Introductory Statistics
Prerequisite: Secondary Math II

Statistics is a branch of mathematics that explores concrete connections with everyday living. Students will develop critical thinking skills with life-long application. Students will gather, graph, examine, compare and interpret data using technology, including graphing calculators or computer statistics software. They will describe data and make informed decisions and predictions based on data.

*Note: The course may be taught as a one-semester or two semester course. Content marked with * may be reduced in depth or eliminated for a one-semester course.*

Standard I: Students will understand, use, and evaluate random processes underlying statistical analysis.

Objective 1: Use sample survey data collected through random samples to draw conclusions about populations.
   a. Recognize sources of bias in surveys, and discuss how surveys may be intentionally biased to support certain agendas.
   b. Explain the importance of randomness in good survey design.
   c. Pose a question, choose an appropriate method of random selection, conduct a survey, and summarize the results in graphical displays.
   d. Distinguish between different survey designs such as SRS, cluster sampling, stratified sampling, and systematic sampling.*

Objective 2: Describe and use the features of good experimental design, such as random assignment of treatments, controls, placebos, blinding, and blocking.
   a. Distinguish between an observational study and an experiment, and be able to select which method is appropriate to collect desired information.
   b. Recognize possible sources of bias in various experiments, and describe how the features of good experimental design will reduce bias.
   c. Pose a question, conduct one or more simple experiments using appropriate features of experimental design for the data that is being collected, and summarize the results in graphical displays.
   d. Explain the importance of experimental ethics, and debate historical violations of experimental ethics.*

Objective 3: Discuss and interpret surveys, experiments, and observations using information from government data, current events, medical experiments, polls, and news media.
   a. Consider the reasonableness of claims of data from various sources, using examples to illustrate the uses and misuses of statistics that appear in the media.
   b. Distinguish between causality and correlation, and be able to recognize unwarranted conclusions.

    c. Recognize when data is misrepresented by graphical manipulation, such as modified axes or use of incorrect visual proportions.

    d. Discuss the role of government reports such as the consumer price index for making comparisons in data.*

    e. Calculate percent change and perform simple calculations for price changes over the years due to inflation.*

Mathematical Language and Symbols Students Should Use:

data, survey, SRS (simple random sampling), cluster sampling, stratified sampling, systematic sampling, experiment, observation, treatment, control, placebo, blinding, blocking, census, percent change, consumer price index, causality, correlation

---

Standard II: Students will summarize and interpret data.

Objective 1: Interpret and display data by selecting appropriate graphical methods.
    a. Distinguish between quantitative and categorical data.
    b. Use quantitative data to create dot plots, stem plots, histograms, box plots, and scatter plots and use them to make sense of the data.
    c. Use categorical data to create circle graphs, bar graphs and frequency tables and use them to make sense of the data.

Objective 2: Summarize data and be able to use technology such as calculators or computer software to assist in calculations.
    a. Calculate measures of center, and estimate center from data presented in a variety of forms, such as charts, tables, and graphs.
    b. Select and interpret appropriate measures of spread.
    c. Describe the distribution of data considering shape, skewness, modality, and outliers.

Objective 3: Use data summaries to interpret and compare data.
    a. Describe and compare individual performances in terms of quartiles, percentiles and standard deviations.
    b. Interpret differences in shape, center, and spread in the context of the data sets, accounting for possible effects of outliers.
    c. Use statistics appropriate to the shape of the data distribution to compare center and spread of two or more different data sets.

Objective 4: Describe the characteristics of the normal distribution, and create an understanding of the standard deviation as a measure of spread.
    a. Examine data sets that approximate the normal distribution, and recognize the characteristics of data that are normally distributed.
    b. Compare individual measurements using the mean and standard deviation to find standardized scores and identify unusual data points.
    c. Use the 68%-95%-99.7% rule to determine the probability of events.
    d. Use the 68%-95%-99.7% rule to create and explain confidence intervals.*

Standard III: Students will make inferences and justify conclusions based on data.

Objective 1: Summarize, represent, and interpret bivariate data.
    a. Create and use graphs of bivariate data to visually assess trends and recognize patterns.
    b. Calculate regression lines and correlation coefficients for linear data using technology such as calculators or computer software.
    c. Use regression equations to make appropriate predictions.
    d. Interpret the slope (rate of change) and the intercept (constant term) of a linear model in the context of the data.
    e. Make predictions based on patterns and trends of non-linear data, such as seasonal data, tidal tables, sunspots, and population changes.*

Objective 2: Display and compare data to make predictions and formulate conclusions.
    a. Describe the effect of outliers on predictions.
    b. Recognize and discuss the pitfalls of extrapolation in predictions.
    c. Compare actual data measurements with predicted values, and discuss the reasonableness of predictions.

Objective 3: Make inferences and justify conclusions from sample surveys, experiments, and observational studies.
    a. Understand statistics as a process for making inferences about population parameters based on a random sample from that population.
    b. Understand and interpret confidence intervals generated from data.*
    c. Use the results of hypothesis testing to interpret sample data and draw conclusions.*

Standard IV: Students will understand and use probability rules.

Objective 1: Use the rules of probability to calculate independent and conditional probabilities in real contexts.
    a. Distinguish between subjective, experimental, and theoretical probability.
    b. Calculate probabilities using addition and multiplication rules, tree diagrams, and two-way tables using correct probability notation.

    c. Calculate conditional probabilities of compound events using two-way tables and Venn diagrams.

    d. Use permutations and combinations to find probabilities.*

Objective 2: Adapt probability models to solve real-world problems.
    a. Perform simulations to estimate probability outcomes using technology and objects such as coins, spinners, cards, and dice.

    b. Identify and explain common misconceptions regarding probability, including long-run vs. short-run behavior.

    c. Discuss probability applications in decision making, using terms such as "odds" and "risk," including applications in insurance, medical treatments, and extreme sports.*

Objective 3: Use probability to make decisions and analyze outcomes.*
    a. Calculate expected values and use them to solve problems.*

    b. Develop a probability distribution for a random variable and find the expected value.*

    c. Weigh the possible outcomes of a decision by assigning probabilities to payoff values and finding expected values.*

    d. Use probabilities to make fair decisions.*

Mathematical Language and Symbols Students Should Use:

theoretical, subjective and experimental probability, independence, conditional probability, two-way table, permutation, combination, simulation, tree diagram, addition and multiplication laws, $P(A)$, $P(A\mid B)$, $_nC_r$, $_nP_r$