

Math 207Q, Probability and Statistics
Spring Semester, 2014
Dr. Evelyn Bailey

Office hours: Posted weekly on the class conference

Reader: Super Crunchers by Ian Ayres

Materials: Typed formal notes with homework problems, class notes, and articles are provided on the Blackboard conference; a calculator (TI-84, or equivalent).

Content: Probability, Bayes Theorem, counting, probability functions (in general), Chebyshev's Theorem, discrete distributions (binomial, hypergeometric, Poisson, uniform), continuous distributions (Exponential, Normal, Uniform), Central Limit Theorem, visual displays of data, measures of central tendency and of variability, classification of data, Confidence Intervals, Hypothesis Testing (for means and for proportions, for one and two samples), Chi Square goodness of fit tests and Contingency Tables, one-way ANOVA, simple linear regression and correlation, nonparametric tests (median, Wilcoxon Rank Sum Test, Kruskal-Wallis Test). The first half uses calculus to explore concepts of probability upon which statistics is based.

Goals: At the end of this course students should be able to:

- * work various probability problems,
- * understand the role of functions in statistics,
- * categorize data,
- * recognize several standard distributions,
- * analyze interval data involving difference of means, difference of proportions,
- * check for inherent assumptions for the statistical models in this course,
- * interpret relationships in bivariate data,
- * compare distributions of responses,
- * analyze data using rankings (nonparametric statistics),
- * understand the role of statistics in analyzing data and in inference,
- * describe major misuses of statistics.

In addition, each student will be expected to actively participate in a class project that includes gathering and analyzing data, writing a formal report, and presenting this report to the appropriate audience. The class project takes time and needs all students participating. Out of class meetings with other students are necessary.

Inquiry: Math 207 is an inquiry (INQ) course. Courses driven by inquiry are designed to be transformative in that students not only learn elemental concepts, principles, assumptions, and terminology of a particular discipline, but they understand and question the way knowledge is sought by actively learning and practicing the discipline's approaches to inquiry. These explorations often engage ethical issues and social responsibility, make connections across disciplines, and create contexts for experimental learning. Ways of Inquiry courses, although primarily focus on ways of seeking knowledge rooted within a given discipline, also strive to develop students' abilities in areas that in some ways transcend disciplines: reading critically, writing cogently, communicating effectively, and independently pursuing knowledge through inquiry.

Pre-requisite: It is assumed that students enrolled have completed Calculus II, either Math 112 or AP score of 4 or 5. Concepts from calculus will be briefly reviewed as needed but not taught.

Grading: Grades will be determined by student performance on four different problem sets, two group experiments, a class project, responses to the reader, and a final exam.

In addition, there will be opportunities for **extra credit work**. Extra credit problems are usually not the standard type problems but those that require more thought and some original work. **You must do work independently for credit on bonus work unless otherwise indicated and pledge that you have done so.** Points earned on extra credit will be added to your total points that will determine your grade.

The total sum of points for each student determines the student's grade.

Points are determined as follows:

4 problem sets @ 100	400
2 small group experiments @ 40	80
1 Class Project	200
3 Responses to the Readers @40	120
1 final exam	<u>200</u>
Total	1000 points

In general,

900 points and up	A, A-
750 to 899 points	B+, B, B-
600 to 749 points	C+, C, C-
below 600 points	F

Some Policies:

Problem Sets: All **problem sets** will be given out at least one week before the due date. All problem sets are due at class time on the dates indicated. Fifty points will be deducted per day for late problem sets. Emergencies will be handled on an individual basis.

For work on problem sets, you will select a partner with whom to work. (In case of an odd number, a student may elect to work alone or three students may get permission to work together). You and your partner may use your own notes (those you have taken in class), the notes provided for this class, and your calculator. You will turn in ONE problem set with signatures of those to be credited. In addition, summarize the contributions made by each person.

Group Experiments: Instructions regarding **group experiments** will be explained in class, on the day the experiment is assigned. There will be two experiments, worked in small groups (two or three students each). Dates are given on the attached outline.

Class Project: The class project will be in a survey form. We will elicit students' opinions about the Writing Center. We will be closely working with Joe Johnson, director of the Writing Center. The class will design, pilot the survey. The class will collect data and analyze the data. The end result will be a presentation and a final typed report.

The class project includes components of a good experimental design: determining well-defined question(s) and researching information related to what is to be accomplished, designing and piloting a survey or an interview format of questions, finalizing a survey or interview outline, gathering data (random sampling), analyzing data, making conclusions, determining concrete recommendations, and presenting findings to the appropriate audience.

The class elects a chairperson and secretary for the class project. The secretary keeps up with what is accomplished in class meetings and posts information from other class members so that there is a complete record of the procedure. The chairperson conducts class during those times we work on the class project. The chairperson is to keep Dr. Bailey informed of progress and to discuss any problems.

Each person in the class is expected to contribute substantially in many and various ways. To this end, each student will keep a log that includes the individual's ideas, thoughts, and contributions to the project along with a record of what and when his/her contributions took place. This log may be kept on the student's computer and printed out at the end of the semester OR the log may be recorded in a notebook.

The class project paper is due (typed, polished, complete copy posted on the class conference) no later than **April 4**. The date for the presentation can be determined after consulting with those who will be invited but should be done sometime **between April 9 - 23**, the sooner it is scheduled, the better we will be able to get those who are interested to attend. The presentation includes an appropriate power point.

It is important to stay on schedule so as to have a complete project of which you may be proud. **The syllabus topics will be shifted to accommodate the presentation and needed time to work on the project in class.**

Periodically, your instructor will post (by number of checks) the evaluation of your contribution to the class project. This evaluation will be based on postings on the conference, contributions related to the project during class time, activities related to the class project, and other visual and auditory information from others in the class. The log is the final verification of individual participation for each participant's grade (number of points) on the class project.

Homework Problems: Homework problems may be worked with other members of this class. Some solutions to some homework will be posted on the class conference. You will need to keep your class notes and homework problems well organized and complete so that they will be useful to you on your problem sets and the final exam.

Reader: Three individual assignments from the reader, *Super Crunchers*, are scheduled. Each student completes these assignments **individually**.

Responsibilities:

* Each **student** has the following responsibilities:

1. Come prepared and on time to every class.
2. Complete all work on time with proper thought.
3. Consider that it is not always the fault of the instructor if the student doesn't understand the material. Use your outside help (office hours, SI sessions, e-Reserves)
4. Treat the instructor and peers with respect.
5. Ask questions. Asking questions is a sign of maturity, not ignorance, as long as the student thinks clearly before asking.
6. Understand that the instructor is not trying to "nit pick" when grading and remember that grading is the responsibility of the instructor. Accuracy is important in this class!
7. Actively participate in the class project by contributing as needed to the outcome.

* The **instructor** has the following responsibilities:

1. Come prepared to every class.
2. Design each class so students can accomplish the cognitive objectives listed in the syllabus.
3. Provide appropriate tips for studying and study materials as seem appropriate.
4. Create a mutually respectful classroom environment.
5. Return tests and quizzes in a timely manner so that students will know their grade.
6. Grading, as far as possible, to be consistent and impersonal even though students might not agree with the decisions concerning partial credit.
7. Providing class time for students to organize, to work together, and to discuss the class project.

THE HONOR CODE OF OXFORD COLLEGE APPLIES TO ALL WORK IN THIS CLASS! YOUR PROBLEM SETS AND ANY OTHER WORK ARE PLEDGED TO BE IN ACCORDANCE WITH INSTRUCTIONS GIVEN FOR THE ASSIGNMENT.

OUTLINE

Changes may occur to accommodate the class project. We will complete all topics.

INTRODUCTION

Wednesday, January 15
Friday, January 17

Introduction, Orientation, Jerome Cardan, Model
Building, Class Project, Experimental Design

Read the Math 207 projects posted on the conference. Prepare any questions you may have about the study.

PROBABILITY

Wednesday, January 22	Class Project,
Friday, January 24	Definitions, Addition Rule, Multiplication Rule,
Monday, January 27	Bayes Theorem, Birthday Problem, Craps,
Wednesday, January 29	

Know definitions: experiment, sample space, certain event, impossible event, mutually exclusive, independent

Reader Assignment I assigned 1/22, due on 1/27

Finish problems on probability in the typed notes.

COUNTING

Friday, January 31	Fundamental Theorem of Counting, permutations,
Monday, February 3	combinations, Lottery models, Probability and
Wednesday, February 5	Counting

Group Experiment I assignment on 2/3, due 2/10

Finish problems on Counting in the typed notes.

FUNCTIONS (THEORETICAL)

Friday, February 7	Random Variable, Density Functions
Monday, February 10	Joint Density Functions, Marginal Distributions
Wednesday, February 12	

Be able to explain the difference between a pdf and a cdf for continuous and discrete functions.

Receive Problem Set 1 on 2/7, due 2/14

Group Experiment due 2/10

Problems in typed notes.

Know the following definitions: random variable, joint probability distribution, marginal distribution, conditional distribution, independence.

DISCRETE FUNCTIONS

Friday, February 14	Discrete Functions, Binomial Distribution,
Monday, February 17	Poisson, Hypergeometric, and Uniform Distributions

Problem Set 1 due on 2/14

Problems in typed notes.

Know the following definitions: expectation, moments (about the origin and about the mean), mean, variance, skewness, kurtosis.

Reader Assignment II given on 2/17, due on 2/21

CONTINUOUS FUNCTIONS

Wednesday, February 19 Continuous Functions, Chebyshev's Theorem, Normal
 Friday, February 21 Distribution, empirical rule, Central Limit Theorem,
 Monday, February 24 Normal to approximate the binomial as a model, uniform

Problems in typed notes

Reader Assignment II due on 2/21

Receive Problem Set II on Friday, 2/24, due on 3/3

DATA AND MEASUREMENTS

Wednesday, February 26 Descriptive Statistics
 Friday, February 28 Data measures and classification

Problems in typed notes.

Know the following definitions: random sample, stem-and-leaf, outlier, statistical inference, histogram, quartiles, parametric vs nonparametric statistics, types of data (nominal, interval, ordinal, ratio), measures of central tendency and of variability.

CONFIDENCE INTERVALS

Monday, March 3 Confidence Intervals for means and for proportions
 Wednesday, March 5

Problem Set II due on 3/3

Know the following terms: inferential statistics, point estimate, maximum error of estimate.

Friday, March 7 Review Progress on the Class Project

Complete anything for which you are responsible for the Class Project

Spring Break March 10 - 14

HYPOTHESIS TESTING

Monday, March 17 Theoretical hypothesis testing

Reader Assignment III given, due 3/24

Definitions and problems in the typed notes

Wednesday, March 19 Hypothesis testing – means (one sample,
 Friday, March 21 and small)

Problems in the typed notes

Monday, March 24	Means continued [two samples (dependent, large
Wednesday, March 26	sample, small sample, homogeneity of variance)]

Reader Assignment III due on 3/24

Problems in typed notes

Friday, March 28	Hypothesis Testing - proportions, and
Monday, March 31	Review Hypothesis Testing

Problems in the typed notes

Receive Problem Set III on 3/31, due 4/7

NOTE: Course topics on the schedule below may be altered based on timing needs for the class project and presentation schedule . . .

REGRESSION

Wednesday, April 2	Correlation and Simple Linear Regression
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Problems in the typed notes

Know the following definitions: bivariate data, coefficient of determination, covariance, method of least squares, spuriously correlated

Friday, April 4	ANOVA/Status of Class Experiment Evaluated
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Problems in the typed notes

Class Project Report due

Begin putting together the power point and discuss the presentation to be given one day **between April 9 – April 23**

NONPARAMETRIC STATISTICS

Monday, April 7	Chi Square Tables, Multinomial Experiment
Wednesday, April 9	Class Project
Friday, April 11	

Problems in the typed notes

Problem Set III due 4/7

Group Experiment II assigned on 4/7, due 4/18

Monday, April 14	Wilcoxon Rank-Sum, Kruskal-Wallis
Wednesday, April 16	

Problems in the typed notes

Receive Problem Set IV on 4/16, due 4/25

PULL IT ALL TOGETHER

Friday, April 18	Discuss Major Misuses of Statistics, Catch Up
Monday, April 21	
Wednesday, April 23	Review, Evaluate
Friday, April 25	
Monday, April 28	

Finish problems in typed notes

Group Experiment due 4/18

Individual logs due 4/21

Problem Set IV due Friday, 4/25

Receive Take Home part of final exam due on 4/30

Wednesday, April 30 Absolute deadline for *take home* final exam.

Wednesday, April 30 9:00 am, *in class* final exam

Statistical thinking will one day be as necessary for efficient citizenship as the ability to read and write.

H. G. Wells