Syllabus
Applied Mathematics and Statistics, 553.112
Statistical Analysis II
Summer 2017
(4 credits, EQ)

Description: 553.112, Statistical Analysis II, builds on the material in 553.111 and provides a general survey of introductory statistics. Topics include one- and two-sample hypothesis tests, analysis of variance, linear and multiple regression, categorical data analysis, and, time permitting, nonparametric statistics We will use computational software, in particular the freely available and widely-used R programming language, to solve statistical problems. During the semester, we will also investigate case studies involving real-world applications of statistical methodology.

We will cover approximately Chapters 9 through 14 of the required text by Mendenhall, Beaver, and Beaver (MBB). If you are unfamiliar with R, please see the worksheets on Blackboard (in the section titled "R Worksheets") which provide a step-by-step guide to installing R and executing some basic commands.

Prerequisites: Statistical Analysis I, 553.111

Instructor
Long Wang
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Office: 201-A Whitehead Hall
Office hours: MTWTh 11:30 AM to 12:30 PM, and by appointment

Additional Help: Feel free to stop by the instructor's office hours. I am here to help! Stop by sooner rather than later-don't wait until the last 1 minute. Additional support for the course is also available through the Learning Den; see the schedule at `http://academicsupport.jhu.edu/learning-den-tutoring/schedule/`.

Meetings: The class has four meetings per week on MTWTh from 09:00 AM to 11:30 AM.

Textbook
Required: *Introduction to Probability and Statistics*, by William Mendenhall, Robert Beaver, and Barbara Beaver, 14th ed.

Online Resources
Web information: including occasional lecture videos, readings, homework assignments, data sets, and case study materials, and course announcements: on Blackboard. Email will also be used to communicate course information and announcements. Students are expected to check Blackboard and email regularly!

Lecture videos: Occasional lecture videos (designed by Avanti Athreya and Daniel Naiman) will be posted on Blackboard, and should be viewed as they are assigned.

Course Content and Objectives

(1) Students will learn the foundations of one- and two-sample hypothesis testing for population means and variances.
(2) Students will learn about classical sampling distributions, including the t-distribution, the chi-squared distribution, and the F-distribution.
(3) Students will learn about classical analysis of variance (ANOVA) techniques for one- and two-way layouts, as well as factorial experiments. Students will use R to conduct analyses of variance for certain data sets.
(4) Students will learn simple linear regression, including model assumptions and consequences, the estimation of regression coefficients, and hypothesis tests about regression coefficients. Students will use R to conduct regression analyses.
(5) Students will learn how to interpret R for a multiple regression and how to interpret output for regression involving categorical data.
(6) Students will learn how to conduct simple categorical data analysis.
(7) Time permitting, students will examine nonparametric tests.

Course Topics

- One- and two-sample hypothesis testing about population means and variances; t, chi-squared, and F distributions.
- Analysis of variance: one- and two-way layout. Factorial experiments; interaction effects. Tukeys test.
- Simple linear regression: model assumptions; computing regression coefficients; conducting hypothesis tests about coefficients in a simple linear model. Interpreting regression coefficients.
- Using R to conduct simple linear regression. Interpreting output and analyzing plots to test model assumptions.
- Multiple regression; interpreting regression coefficients. Analyzing R output for a multiple regression. Coefficient of determination.
- Categorical data analysis.
- Nonparametric estimation: Wilcoxon signed-rank test; Mann-Whitney test.

Course Expectations, Policies, & Grading

Your grade in this course is based on your performance on weekly homework assignments, two midterm examinations, and a final examinations. Details are as follows.

(1) **Homework.** Homework will be assigned weekly will be due the following Monday at the **start of lecture**. There will be approximately 4 homework assignments throughout the semester. **Late homework will not be accepted for any reason, and no homework scores will be dropped. If you miss a homework for a documented and justified reason, such as illness or family emergency, your score for that homework will be replaced by the average on the remaining homework.**
(2) **Midterm examinations.** There will be one midterm exam on Thursday, July 20, 2017. NO MAKE-UP EXAMS WILL BE GIVEN UNDER ANY CIRCUMSTANCES.

If you miss an exam for a documented and justified reason, such as an illness, family emergency, religious observance, or official, university-sanctioned event, your score for the missed exam will be replaced by a weighted average of your score on the remaining exam and the final exam. If you know you will have to miss an exam due to a religious observance or a universitysanctioned event, you must notify me at lwang100@jhu.edu as soon as possible. If you have to miss an exam for an unforeseen reason, such as illness, you must let me know as soon as you can, preferably within 24 hours of the missed examination.

(3) **Final examination.** The final examination is held on Thursday, August 3, 2017, from 9 a.m. to 11:30 p.m. NO EARLY FINAL EXAMS WILL BE GIVEN.

Each of these components (homework, midterm examinations, and the final exam) will contribute to your overall course percentage as follows:

(1) Homework: 30%
(2) Midterm examinations: 30%
(3) Final Exam: 40%

For example, suppose that a students semesters homework percentage is 85% (that is, he or she received 85% of the total homework points possible in the semester). Suppose also and his or her percentage on the midterm exam was 80% and his or her final exam percentage was 83%. Then this students final course percentage is calculated by taking the sum of the products of each of those percentages and the above weighting, as follows:

$$(0.85) \times 0.3 + (0.80) \times 0.3 + (0.83) \times 0.4 = 0.827$$

Grading: Letter grades will be determined at the end of the course, after all exam and homework data has been collected. The following scale, based on the final class percentage calculated according to the weights above, will be used:

- 90%-100% A; 90%-92% A-
- 87%-89% B+; 83%-86% B; 80%-82% B-
- 77%-79% C+; 73%-76% C; 70%-72% C-
- 67%-69% D+; 60%-66% D
- Below 60% F

Please note that the difficulty of the exams will be taken into account and may lead to some adjustment of this scale.

Regrade requests for exams. Midterm exam is held on Thursday, and we endeavor to grade the exams in a timely manner and return them to you in the following week. Every effort is made to grade exams accurately. However, if you notice an error in the grading and wish to request a regrade, you must submit in writing (on a separate sheet of paper from the exam itself) which problems you think are inaccurately graded, and why. If you are submitting a regrade request, you MUST submit your regrade request at the END of the lecture in which the exam is returned. No late regrade requests will be accepted.

SAVE ALL WORK. All of your work in this class should be SAVED, including ALL homework and ALL EXAMS. In the event of a dispute over an entered grade, you MUST have the original hard copy of the specific homework or exam.

Key Dates
The midterm examinations and final examination dates are as follows. PLEASE NOTE that the midterm examination dates are tentative and may be adjusted, but the final examination date is determined and is fixed.

(1) **Midterm Exam:** Thursday, July 20, 2017, at 9 a.m.
(2) **Final Examination:** Thursday, August 3, 2017, from 9 a.m. to 11:30 a.m.

Readings: As mentioned previously, each week, textbook readings (and occasional lecture videos) will be posted on Blackboard.

Ethics
The strength of the university depends on academic and personal integrity. In this course, you must be honest and truthful. Ethical violations include cheating on exams, plagiarism, reuse of assignments, improper use of the Internet and electronic devices, unauthorized collaboration, alteration of graded assignments, forgery and falsification, lying, facilitating academic dishonesty, and unfair competition.

In addition, the specific ethics guidelines for this course are:

(1) You may collaborate with others on your homework, but the work you submit must be your own, and you should understand everything you write. Calculators are permitted on the homework.
(2) ALL EXAMS ARE CLOSED-BOOK, CLOSED NOTES, AND NO CALCULATORS ARE PERMITTED ON THE EXAMS.

You can find more information about university misconduct policies on the web at these sites:

- Undergraduates: `e-catalog.jhu.edu/undergrad-students/student-life-policies/`
- Graduate students: `e-catalog.jhu.edu/grad-students/graduate-specific-policies/`

Students with Disabilities
Statement of Diversity and Inclusion: Johns Hopkins University is a community committed to sharing values of diversity and inclusion in order to achieve and sustain excellence. We believe excellence is best promoted by being a diverse group of students, faculty and staff who are committed to creating a climate of mutual respect that is supportive of one anothers success. Through its curricula and clinical experiences, we purposefully support the Universitys goal of diversity, and in particular, work toward an ultimate outcome of best serving the needs of students. Faculty and candidates are expected to demonstrate an understanding of diversity as it relates to planning, instruction, management, and assessment.

Any student with a disability who may need accommodations in this class must obtain an accommodation letter from Student Disability Services, 385 Garland Hall, (410) 5164720, *studentdisabilityservices@jhu.edu*.

ABET Outcomes

- An ability to apply knowledge of mathematics, science, and engineering (a).

- An ability to design and conduct experiments, as well as to analyze and interpret data. (b).
- Ability to function on multidisciplinary teams (d).
- Understanding of professional and ethical responsibility (f).
- Ability to communicate effectively (g).
- Recognition of the need for and an ability to engage in life-long learning (i).
- Knowledge of contemporary issues (j).