Composite Course Syllabus: CAS MA 213 Basic Statistics and Probability

Instructor Name:
Office Location:
Contact Information: instructor@bu.edu, etc.
Office Hours:

Course Dates:
Course Time & Location:
Course Credits:

TA/TF/Learning Assistant information, if relevant

Question-driven Course Description.
How can a polling firm take a sample of a few hundred people and use the results to predict the outcome of an election with hundreds of millions of voters? How do pollsters compute the margin of error and what does it mean? How do we verify a claim based on a small sample? For example, if you flip a coin 100 times and it lands on heads 60 times, does this "prove" the coin is unfair or is this observation a likely outcome for a fair coin?

Statistics is the process of interpreting the evidence from a sample so that we may draw valid inferences about the population as a whole. This course serves as an introduction to basic concepts and tools in probability and statistics. We begin with techniques for describing data. Then we study the elements of probability theory, including probability densities, means, variances, correlation, independence, the binomial distribution, and the central limit theorem. Finally, we combine data description and probability theory into an approach to statistical inference. Students should emerge from this course with the ability to incorporate a variety of skills in analyzing and reasoning from data.

In addition to lecture and discussion sessions all students must be enrolled in the MA213 lab. The labs will utilize three educational strategies: active learning, experiential learning, and project based learning activity.

Hub Learning Outcomes
In this course students will acquire a wide range of quantitative skills including those that are required to satisfy the BU Hub Quantitative Reasoning Unit II.

In particular,

1. Students will use statistical methods to set up problems arising from real world situations, including deciding on their own real world topic of interest and developing statistical questions.
2. Students will apply statistical tools to analyze sets of data in order to make inferences about the populations of interest.
3. Students will use statistical methods on data sets to analyze claims about populations of interest.
4. Students will take data and give graphical and numerical summaries. They will be expected to present these summaries to their peers in a class presentation.
5. Students will give a margin of error and a degree of uncertainty with any inferential statistical analysis. A key component of statistics is being able to quantify the likelihood of drawing the wrong conclusions from observations.

This course, particularly the lab, will also satisfy one unit of Teamwork/Collaboration from the BU Hub Intellectual Toolkit.

1. Students will be assigned to groups to promote diversity of backgrounds, skills, and work ethic by using a survey conducted on the free online platform CATME (http://info.catme.org/). During the

first lab meeting students will be given a team policies worksheet and determine team expectations that they will adhere to for the remainder of the semester. Students will also be regularly provided with extra guidance on teamwork including communications strategies and ways to promote team cohesion and individual accountability. Students will be directed to read "Successful teamwork: A case study" (Tarricone, Luca, 2002) and to watch presentations on effective teamwork provided by Babson College. These resources and the sustained experience of collaboration will enable students to identify the characteristics of a well-functioning team.

2. Students will be assigned roles, including coordinator, recorder, monitor, and checker, that will rotate among team members throughout the course to encourage equal and varied contributions from each student. Students will be provided with troubleshooting strategies for dealing with problems that may arise in their team. Peer-, self- and team-evaluations will be collected and students will be encouraged to regularly discuss team roles and to plan for upcoming tasks and reports. These evaluations will be used to help direct students in techniques for troubleshooting and problem solving within the team. Peer ratings will also be used to adjust scores for each team member.

School, Department, and/or Program Outcomes.
List and link to larger program (e.g., major/minor).

Course-Specific Objectives.
1. Students will demonstrate an understanding of the fundamental concepts of probability and statistics---probabilities of events, probability densities, independence, conditional probability, estimation, confidence intervals, and testing.
2. Students will demonstrate an ability to carry out the computations that are expected of someone who has completed a first course in statistics. This will include the use of statistical software to perform these calculations. They will be able to compute probabilities for binomial, normal, t, and Poisson random variables, and will be able to compute sample means, variances, correlations, confidence intervals and p-values. Students will also be able to use Monte Carlo methods.
3. Students will demonstrate an understanding for the major theory discussed in the course. This will include the basic set theory, axioms of probability, combinations, Bayes rule, and the central limit theorem.

Instructional Format, Course Pedagogy, and Approach to Learning
Instructors might find the **CTL BU Hub Guides** helpful for this section.

Books and Other Course Materials

Title	**Statistics**
Author	James T. McClave; Terry Sincich
ISBN	978-0-13-408021-5
Publisher	Pearson Education
Publication Date	January 3, 2016

Courseware
This class will use blackboard www.learn.bu.edu to post homework assignments, lab activities, and information about the project.

Assignments and Grading Criteria.

1. GRADING: problem sets (25%), project (20%), lab activities (5%), midterm exam (20%), and a final exam (30%).
2. HOMEWORK: Homework problem sets will be assigned each Tuesday and due the following

week (in discussion sessions). These assignments will consist of problems taken from the course textbook. Please feel free to collaborate on these, but make sure that the problem sets you hand in reflect your own understanding of the material. Late homeworks will not be accepted at all. See table below for assignments and due dates.

3. DATA COLLECTION AND ANALYSIS PROJECT: You will work in groups to complete a semester long project, in which you will identify some interesting questions to address, collect data, and perform a statistical analysis using the methods we will learn in class. You will hand in a number of project milestones throughout the semester, submit a final project report, and present your findings to the class. Students peer-evaluations will also be incorporated into assessment of the team data collection and analysis project.
4. SCHEDULE OF EXAMS: The midterm exam will be held on Thursday, October 19th from 12:30pm to 1:45pm and will cover all that has been done up to Tuesday, October 17th included. The (cumulative) final exam date will be announced later. No documents or calculators will be allowed.
5. EXTRA CREDIT OPPORTUNITIES: There are a number of ways to earn extra credit for the course. In each class, there will be clicker questions to test your comprehension of the material. The more questions you get right, the more extra credit you earn. You will also earn a bonus for answering at least 90% of all the clicker questions in the lecture and lab/studio sections. Extra credit points for outstanding participation in the discussion sections will also be awarded.

Resources/Support/How to Succeed in This Course:

1. You are welcome and encouraged to visit the office hours. If you are not able to attend, please email to set up an alternate time.
2. The Mathematics and Statistics Tutoring Room, MCS B24, is open Monday-Thursday, 10am-4pm, and Friday, 10am-2pm, until classes end on December 12. The schedule is posted here. This room is also a good place to study between classes.
3. Professor Wayne Snyder will supervise "Math Help Night" in the Cinema Room of Rich Hall on West Campus on Tuesdays, 7:30-10:30 pm. You do not need to live on West Campus to take advantage of this opportunity.
4. The Education Resource Center offers free individual and group tutoring. The Center gets very busy as the end of the semester approaches, so it is good to make contact with them earlier rather than later.
5. Accommodations for Students with Documented Disabilities: If you are a student with a disability or believe you might have a disability that requires accommodations, please contact the Office for Disability Services (ODS) at (617) 353-3658 to coordinate any reasonable accommodation requests. ODS is located at 19 Deerfield Street on the second floor.
6. To succeed in this course students should come to class having read the material beforehand, attend all lectures, come to discussion prepared with questions, complete all assignments on time, and discuss problems and material with your fellow classmates. Sometimes it may not be

Community of Learning: Class and University Policies

1. Course members' responsibility for ensuring a positive learning environment (e.g., participation/ discussion guidelines).

2. **Attendance & Absences.** If for some reason you are not able to attend a lecture, discussion, or lab session, please let the appropriate instructor know so that the appropriate accommodations may be made. If you know that you will miss a lab, you need to contact the members of your group to have them fill you in on what you missed. **BU Policy on Religious Observance**

3. **Assignment Completion & Late Work**. No late homework will be accepted. If you know of a planned absence, for example a religious holiday, please arrange to turn in any assignments ahead of time if it can be reasonably completed before the due date.

4. **Academic Conduct Statement.** Please feel free to collaborate on homework assignments, but make sure that the problem sets you hand in reflect your own understanding of the material. The lab activities will be completed as a group, however it is up to each individual, and the group as a whole, to ensure that the group members share an equitable amount of work. Of course, no phones are allowed during exams. Academic Conduct Code: *https://www.bu.edu/academics/policies/academic-conduct-code/*

Detail of Class Meetings: Date, Topic, Readings Due, Assignments Due
This detail of class meetings is for the fall 2017 semester. There is a slight shift of which topics are covered in which week due to the varying holiday schedule.

Week	Class	Topics or Activities
1	Lecture	Class logistics, terminology, graphs, numerical measures of central tendency and variability
	Lab 1	Assigned into groups, decide on the topic of interest for the project
2	Lecture	Standard deviation, z-scores, outliers, bivariate relationships, errors in statistical analyses
	Lab 2	Descriptive Statistics activity
3	Lecture	Probability, sample points, events, combinations, unions and intersections, additive rule, mutually exclusive events, conditional probability
	Lab 3	Project design: identify variables of interest, develop plan to collect data
4	Lecture	Bayes' rule, random sampling, random variables, discrete random variables, probability distributions
	Lab 4	Monte Carlo lab activity. Start collecting a small sample of data for the project.
5	Lecture	Continue discrete random variables, continuous random variables, uniform distribution
	Lab 5	Analyze pilot data for project. Identify issues with data collection that need to be addressed before large scale data collection.
6	Lecture	Normal distribution, assessing normality
	Lab	No lab due to holiday
7	Lecture	normal approximation to binomial, exponential distribution, Midterm Exam
	Lab 6	Conditional probability and Bayes' rule lab activity
8	Lecture	Continuous random variables, sampling distributions
	Lab 7	Provide descriptive statistics and graphs for project data, identify any correlations
9	Lecture	Central Limit Theorem, distribution of sample proportion, confidence intervals, large sample confidence intervals. (Sections 7.1-7.4)
	Lab 8	Confidence interval lab activity
10	Lecture	Large sample confidence interval for proportion, determining sample size, hypothesis tests. (Sections 8.1-8.4)
	Lab 9	Make inferences from project data: provide confidence intervals, conduct hypothesis tests
11	Lecture	One and two-tailed tests, z-test, p-value, t-tests, test for proportions.
	Lab 10	One-sample and two-sample hypothesis testing
12	Lecture	Power of a test, chi-squared test for variance
	Lab	No lab due to holiday

13	Lecture	Hypothesis test and confidence intervals for standard deviation, and hypothesis test and confidence intervals for two means; both independent sample and paired difference
	Lab	Project presentations day 1
14	Lecture	Hypothesis test for two sample proportions, determining sample size
	Lab	Project presentations day 2. All projects due in lab
15	Lecture	Review
	Lab	No labs due to no classes