MTH 155 - Statistical Reasoning

Course Description

Effective: 2019-08-01

Presents elementary statistical methods and concepts including visual data presentation, descriptive statistics, probability, estimation, hypothesis testing, correlation and linear regression. Emphasis is placed on the development of statistical thinking, simulation, and the use of statistical software. This is a Passport Transfer course. Lecture 3 hours, Total 3 hours per week.

3 credits

General Course Purpose

Statistical Reasoning is a first course in statistics for students whose college and career paths require knowledge of the fundamentals of the collection, analysis, and interpretation of data. Emphasis is placed on the development of statistical thinking, simulation, and the use of statistical software. Students should develop an appreciation of the need for data to make good decisions and an understanding of the dangers inherent in basing decisions on anecdotal evidence rather than data. To that end, students will use appropriate data-collection methods and statistical techniques to support reasonable conclusions through the following content learning outcomes: Data Exploration, Statistical Design, Probability and Simulation, and Statistical Inference.

Course Prerequisites/Corequisites

Prerequisite: Competency in MTE 1-5 as demonstrated through placement or unit completion or equivalent or Co-requisite: MCR 5Learning Support for Statistical Reasoning.

Course Objectives

- Communication
  - Interpret and communicate quantitative information and mathematical and statistical concepts using language appropriate to the context and intended audience.
    - Use appropriate statistical language in oral, written, and graphical terms.
    - Read and interpret graphs and descriptive statistics.
- Problem Solving
  - Make sense of problems, develop strategies to find solutions, and persevere in solving them.
  - Understand what statistical question is being addressed, use appropriate strategies to answer the question of interest, and state conclusions using appropriate statistical language.
- Reasoning

- o Reason, model, and draw conclusions or make decisions with quantitative information.
  - ▪ Use probability, graphical, and numerical summaries of data, confidence intervals, and hypothesis testing methods to make decisions.
  - ▪ Support conclusions by providing appropriate statistical justifications.
- Evaluation
  - o Critique and evaluate quantitative arguments that utilize mathematical, statistical, and quantitative information.
    - ▪ Identify errors such as inappropriate sampling methods, sources of bias, and potentially confounding variables, in both observational and experimental studies.
    - ▪ Identify mathematical or statistical errors, inconsistencies, or missing information in arguments.
- Technology
  - o Use appropriate technology in a given context.
    - ▪ Use some form of spreadsheet application to organize information and make repeated calculations using simple formulas and statistical functions.
    - ▪ Use technology to calculate descriptive statistics and test hypotheses.
- Graphical and Numerical Data Analysis
  - o Identify the difference between quantitative and qualitative data
  - o Identify the difference between discrete and continuous quantitative data
  - o Construct and interpret graphical displays of data, including (but not limited to) box plots, line charts, histograms, and bar charts
  - o Construct and interpret frequency tables
  - o Compute measures of center (mean, median, mode), measures of variation, (range, interquartile range, standard deviation), and measures of position (percentiles, quartiles, standard scores)
- Sampling and Experimental Design
  - o Recognize a representative sample and describe its importance
  - o Identify methods of sampling
  - o Explain the differences between observational studies and experiments
  - o Recognize and explain the key concepts in experiments, including the selection of treatment and control groups, the placebo effect, and blinding
- Probability Concepts
  - o Describe the difference between relative frequency and theoretical probabilities and use each method to calculate probabilities of events
  - o Calculate probabilities of composite events using the complement rule, the addition rule, and the multiplication rule.
  - o Use the normal distribution to calculate probabilities
  - o Identify when the use of the normal distribution is appropriate.
  - o Recognize or restate the Central Limit Theorem and use it as appropriate.
- Statistical Inference
  - o Explain the difference between point and interval estimates.
  - o Construct and interpret confidence intervals for population means and proportions.
  - o Interpret the confidence level associated with an interval estimate.

- o Conduct hypothesis tests for population means and proportions.
- o Interpret the meaning of both rejecting and failing to reject the null hypothesis.
- o Use a p-value to reach a conclusion in a hypothesis test.
- o Identify the difference between practical significance and statistical significance.
- Correlation and Regression
  - o Analyze scatterplots for patterns, linearity, and influential points
  - o Determine the equation of a least-squares regression line and interpret its slope and intercept.
  - o Calculate and interpret the correlation coefficient and the coefficient of determination.
- Categorical Data Analysis
  - o Conduct a chi-squared test for independence between rows and columns of a two-way contingency table.

Major Topics to be Included

- Graphical and Numerical Data Analysis
- Sampling and Experimental Design
- Probability
- Statistical Inference
- Correlation and Regression
- Categorical Data Analysis