*Unit 7 Probability

Content Area: **Mathematics**
Course(s): **Geometry CP, Geometry Honors**
Time Period: **May**
Length: **8 Blocks**
Status: **Published**

Transfer Skills

Previous coursework: mainly scatterplots and statistical analysis

By the end of this unit: Students will be comfortable using set notation and calculating probability for an event to occur given a sample space. Honors students will go further by analyzing real world scenarios where probability has been used to see if it was used in a way that skewed the results.

Instructional Strategies:

- Use Venn diagrams and set notation to describe sample spaces to connect to the words "and" and "or" visually.
- Since this is the first time students have worked with probability is a while, start with simple probability as a review.
- (+) = denotes Honors only skill

Enduring Understandings

Sample spaces can be represented using tree diagrams, lists, Venn diagrams, and set notation.

Sample spaces can be independent or dependent and events can be mutually exclusive or not mutually exclusive.

Essential Questions

What are the different ways we can represent a sample space?

What are the different conditions that will affect how probability is calculated?

Content

Describing Sample Spaces

Conditional Probability

Two-Way Frequency Tables

Everyday Probability

Permutations and Combinations (+)

Analyzing Probability in Real Life (+)

Opportunities for Algebra Review:

- Operations with Fractions

Skills

Describe the difference between theoretical and experimental probability

Diagram and visualize sample spaces using set lists, tree diagrams, tables, and Venn diagrams.

Use mutually exclusive, complement, intersection and union to describe subsets of sample space and diagram them using a Venn diagram.

Explain what independence between two event means.

Determine if two events are independent of each other using P(A) • P(B) = P(A and B).

Define and distinguish between mutually exclusive and independent.

Define independence using a conditional probability.

Determine if the probabilities probability is independent or not.

Test if events are independent or not by checking if $P(A|B) = P(A)$.

Construct a two-way frequency table.

Complete a two-way table given partial information.

Determine from a two-way frequency table basic probabilities, intersections, unions and conditional probabilities.

Determine independence of events using the data found in a two-way frequency table.

Determine convert a two-way frequency table to a two-way relative frequency table.

Recognize the concepts of conditional probability based on everday language and every day situations.

Recognize the concepts of independence based on everyday language and every day situations.

Calculate conditional probabilities for both independent and dependent events.

Explain conditional probability through Venn diagrams.

Calculate probabilities using the Addition Rule of probability.

Understand the Addition Rule of probability through Venn diagrams.

Calculate probabilities using the General Rule of Multiplication, $P(A \text{ and } B) = P(A)P(B|A) = P(B)P(A|B)$. (+)

Understand the General Rule of Multiplication through Venn diagrams. (+)

Determine whether the sample space is a Fundamental Counting Principle, Permutation or Combination format. (+)

Determine sample spaces using Permutation and Combinations. (+)

Determine probabilities using Permutations and Combinatioins. (+)

Derive and explain where the formulas for Permutations and Combinations come from. (+)

Use probability to make fair decisions. (+)

Analyze a given situation to determine if probability is used appropriately. (+)

Resources

Pearson Resources:

Ch. 13

Online Resources:

http://www.shmoop.com/common-core-standards/math-statistics-probability-conditional-probability-rules-probability.html

http://www.shmoop.com/common-core-standards/math-statistics-probability-using-probability-make-decisions.html

https://www.illustrativemathematics.org/HSS-CP (There are quite a few in this link)

Standards

NJSLS 2016

Statistics and Probability

CONDITIONAL PROBBILITY AND THE RULES OF PROBABILITY

A. Understand independence and conditional probability and use them to interpret data

1. Describe events 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").

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.

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.

4. Construct and interpret two-way frequency tables of data when two categories are associated with each object being classified. Use the two-way table as a sample space to decide if events are independent and to approximate conditional probabilities. For example, collect data from a random sample of students in your school on their favorite subject among math, science, and English. Estimate the probability that a randomly selected student from your school will favor science given that the student is in tenth grade. Do the same for other subjects and compare the results.

5. Recognize and explain the concepts of conditional probability and independence in everyday language and everyday situations. For example, compare the chance of having lung cancer if you are a smoker with the chance of being a smoker if you have lung cancer.

B. Use the rules of probability to compute probabilities of compound events in a uniform probability model

6. Find the conditional probability of A given B as the fraction of B's outcomes that also belong to A, and interpret the answer in terms of the model.

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.

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.

9. (+) Use permutations and combinations to compute probabilities of compound events and solve problems.

Mathematics | Standards for Mathematical Practice

1 Make sense of problems and persevere in solving them.

Mathematically proficient students start by explaining to themselves the meaning of a problem and looking for entry points to its solution. They analyze givens, constraints, relationships, and goals. They make conjectures about the form and meaning of the solution and plan a solution pathway rather than simply jumping into a solution attempt. They consider analogous problems, and try special cases and simpler forms of the original problem in order to gain insight into its solution. They monitor and evaluate their progress and change course if necessary. Older students might, depending on the context of the problem, transform algebraic expressions or change the viewing window on their graphing calculator to get the information they need. Mathematically proficient students can explain correspondences between equations, verbal descriptions, tables, and graphs or draw diagrams of important features and relationships, graph data, and search for regularity or trends. Younger students might rely on using concrete objects or pictures to help conceptualize and solve a problem. Mathematically proficient students check their answers to problems using a different method, and they continually ask themselves, "Does this make sense?" They can understand the approaches of others to solving complex problems and identify correspondences between different approaches.

2 Reason abstractly and quantitatively.

Mathematically proficient students make sense of quantities and their relationships in problem situations. They bring two complementary abilities to bear on problems involving quantitative relationships: the ability to decontextualize—to abstract a given situation and represent it symbolically and manipulate the representing symbols as if they have a life of their own, without necessarily attending to their referents—and the ability to contextualize, to pause as needed during the manipulation process in order to probe into the referents for the symbols involved. Quantitative reasoning entails habits of creating a coherent representation of the problem at hand; considering the units involved; attending to the meaning of quantities, not just how to compute them; and knowing and flexibly using different properties of operations and objects

4 Model with mathematics.

Mathematically proficient students can apply the mathematics they know to solve problems arising in everyday life, society, and the workplace. In early grades, this might be as simple as writing an addition equation to describe a situation. In middle grades, a student might apply proportional reasoning to plan a school event or analyze a problem in the community. By high school, a student might use geometry to solve a design problem or use a function to describe how one quantity of interest depends on another. Mathematically proficient students who can apply what they know are comfortable making assumptions and approximations to simplify a complicated situation, realizing that these may need revision later. They are able to identify important quantities in a practical situation and map their relationships using such tools as diagrams, two-way tables, graphs, flowcharts and formulas. They can analyze those relationships mathematically to draw conclusions. They routinely interpret their mathematical results in the context of the situation and reflect on whether the results make sense, possibly improving the model if it has not served its purpose.

MA.K-12.1	Make sense of problems and persevere in solving them.
MA.K-12.2	Reason abstractly and quantitatively.
MA.K-12.4	Model with mathematics.
MA.S-CP.A.1	Describe events 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").
MA.S-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.
MA.S-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.
MA.S-CP.A.4	Construct and interpret two-way frequency tables of data when two categories are associated with each object being classified. Use the two-way table as a sample space to decide if events are independent and to approximate conditional probabilities.
MA.S-CP.A.5	Recognize and explain the concepts of conditional probability and independence in everyday language and everyday situations.
MA.S-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 answer in terms of the model.
MA.S-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.
MA.S-CP.B.8	Apply the general Multiplication Rule in a uniform probability model, $P(A\ and\ B) = [P(A)] \times [P(B\vert A)] = [P(B)] \times [P(A\vert B)]$, and interpret the answer in terms of the model.
MA.S-CP.B.9	Use permutations and combinations to compute probabilities of compound events and solve problems.
MA.S-MD.B.6	Use probabilities to make fair decisions (e.g., drawing by lots, using a random number generator).
MA.S-MD.B.7	Analyze decisions and strategies using probability concepts (e.g., product testing, medical testing, pulling a hockey goalie at the end of a game).