BIOSTATISTICS: BIO9100-01 (6080) / MAT9100-01 (4414)

SYLLABUS AND CLASS SCHEDULE: SPRING 2024

SECTION 1: INSTRUCTOR INFORMATION AND OFFICE HOURS

Instructor: Dr. Tamari

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Lectures: Online-Asynchronous

Labs: N/A

Office Hours: Virtual & optional, Mondays 9:00 AM – 10:00 AM

SECTION 2: COURSE DESCRIPTION

4 Credit(s)4 hrs. Hours Cross-Listed With: MAT 9100 An introduction to the theories and techniques relating to probability, statistics and data analysis as pertaining to biology. Discrete and continuous probability distributions are studied including binomial, normal and t-distributions. Classical and Bayesian statistics, estimation, hypothesis testing will be emphasized. SPSS software will be introduced and used in the laboratory achievements.

Prerequisite(s): MAT 9010 or MAT 9B0 or MAT 900.

Required Core: Mathematical and Quantitative Reasoning. Flexible Core: Scientific World (Group E)

Students who have completed MAT 19A0 or MAT 2010 or MAT 2000 or MAT 2200 /BA 2200 will not receive credit for this course.

SECTION 3: COURSE OBJECTIVES

The objectives of this course are to:

1. Provide students with the theoretical and practical knowledge necessary to understand and carry out statistical tests.
2. Prepare students to interpret results of statistical tests and make informed conclusions.
3. Train students to communicate statistical reports (in an appropriate form, e.g. tables and graphs) and conclusions using oral and written communications skills.
4. Foster analytical and critical thinking skills development.
5. Facilitate the development of communication skills.

SECTION 4: COURSE/STUDENT LEARNING OUTCOMES

1. Calculate measures of central tendency using biological data.
2. Apply the principles and techniques of probability to solve problems in the biological sciences.
3. Select the appropriate inferential test to statistically analyze biological data.
4. Perform an inferential test on biological data.
5. Critique the statistics presented in an article from a scientific journal.

SECTION 5: REQUIRED COURSE TEXTBOOK AND PROTECTIVE EQUIPMENT

Textbook: **OER:** Barbara Illowsky and Susan Dean (Senior Contributing Authors). *Introductory Statistics*. 2018. ***OpenStax***. Rice University. Pdf Version ISBN-10 1-947172-05-0 Pdf Version ISBN-13 978-1-947172-05-0.

Software Manual: **OER:** All required software literature will be either via online videos and/or created and provided by Dr. Tamari. You will need a bound notebook, a ruler, multiple pencils and pens (different colors).

You also will need the following additional items:

1. Graphing notebook
2. Scientific calculator with statistical capacity (e.g. Casio, fx-260, approximate cost 14 dollars, various vendors, or similar)
3. Access to a computer with Wifi capacity and great bandwidth

SECTION 6: ACADEMIC INTEGRITY AND CIVILITY

You are expected to adhere to Kingsborough's Academic Integrity Policy with respect to cheating and plagiarism. "Kingsborough Community College strives to promote academic integrity among students to help prepare them for their future endeavors. The International Center for Academic Integrity defines academic integrity by 5 core values. These values are as follows: **1. Honesty:** The quest for truth and knowledge by requiring intellectual and personal honesty in learning, teaching, research, and service **2. Trust:** Academic institutions must foster a climate of mutual trust in order to stimulate the free exchange of ideas. **3. Fairness:** All interactions among students, faculty and administrators should be grounded in clear standards, practices and procedures. **4. Respect:** Learning is acknowledged as a participatory process, and a wide range of opinions and ideas is respected. **5. Responsibility:** A thriving community demands personal accountability on the part of all members and depends upon action in the face of wrongdoing. To reach academic success, one needs to uphold the 5 core values of honesty, trust, fairness, respect and responsibility. Failure to do so may result in charges of academic dishonesty. Academic dishonesty is prohibited by CUNY and Kingsborough Community College and is punishable by penalties, including failing grades, suspension, and expulsion. Examples of academic dishonesty include, but are not limited to, cheating, plagiarism, internet plagiarism, obtaining unfair advantages, and falsification of records. For further detail, see the KCC website: https://www.kbcc.cuny.edu/studentaffairs/student_conduct/academic_integrity.html"

SECTION 7: STUDENTS WITH DISABILITIES

Access-Ability Services (AAS) serves as a liaison and resource to the KCC community regarding disability issues, promotes equal access to all KCC programs and activities, and makes every reasonable effort to provide appropriate accommodations and assistance to students with disabilities. **Their office is located at the D cluster, room 205, their number is (718) 368-5175, and their email address is aas@kbcc.cuny.edu.** Please contact this office if you require such accommodation and assistance. Your instructor will be glad to provide the accommodation you need, but you must have documentation from the Access-Ability office for any accommodations.

All accommodation requested through Accessibility must be provided by that office in writing directly to the instructor via email. In addition, all requests must be provided with sufficient advance notice, prior to exams.

SECTION 8: BLACKBOARD

Blackboard is an online system that allows you access to my course materials. You will need to use blackboard to download my syllabus, lectures, and assignments and to get pertinent information and announcements about this course. Please use your portal login information (used for registration etc.) to login. Please visit www.cuny.edu, or http://www.kbcc.cuny.edu/bb/ or contact Student Help Desk at L-117 phone: 718-368-6679. You can also go to the following locations for help with Blackboard: 1. Cyber Lounge, Mac Building, M200, 2. Library computer lab, 1st floor. 3. Student help desk, Library, 1st floor - L106, 4. M-224, Mac Building, 2nd floor.

SECTION 9: GRADING

There are three midterm exams, each worth 15% of your final grade. A cumulative final exam constitutes 20% of your final grade. This totals 65% of your final grade. Other assessments account for the remaining 35% of your final grade. You will complete several assignments collectively worth 20% of your final grade. Please note that throughout the course homework will include assignments that you submit for grading, and assignments that you will complete as homework, which are not graded and do not contribute to your final grade. Additionally, you will complete a group computer project, the report contributing an additional 15% to your final grade. There is no extra credit, dropping of grades, or makeup exams under any circumstances. Missed work, with a legitimate excuse (doctor's note or death certificate) will be managed at the discretion of your instructor. The table 1 below summarizes your grading:

Lecture Assessments	**% of Final**	**Other Assessments**	**% of Final**
1st module exam	15	Assignments	20
2nd module exam	15	Computer group project	15
3rd module exam	15	Extra credit	0
Cumulative final exam	20		
Total	**65**	**Total**	**35**

Table 1: Final grade breakdown

Do not miss the exams and assignments and reports, as there are no make-ups offered. Only legitimate excuses such as documented illness or documented death in the family are acceptable. Other excuses are to be considered as legitimate only at my discretion. Grading for students missing an exam or an assignment/report with legitimate excuses will be decided on an individual basis. Failing to write an exam or to complete other work in the course without a legitimate excuse will result in a grade of 0 (zero) for your mark and automatically drops your final grade. The dates for the exams and other work are found in the class schedule and are **tentative**. Possible changes to dates will be announced during meetings or using Blackboard. Please also see the class schedule.

How to succeed in the course:

- Complete all assignments and turn them in on time. Late assignments are not accepted.
- Attend all Blackboard sessions.

- Read and review the assigned textbook pages, slides, and laboratory handouts BEFORE the Live Q&A sessions so you can use this time to ask questions.
- Review your class notes as soon as possible after lecture and immediately before lecture.
- Participate in a study group on a weekly basis. This can be done through Zoom, or any other group meeting apps available.
- Know the vocabulary! You need to know the vocabulary to understand the concepts.
- Get a good night's sleep before the exam.

SECTION 10: OTHER INFORMATION

BIO 9100 is offered as an online/asynchronous course. As such there are no in-person/synchronous meetings, other than the optional on-line office hours. In lieu of attendance, you must submit all assessments (exams, assignments, projects) on time and by the given deadlines as per the class schedule below. In addition, there are informal assignments/homework that are submitted but are not graded. This work must also be completed by the announced deadlines or those provided in the class schedule. In addition to their academic values, there is an administrative purpose for such assignments. **Students who fail to participate or complete the work by the VOE Roster due date stated in the Academic Calendar will receive a grade of WN.**

Please use your school email account **only** for all communications. Email sent via personal email accounts will be deleted without a response.

SECTION 11: COURSE TOPIC OUTLINE AND SCHEDULE			
Week	**Date**	**Weekly lecture module & activities**	**Assignment & Assessments**
1	3/1-3/8	Course introduction. Class syllabus + class policies + class schedule **Chapter 1: Sampling and Data** 1.1 Definitions of Statistics, Probability, and Key Terms 1.2 Data, Sampling, and Variation in Data and Sampling 1.3 Frequency, Frequency Tables, and Levels of Measurement 1.4 Experimental Design and Ethics	
2	3/11-3/15	**Chapter 2: Descriptive Statistic** 2.1 Line Graphs, and Bar Graphs 2.2 Histograms, Frequency Polygons, and Time Series Graphs 2.3 Measures of the Location of the Data 2.5 Measures of the Center of the Data 2.6 Skewness and the Mean, Median, and Mode 2.7 Measures of the Spread of the Data 2.8 Descriptive Statistics	Assignment 1: Blackboard quiz on syllabus. Due: March 14
3	3/18-3/22	**Chapter 3: Probability Topics** 3.1 Terminology 3.2 Independent and Mutually Exclusive Events 3.3 Two Basic Rules of Probability 3.4 Contingency Tables 3.5 Tree and Venn Diagrams	Assignment 2: Data graphing. Due: March 22
4	3/25-3/29	**Chapter 4: Discrete Random Variables** 4.1 Probability Distribution Function (PDF) for a Discrete Random Variable 4.2 Mean or Expected Value and Standard Deviation 4.3 Binomial Distribution 4.6 Poisson Distribution	
5	4/1-4/5	**Chapter 5: Continuous Random Variables** 5.1 Continuous Probability Functions 5.2 The Uniform Distribution **Chapter 6: The Normal Distribution** 6.1 The Standard Normal Distribution 6.2 Using the Normal Distribution **Chapter 7: The Central Limit Theorem** 7.1 The Central Limit Theorem for Sample Means (Averages) 7.2 The Central Limit Theorem for Sums (Optional) 7.3 Using the Central Limit Theorem	Exam 1: Chapters 1, 2, 3, 4. Date: April 4 Introduction to formal project and group formation
6	4/8-4/12	**Chapter 8: Confidence Intervals** 8.1 A Single Population Mean Using the Normal Distribution 8.2 A Single Population Mean Using the Student's t-Distribution 8.3 A Population Proportion	
7	4/15-4/19	**Chapter 9: Hypothesis Testing with One Sample** 9.1 Null and Alternative Hypotheses 9.2 Outcomes and the Type I and Type II Errors 9.3 Distribution Needed for Hypothesis Testing 9.4 Rare Events, the Sample, and the Decision and Conclusion 9.5 Additional Information and Full Hypothesis Test Examples	
8	5/1-5/10	**Chapter 10: Hypothesis Testing with Two Samples** 10.1 Two Population Means with Unknown Standard Deviations 10.2 Two Population Means with Known Standard Deviations 10.3 Comparing Two Independent Population Proportions 10.4 Matched or Paired Samples	Exam 2: Chapters 5, 6, 7, 8, 9. Date: May 2 Formal project data selection Assignment 3: T-Test. Due: May 1
9	5/13-5/17	**Chapter 11: The Chi-Square Distribution** 11.1 Facts About the Chi-Square Distribution 11.2 Goodness-of-Fit Test 11.3 Test of Independence 11.4 Test for Homogeneity 11.5 Comparison of the Chi-Square Tests 11.6 Test of a Single Variance	Formal project data setup

10	5/20-5/24	**Chapter 12: Linear Regression and Correlation** 12.1 Linear Equations 12.2 Scatter Plots 12.3 The Regression Equation 12.4 Testing the Significance of the Correlation Coefficient 12.5 Prediction	Assignment 4: Chi-square statistics. Due: May 21 Formal project write-up Exam 3: Chapters 10, 11, 12. Date: May 23
11	5/27-5/31	**Chapter 13: F Distribution and One-way ANOVA** 13.1 One-Way ANOVA 13.2 The F Distribution and the F Ratio 13.3 Facts About the F Distribution 13.4 Test of Two Variances	
12	6/3-end	**Special Topics: Non-Parametric Tests** ST. 1 Mann-Whitney U test. Kruskal Wallis Test ST. 2 Kruskal Wallis Test	Formal project due: June 3 Final Cumulative Exam: All chapters. June 7

This schedule is tentative & subject to change by Dr. Tamari as needed during the semester. This syllabus, and the course schedule of topics, are subject to change by consideration of the instructor, or by factors outside the instructor's control. Changes will be announced on Blackboard &/or by email. Please check your emails & Blackboard frequently (on a daily basis). All work is due by 10:00 pm on the date indicated. Reading modules involve reading chapters/notes/other posts.

STUDENT OBJECTIVES (Adopted from Dr. M. Ortiz)

Ch.1 – Sampling and Data

- Define: data, statistics, population, sample, parameter, statistic, qualitative, quantitative, discrete, continuous.
- Distinguish between sample and population, parameter and statistic, a retrospective and prospective study, a single and double blind study.
- Define: observation study, experiment, clinical trial, treatment group, control group, cross sectional study, retrospective and prospective study, placebo effect, blinding, single and double blinded study, randomization, replication, error.
- Provide an example of systematic, convenience, stratified and cluster sampling.

Ch.2 – Descriptive Statistics

- Define: frequency distribution, histogram.
- Construct a frequency distribution for biological data.
- Construct a histogram, pie chart, time-series graph.
- Define: mean, median, mode, midrange, skewness.
- Calculate a mean, median, mode, midrange for a set of biological data.
- Define: range, standard deviation, and variance.
- Calculate the range, standard deviation and variance for a set of biological data.
- State and use Chebyshev's Theorem.
- Define: standard z score, quartile, and percentile.
- Calculate a standard z score for a set of biological data.
- Determine the quartiles and percentiles for a set of biological data.

Ch. 3 – Probability Topics

- Define: prevalence, event, probability, mutually exclusive, independent, and dependent.
- Calculate the probability of a biological event.
- State and use the Addition Rule for probability using biological data.
- State and use the Rule of Complementary Events for probability using biological data.
- State and use the Multiplication Rule for probability using biological data.
- Define Conditional Probability.
- Define and calculate rate, mortality rate, fertility rate, morbidity rate for a population.

Ch. 4 – Discrete Random Variables

- Define: random variable, probability distribution, discrete random variable, binomial probability distribution.
- Analyze a probability distribution for a set of biological data.
- Determine whether a set of biological data meet the requirements for a binomial distribution.
- Determine the mean, variance and standard deviation for the binomial distribution of a set of biological data.
- Define and use the Poisson Distribution for a set of biological data.

Ch. 5 – Continuous Random Variables

- Define: continuous random variable

Ch. 6 – The Normal Distribution

- Define: normal distribution, uniform distribution, standard normal distribution.
- Analyze the normal distribution for a set of biological data.

Ch. 7 – The Central Limit Theorem

- State the Central Limit Theorem.
- Apply the Central Limit Theorem to a set of biological data.
- Use the Normal Distribution as an approximation to the Binomial Distribution on a set of biological data.

Ch. 8 – Confidence Intervals

- Distinguish between proportion, probability and percent.
- Define: confidence interval.
- Determine the confidence interval for a set of biological data.
- Estimate a population mean with standard deviation known.
- Estimate a population mean with standard deviation unknown.

Ch. 9 – Hypothesis Testing with One Sample

- Define: hypothesis, hypothesis test.
- Given a claim, state the null and alternative hypothesis.
- Given a claim and biological data, calculate the test statistic.
- Identify the Critical and P-Values for a set of biological data.
- State the conclusion of a hypothesis test on a set of biological data.
- Identify potential errors when testing a claim about biological data.
- Test a claim about a proportion.
- Test a claim about a mean with standard deviation known.
- Test a claim about a mean with standard deviation unknown (t-Test).

Ch. 10 – Hypothesis Testing with Two Samples

- Use a test statistic to compare two population proportions.
- Perform a t-Test on two means with independent samples.
- Perform a t-Test on matched pairs of biological data.
- Perform an F-Test on a set of biological data.

Ch. 11 – The Chi-Square

- Estimate a population variance.
- Test a claim about a standard deviation or variance.
- Test for Independence or Homogeneity

Ch. 12 – Linear Regression and Correlation

- Define: correlation, scatterplot, linear correlation coefficient (Pearson Coefficient), regression.
- Perform a correlation on a set of biological data.
- Perform a regression on a set of biological data.

Ch. 13 – F Distribution and One-Way ANOVA

- Define ANOVA.
- Perform a One-Way ANOVA on a set of biological data.

Special Topics – Nonparametric Tests

- Define: parametric test, nonparametric test, Wilcoxon Rank-Sum Test, Kruskal-Wallis Test (H Test).
- Perform a Wilcoxon Rank-Sum Test on a set of biological data.
- Perform a Kruskal-Wallis Test (H Test) on a set of biological data.