Department of Education

Statewide Dual Credit Learning Objectives

Introduction to Probability & Statistics (MATH 1530)

Topics Covered

1. Appropriate types of samples and sampling methods
2. Appropriate representation of data
3. Measure of Center and Variation
4. Probability and Statistics
5. Discrete Probability Distribution Objectives
6. Normal Probability Distribution
7. Sampling Distributions and the Central Limit Theorem
8. Estimates and Sample Sizes (Confidence Intervals)
9. Estimating a Population Mean: σ Known and Not Known
10. Hypothesis testing Objectives
11. Linear Regression and Correlation

Learning Objectives

1. Appropriate types of samples and sampling methods

a. Recognize whether a study is using simple random, systematic, stratified, or cluster sampling.
b. Recognize the following methods of poor sampling: judgmental, convenience, and voluntary.
c. Obtain a simple random sample using technology or tables.
d. Distinguish between an Experiment and an Observational Study.
e. Define and distinguish between non-sampling error and sampling error.
f. Discuss how bias can affect the outcome of a study.

2. Appropriate representation of data

a. Understand the term “variable” and differentiate between the data types: measurement, categorical, univariate and bivariate.
b. Explain what is meant by “frequency distribution”.
c. Create a frequency distribution from a list of quantitative and qualitative data.
d. Analyze a quantitative frequency distribution table by finding the class width used, sample size, and class midpoints.
e. Calculate the relative and cumulative frequencies from a quantitative frequency distribution table.

f. Calculate relative frequencies for a categorical frequency distribution table.
g. Construct a histogram from frequency distribution table.
h. Construct and/or interpret the following statistical graphs: Histogram, Scatterplot, Pie Chart, Bar Graph, Pareto Chart, Time series, Stem and Leaf plot, Dot plot, and Box plot.
i. Interpret the shape of the distribution from a histogram (i.e. symmetrical, skewed, uniform, and bimodal).
j. Identify why a graph might be misleading.
k. Compare strengths and weaknesses of each type of statistical graph.
l. Compare the distribution of two or more data sets that have used various graphical tools.

3. Measure of Center and Variation

a. Understand the measurements of center such as mean, median, and mode.
b. Understand the measurements of spread such as range, variance, and standard deviation.
c. Understand the effects of outliers on the measurement of center and measurement of spread.
d. Calculate the mean and median using a set of data.
e. Recognize the mode from a set of data.
f. Calculate mean of a frequency distribution such as GPA and weighted grade.
g. Recognize the mode from a frequency distribution.
h. Calculate range from a data set.
i. Calculate and interpret the standard deviation from a set of data with or without technology.

4. Probability and Statistics

a. Explain the difference between empirical, theoretical, and subjective probability.
b. Understand the concept of randomness (i.e. flipping a coin, rolling a die, drawing a card from a standard 52 card deck).
c. List the elements of events and the sample space from an experiment.
d. Find basic probabilities using the definition of probability.
e. Use tree diagrams, Venn diagrams, and/or lists to solve probability problems where appropriate.
f. Explain the Law of Large Numbers.
g. Calculate and interpret probabilities using the complement rule, addition rule, and multiplication rule.
h. Calculate and interpret conditional probabilities.
i. Identify events as mutually exclusive or not mutually exclusive.
j. Identify events as independent or dependent.
k. Discuss the differences in the ways probabilities are calculated when events are mutually exclusive versus not mutually exclusive.
l. Discuss the differences in the ways probabilities are calculated when events are independent versus dependent.

m. Explain the difference between mutually exclusive events and independent events.

5. Discrete Probability Distribution Objectives

a. Identify the random variable in a probability experiment.
b. Distinguish between discrete random variables and continuous random variables.
c. Create a simple probability distribution for the values of a discrete random variable.
d. Create a probability table for a discrete random variable.
e. Use a probability function to determine probabilities associated with a discrete random variable.
f. Create a probability histogram based on a probability table.
g. Calculate and interpret the mean/expected value, variance, and standard deviation of a discrete random variable.
h. Define and recognize discrete binomial probability distribution.
i. Understand proper notation and calculate binomial probabilities.
j. Calculate the Mean/Expected Value, Variance, and Standard Deviation for Discrete Binomial Probability Distributions.
k. Use both range rule of thumb and probabilities to determine unusual values for the random variables.

6. Normal Probability Distribution

a. Explain the characteristics of why the normal distribution is so important.
b. Use area under a probability density curve to find probabilities for two different continuous random variables (the uniform distribution and the normal distribution).
c. Know what "standardizing" data means so that the z-table can be used if the data are normally distributed.
d. Calculate and interpret a z-score.
e. Given a histogram from raw data determine if the distribution is a normal model.
f. Understand the Empirical Rule and the general properties of the normal distribution. (i.e., 100% is the total area under the curve, exactly 50% is to the left and right of the mean, and it is perfectly symmetric about the mean).
g. Use the Z-table or TI-83/84 calculator to find area under the curve for any normal distribution model (left, right, between).
h. Use the Z-table or TI-83/84 calculator to find percentiles, quartiles, or any other numerical value of X for a specified area under the curve for any normal distribution model.

7. Sampling Distributions and the Central Limit Theorem

a. Describe the characteristics of the distribution of the sample mean: normal population.
b. Describe the characteristics of the distribution of the sample mean: non-normal population.

c. Describe the characteristics of the distribution of the sample proportion.
d. Understand the impact of sample size on sampling variability.
e. Understand the Central Limit Theorem and conditions to apply.
f. Apply the Central Limit Theorem to normal and non-normal populations and compute probabilities of a sample mean.

8. Estimates and Sample Sizes (Confidence Intervals)

a. Estimating a Population Proportion p
b. Calculate sample proportion.
c. Understand that the sample proportion is the best point estimate of the population proportion.
d. Find critical values $z_{\alpha/2}$ for a given value of α.
e. Calculate the margin of error using sample statistics.
f. Use a sample proportion to construct a confidence interval to estimate the true value of a population proportion.
g. Interpret a confidence interval in context.
h. Understand the effect of changing the confidence level and/or the sample size on the width of the confidence interval.
i. Verify the conditions are met for estimating a population proportion.
j. Write a confidence interval in 3 different forms (point estimate plus/or minus margin error, interval notation, set notation).
k. Find the best point estimate and the margin of error when given a confidence interval.
l. Know how to find the sample size necessary to estimate a population proportion.

9. Estimating a Population Mean: σ Known and Not Known

a. Understand that the sample mean $\bar{x}$ is the best point estimate of the population mean μ.
b. Know the difference between the sample standard deviation (s) and standard error of the mean $\left(\frac{s}{\sqrt{n}}\right)$
c. Find critical values or either $z_{\alpha/2}$ or $t_{\alpha/2}$ for a given value of α and degrees of freedom depending on if sigma is known.
d. Calculate the margin of error using sample statistics.
e. Use sample data to construct a confidence interval for estimating the value of a population mean, and interpret such confidence intervals.
f. Write a confidence interval in 3 different forms (point estimate plus/or minus margin error, interval notation, set notation).

g. Find the best point estimate and the margin of error when given a confidence interval.

10. Hypothesis testing Objectives

a. Identify the claim in a problem.
b. Determine the appropriate null and alternative hypothesis when presented with a problem.
c. Determine if a test is left - , right - or two-tailed.
d. Understand and list the assumptions for a z-test and t-test.
e. Calculate critical values for tests involving a single proportion, a single mean, and difference between two means.
f. Find p-values for z test statistics using a z-table or technology.
g. Find p-values for t test statistics using t-table or technology.
h. Determine whether or not to reject or fail to reject the null hypothesis using both the traditional and p-value methods.
i. Conduct hypothesis testing for single proportion, single mean, and the difference between two means.
j. Draw conclusions and make inferences about claims based on hypothesis testing.
k. Explain Type I and Type II errors.
l. Distinguish between independent and dependent sampling.
m. Test hypotheses regarding the difference of two independent means (assume the variance are not pooled).

11. Linear Regression and Correlation

a. Understand the assumptions of linear regression.
b. Demonstrate the ability to identify the independent/explanatory variable (x) and the dependent/response variable (y).
c. Demonstrate the ability to draw a scatter diagram, identify the type of relationship that exist between two variables and find the correlation coefficient either using a technology or the traditional method (formula).
d. Find the line of best fit and interpret the coefficient of determination (as well as effects of confounding variables).
e. Determine if line of best fit is statistically significant.
f. For a given value of x, find the appropriate estimated value of y.
g. Understand the difference between practical and statistical significance.
h. Understand that correlation does not apply causation.
i. Understand the difference of interpolation and extrapolation.
j. Understand the possible problems of extrapolation.
k. Calculate a residual using the line of best fit.
l. Perform residual analysis to check assumptions of regression.