1. Why do we sample?
   1. Explain the purpose of statistics.
   2. Explain the difference between Descriptive Statistics and Statistical Inference.
   3. Explain the difference between a Population and a Sample, and why good sampling can be useful.
   4. Identify variable types –quantitative versus qualitative, continuous versus categorical.
   5. Understand the importance of representative or random samples.
   6. Recognize sources of potential bias when a sample is nonrandom (e.g., self-selected samples).
   7. Know where data come from.
   8. Explain the difference between an observational study and controlled/randomized experiment.
   9. Explain the definition of a confounder, and the potential role of confounding variables in observational studies.
   10. Understand when controlled/randomized studies may or may not be possible.
   11. Examine an article about statistical findings from a media source – depending on the information provided, identify the source of the data, the kind of experiment that was used (e.g., observational versus controlled), the types of variables measured, potential confounding variables for observational studies (either reported or unreported), and any reported sample sizes or measures of reliability.
2. How do we visualize data?
   1. Understand the difference between Descriptive Statistics and Statistical Inference.
   2. Identify variable types (categorical versus continuous), and what charts or graphs are appropriate for each.
   3. Construct frequency tables for class/categorical variables.
   4. Construct and interpret bar charts, Pareto charts, and pie charts for class/categorical variables.
   5. Construct and interpret dot plots, stem-and-leaf plots, and histograms for continuous variables.
   6. Understand and identify patterns of skewness, modality, and outliers using plots for continuous variables.
3. How do we summarize data? Measures of Center
   1. Understand the distinctions between and purposes of Measures of Center and Measures of Variability.
   2. Explain difference between the mean and median for a population and for a sample.
   3. Compute and interpret the mean, median, and mode for a given data set.
   4. Understand the relationship between skewness and the mean and median.
4. How do we summarize data? Measures of Variability
   1. Compute and interpret the variance and standard deviation for a given data set.
   2. Understand the definition of a population variance (or standard deviation) versus a sample variance (or standard deviation).
   3. Apply and interpret Chebyshev’s Rule and the Empirical Rule –know when the Empirical Rule is appropriate.
   4. Understand and interpret percentiles and quartiles.
   5. Given the quartiles, compute and interpret the interquartile range (IQR).
   6. Given a data set and quartiles, construct and interpret a boxplot.
   7. Compute and interpret a z-score, and understand the connection between a z-score and the Empirical Rule.
   8. Identify potential outliers using quartiles or z-scores.
   9. Explain how outliers may arise, and how they should be treated in an analysis.
5. What is probability and why do we need to know about it?
   1. Explain how probability can help us to make statistical inferences.
   2. Define an experiment, a sample space, and a sample point.
   3. Explain how probability is a measure of likelihood (in terms of long-term relative frequency).
   4. Explain the rules of probability with respect to a sample space.
   5. Define an event and the probability of an event.
   6. Know when to use the Combinations Rule when sampling objects without replacement from a fixed population.
6. How do we compute probabilities related to two or more events?
   1. Understand event unions and intersections.
   2. Use a Venn diagram to organize information about events in a sample space.
   3. Define an event complement, and know the probability of an event complement.
   4. Use the Additive Rule to compute the probability of an event union.
   5. Define mutually exclusive events, and sketch them using a Venn diagram.
   6. Know and apply the definition of conditional probability.
7. What is “Independence”, and how to we use Bayes’ Rule?
   1. Know and apply the Multiplicative Rule when computing probabilities for event intersections (constructing a tree diagram, if useful or necessary)
   2. Know and explain the definition of independence with regard to two events.
   3. Use the definition of independence to assess whether events are dependent or independent.
   4. Understand the role of random sampling in ensuring that the sampled subjects are independent.
   5. Know and apply Bayes’ rule for two events.
8. What is a discrete random variable, and how do we use the binomial distribution?
   1. Define a random variable, and identify whether a sampled variable is discrete or continuous.
   2. Understand and use a probability distribution for a discrete random variable, expressed either as a table, a chart/plot, or (if available) a formula.
   3. Define and compute the expected value and variance of a discrete random variable.
   4. Use the binomial distribution to compute probabilities for a sample count (from a fixed sample size).
   5. Compute the mean and variance of a binomial distribution.
9. What is the normal distribution, and how do we use it?
   1. Understand how probability density functions (pdf) are used to compute probabilities for continuous random variables (using the area under a pdf curve).
   2. Know why the normal distribution is so commonly used in research and data analysis.
   3. Identify the two parameters – mean and variance – that define a normal distribution.
   4. Use a table to find probabilities for standard normal variable, or to find quantiles or percentiles corresponding to a given probability.
   5. Compute and interpret a score for a normally distributed variable.
   6. Compute probabilities for normally distributed random variables with any given mean and variance.
10. How does a sampling distribution allow us to make a statistical inference?
    1. Define a population parameter, a sample statistic or estimate, and an unbiased estimate.
    2. Understand that a parameter is fixed, and a sample statistic or estimate is a random variable.
    3. Know that a sample mean, sample variance, and sample proportion are each respectively (unbiased) estimates of a population mean, a population variance, and a population proportion.
    4. Given the population mean and variance, know and compute the expected value and standard deviation for a sample mean.
    5. Understand that the sample mean is always normally distributed if the sampling population is normally distributed.
    6. Explain the main implication of the Central Limit Theorem (CLT): averages and sums of random variables tend to be normally distributed, even if the sample does not come from a normal distribution.
    7. Justify whether a sample mean is normally distributed when the sample comes from a non-normal population (using the CLT for a sufficiently large sample size).
    8. Compute probabilities relative to a sample mean when we can assume that the sample mean follows a normal distribution.
    9. Given a population proportion p, know and compute the expected value and standard deviation for a sample proportion p hat.
    10. Justify whether a sample proportion is normally distributed (using the CLT for a sufficiently large sample size).
    11. Compute probabilities relative to a sample proportion p hat when we can assume that follows a normal distribution.
11. What is a confidence interval?
    1. Explain what a parameter, a point estimator, and interval estimator are.
    2. Compute and interpret a confidence interval for a population mean when the population variance is known.
    3. Compute and interpret a confidence interval for a population mean when the population variance is not known (with the sample variance), using a normal distribution with a large sample size, or a t distribution for a relatively smaller sample size.
    4. Compute and identify the standard error of a sample mean.
    5. Identify the margin of error (aka, the sampling error) of a confidence interval.
    6. Compute and interpret a confidence interval for a population proportion.
    7. Compute and identify the standard error of a sample proportion.
    8. Identify the margin of error (aka, the sampling error) of a confidence interval for a sample proportion.
    9. Find the necessary sample size to achieve a given level of sampling error, either for a mean or a proportion.
12. What is a hypothesis test?
    1. Explain the role of the two sides of statistical inference: estimation versus hypothesis testing.
    2. Define a null hypothesis and an alternative hypothesis.
    3. Understand the difference between a one- and two-sided alternative hypothesis.
    4. Explain how a significance level is used for a hypothesis test, and determine a rejection region for a given alternative hypothesis using a specified significance level.
    5. For a hypothesis test involving a population mean, compute a test statistic and p-value, using a normal distribution when the sample size is large or a distribution when the sample size is relatively small.
    6. Interpret the result of a hypothesis test, based either on a rejection region or a p-value.
    7. Explain a Type I or Type II error in hypothesis testing.
    8. For a hypothesis test involving a population proportion, compute a test statistic and p-value, and interpret the result.
13. How do we compare two sample means?
    1. Estimate the difference between two means using the sample means from two groups
    2. When the group sample sizes are large (i.e., both are ≥ 30)
       1. Compute the standard error of the difference in means
       2. Compute and interpret a confidence interval for the difference in means using a normal distribution
       3. Carry out and interpret a test of the hypothesis that the means are equal (versus either a one- or two-sided alternative) by computing a test statistic and p-value using a normal distribution
    3. When at least one of the group sample sizes is relatively small (i.e., < 30)
       1. Decide whether or not we can assume that the group variances are equal
       2. Compute the standard error of the difference in means, based on whether we can assume the variances are equal or unequal
       3. Compute and interpret a confidence interval for the difference in means using the appropriate t distribution
       4. Carry out and interpret a test of the hypothesis when the means are equal (versus either a one- or two-sided alternative) by computing a test statistic and p-value using the appropriate t distribution
14. How can we use linear regression to examine relationships between two variables?
    1. Construct and interpret a scatterplot when exploring the relationship between two variables.
    2. Identify the independent variable x and dependent variable y in a linear regression setting.
    3. Conceptually explain the two components of a linear model: the line (deterministic component) and the variability around the line.
    4. Given a least-squares linear regression fit, interpret the estimated slope and intercept.
    5. Interpret a confidence interval for a model slope.
    6. Interpret the result of a t test for a model slope.
    7. Interpret a correlation coefficient, and explain what the correlation coefficient measures.