J. Sargeant Reynolds Community College
Course Content Summary

Course Prefix and Number: MTH 155 **Credits:** 3

Course Title: Statistical Reasoning

Course Description: 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. Replaces MTH 146 or MTH 157. Credit will not be awarded for both MTH 155 and MTH 245. Prerequisite: Competency in MTE 1-5 as demonstrated through placement or unit completion or equivalent or co-requisite MCR 5. Lecture 3 hours.

General Course Purpose: Students whose college and career paths require knowledge of the fundamentals of the collection, analysis, and interpretation of data will benefit from this course. In the VCCS, this course will meet the mathematics requirement of students in a non-STEM field who do not require further studies in statistical or research methods.

Course Prerequisites and Co-requisites:
Prerequisite: Competency in MTE 1-5 as demonstrated through placement or unit completion or equivalent or co-requisite MCR 5.

Student Learning Outcomes:
Upon completing the course, the student will be able to

1. Perform graphical and numerical data analysis
   a. Identify the difference between quantitative and qualitative data
   b. Identify the difference between discrete and continuous quantitative data
   c. Construct and interpret graphical displays of data, including (but not limited to) box plots, line charts, histograms, and bar charts
   d. Construct and interpret frequency tables
   e. Compute measures of center (mean, median, mode), measures of variation, (range, interquartile range, standard deviation), and measures of position (percentiles, quartiles, standard scores)

2. Demonstrate an understanding of sampling and experimental design
   a. Recognize a representative sample and describe its importance
   b. Identify methods of sampling
   c. Explain the differences between observational studies and experiments
   d. Recognize and explain the key concepts in experiments, including the selection of treatment and control groups, the placebo effect, and blinding

3. Demonstrate an understanding of probability concepts
   a. Describe the difference between relative frequency and theoretical probabilities and use each method to calculate probabilities of events
   b. Calculate probabilities of composite events using the complement rule, the addition rule, and the multiplication rule
   c. Use the normal distribution to calculate probabilities

d. Identify when the use of the normal distribution is appropriate
e. Recognize or restate the Central Limit Theorem and use it as appropriate

4. Demonstrate an understanding of statistical inference
   a. Explain the difference between point and interval estimates
   b. Construct and interpret confidence intervals for population means and proportions
   c. Interpret the confidence level associated with an interval estimate
   d. Conduct hypothesis tests for population means and proportions
   e. Interpret the meaning of both rejecting and failing to reject the null hypothesis
   f. Describe Type I and Type II errors in the context of specific hypothesis tests
   g. Use a p-value to reach a conclusion in a hypothesis test
   h. Identify the difference between practical significance and statistical significance

5. Demonstrate an understanding of correlation and regression
   a. Analyze scatterplots for patterns, linearity, and influential points
   b. Determine the equation of a least-squares regression line and interpret its slope and intercept
   c. Calculate and interpret the correlation coefficient and the coefficient of determination

6. Demonstrate an understanding of contingency table
   a. Conduct a chi-squared test for independence between rows and columns of a two-way contingency table

Major Topics to Be Included:

1. Graphical and Numerical Data Analysis—Data Types; Displays of Data; and Measures of Center, Variation, and Position
2. Sampling and Experimental Design
3. Probability Concepts—Simple and Conditional Probabilities; Law of Large Numbers; Normal Distributions; and Central Limit Theorem
4. Statistical Inference—Confidence Intervals; Hypothesis Testing; and Significance
5. Correlation and Regression
6. Categorical Data Analysis—Contingency Table

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