

**Dover-Sherborn High School**  
**Mathematics Curriculum**  
**Probability and Statistics**

A. DESCRIPTION

This is a full year courses designed to introduce students to the basic elements of statistics and probability. Emphasis is placed on understanding terminology and real life applications

B. OBJECTIVES

The student should be able to:

1. differentiate between descriptive and inferential statistics;
2. organize and display data;
3. find measures of central tendency;
4. construct various plots and graphs from data;
5. compare sets of data;
6. find measures of spread/dispersion;
7. recognize uniform, skewed and normal distributions of data;
8. determine, for a normal distribution, the percent of data within a given interval and find percentiles, identify their limitations, and estimate population characteristics based on samples;
9. determine different types of sampling procedures, identify their limitations, and estimate population characteristics based on samples;
10. develop an understanding of the meaning of probability theory;
11. analyze and solve problems involving permutations and combinations, and probability
12. solve applied problems involving binomial, poisson, and normal probability distributions;
13. determine confidence intervals for certain statistics within a data set to better quantify the validity of a given descriptive statistic;
14. test claims made about population means, proportions, or standard deviations to form conclusions based on a formal hypothesis test;
15. use hypothesis testing to make inferences from two samples;
16. develop an understanding of correlation and regression necessary to describe the relationship between two variables and to make predictions for specific data values;
17. construct a contingency table to test for independence between two variables;
18. apply analysis of variance to test the claim that multiple samples come from populations with the same mean;
19. develop a basic understanding of non-parametric statistics to test claims about data that do not follow a normal distribution.

C. OUTLINE

1. Introduction to Statistics [9-12.S.IC.1, 9-12.S-MD.6]
  - a. Overview
  - b. The Nature of Data
  - c. Uses and Abuses of Statistics
  - d. Design of Experiments

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2. Describing, Exploring, and Comparing Data [9-12.S-ID.1, 9-12.S-ID.2, 9-12.S-ID.3, 9-12.S-ID.5]
  - a. Summarizing Data with Frequency Tables
  - b. Pictures of Data
  - c. Measures of Center
  - d. Measures of Variation
  - e. Measures of Position
  - f. 2-7 Exploratory Data Analysis
3. Probability [9-12.S-CP.6, 9-12.S-CP.7, 9-12.S-CP.8, 9-12.S-CP.9]
  - a. Fundamentals
  - b. Addition Rule
  - c. Multiplication Rule: Basics
  - d. Multiplication Rule: Complements and Conditional Probability
  - e. Counting
4. Probability Distributions [9-12.S-IC.5]
  - a. Random Variables
  - b. Binomial Probability Distributions
  - c. Mean, Variance, and Standard Deviation for the Binomial Distribution
  - d. The Poisson Distribution
5. Normal Probability Distributions [9-12.S-ID.4]
  - a. The Standard Normal Distribution
  - b. Normal Distributions: Finding Probabilities
  - c. Normal Distributions: Finding Values
  - d. The Central Limit Theorem
6. Estimates and Sample Sizes [9-12.S-IC.4]
  - a. Estimating a Population Mean: Large Samples ( $n > 30$ )
  - b. Estimating a Populations Mean: Small Samples ( $n \leq 30$ )
  - c. Determining Sample Size Required to Estimate  $\mu$
  - d. Estimating a Population Proportion
  - e. Estimating a Population Variance
7. Hypothesis Testing
  - a. Fundamentals of Hypothesis Testing
  - b. Testing a Claim about a Mean: Large Samples
  - c. Testing a Claim about a Mean: Small Samples
  - d. Testing a Claim about a Proportion
  - e. Testing a Claim about a Standard Deviation or Variance

D. TEXT

Elementary Statistics, 8<sup>th</sup> edition, Mario F. Triola  
ISBN 0-201-61477-4 (hc)

E. SUPPLEMENTARY MATERIALS

1. Graphing Calculators
2. Teacher-prepared materials
3. Test-GenEQ 3.0

**Dover-Sherborn High School**  
**Mathematics Curriculum Road Maps**  
**Probability and Statistics**

Course Title: Probability and Statistics

Grade: 12

Unit: Introduction to Statistics

Month Presented: September

Unit Length (in weeks): 1-2

**Essential Question(s):**

- Can I define the terms: population, sample, parameter, statistic, census?
- Can I distinguish between different types of data?
- Can I give examples of uses and abuses of statistics?
- Can I give examples of various experimental designs?

**Learning Objectives:**

- Define the terms: population, sample, parameter, statistic, census
- Distinguish between quantitative and qualitative data
- Distinguish between continuous and discrete data
- Give examples of uses and abuses of statistics
- Give examples of various experimental designs

**Instructional Strategies & Activities:**

- Note taking
- Guided exploration
- Cooperative learning/group work
- Competitive Review Games

**Materials Utilized:**

- Textbook
- Teacher generated notes and homework worksheets

**Assessment Strategies:**

- Discussion/Daily class performance
- Openers/Warm-Ups
- Daily homework/Error analysis
- Tests and quizzes
- Reflection and Self-Assessment

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**Probability and Statistics**

Course Title: Probability and Statistics

Grade: 12

Unit: Describing, Exploring, and Comparing Data

Month Presented: September/October

Unit Length (in weeks): 6-7

**Essential Question(s):**

- Can I construct and interpret different types of tables and graphs as a means of displaying data?
- Can I calculate descriptive statistics such as the mean, median, mode, range, standard deviation, and variance for a given data set or frequency table?
- Can I describe the symmetry of a given distribution?
- Can I use the Empirical Rule to interpret data?
- Can I calculate and interpret a z-score?
- Can I calculate and interpret percentiles, deciles, and quartiles for a data set?

**Learning Objectives:**

- Construct and interpret a frequency table, relative frequency table, and a cumulative frequency table from a set of data
- Construct and interpret a histogram, a relative frequency histogram, a stem and leaf plot, and a pareto chart (bar graph for qualitative data)
- Calculate mean, median, and mode from a set of data
- Calculate mean from a frequency table
- Calculate a weighted mean from a set of data
- Identify a distribution as being negatively skewed, positively skewed, or symmetric
- Find range from a set of data
- Calculate standard deviation of a sample or population
- Calculate variance of a sample or population
- Find a rough estimate of the standard deviation using the range rule of thumb
- Understand Empirical Rule
- Define z-score and know formula for computing z-score
- Know difference between percentiles, deciles, and quartiles
- Given a value, find the corresponding percentile
- Given a percentile, find the corresponding value
- Find the 5-number summary and construct a boxplot for a set of data

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**Probability and Statistics**

Course Title: Probability and Statistics

Grade: 12

Unit: Probability

Month Presented: October/November

Unit Length (in weeks): 4

**Essential Question(s):**

- Can I define basic terms in probability such as: event, sample space, complement, mutually exclusive, independent, and dependent?
- Can I distinguish between theoretical and experimental probability?
- Can I explain the Law of Large Numbers?
- Can I give the range of values for probabilities and give the probability of events that are impossible or certain?
- Can I use the addition and multiplication rules to calculate the probabilities of different events?
- Can I use the fundamental counting principle, factorials, permutations, and combinations solve probability problems?

**Learning Objectives:**

- Define: event, sample space
- Know difference between theoretical probability and experimental probability of an event occurring
- Describe the Law of Large Numbers
- Know probability of an impossible event is 0, a event that is certain is 1, and that all other probabilities are between 0 and 1
- Define the complement of an event
- Addition Rule  $P(A \text{ or } B) = P(A) + P(B) - P(A \text{ and } B)$
- Use the addition rule to find probabilities
- Define: mutually exclusive
- Given the probability of an event, find the probability of a complementary event
- Multiplication Rule: Basics
- Use the multiplication rule to find probabilities
- Define: independent events, dependent events
- For independent events,  $P(A \text{ and } B) = P(A) \cdot P(B)$
- For dependent events,  $P(A \text{ and } B) = P(A) \cdot P(B|A)$
- Multiplication Rule: Complements and Conditional Probability
- Use complements to find the probability of "at least one"
- Define and use conditional probability
- Counting
- Use Fundamental Counting Rule to solve problems
- Use Factorial Rule to solve problems
- Find number of permutations of n objects, know when to use permutations
- Find number of combinations of n objects, know when to use combinations

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**Probability and Statistics**

Course Title: Probability and Statistics

Grade: 12

Unit: Probability Distributions

Month Presented: December/January

Unit Length (in weeks): 5

**Essential Question(s):**

- Can I define and give examples of a random variable?
- Can I identify a probability distribution based on its requirements?
- Can I distinguish between discrete and continuous random variables?
- Can I calculate descriptive statistics for a probability distribution?
- Can I use the Binomial distribution to give descriptive statistics about a data set and find probabilities of different events?
- Can I use the Poisson distribution to give descriptive statistics about a data set and find probabilities of different events?

**Learning Objectives:**

- Define random variable, probability distribution
- Know requirements for a probability distribution
- Distinguish between discrete and continuous random variables
- Find mean for a probability distribution and standard deviation for a probability distribution
- Find expected value of a discrete random variable
- Binomial Probability Distributions
- Know requirements and notation for a binomial probability distribution
- Find probabilities using the binomial probability formula, Table A-1, or a graphing calculator
- Mean, Variance, and Standard Deviation for the Binomial Distribution
- Know and use formulas for mean, variance, and s.d. for the binomial distribution
- Find minimum and maximum usual values given a mean and standard deviation
- The Poisson Distribution
- Know requirements and notation for a Poisson distribution
- Given mean, compute  $P(x)$  using Formula 2-9 or on a graphing calculator

**Instructional Strategies & Activities:**

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**Materials Utilized:**

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**Assessment Strategies:**

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- Openers/Warm-Ups
- Daily homework/Error analysis
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Course Title: Probability and Statistics

Grade: 12

Unit: Normal Probability Distributions

Month Presented: January/February

Unit Length (in weeks): 3-4

**Essential Question(s):**

- Can I find probabilities given a standard normal, uniform, or normal distribution?
- Can I use the normal distribution to find values corresponding to a given percentile and vice versa?
- Can I describe the Central Limit Theorem and know how and when it is appropriate to use it?

**Learning Objectives:**

- Define: normal distribution, standard normal distribution, uniform distribution
- Find probabilities given a uniform distribution
- Find probabilities when given z-scores
- Finding z-scores when given probabilities
- Normal Distributions: Finding Probabilities
- Convert values to standardized z-scores
- Once you have obtained z-scores, use z-scores to find probabilities
- Normal Distributions: Finding Values
- Given a percentile, find value corresponding to the percentile
- The Central Limit Theorem
- Define: Central Limit Theorem
- Find probabilities of sample means using the Central Limit Theorem

**Instructional Strategies & Activities:**

- Note taking
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**Assessment Strategies:**

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Course Title: Probability and Statistics

Grade: 12

Unit: Estimates and Sample Sizes

Month Presented: March

Unit Length (in weeks): 4

**Essential Question(s):**

- Can I construct and interpret confidence intervals for large samples, small samples, proportions and standard deviations?
- Can I determine the minimum sample size required to estimate statistics of a population with a given degree of confidence?

**Learning Objectives:**

- Define: Confidence Interval, Degree of Confidence, Margin of Error, Critical Value, Student t-distribution, Degrees of Freedom
- Construct a confidence interval and give a correct interpretation for large samples and small samples using the z-distribution and the t-distribution.
- Determine sample size required to estimate the mean with a given degree of confidence
- Construct confidence intervals for population proportions
- Determine sample size required to estimate a proportion
- Use Chi-Square Distribution to find critical values
- Construct a confidence interval for population standard deviation

**Instructional Strategies & Activities:**

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Course Title: Probability and Statistics

Grade: 12

Unit: Hypothesis Testing

Month Presented: April/May

Unit Length (in weeks): 7

**Essential Question(s):**

- Can I construct a 5-step hypothesis test to test a claim made about a population mean, proportion, or variation based on sample data using both the traditional method and the p-value method?
- Can I identify the type I and type II error for a hypothesis test based on the original claim?

**Learning Objectives:**

- Identify null and alternative hypotheses in a given problem
- Find test statistic and critical values and determine if test is right-tailed, left-tailed, or two-tailed
- Decide to reject or fail to reject  $H_0$  and state the final conclusion in reference to the original claim
- Identify type I and type II error for a hypothesis test
- Use traditional method and p-value method for testing hypotheses of means when  $n > 30$
- Use traditional method and p-value method for testing hypotheses of means when  $n \leq 30$
- Use traditional method and p-value method for testing hypotheses of proportions
- Use traditional method and p-value method for testing hypotheses of standard deviations or variances

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