STA 210 MAKING SENSE OF UNCERTAINTY: AN INTRODUCTION TO STATISTICAL REASONING
(UK Course) (3 credit hours)

Official Course Description	The goal of this course is to help students develop or refine their statistical literacy skills. Both the informal activity of human inference arising from statistical constructs, as well as the more formal perspectives on statistical inference found in confidence intervals and hypothesis tests are studied. Throughout, the emphasis is on understanding what distinguishes good and bad inferential reasoning in the practical world around us. Prerequisites: Quantitative Reasoning College Readiness Indicators as defined by CPE (ACT 19 or higher, or equivalent as determined by placement examination)

OFFICIAL COURSE COMPETENCIES/OBJECTIVES

Upon completion of this course, the student can:

1. Begin to absorb common statistical information appropriately and form associated human inferences carefully.
2. Develop an evolved sense of what statistical confidence means and doesn't mean by involving students in real surveys they will enjoy discussing.
3. Juxtapose the concepts and language of hypothesis testing with the more easily accessible ideas of sensitivity and specificity in an effort to demystify these more difficult ideas and facilitate a discussion of the related statistical issues.

OFFICIAL COURSE OUTLINE

I. Begin to absorb common statistical information appropriately and form associated human inferences carefully.
   - A. Identify categorically good or bad statistical summaries, charts and graphs, and explain the reasons they are so categorized.
   - B. Identify categorically good or bad statistical arguments based on statistical summaries, charts, and graphs, and explain the reasons they are so categorized.
   - C. Distinguish the concepts of correlation and causation and explain how they offer different types of evidence.
   - D. Identify hidden or confounding variables in studies reported by the media or in the literature.
   - E. Explain if and how hidden or confounding variables can or did affect the associated common-sense inferences.
   - F. Define what is meant by Simpson's Paradox.
   - G. Explain how a misinterpretation of randomness leads to poor human inferences.
   - H. Explain how not having enough or the right information leads to poor human inference.
   - I. Present examples relative to each of parts E, F, G, and H.
   - J. Identify and present at least one argument from psychology or neuroscience that supports the contention that poor human inferences are common.

II. Develop an evolved sense of what statistical confidence means and doesn't mean by involving students in real surveys they will enjoy discussing.
   - A. Identify categorically good or bad surveys and explain the reasons they are so categorized.
   - B. Identify a push poll from the news and explain the reasons such a poll is likely not a source of useful information.
   - C. Explain the difference between sampling variability and non-sampling variability.
   - D. Identify strategies for understanding non-sampling variability.
   - E. Identify a margin of error that is in the news, but not discussed in class, from the associated confidence interval and use statistical language to explain the sort of confidence that is being offered, and the type of risk that is being quantified.
   - F. Compare and contrast the information contained in a Cosmopolitan on-line poll, a CBS Evening News call-in poll, a Gallup random-dialing poll, and a door-to-door political campaign poll.
   - G. Define sampling variability and explain the role it plays in the construction of a confidence interval.
   - H. Define sampling distribution and demonstrate the Central Limit Theorem by hands-on repeated sampling.
   - I. Produce a non-95% confidence interval for a proportion or mean, based on data from a simple random sample.
   - J. Explain what happens to a confidence interval as the confidence level changes and/or the sample size changes.

III. Juxtapose the concepts and language of hypothesis testing with the more easily accessible ideas of sensitivity and specificity in an effort to demystify these more difficult ideas and facilitate a discussion of the related statistical Issues.
   - A. Define sensitivity and specificity.
   - B. Read about a dichotomous decision process that is in the news, not discussed in class, and explain the roles for sensitivity and specificity in assessing the integrity of that process.
   - C. Identify the structure of a test of hypothesis and explain the purpose of the null and the alternative hypotheses, and the way in which the evidence that is gathered is used.
   - D. Define significance and power and explain the roles each play in assessing the integrity of dichotomous significance test.

E. Read about a test of significance associated with an experiment that is in the news, but not discussed in class, and use the language of statistics to explain and evaluate the nature of the evidence that is presented.
F. Explain the role of modeled error in a simple test of hypothesis for a simple experimental design.
G. Define the Prosecutor's Fallacy.
H. Explain the importance of the Prosecutor's Fallacy to interpreting specificity and sensitivity.
I. Explain the importance of the Prosecutor's Fallacy to describing the results of null hypothesis testing.
J. Read a news story and identify and demonstrate the difference between various conditional events and unconditional events discussed in that story.

GENERAL EDUCATION COMPETENCIES

A. Knowledge of human cultures and the physical and natural worlds through study in the sciences and mathematics, social sciences, humanities, histories, languages, and the arts.
B. Intellectual and practical skills, including
- inquiry and analysis
- critical and creative thinking
- written and oral communication
- quantitative literacy
- information literacy
- teamwork and problem solving

C. Personal and social responsibility, including
- civic knowledge and engagement (local and global)
- intercultural knowledge and competence
- ethical reasoning and action
- foundations and skills for lifelong learning

D. Integrative and applied learning, including synthesis and advanced accomplishment across general and specialized skills.

STUDENT LEARNING OUTCOMES FOR QUANTITATIVE REASONING (Approved Fall 2017)

1. Interpret information presented in mathematical and/or statistical forms. (B)
   - Explain if and how hidden or confounding variables can or did affect the associated common-sense inferences.
   - Explain the difference between sampling variability and non-sampling variability.
   - Define significance and power and explain the roles each play in assessing the integrity of dichotomous significance test.
2. Illustrate and communicate mathematical and/or statistical information symbolically, visually, and/or numerically. (A, B and C)
   - Identify categorically good or bad statistical summaries, charts and graphs, and explain the reasons they are so categorized.
   - Identify categorically good or bad statistical arguments based on statistical summaries, charts, and graphs, and explain the reasons they are so categorized.
3. Determine when computations are needed and to execute the appropriate computations. (B)
   - Define sampling distribution and demonstrate the Central Limit Theorem by hands-on repeated sampling.
   - Define sensitivity and specificity.
4. Apply an appropriate model to the problem to be solved. (A, C and D)
   - Distinguish the concepts of correlation and causation and explain how they offer different types of evidence.
   - Identify the structure of a test of hypothesis and explain the purpose of the null and the alternative hypotheses, and the way in which the evidence that is gathered is used.
5. Make inferences, evaluate assumptions, and assess limitations in estimation modeling and/or statistical analysis. (B, C and D)
   - Produce a non-95% confidence interval for a proportion or mean, based on data from a simple random sample.
   - Explain what happens to a confidence interval as the confidence level changes and/or the sample size changes.
   - Explain the role of modeled error in a simple test of hypothesis for a simple experimental design.

LEARNING RESOURCES

Beyond the Numbers: Student-Centered Activities for Learning Statistical Reasoning, current edition, by William Rayens, Van-Griner Publishers
StatCrunch Student 6-Month Access Code