

**Course Title: Introduction to Statistics**

**Board Approval Date:**

**Credit / Hours: 1**

**Reviewed Annually**

**Course Description:**

This is an introductory course in statistics intended for students in a wide variety of areas of study. Topics discussed include displaying and describing data, the normal curve, regression, probability, statistical inference, confidence intervals, and hypothesis tests with applications in the real world. Students also have the opportunity to analyze data sets using technology.

**Learning Activities / Modes of Assessment:**

Large group instruction  
Tests and Quizzes  
Experiments  
Teacher Observation  
Small group/team work  
Projects with Rubrics  
Journals/Learning Logs

**Instructional Resources:**

Book – Elementary Statistics 3<sup>rd</sup> edition (1998)  
Teacher made materials including Microsoft One Note Digital Notebooks  
TI-84 Graphing/Statistics Calculator

## Course Pacing Guide

Course: Introduction to Statistics

<b>Course Unit (Topic) (Days/Periods)</b>	<b>Length of Instruction</b>
1. U1 Sampling & Experimentation: Planning & Conducting a study	10 days
2. U2 Exploring Data: Describing patterns & Departures from patterns	41 days
3. U3 Anticipating Patterns: Exploring random phenomena using Probability & simulation	40 days
4. U4 Statistical Inference: Estimating population parameters & testing hypotheses	<u>60 days</u>
Total Days	151 days

Days: 10

Subject: Introduction to Statistics

Grade: 10,11,12

Unit One KUD: Sampling and experimentation: Planning and conducting a Study

By the end of this unit, students will be able to..•

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**Know:**

- Overview of methods of **data** collection.

Census, Sample Survey, Experiment, and Observational Studies.

- Planning and Conducting Studies.

Characteristics of a well-designed and well-conducted survey.

Populations, samples, and random samples.

Sources of bias In sampling and surveys

Sampling methods including simple random sampling, stratified random sampling, and cluster sampling.

- Planning and Conducting experiments.

Characteristics of well-designed and well-conducted surveys.

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**Understand:**

Creating and implementing a well-designed study or experiment is very difficult, and if not done properly can lead to **bias** and unreliable **data and** conclusions.

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**Do:**

- Identify characteristics of a well-designed study.

- Understand and create a well-designed study.

- Identify different problems created by sample surveys that are aeted poorly.

- Identify characteristics of a well-designed experiment.

- Understand and create a well-designed experiment.

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Know:

Treatments, control groups, experimental units, random assignments, and replication.

Sources of bias and confounding, including placebo effect and blinding.

Completely randomized design.

Randomized block design, Including matched pairs design.

- Generalizability of results and types of conclusion that can be drawn from observational studies, experiments, and surveys.

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Understand:

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Do:

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Days: 41

Subject: Introduction to Statistics

Grade: 10,11,12

Unit Two KUO: Exploring Data: Describing patterns and departures from patterns.

By the end of this unit, students will be able to...

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Know:

- Constructing and interpreting graphical displays of distributions of univariate data.

Center, Spread, Clusters, Gaps, Outliers, and Shape

- Summarizing Distributions of univariate data.

Median, Mean, Range, IQR, Standard Deviation, Quartiles, percentiles, standardized scores.

Using Boxplots.

- Comparing distributions of univariate data.

Comparing clusters, gaps, outliers, center, spread, and shape between groups.

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Understand:

Graphs and Charts can give us much information about how the data is centered, spread out, distributed, and if there are any outliers.

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Do:

Describe SOCS for any graph that the students are given.

Use a two-way table to identify marginal and conditional probabilities.

Interpret Box-Plots for SOCS and find outliers.

Understand the relationship between percentiles and z-scores.

Use the Empirical Rule to identify standard deviations of data.

Calculate and interpret Standard Deviation.

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Know:

- Exploring categorical  
Data.

Frequency Tables and Bar  
Graphs.

Marginal and Joint  
Frequencies for two-way  
tables.

Conditional relative  
frequencies and  
association.

Comparing distributions  
using bar charts.

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Understand:

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Do:

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Days: 40

Subject: Introduction to Statistics

Grade: 10,11,12

Unit Three KUO: Anticipating Patterns: Exploring random phenomena using probability and simulation.

By the end of this unit, students will be able to...

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Know:

- Probability

Interpreting probability, including long-run relative frequency interpretation.

Law of Large Numbers

Addition and Multiplication Rule, Conditional Probability and independence.

Discrete Random Variables and their probability distributions, and including binomial and geometric.

Simulation of random behavior and probability distributions.

Mean (expected Value) and standard deviation of a random variable, and linear transformation of a random variable.

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Understand:

To be able to identify the different types of random variables and to be able to use the different statistical data for each type of random variable correctly.

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Do:

Understand the concept of Law of Large Numbers.

Set-up and Run a Simulation.

Identify if two events are Independent, Dependent, and/or mutually exclusive.

Identify the difference between Discrete and Continuous Random Variables.

Find the mean and SD of Discrete and Continuous Random Variables.

Understand what changes are made to SOCS when a linear transformation occurs to a Discrete Random Variable.

Interpret Binomial and Geometric Random Variables and their characteristics.

Understand the difference between **biased** and unbiased estimators.

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Know:

- Combining independent random variables.

Independence versus dependence.

Mean and SD for sums and differences of Independent random variables.

- The Normal Distribution

Properties of the normal distribution.

Using Tables of the normal distribution.

The normal distribution as a model for measurements.

- Sampling Distributions

Sampling distributions of a sample proportion and sample mean.

Central Limit Theorem

Sampling Distribution of a difference between two Independent sampling proportions.

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Understand:

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Do:

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Days: 60

Subject: Introduction to Statistics

Grade: 10,11,12

Unit Four KUO: Statistical Inference: Estimating population parameters and testing hypotheses.

By the end of this unit, students will be able to...

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Know:

- Estimation

Estimating population parameters and margins of error.

Properties of point estimators, including unbiasedness and variability

Logic of confidence intervals, meaning of confidence level and confidence intervals, and properties of confidence Intervals.

Large sample confidence interval for a proportion.

Large sample confidence Interval for a difference between two proportions.

Confidence Interval for a mean and difference between two means.

Confidence Interval for the slope of a LSR.

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Understand:

To be able to identify and utilize the correct test for a given situation.

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Do:

Interpret Confidence Levels and Intervals.

Identify the correct test to be used for a given problem.

Write a test claim, run the simulation, and draw correct conclusions from the data about your claim.

Create an Inference of categorical data and use the appropriate test.

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Know:

- Test of Significance.

Logic of significance  
test, null and  
alternative hypotheses: p-  
values, one and two-sided  
tests, concepts of Type I  
and Type II errors,  
concepts of Power.

Large Sample test for a  
proportion and difference  
between two proportions.

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Understand:

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Do:

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*Unit Essential Question:*  
How do we analyze 1-variable statistics?

<p><b><u>Concept:</u></b> Organizing Data</p>	<p><b><u>Concept:</u></b> Displaying Data</p>	<p><b><u>Concept:</u></b> Numerical Summaries for Quantitative Data</p>
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<p><b><u>Lesson Essential Question/s:</u></b> How do we organize 1-variable data?</p>	<p><b><u>Lesson Essential Question/s:</u></b> How do we display 1-variable data?</p>	<p><b><u>Lesson Essential Question/s:</u></b> How do we calculate and interpret summary statistics?</p>
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<p><b><u>Vocabulary:</u></b></p> <ul style="list-style-type: none"> <li>• Individuals</li> <li>• Variable</li> <li>• Categorical Variable</li> <li>• Quantitative Variable</li> <li>• Frequency Table</li> <li>• Relative Frequency Table</li> </ul>	<p><b><u>Vocabulary:</u></b></p> <ul style="list-style-type: none"> <li>• <i>Bar Graphs</i></li> <li>• <i>Dot plots</i></li> <li>• <i>Stem plots</i></li> <li>• <i>Histograms</i></li> <li>• <i>Box Plots</i></li> <li>• <i>SOCS</i></li> </ul>	<p><b><u>Vocabulary:</u></b></p> <ul style="list-style-type: none"> <li>• Median</li> <li>• Mean</li> <li>• Standard Deviation</li> <li>• IQR</li> <li>• Outlier Rule</li> </ul>
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*Unit Essential Question:*  
How do we model one-variable quantitative data?

<b><u>Concept:</u></b> Describing Location in a distribution	<b><u>Concept:</u></b> Transforming Data	<b><u>Concept:</u></b> Density Curves	<b><u>Concept:</u></b> Normal Distributions
			
<b><u>Lesson Essential Question/s:</u></b> How do we calculate and interpret location in a distribution?	<b><u>Lesson Essential Question/s:</u></b> What happens to summary statistics when we make changes to all the values in the data set?	<b><u>Lesson Essential Question/s:</u></b> What are the characteristics of a density curve?	<b><u>Lesson Essential Question/s:</u></b> How do we calculate and interpret the probability of an event occurring in a normal distribution?
			
<b><u>Vocabulary:</u></b> <ul style="list-style-type: none"> <li>• Percentile</li> <li>• Z-score</li> </ul>	<b><u>Vocabulary:</u></b> <ul style="list-style-type: none"> <li>•</li> </ul>	<b><u>Vocabulary:</u></b> <ul style="list-style-type: none"> <li>•</li> </ul>	<b><u>Vocabulary:</u></b> <ul style="list-style-type: none"> <li>• Empirical Rule</li> <li>• Standard Normal Distribution</li> <li>• normalcdf( )</li> <li>• invnorm( )</li> </ul>

*Unit Essential Question:*  
 What are the basic rules of probability and how do we use them to solve real world problems?

<p><b><u>Concept:</u></b></p> <p>Randomness, Probability, and Simulation</p>	<p><b><u>Concept:</u></b></p> <p>Probability Models and Probability Rules</p>	<p><b><u>Concept:</u></b></p> <p>Conditional Probability, Multiplication Rules and Independence</p>
		
<p><b><u>Lesson Essential Question/s:</u></b></p> <p>How do we use simulations and the Law of Large numbers to help us make predictions?</p>	<p><b><u>Lesson Essential Question/s:</u></b></p> <p>How do we use two-way tables to help us find the probability of 2 events occurring?</p>	<p><b><u>Lesson Essential Question/s:</u></b></p> <p>How do we find the probability of 2 events occurring when they are not independent?</p>
		
<p><b><u>Vocabulary:</u></b></p> <ul style="list-style-type: none"> <li>• probability</li> <li>• law of large numbers</li> <li>• simulation</li> </ul>	<p><b><u>Vocabulary:</u></b></p> <ul style="list-style-type: none"> <li>• probability model</li> <li>• event</li> <li>• complement rule</li> <li>• general addition rule</li> <li>• mutually exclusive events</li> <li>• two-way table</li> <li>• Venn-diagrams</li> </ul>	<p><b><u>Vocabulary:</u></b></p> <ul style="list-style-type: none"> <li>• conditional probability</li> <li>• general multiplication rule</li> <li>• tree diagram</li> <li>• independent events</li> </ul>

*Unit Essential Question:*

How can we tell the difference between the different types of random variables?

**Concept:**

Discrete Random Variables vs Continuous Random Variables

**Concept:**

Binomial random variables and their distributions



**Lesson Essential Question/s:**

How do we tell the difference between discrete random variables and continuous random variables and what do their distributions look like?

**Lesson Essential Question/s:**

How do we prove a distribution is binomial and what does the distribution look like?





**Vocabulary:**

- random variable
- probability distribution
- discrete random variables
- continuous random variables
- expected value

**Vocabulary:**

- binomial setting
- BINS
- Binomial random variable
- Binomial distribution
- 10% rule

*Unit Essential Question:*  
  
*What is a sampling distribution and how do we describe it?*

<p><b><u>Concept:</u></b> The idea of a sampling distribution</p>	<p><b><u>Concept:</u></b> Sample proportions</p>	<p><b><u>Concept:</u></b> Sample Means</p>
		
<p><b><u>Lesson Essential Question/s:</u></b> What is a sampling distribution and why do we use them?</p>	<p><b><u>Lesson Essential Question/s:</u></b> How do we find the shape, center, and spread of a sampling distribution of a sample proportion?</p>	<p><b><u>Lesson Essential Question/s:</u></b> How do we find the shape, center, and spread of a sampling distribution of a sample mean?</p>
		
<p><b><u>Vocabulary:</u></b></p> <ul style="list-style-type: none"> <li>• Parameter</li> <li>• Statistic</li> <li>• Sampling distribution</li> <li>• Unbiased estimator</li> </ul>	<p><b><u>Vocabulary:</u></b></p> <ul style="list-style-type: none"> <li>• Sampling distribution of a sample proportion</li> <li>• Shape – Large Counts</li> <li>• Center – <math>p</math></li> <li>• Spread – standard deviation of the sample proportion</li> </ul>	<p><b><u>Vocabulary:</u></b></p> <ul style="list-style-type: none"> <li>• Sampling distribution of a sample mean</li> <li>• Shape – CLT or graphs</li> <li>• Center – sample mean</li> <li>• Spread – standard deviation of the sample mean</li> </ul>

*Unit Essential Question:*  
*How do we use confidence intervals to estimate a population parameter?*

<p><b><u>Concept:</u></b> Idea of a confidence interval</p>	<p><b><u>Concept:</u></b> Confidence intervals for a sample proportion</p>	<p><b><u>Concept:</u></b> Confidence intervals for a sample mean</p>
<p><b><u>Lesson Essential Question/s:</u></b> What is a confidence interval and how can we change the margin of error?</p>	<p><b><u>Lesson Essential Question/s:</u></b> How do we estimate and interpret the confidence interval for a sample proportion?</p>	<p><b><u>Lesson Essential Question/s:</u></b> How do we estimate and interpret the confidence interval for a sample mean?</p>
<p><b><u>Vocabulary:</u></b></p> <ul style="list-style-type: none"> <li>• Confidence interval</li> <li>• Confidence level</li> <li>• Point estimate</li> <li>• Margin of error</li> </ul>	<p><b><u>Vocabulary:</u></b></p> <ul style="list-style-type: none"> <li>• Conditions for a confidence interval for a sample proportion</li> <li>• Critical value (<math>z^*</math>)</li> <li>• Standard error of sample proportion</li> <li>• 1-prop-z-interval</li> </ul>	<p><b><u>Vocabulary:</u></b></p> <ul style="list-style-type: none"> <li>• Conditions for a confidence interval for a sample mean</li> <li>• Critical value (<math>t^*</math>)</li> <li>• Standard error of sample mean</li> <li>• 1-sample-t-interval or t-interval</li> </ul>



*Unit Essential Question:*  
*How do we use hypothesis tests to test a claim?*

<p><b><u>Concept:</u></b></p> <p>Idea of a hypothesis test</p>	<p><b><u>Concept:</u></b></p> <p>Hypothesis test for a sample proportion</p>	<p><b><u>Concept:</u></b></p> <p>Hypothesis test for a sample mean.</p>
<p><b><u>Lesson Essential Question/s:</u></b></p> <p>What is a hypothesis test and what type of errors could we make?</p>	<p><b><u>Lesson Essential Question/s:</u></b></p> <p>How do we perform and interpret a hypothesis test for a sample proportion?</p>	<p><b><u>Lesson Essential Question/s:</u></b></p> <p>How do we perform and interpret a hypothesis test for a sample mean?</p>
<p><b><u>Vocabulary:</u></b></p> <ul style="list-style-type: none"> <li>• Significance test</li> <li>• Null hypothesis</li> <li>• Alternate hypothesis</li> <li>• One-sided test</li> <li>• Two-sided test</li> <li>• P-value</li> <li>• Significance level</li> <li>• Type I Error</li> <li>• Type II Error</li> </ul>	<p><b><u>Vocabulary:</u></b></p> <ul style="list-style-type: none"> <li>• Conditions for a hypothesis test for a sample proportion</li> <li>• 1-prop-z-test</li> </ul>	<p><b><u>Vocabulary:</u></b></p> <ul style="list-style-type: none"> <li>• Conditions for a hypothesis test for a sample mean.</li> <li>• 1-sample-t-test or t-test</li> </ul>

*Unit Essential Question:*  
*How do we compare two different populations with confidence intervals or hypothesis tests?*

<p><b><u>Concept:</u></b> Inference about two proportions</p>	<p><b><u>Concept:</u></b> Inference about two means</p>	<p><b><u>Concept:</u></b> Inference about a mean difference in Paired Data</p>
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<p><b><u>Lesson Essential Question/s:</u></b> How do we make inferences about two proportions?</p>	<p><b><u>Lesson Essential Question/s:</u></b> How do we make inferences about two means?</p>	<p><b><u>Lesson Essential Question/s:</u></b> How do we make inferences in paired data?</p>
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<p><b><u>Vocabulary:</u></b></p> <ul style="list-style-type: none"> <li>• Conditions for the test</li> <li>• Shape</li> <li>• Center</li> <li>• Spread</li> </ul>	<p><b><u>Vocabulary:</u></b></p> <ul style="list-style-type: none"> <li>• Conditions for the test</li> <li>• Shape</li> <li>• Center</li> <li>• Spread</li> </ul>	<p><b><u>Vocabulary:</u></b></p> <ul style="list-style-type: none"> <li>• Paired Data</li> <li>• Conditions for the test</li> <li>• Shape</li> <li>• Center</li> <li>• Spread</li> </ul>
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*Unit Essential Question:*  
*How do we make inferences about categorical data?*

<p><b><u>Concept:</u></b> Tests about the Distribution of One Categorical Variable</p>	<p><b><u>Concept:</u></b> Tests about the Distribution of Two Categorical Variable</p>
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<p><b><u>Lesson Essential Question/s:</u></b> How do we perform and interpret a chi-square goodness of fit test?</p>	<p><b><u>Lesson Essential Question/s:</u></b> How do we perform and interpret a chi-square test of association?</p>
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<p><b><u>Vocabulary:</u></b></p> <ul style="list-style-type: none"><li>• Conditions for the test</li><li>• Expected Counts</li><li>• Chi-square test statistics</li><li>• Chi-square distribution</li></ul>	<p><b><u>Vocabulary:</u></b></p> <ul style="list-style-type: none"><li>• Conditions for the test</li><li>• Expected counts</li></ul>
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