards regression). • Write down the equation for a regression model and describe what each parameter means (e.g., simple linear regression, multiple linear regression, logistic regression, proportional hazards regression). • Interpret both the residual plot and the model R^2 value. • Explain what variable selection is, how to recognize it in an article, and why it is a potential issue. 	
Communicate audience-appropriate public health content, both in writing and through oral presentation	<ul style="list-style-type: none"> • Create an Article Review that uses knowledge of statistical concepts to critically evaluate the chosen article. 	<ul style="list-style-type: none"> • Article Review and Literature Project
Perform effectively on interprofessional teams	<ul style="list-style-type: none"> • Work as a team to create the Article Review and the Literature Project 	<ul style="list-style-type: none"> • Project self- and peer-evaluations

Assessment Descriptions	
Weekly Readiness quizzes	The readiness quizzes are based on the readings and lectures. The questions are all multiple-choice format and are written to show that the students have adequately prepared for class as outlined in the unit learning objectives. Examples of questions they may encounter include definitions, matching terminology to situations, and basic interpretation of concepts. Students are encouraged to consult the textbook and the course materials during the quizzes. They may also work collaboratively with other students in the class. Students get up to two attempts on each quiz, and are only shown their quiz score (and not question-level scores) after the attempts. The higher score on the two attempts will be final score that is counted toward their course grade.
Weekly End-of-Unit quizzes	The end-of-unit 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 all 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. The end-of-unit quizzes must be completed independently. Students are encouraged to check all of the forums and collaborative keys for any comments or clarifications from the instructor *before* beginning the quizzes.
Article Review and Literature Project	The Project consists of two major components for the students to demonstrate their ability to read and interpret statistical results in their scientific field of interest. Both components will take place throughout the semester. The <i>Article Review</i> allows the students to use their knowledge of statistical concepts to critically evaluate a chosen article. The <i>Literature Project</i> allows the students to use their knowledge of statistical concepts to create a learning activity. This “learn by teaching” approach will help the students synthesize their understanding of the statistical material. The students will have a choice of working individually or in small groups to complete both components. The culmination of the Project will be sharing your Literature Project with your peers during the last week of the semester.

Project self- and peer-evaluations

The students will have a choice of working individually or in small groups to complete the *Article Review* and the *Literature Project*. Both components require the students to apply the concepts learned in the course at a higher level. Students are required to collaborate to make decisions in each component and complete the necessary project milestones. To assess peer and self contribution to the group, students complete a survey at the end of the semester rating their group members and themselves on each individual's participation (both quantity and quality).