Monroe Community College
STATE UNIVERSITY OF NEW YORK

MTH 160 STATISTICS I

The purpose of this course is to introduce the student to Statistics in a way that will make the student aware of the techniques of Statistics as they apply to the solutions of practical problems in various fields. This introduction is presented with particular attention to statistical vocabulary; interpreting statistical formulas and graphs; and representing statistics symbolically, visually, numerically, and verbally.

Students gain a foundational understanding from the judicious use of formulas for small data sets. In addition, calculations and graphs for any size data sets are facilitated through the utilization of statistical software, such as Minitab. Unless stated otherwise in the objectives, work may be done by hand and/or technology. Regardless of the approach, the focus is on the interpretation of the results. Since this is a course in Statistics, topics of basic probability are included only as needed.

1. Descriptive Statistics
    - 1.1 Define the terms population, sample, statistical experiment, variable (discrete and continuous), data (qualitative and quantitative), statistic, and parameter.
    - 1.2 Define various sampling techniques and potential bias.
    - 1.3 Determine the following statistics and use them to describe and compare data sets: mean, median, mode, range, variance, standard deviation, percentiles, quartiles, and five-number summary.
    - 1.4 Produce and analyze frequency distributions.
    - 1.5 Produce and analyze histograms and box-and-whisker displays.
    - 1.6 Identify the shape and describe the characteristics of the following distributions: normal, symmetrical, uniform (or rectangular), skewed, and bimodal.
    - 1.7 Use the shape and measures of central tendency and dispersion to describe and analyze distributions.
2. Correlation and Regression
    - 2.1 Define the terms bivariate data, data point, scatter diagram, correlation coefficient *r*, regression line, and regression coefficients, and explain the method of least-squares.
    - 2.2 Explain correlation and regression, including their use and limitations.
    - 2.3 Given a set of bivariate data:
        - a. Produce and interpret a scatter diagram.
        - b. Determine and interpret the linear correlation coefficient *r*.
        - c. Determine and interpret the equation of the least-squares regression line.
        - d. Determine and interpret a predicted value of *y*.
        - e. Produce and interpret the graph of the least-squares regression line.
    - 2.4 Estimate a reasonable value for *r* given a scatter diagram.
3. Probability (It is recommended that the objectives in this section be incorporated as much as possible into the coverage of the objectives for discrete, binomial, and normal probability distributions.)
    - 3.1 Define the following terms: probability, simple probability experiment, sample space, simple event, compound event, complementary events, mutually exclusive events, dependent events, and independent events.
    - 3.2 Calculate probabilities using relative frequency.
    - 3.3 Apply the addition rule (for mutually exclusive events), multiplication rule (for independent events), and complement rule.

4. Discrete Probability Distribution
    - 4.1 Differentiate between a discrete and continuous random variable.
    - 4.2 Construct a discrete probability distribution.
    - 4.3 Describe the properties of a discrete probability distribution.
    - 4.4 Given a discrete probability distribution, calculate and interpret probabilities for the associated discrete random variable.
    - 4.5 Calculate the mean (or expected value) of a discrete random variable.
5. Binomial Probability Distribution
    - 5.1 Describe the characteristics of a binomial probability experiment.
    - 5.2 Determine whether a variable is a binomial random variable.
    - 5.3 Explain why a binomial random variable is an example of a discrete random variable.
    - 5.4 Calculate probabilities for a binomial random variable.
    - 5.5 Calculate and interpret probabilities for multiple values of a binomial random variable.
    - 5.6 Calculate the mean and standard deviation for a binomial probability distribution.
6. Normal Probability Distribution
    - 6.1 Explain why a normal random variable is an example of a continuous random variable.
    - 6.2 Describe the properties of the normal probability distribution.
    - 6.3 Define the Empirical Rule and its relationship to the normal probability distribution.
    - 6.4 Use the Standard Normal Distribution to:
        - a. Calculate and interpret the area under the standard normal curve for given values of z.
        - b. Determine z for a given area under the standard normal curve.
    - 6.5 Given μ and σ for a normal random variable, represent associated probabilities with:
        - a. a sketch of the normal curve and shading the appropriate area
        - b. mathematical symbols and numbers; e.g. P($x > 115$)
        - c. a written statement
    - 6.6 Calculate z for a normal random variable x.
    - 6.7 Use the Standard Normal Distribution to:
        - a. Calculate and interpret probabilities for given values of a normal random variable.
        - b. Determine values of a normal random variable for given probabilities.
7. Sampling Distribution
    - 7.1 Define and create a sampling distribution for the sample mean $\bar{x}$.
    - 7.2 Explain the Central Limit Theorem and use it to describe the properties of the sampling distribution of the sample mean, $\bar{x}$.
    - 7.3 Calculate and interpret probabilities for values of a sample mean, $\bar{x}$.
8. Statistical Inference - Estimation and Hypothesis Testing
    - 8.1 Describe the relationship between a sample statistic and its corresponding population parameter.
    - 8.2 Describe the process of estimation, including a discussion of point estimate, level of confidence, maximum error of estimate, and confidence interval.
    - 8.3 Describe the process of hypothesis testing, including a discussion of null hypothesis, alternative hypothesis, level of significance, Type I and Type II errors and their associated probabilities, test statistic, p-value, decision, and conclusion.

8.4 Describe the Student's *t*-distribution and compare it with the standard normal distribution.

8.5 Generate and interpret confidence intervals that estimate mu using the Student's *t*-distribution for varying levels of confidence.

8.6 Generate and interpret confidence intervals that estimate *p* using the Standard Normal Distribution for varying levels of confidence.

8.7 Generate and interpret hypothesis tests for mu using the Student's *t*-distribution.

8.8 Generate and interpret hypothesis tests for *p* using the Standard Normal Distribution.

8.9 Recognize the limitations of the methods used to generate confidence intervals and hypothesis tests.

9. Statistical Software

9.1 Analyze and interpret statistical output corresponding to the following topics. The output is produced either by students exclusively or by a combination of students and the instructor.

a. Graphs, including histograms, box-and-whisker displays, and scatter diagrams.

b. Descriptive measures, including mean, median, mode, range, variance, standard deviation, and quartiles.

c. Linear correlation coefficient.

d. Linear regression equation and its graph on the scatter diagram.

e. Confidence interval to estimate the mean and proportion.

f. Hypothesis test of the mean and proportion.

10. Statistical Project

10.1 Obtain real quantitative data from a Web site, publication, survey, or experiment.

10.2 Collect, organize, analyze, interpret, and represent numerical data, taking advantage of statistical software to facilitate calculations and graphing while minimizing labor-intensive work done by hand.

Optional topics:

- Law of large numbers demonstration
- More hands-on activities/case studies
- More Lab work using statistical software
- Data mining
- Inferences about two proportions and/or two means