# **36-226 Introduction to Statistical Inference** Spring 2015

Instructor: Rebecca Nugent Baker Hall 232C

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Office Hours: TBA

#### **Teaching Assistants:**

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Class Meetings: Mondays, Wednesdays, Fridays 9:30-10:20am, GHC 4401

Website: http://www.cmu.edu/blackboard

#### **Prerequisites:**

at least a C in any of 15-359, 21-325, 36-217, 36-225, solid understanding of calculus

### Textbook:

Mathematical Statistics with Applications, 7th Ed. Wackerly, Mendenhall, Scheaffer

#### General Course Plan:

This course is the second half of a year long course in probability and mathematical statistics. Using the probability theory developed in a mathematical probability class, such as 36-225, this course turns to the basic ideas and methods of analyzing data and making inferences about an unknown population based on information contained in a sample. We will study the formalisms behind frequently used statistical methods, and develop a link between statistical theory and practice. Topics include methods and properties of estimation, hypothesis testing, linear models, and analysis of variance. In addition, we will emphasize the application of statistical methods and the interpretation and the analysis of data. Time permitting, we will include categorical data analysis, nonparametric statistics, and Bayesian inference.

## **Course Objectives:**

- 1. Learn and apply the basic ideas and methods that underlie the mathematical theory of statistics.
- 2. Develop and use methods for summarizing and evaluating numerical data.
- 3. Develop skills in the applications of statistical methods to problems in the sciences and the social sciences, including specification of models, assessment of model assumptions, and interpretation of results.
- 4. Use the statistical package R to complement statistical theory

**<u>Course Work:</u>** Your grade in this course will be determined by homework assignments, two midterms, and a final exam.

• Weekly homework assignments will be due at the beginning of class (9:30am) on Fridays. Assignments should be submitted in class. Late homeworks are not accepted (exceptions may be made depending on circumstances; instructor permission required in advance). Note that the HW deadline is the <u>beginning</u> of class. There is a grace period of 10 minutes to account for printer mishaps, etc. HWs received after the grace period will not receive any credit (but you can request grading for feedback).

<u>Homework Format:</u> name on front page; questions answered in order; all answers marked and labeled. *If you do not staple (or paper clip) your homework, we will take off points.* You must show ALL WORK. You will not receive credit for just writing down a numerical answer or mathematical expression. How you arrived at the solution is more important.

If the HW requires R output or graphs, just circling the answers or attaching graphs with no labels or explanation is not acceptable. Answers should be written up appropriately. Any required graphs should be as close to the corresponding problem as possible.

- The two midterm exams will cover material from (roughly) the previous five weeks. They will be Thursday evening exams (see schedule) and will be closed book/closed notes. You will be given a formula sheet for the exam (made available in advance). **Conflicts with exam times must be discussed in advance; missed exams will not be made up.**
- The final exam is cumulative; the day/time of the final exam will be determined by the registrar. It is your responsibility to ensure that any travel plans do not conflict with the final exam. There will be no makeup exams. As with the midterms, the final exam is closed book/closed notes. You will be given a formula sheet (made available in advance).

**Grading policy:** You are encouraged to discuss homework problems with your fellow students, however the work you submit must be your own. Acknowledge any help received on your assignments. Copied work will receive no credit. Your lowest homework grade will be dropped. **Please come talk to me if there are difficulties; problems/conflicts must be discussed IN ADVANCE.** Cheating/copying on exams results in a zero for the exam and a letter to your dean. Do your own work. Final grades will be computed with the following weights:

Homeworks	.30
Midterm Exam 1	.20
Midterm Exam 2	.20
Final Exam	.30

You have <u>one week</u> from the day an assignment, exam, etc is handed back in class to bring any grading issues, comments, complaints, etc to the attention of the instructor. Please note that if you are absent the day something is handed back, you will not receive an extension unless arrangements have been made in advance with the instructor.

Final letter grades will be determined as usual: [90,100] = A, [80,89] = B, [70,79] = C, [60,69] = D, [< 60] = R. Grades may be curved at the instructor's discretion.

NOTE: you must receive at least a C in 36-226 to be able to enroll in 36-401, 36-402, 36-46x.

**Computing:** The statistical computing package we will use in this course is R. R is available on many campus computers, and you may download a free version from www.r-project.org. You may also use the nearly-identical (but not free) program called S+, available on all campus computers. You can obtain a free temporary version from myandrew. This version is good for 1 year; you can keep renewing the license as long as you are a CMU student.

R References: manuals available on R website;

http://www.stat.cmu.edu/~rnugent/teaching/introR Introductory Statistics with R, Peter Dalgaard; Springer-Verlag Modern Applied Statistics with S-Plus Venables, Ripley; Springer

**Laptop Policy:** Students are expected to be participating in class; any laptop use during class should pertain directly to the class. Instructor reserves the right to not allow laptop use during class. When the class has a guest speaker, laptops must be turned off and put away.

**Cellphones/Pagers, etc**: All cellphones, pagers, and anything else that makes noise should either be turned off or silenced during class. Texting is not allowed nor is it acceptable professional behavior.

**Communication:** Assignments and class information will be posted on Blackboard. Help with using Blackboard is available at www.cmu.edu/blackboard/help/. Emails will be sent to the class from stat.cmu.edu; email filters should be set to receive emails from that server.

**Email:** Sending email to your professor or teaching assistants should be treated as professional communication. Emails should have an appropriate greeting and ending; students should refrain from using any kind of "shortcuts", abbreviations, acronyms, slang, etc. in the email text. Emails not meeting these standards may not be answered.

Email questions must be sent a reasonable amount of time before a deadline. Students should not assume that their emails will be answered right away. Ask questions early.

Academic Integrity: All students are expected to comply with the CMU policy on academic integrity. This policy is online at www.studentaffairs.cmu.edu/acad\_integ/acad\_int.html

Cheating, copying, etc will not be tolerated; please ask if you unsure of whether or not your actions are complying with assignment/exam instructions. Always ask if you are unsure; always default to acknowledging any help received.

**Video/Audiotaping:** No student may record or tape any classroom activity without the express written consent of the professor. If a student believes that he/she has a disability and needs to record or tape classroom activities, he/she should contact the Office of Equal Opportunity Services, Disability Resources to request an appropriate accommodation.

**Disability Services:** If you have a disability and need special accomodations in this class, please contact the instructor. You may also want to contact the Disability Resources office at 8-2013.

# TENTATIVE SCHEDULE: subject to change

Date	Торіс	Due
Mon 1/12	Intro; Probability Review	
Wed 1/14	R.V. and Probability Distribution Review	
Fri 1/16	R.V. and Probability Distribution Review	Intro Survey
Mon 1/19	No class; MLK day	
Wed 1/21	Relationships Between Distributions	
Fri 1/23	Sampling Distributions; CLT	HW 1
Mon 1/26	Estimation: Bias, Variance, MSE	
Wed 1/28	Estimation: MSE, Relative Efficiency, Consistency	
Fri 1/30	Confidence Intervals, Sample Size	HW 2
Mon 2/1	Method of Moments	
Wed 2/4	Method of Moments	
Fri 2/6	Sufficiency, Likelihood	HW 3
Mon 2/9	Sufficiency, Rao-Blackwell	
Wed 2/11	Rao-Blackwell, MVUE	
Fri 2/13	MVUE, Order Statistics	HW 4
Mon 2/16	Examples	
Wed 2/18	Review	
Fri 2/20	Exam Overview, Applications	Midterm 1; Thurs 2/19
Mon 2/23	Method of Maximum Likelihood	
Wed 2/25	Method of Maximum Likelihood	
Fri 2/27	Cramer-Rao, Exponential Family	HW 5
Mon 3/2	Hypothesis Tests: Large Sample	
Wed 3/4	Hypothesis Tests: Small Sample	
Fri 3/6	No class; Mid-semester break	
	Mon 3/9 - Fri 3/12: Spring Break	
Mon 3/16	Hypothesis Tests: Variance	
Wed 3/18	Type II errors; Power of Tests	
Fri 3/20	Type II errors; Power of Tests	HW 6
Mon 3/23	Neyman-Pearson	
Wed 3/25	Likelihood Ratio Test	
Fri 3/27	Putting it all together	HW 7
Mon 3/30	Examples	
Wed 4/1	Review	
Fri 4/3	Exam Overview	Midterm 2; Thurs 4/2
Mon 4/6	Linear Regression	
Wed 4/8	Linear Regression	
Fri 4/10	Linear Regression	HW 8
Mon 4/13	Analysis of Variance	
Wed 4/15	Anova: One-Way Layout	
Fri 4/17	No class; Carnival	
Mon $4/20$	Special Topics	
Wed 4/22	Special Topics	
Fri 4/24	Special Topics	Н
Mon $4/2'$	Special Topics	
wea 4/29	Keview	<b>HW</b> / 10
Fri 5/1	Theory Games	HW 10

Note: Final Exam will be scheduled by the registrar