Milford Public Schools Curriculum

Department: Mathematics
Course Name: Statistics & Probability Level 2

UNIT 1

Unit Title: Introduction to Statistics
Unit Description: In this unit, students will be introduced to the basic concepts and goals of statistics. Students will learn many ways to collect data for both samples and populations. Students will learn about different sampling techniques along with the benefits of each technique. Students will also learn about the difference between observational studies and experimental studies, and blind and double blind experiments.

LEARNING GOALS

Enduring Understanding(s):
Statistics is necessary to make accurate decisions involving data
Statistics is a process for making inferences about population parameters based on a random sample from that population.
Poor data collection can lead to misleading and meaningless conclusions.
The way that data is collected, organized and displayed influences interpretation.

Essential Question(s):
What is the difference between and population and a sample?
How can you distinguish between quantitative and qualitative data?
How can you collect data?
How can you design a statistical study?

Content and Skills:
Basic Statistics Vocabulary
Variables and Types of Data
Sampling Techniques
Data Collections Methods
Uses and Misuses of Statistics

Standards Addressed:
HSS.IC.A.1: Understanding statistics as a process for making inferences about population parameters based on a random sample from that population
HSS.IC.B.3: Recognize the purposes of and differences among sample surveys, experiments, and observational studies; explain how randomization relates to each

UNIT 2

Unit Title: Descriptive Statistics
Unit Description: In this unit students will learn different graphing methods and the appropriate use for each method. Students will learn how to create and use graphs to analyze the data.

LEARNING GOALS

Enduring Understanding(s):	**Essential Question(s):**
Relationships between quantities can be represented symbolically, numerically, graphically and verbally in the exploration of real world situations. Descriptive statistics can be used to communicate solutions to solve real world problems	How can you display different types of data? How can you utilize graphs to make decisions in the real world?

Content and Skills:
Bar and Pareto Graphs
Stem and Leaf Plots
Dot Plots
Pie Charts
Scatter Plots
Time Series Charts
Histograms

Standards Addressed:
HSS.ID.A.1: Represent data with plots on the real number line (dot plots, histogram, and box plots)
HSS.ID.A.3: Interpret differences in shape, center, and spread in the context of data sets, accounting for possible effects of extreme data points (outliers)

UNIT 3

Unit Title: Measures of Central Tendencies
Unit Description: In this unit, students will learn more about data. Students will learn to calculate central tendencies, describe shape, center, and spread, and create box plots based on the data. Students will also learn to interpret data based on the graphs.

LEARNING GOALS

Enduring Understanding(s):	**Essential Question(s):**
Relationships between quantities can be represented symbolically, numerically, graphically and verbally in the exploration of real world situations. Descriptive statistics can be used to communicate solutions to solve real world problems Measuring the spread of data is essential for comparing data sets	How do you use the measures of central tendencies to describe data? What is an outlier and how does it affect the data set? How can you use a box plot to analyze a data set?

Content and Skills:
Mean, Median, Mode
Population and Sample Means
Deviation
Variance
How to Calculate and the Effects of Outliers
Shapes of Distributions

Range
Box Plots

Standards Addressed:
HSS.ID.A.1: Represent data with plots on the real number line (dot plots, histogram, and box plots)
HSS.ID.A.2: Use statistics appropriate to the shape of the data distribution to compare center (median, mean) and spread (interquartile range, standard deviation) of two or more data sets
HSS.ID.A.3: Interpret differences in shape, center, and spread in the context of data sets, accounting for possible effects of extreme data points (outliers)

UNIT 4

Unit Title: Normal Probability Distribution
Unit Description: In this unit students will learn to recognize normal bell shaped distributions and how to use their properties in real life applications. Normal distributions can be used to model many sets of measurements in nature, industry, and business.

LEARNING GOALS

Enduring Understanding(s):
Students demonstrate an understanding of the normal distributions and can use the distribution to solve for events and problems.
Students know the central limit theorem and can use it to obtain approximations for probabilities in problems of finite sample spaces.
Students understand the probability of an outcome as the area of a region under the graph of the standard normal curve.

Essential Question(s):
How does normal distribution apply to the real world?
Why is the normal distribution essential to the study of statistics?
What does the area under the curve of a normal distribution describe?

Content and Skills:
Normal Distribution
Empirical Rule
Calculating *z*-scores
Finding Areas Under the Curve
Finding Probabilities for Normal Distributions
Standard Error of the Mean
Central Limit Theorem

Standards Addressed:
HSS.ID.A.3: Interpret differences in shape, center, and spread in the context of the data sets, accounting for possible effects for data points (outliers).
HSS.ID.A.4: Use the mean and standard deviation of a data set to fit it to a normal distribution and to estimate population percentages. Recognize that there are data sets for which such as procedure is not appropriate. Use calculators, spread sheets, and tables to estimate areas under the normal curve.

UNIT 5

Unit Title: Probability
Unit Description: Students will collect and describe data to determine the probability of an event. Students will understand when to apply the Multiplication and Addition Rules to answer certain probability questions.

LEARNING GOALS

Enduring Understanding(s):
The quality of the question used impacts the data collected and the validity of the results.
The expected outcome is a prediction of what might happen in the long run.
Probability is the study of the laws of chance. Through it we can make reasonable predictions of future outcomes based upon past trends and data patterns.

Essential Question(s):
How does the sample space of a probability experiment identify simple events?
How does the fundamental counting principle help find the number of ways two or more events can occur?

Content and Skills:
Outcome and Sample Space
Fundamental Counting Principle
Classical, Empirical, and Subjective Probability
Complement of an Event
Tree Diagrams
Conditional Probability
Mutually Exclusive Events
Independent and Dependent Events
Multiplication Rule
Addition Rule
Permutations
Combinations

Standards Addressed:
HSS.CP.A.1: Describe events such as subsets of a sample space (the set of outcomes) using characteristics (or categories) of the outcomes, or as unions, intersections, or complements of other events ("or," "and," "not").
HSS.CP.A.2: Understand that two events A and B are independent if the probability of A and B occurring together is the product of their probabilities, and use this characterization to determine if they are independent.
HSS.CP.A.3: Understand the conditional probability of A given B as P(A and B)/P(B), and interpret independence of A and B as saying that the conditional probability of A given B is the same as the probability of A, and the conditional probability of B given A is the same as the probability of B.
HSS.CP.A.5: Recognize and explain the concepts of conditional probability and independence in everyday language and everyday situations.
HSS.CP.B.6: Find the conditional probability of A given B as the fraction of B's outcomes that also belong to A, and interpret the answers in terms of the model.
HSS.CP.B.7: Apply the Addition Rule, P(A or B) = P(A) + P(B) – P(A and B), and interpret the answer in terms of the model.
HSS.CP.B.8: Apply the general Multiplication Rule in a uniform probability model,
P(A and B) = P(A)P(B|A) = P(B)P(A|B) and interpret the answer in terms of the model.
HSS.CP.B.9: Use permutations and combinations to compute probabilities of compound events and solve problems.
HSS.MD.B.6: Use probabilities to make fair decisions (e.g., drawing by lots, using a random number

generator).

UNIT 6

Unit Title: Discrete Probability Distribution
Unit Description: Students will learn how to create and use probability distributions. Knowing the shapes, center, and variability of a probability distribution enables students to make decisions in inferential statistics.

LEARNING GOALS

Enduring Understanding(s):
Probability models are useful tools for making decisions and predictions.
A probability distribution combines descriptive statistical techniques and probabilities to form a theoretical model of behavior.

Essential Question(s):
How can we differentiate between continuous and discrete random variables?
How can you use probability and binomial distribution?
How can measures of variation determine and interpreted?
What determines if an experiment is a binomial distribution or a geometric distribution?

Content and Skills:
Probability Distributions
Expected Value
Binomial Distribution
Geometric Distribution
Approximating Binomial Probabilities

Standards Addressed:
HSS.MD.A.1: Define a random variable for a quality of interest by assigning a numerical value to each event in a sample space; graph the corresponding probability distribution using the same graphical displays as for data distributions
HSS.MD.A.2: Calculate the expected value of a random variable; interpret it as the mean of the probability distribution
HSS.MD.A.3: Develop a probability distribution for a random variable defined for a sample space in which theoretical probabilities can be calculated; find the expected value.
HSS.MD.B.5: Weigh the possible outcomes of a decision by assigning probabilities to payoff values and finding expected values
HSS.MD.B.5A: Find the expected payoff for a game of chance.
HSS.MD.B.5B: Evaluate and compare strategies on the bases of expected values.

UNIT 7

Unit Title: Correlation and Regression
Unit Description: In this unit, students will study how to describe and test the significance of relationships between two variables when data are presented as ordered pairs. Students will be able to determine how the correlation is significant to a data set. Students will also be able to use the regression line to predict data and determine how well it represents the relationship between the two variables.

LEARNING GOALS

Enduring Understanding(s):
Modeling an equation from data allows one to predict future behavior
Graphs produce visual displays of data in meaningful ways

Essential Question(s):
How do you find a correlation coefficient?
How can you determine the strength of a relationship between two variables?
How do you know how well an equation models a set of data?

Content and Skills:
Correlation
Line of Best Fit
Interpreting r and r^2
Residuals

Standards Addressed:
HSS.ID.B.6: Represent data on two quantitative variables on a scatter plot, and describe how the variables are related.
HSS.ID.B.6A: Fit a function to the data; use functions fitted to a data to solve problems in the context of the data. Use given functions or choose a function suggested by the context. Emphasize linear, quadratic, and exponential models.
HSS.ID.B.6B: Informally assess the fit of a function by plotting and analyzing residuals.
HSS.ID.B.6C: Fit a linear function for a scatter plot that suggests a linear association.
HSS.ID.C.7: Interpret the slope (rate of change) and interpret (constant term) of a linear model in the context of the data.
HSS.ID.C.8: Compute (using technology) and interpret the correlation coefficient of a linear fit.
HSS.ID.C.9: Distinguish between causation and correlation.