

Course Title:	Statistics (H)
Grade(s):	10, 11, & 12

Course Description

This course is intended for students whose interests lie not only in mathematics but also in the social, physical, and life sciences. It is also highly recommended, as a large number of college majors and careers now require some level of understanding of statistics and data analysis. Topics include observing patterns and departures from patterns, deciding what and how to measure, producing models using probability theory and simulation, and confirming models. The course exposes students to the conceptual themes: Exploring Data, Sampling and Experimentation, Anticipating Patterns and Statistical Inference. This course adheres to the philosophy and methods of modern data analysis with an emphasis on technological practices. The curriculum for Statistics provides activities that guide students to discover statistical concepts, explore statistical principles, and apply statistical techniques. Students work toward these goals through the analysis of data and through interaction with one another, with the instructor, and with technology.

Honors Level (H)

Honors-level courses are designed to challenge the advanced learner. Students should expect to reach a deeper scope of skills than the academic class: a higher reading stamina, the motivation to revise work, critical thinking skills, and the propensity to finish complex tasks in a timely manner. Students in honors-level classes are expected to have a solid foundation of skills from previous courses, an ability to connect these skills to new learning, and the ability to apply them in problem-solving. Students taking an honors-level class have demonstrated the ability to take responsibility for their own learning and work fluidly both independently and collaboratively. These students should consistently aspire to achieve higher-level quality work through self-reflection and self-advocacy. These classes are recommended to students by teachers who have evaluated a student's past practice and achievement.

Course Units:

1. Exploring Data
2. Modeling Distributions of Data
3. Describing Relationships
4. Designing Studies & Collecting Data
5. Probability - What are the Chances
6. Random Variables
7. Sampling Distributions (Honors)
8. Inference (Honors)

9. Projects

Approved Curricular Materials/Textbook(s)

The Practice of Statistics (sixth edition) by Starnes/Tabor/Yates/Moore

Unit Title	Unit Description (Include Unit Objectives)	Unit Pacing
Unit 1: EXPLORING DATA	In this introductory unit, students move beyond simple numbers to understand the "story" behind data. We begin by defining the difference between categorical and quantitative variables and mastering the concept of a distribution. Students will learn to identify relationships between variables, construct meaningful visual displays, and provide precise numerical summaries that reveal the underlying patterns in a dataset. Unit Topics Include: - Analyzing Categorical Data - Frequency and relative frequency tables - Visualizing data with bar charts and pie charts - Exploring relationships between two categorical variables - Displaying Quantitative Data with Graphs - Constructing dotplots, stemplots, and histograms - Identifying the "shape" of data (Symmetry vs. Skewness) - Comparing distributions across different groups - Describing Quantitative Data with Numbers - Measuring center: Mean vs. Median - Measuring variability: Range, Standard Deviation and Interquartile Range (IQR) - Identifying mathematical outliers	4 weeks (August - September)
Unit 2:	In this unit, we shift from describing entire datasets to pinpointing an individual's relative standing within a distribution. We begin by calculating percentiles and z-	4 weeks

MODELING DISTRIBUTIONS OF DATA	scores to answer the question, "Where do I stand?" Students will explore how mathematical transformations (like shifting or scaling) affect a distribution's shape, center, and spread. Finally, we introduce density curves, focusing specifically on the Normal Distribution—a symmetric, bell-shaped model used to estimate percentiles and probabilities for a wide variety of real-world variables. Unit Topics Include: • Describing Location in a Distribution - Calculating and interpreting Percentiles and Cumulative Relative Frequency graphs - Standardizing values using z-scores - Analyzing the effects of transforming data (adding, subtracting, multiplying, or dividing by a constant) • Density Curves and Normal Distributions - Transitioning from histograms to smooth Density Curves (where the total area = 1) - Identifying the Mean and Standard Deviation of a density curve - Applying the 68-95-99.7 Rule (The Empirical Rule) - Calculating areas under the Normal curve and finding values from known percentiles (Inverse Normal)	(September - October)
Unit 3: DESCRIBING RELATIONSHIPS	In this unit, we shift our focus from analyzing single variables to exploring the relationships between two quantitative variables. Students will learn to visualize these connections using scatterplots and quantify the strength and direction of their association through correlation (r). The core of the unit involves constructing and interpreting the Least-Squares Regression Line - a mathematical model used to predict outcomes and analyze how well a linear trend fits the observed data. Unit Topics Include: • Scatterplots and Correlation - Identifying Explanatory vs. Response variables - Describing patterns using Direction, Form, Strength, and Outliers - Interpreting the Correlation Coefficient (r) and its properties • Least-Squares Regression	4 weeks (October - November)

	- Constructing the regression equation: $y = a + bx$ - Interpreting the slope and y-intercept in context - Calculating and interpreting residuals (Observed - Predicted) - Using the model to make predictions and avoiding extrapolation • Assessing the Fit of a Regression Line - Analyzing Residual Plots to determine if a linear model is appropriate - Interpreting the Standard Deviation of the Residuals - Interpreting the Coefficient of Determination (r^2) - Identifying the impact of outliers and influential points on the regression line	
Unit 4: DESIGNING STUDIES & COLLECTING DATA	In this unit, we explore the critical methods used to gather reliable data through surveys, observational studies, and experiments. Students will learn that "how" data is collected determines "what" conclusions can be drawn. We will focus on the principles of randomization to reduce bias and the specific structures of well-designed experiments. Finally, we will analyze the scope of inference, distinguishing between when we can generalize results to a population versus when we can establish a true cause-and-effect relationship. Unit Topics Include: • Sampling and Surveys - Identifying Population vs. Sample - Mastering sampling methods: Simple Random Sample (SRS), Stratified, Cluster, and Systematic - Recognizing Bias: Undercoverage, Nonresponse, and Response Bias • Experiments - Distinguishing between Observational Studies and Experiments - The Four Principles of Experimental Design: Comparison, Random Assignment, Control, and Replication - Advanced designs: Randomized Block Design and Matched Pairs - The role of Placebos and Blinding (Single vs. Double) • Using Studies Wisely	4 weeks (November - December)

	- Scope of Inference: Determining if results apply to a population or prove causation - The ethics of data collection - Understanding Confounding Variables and how they impact study results	
Unit 5: PROBABILITY: WHAT ARE THE CHANCES	In this unit, we move from data analysis to the mathematics of chance. We begin by using simulations to estimate probabilities and understand the "Law of Large Numbers." Students will develop formal probability models and master the fundamental rules of addition and multiplication. By revisiting two-way tables and introducing Venn diagrams and tree diagrams, we will explore the critical concepts of conditional probability and independence—tools that allow us to determine if the occurrence of one event truly changes the likelihood of another. Unit Topics Include • Randomness, Probability, and Simulation - Interpreting probability as a long-run relative frequency - Designing and conducting simulations to estimate outcomes - Understanding the "Law of Large Numbers" vs. the "Law of Averages" myth • Probability Rules - Defining a Sample Space and Probability Models - Mastering the Basic Rules: Complement rule, Addition rule for Mutually Exclusive events, and General Addition rule - Using Venn Diagrams to visualize intersections ($\cap$) and unions ($\cup$) • Conditional Probability and Independence - Calculating Conditional Probability: $P(A B) = \frac{P(A \cap B)}{P(B)}$ - Using The General Multiplication Rule and Tree Diagrams for multi-stage events - Proving Independence: Determining if $P(A B) = P(A)$ - Multiplication rule for independent events	4 weeks (December - January)
Unit 6:	This unit is the bridge between probability theory and the "Big Picture" of	4 weeks - 5 weeks

RANDOM VARIABLES	statistical inference. You are moving from calculating the odds of a single event to understanding the behavior of entire distributions. In this unit, we transition from basic probability to the study of Random Variables—numerical outcomes determined by chance processes. A random variable is a numerical outcome of a chance process, such as the height of a randomly selected student, the number of heads in three flips of a coin, or the difference between the diameter of a randomly chosen cup and the diameter of a randomly chosen lid. We will analyze the "personality" of these variables by examining their probability distributions, specifically focusing on their shape, center, and spread. This unit serves as the essential preparation for statistical inference; understanding how random variables (like sample proportions and means) behave under repeated sampling is the key to building confidence intervals and performing significance tests later in statistics courses. Unit Topics Include: ● Foundations of Random Variables - Distinguishing between Discrete (countable) and Continuous (measured) variables - Constructing and interpreting probability histograms - Measuring Center: Calculating the Expected Value - Measuring Variability: Calculating Variance and Standard Deviation ● Transformations & Combinations - Understanding how linear transformations (adding/multiplying constants) affect the mean and standard deviation - Combining independent random variables: Rules for adding/subtracting means and adding variances ● Binomial and Geometric Random Variables - Binomial Distributions and Shape - Calculating Binomial probabilities using formulas and technology - Geometric Distributions: Modeling the number of trials to get the first success	(January - February)
Unit 7:	In this unit, we move from analyzing individual data points to analyzing the behavior of sample statistics ($\hat{p}$ and $\bar{x}$). We explore the concept of a Sampling	4 weeks - 5 weeks

SAMPLING DISTRIBUTIONS	Distribution: the distribution of values taken by a statistic in all possible samples of the same size from the same population. Students will learn how to describe the center and variability of these distributions and master the Central Limit Theorem, which allows us to use Normal models to make predictions about means even when the underlying population is not Normal. Unit Topics Include • What is a Sampling Distribution? - Distinguishing between a Parameter (population) and a Statistic (sample) - Understanding the concept of "Repeated Sampling" - Defining Bias and Variability in the context of sampling • Sampling Distributions: Center and Variability - Identifying an Unbiased Estimator (when the mean of the sampling distribution equals the true parameter) - Understanding how Sample Size (n) affects the spread (variability) of the distribution - The 10% Condition: When it is safe to calculate the standard deviation • Sample Proportions ($\hat{p}$) - Calculating the mean ($\mu_{\hat{p}} = p$) and standard deviation $\sigma_{\hat{p}} = \sqrt{\frac{p(1-p)}{n}}$ - Checking the Large Counts Condition ($np \geq 10$ and $n(1 - p) \geq 10$) to ensure a Normal shape • Sample Means ($\bar{x}$) - Calculating the mean ($\mu_{\bar{x}} = \mu$) and standard deviation ($\sigma_{\bar{x}} = \frac{\sigma}{\sqrt{n}}$) - Analyzing how the shape of the sampling distribution changes as n increases • The Central Limit Theorem (CLT) - Understanding that for a large enough sample size (usually $n \geq 30$), the sampling distribution of $\bar{x}$ is approximately Normal, regardless of the population's shape - Applying the CLT to calculate probabilities involving sample means	(March - April)
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Unit 8: INFERENCE	Inference is the process of using data from a sample to draw conclusions about a larger population with a known degree of certainty. In this unit, we move from probability models to formal decision-making. Students will learn the two main pillars of inference: Confidence Intervals, which estimate the value of an unknown population parameter, and Significance Tests, which evaluate the evidence for a specific claim. We will apply these tools to both proportions and means, and conclude by using Chi-Square tests to analyze the distribution of categorical variables across multiple groups. Unit Topics Include: • Confidence Intervals - Understanding the "Point Estimate" and the "Margin of Error" - Interpreting "Confidence Level" vs. "Confidence Interval" - Constructing and interpreting a one-sample z -interval for a proportion - Calculating the required sample size for a desired margin of error • Significance Tests - Null Hypothesis and the Alternative Hypothesis - Calculating and interpreting the P-value - Statistical significance • Inference about a Population Mean - Transitioning from z-scores to t-distributions when σ is unknown - Constructing and interpreting one-sample t-intervals - Performing one-sample t-tests for a population mean - Analyzing paired data using matched-pairs t-procedures • Chi-Square Tests - Goodness of Fit: Testing if a sample distribution matches a claimed population distribution - Two-Way Tables: Testing for Independence or Homogeneity between categorical variables - Calculating the Chi-Square statistic (χ^2) and identifying degrees of freedom	4 weeks - 5 weeks (April - May)
Unit 9:	In this culminating unit, students transition from learners to researchers by	3 weeks

PROJECTS	designing and executing an original statistical study. Working individually or in small groups, students will identify a meaningful, school-appropriate topic and develop their own research questions for data collection, design a rigorous data-collection plan, analyze the data using appropriate statistical tools mastered throughout the year, and present their findings in a clear, visual, and engaging format. This project emphasizes real-world application, creativity, and student leadership, requiring a "soup-to-nuts" approach—from the initial hypothesis to a final, polished presentation of data-driven conclusions. To successfully complete this project, students are expected to: • Identify a Topic: Select a school-appropriate topic and formulate a clear, testable hypothesis • Design a Data Collection Plan: Develop a method (survey, observational study, or experiment) that minimizes bias and utilizes proper sampling or assignment techniques • Execute Data Collection: Gather raw data while maintaining ethical standards and documenting the process • Perform Descriptive Analysis: Create appropriate graphical representations (histograms, boxplots, scatterplots) and calculate numerical summaries • Apply Inferential Reasoning: Select and conduct the correct inference procedure (Confidence Interval, T-Test, or Chi-Square) to determine the significance of the findings • Communicate Results: Produce a final report or visual presentation that translates complex calculations into clear, accessible conclusions for a general audience • Reflect on Limitations: Critically evaluate the study's design, identifying potential confounding variables or errors that may have impacted the results	(May - June)
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