Course Syllabus

ISYE 6739-IV

A Gentle Introduction to Statistics

Professor: Dr. David Goldsman

Course Description

This course covers two important methodologies in statistics – confidence intervals and hypothesis testing. Confidence intervals are encountered in everyday life, and allow us to make probabilistic statements such as: "Based on the sample of observations we conducted, we are 95% sure that the unknown mean lies between A and B," and "We are 95% sure that Candidate Smith's popularity is 52% +/- 3%." Hypothesis testing allows us to pose hypotheses and test their validity in a statistically rigorous way. For instance, "Does a new drug result in a higher cure rate than the old drug" or "Is the mean tensile strength of item A greater than that of item B?"

Prerequisites

You will be expected to come in knowing a bit of set theory and basic calculus, as well as the material from the first two mini-courses in this series (our **Introduction to Probability**, **Random Variables**, and **Introduction to Statistics** courses). The prerequisite material is all available for you to access; and in any event, we will try to make the current course as self-contained as possible. In addition, this course will involve a bit of computer programming, so it would be nice to have at least a little experience in something like Excel.

Course Goals

Confidence Intervals and Hypothesis Testing

- Understand what a confidence interval is and how it is used.
- Formulate and interpret confidence intervals for a variety of probability distributions and their parameters.
- Understand what a hypothesis test is and how it is used.
- Learn about the types of errors that can occur with hypothesis testing, and how to design tests to mitigate those errors.
- Formulate and interpret hypothesis tests for a variety of probability distributions and their parameters.
- Study goodness-of-fit tests for distributions.

Grading Policy

- There will be one exam for this course. Test questions are multiple choice or T/F.

- There will be four homework assignments for this course. The HWs often have bonus questions, which you can do to earn a few extra points. Let r = the number of required questions, R = the # of required questions you answer correctly, and B = the number of bonus questions you answer correctly. Then your HW grade will be 100*(R+B)/r.
- You must achieve an overall weighted average of 60% to pass the course.
- Work hard and you will be rewarded – Grading is usually pretty generous.
- But let's be winners, not whiners. We are happy to discuss grades, but please make reasonable requests. 😊
- Grading Breakdown: For this course, the HW counts as 20% and the exam as 80%.

Exam Policy

- The exam covers all the material in the course.

Plagiarism Policy

Plagiarism is considered a serious offense. You are not allowed to copy and paste or submit materials created or published by others, as if you created the materials. All materials submitted and posted must be your own.

Course Materials

- All content and course materials can be accessed online.
- Suggested textbook: D. Goldsman and P. Goldsman, *A First Course in Probability and Statistics* – available for **free** PDF download. $ave $ave $ave!

For an inexpensive hard copy, click the book icon →

Technology/Software Recommendations

- Internet connection (DSL, LAN, or cable connection desirable)
- Adobe Acrobat PDF reader (free download; see https://get.adobe.com/reader/)
- Excel (or equivalent)
- R statistical software (free download; see cran.r-project.org) (or similar statistics packages such as Minitab, JMP, SAS, etc.)
- Bonus software: Any "real", high-level language such as Matlab, Python, etc.

Course Topics and Sample Pacing Schedule

- The table below contains a course topic outline and a SUGGESTED course progression timetable.
- The **SUGGESTED** (but not mandatory) time units are in weeks, so there's one HW per week.
- Note that some topics below are marked as **OPTIONAL**. We have included this material in case you need additional review or would like to delve into a topic further. You will be given extra credit homework on those topics, but you will not be tested on those topics.

	Course Topics
Week 1	**Course IV: Confidence Intervals and Hypothesis Tests** **Module 6: Confidence Intervals** • Lesson 1: Introduction to Confidence Intervals (§6.1 of text) • Lesson 2: Normal Mean (variance known) (§6.2) • Lesson 3: Difference of Two Normal Means (variances known) (§6.3) • Lesson 4: Normal Mean (variance unknown) (§6.4) • Lesson 5: Difference of Two Normal Means (unknown *equal* variances) (§6.5.1)
Week 2	**Module 6 (cont'd): Confidence Intervals** • Lesson 6: Difference of Two Normal Means (variances unknown) (§6.5.2) • Lesson 7: Difference of Paired Normal Means (variances unknown) (§6.5.3) • Lesson 8: Normal Variance (§6.6) • Lesson 9: Ratio of Variances of Two Normals (§6.7) • Lesson 10: Bernoulli Proportion (§6.8)
Week 3	**Module 7: Hypothesis Testing** • Lesson 1: Introduction to Hypothesis Testing (§7.1) • Lesson 2: The Errors of Our Ways (§7.1) • Lesson 3: Normal Mean Test with Known Variance (§7.2.1) • Lesson 4: Normal Mean Test with Known Variance: Design (§7.2.2) • Lesson 5: Two-Sample Normal Means Test with Known Variances (§7.2.3) • Lesson 6: Normal Mean Test with Unknown Variance (§7.3.1) • Lesson 7: Two-Sample Normal Means Tests with Unknown Variances (§7.3.2)
Week 4	**Module 7 (cont'd): Hypothesis Testing** • Lesson 8: Two-Sample Normal Means Test with Paired Observations (§7.3.2) • Lesson 9: Normal Variance Test (§7.4.1) • Lesson 10: Two-Sample Normal Variances Test (§7.4.2) • Lesson 11: Bernoulli Proportion Test (§7.4.3) • Lesson 12: Two-Sample Bernoulli Proportions Test (§7.4.4) • Lesson 13: Goodness-of-Fit Tests: Introduction (§7.5.1) • Lesson 14: Goodness-of-Fit Tests: Examples (§7.5.2) • Lesson 15 **[OPTIONAL]:** Goodness-of-Fit Tests: Honors Example (§7.5.3) **Course IV Exam – Study like crazy and make this test wish it were never born!!** 😊