

**COURSE GOALS**

1. Mathematically and graphically represent sample population characteristics.
2. Relate characteristics of a sample population back to the true population.
3. Determine what probabilistic conclusions can and cannot be made about data.
4. Interpret and evaluate conclusions about data in terms of the research problem.

**TOPIC GOALS****A. Research Methods**

1. Design and/or choose data collection methods to answer a given research question.
2. Articulate the strengths and weakness of various research designs, including but not limited to repeatability, internal/external validity, etc.
3. Recognize biases and limitations in research questions, research design, data collection, statistical tests, data interpretation, and conclusions.
4. Distinguish the nature of designs that permit causal inference from those that do not.
5. Given data, distinguish between valid and invalid inferences to the true population.
6. Given a description of a study, determine how the results generalize from the sample population to a larger population.
7. Recognize the limitations of applying normative conclusions to individuals.
8. Distinguish between statistical and practical (physiological) significance.
9. Evaluate the validity of conclusions presented in research reports.

**B) Probability**

1. Define and interpret what “probability” means.
2. Calculate and combine probabilities.
3. Interpret the probability of a given situation in both words and mathematics.
4. Relate the probability of a situation to the situations assumptions and/or hypotheses.
5. Defend the statement that scientific conclusions are “probabilistic conclusions.”

**C) Describing sample populations (measures of central tendency)**

1. Create appropriate tables and graphs for a given data set.
2. Choose the most appropriate method for presenting a given data set.
3. Interpret tables and graphs to describe what data is being shown (e.g. predict the mean, median, mode).
4. Find the mean, median, and mode of a given data set.
5. Explain why it is necessary to have three different measures of central tendency, including describing what information might be missing if only one measure of central tendency is used to describe a given data set.
6. Describe and graphically interpret how outliers, skewness, and kurtosis affect the mean, median, and mode.
7. Evaluate whether a given measure of central tendency accurately reflects the data or may be misleading.

**D) Describing/interpreting data distributions**

1. Describe what variance means in both generic terms and in the context of a specific scenario.
2. Use the shape of the sample population to determine whether a data set is normally distributed or skewed.
3. In the context of a normal distribution, determine what percentage of a population a z-score represents.
4. On a graph, plot the mean and the number you are comparing it to.
5. Interpret graphs to answer questions about the data OR when given z-scores on the data determine what questions are being asked.

**E) Detecting differences between groups**

1. Given a study design and data, identify the appropriate test to answer a given question (to test a specific hypothesis).
2. Perform the following tests: one sample t-test, two sample dependent t-test, two sample independent t-test, one-way ANOVA, Chi-Square test.
3. Interpret the results of a statistical test in both the context of the null hypothesis and the context of the research question.

4. Distinguish between when to use parametric versus nonparametric tests.

### **F) Testing Hypotheses**

1. Given a study/data set/observation set, state the null and alternative hypotheses and relate those to the research hypothesis.

2. Use distribution tables and/or computer program output to determine the critical value of a test statistic.

3. Explain the relationship between the test statistic, the critical value, and the normal distribution. (Describe what information the test statistic is providing?)

4. Interpret the test statistic and critical value for a statistical test in the context of the null hypothesis, alternative hypothesis, and research question.

5. Relate a hypothesis to the research problem by:

i. Determining whether a given hypothesis is testable or not.

ii. Describing what a given hypothesis does and does not test.

iii. Describing how the result of a hypothesis test contributes to the research problem as a whole.

iv. Creating hypotheses based on the results of previous tests.

v. Creating testable hypotheses based on the constraints of research methods and statistical methods.

### **G) Detecting similarities between factors (regression/correlation)**

1. Describe/identify the following types of correlations: positive, negative, weak, strong, no correlation, non-linear.

2. Create/interpret scatterplots of data.

3. Calculate correlation coefficients.

4. Interpret correlation coefficients in terms of the direction and strength of the correlations.

5. Describe why correlation coefficients are between -1 and 1.

6. Describe the effect of sample size on the significance of a correlation.

7. Determine whether a correlation is statistically significant (from computer outputs or correlation coefficient tables).