Statistics and Probability – UNIT 4
Using Probability to Make Decisions

Introduction: Instructional time will be spent on applying probability rules to create a probability distribution model with a main focus on discrete data sets. Students will use these probability distribution models to make appropriate decisions.

CLUSTER	COMMON CORE STATE STANDARDS
Calculate expected values and use them to solve problems.	HSS.MD.A.1 (+) Define a random variable for a quantity 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. *For example, find the theoretical probability distribution for the number of correct answers obtained by guessing on all five questions of a multiple-choice test where each question has four choices, and find the expected grade under various grading schemes.* HSS.MD.A.4 (+) Develop a probability distribution for a random variable defined for a sample space in which probabilities are assigned empirically; find the expected value. *For example, find a current data distribution on the number of TV sets per household in the United States, and calculate the expected number of sets per household. How many TV sets would you expect to find in 100 randomly selected households?*
Use probability to evaluate outcomes of decisions.	HSS.MD.B.5 (+) Weigh the possible outcomes of a decision by assigning probabilities to payoff values and finding expected values. HSS.MD.B.5.A Find the expected payoff for a game of chance. *For example, find the expected winnings from a state lottery ticket or a*

CLUSTER	COMMON CORE STATE STANDARDS
	game at a fast-food restaurant. HSS.MD.B.5.B Evaluate and compare strategies on the basis of expected values. *For example, compare a high-deductible versus a low-deductible automobile insurance policy using various, but reasonable, chances of having a minor or a major accident.* HSS.MD.B.6 (+) Use probabilities to make fair decisions (e.g., drawing by lots, using a random number generator). HSS.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).
MATHEMATICAL PRACTICES	LEARNING PROGRESSIONS
1. Make sense of problems and persevere in solving them. 2. Reason abstractly and quantitatively. 3. Construct viable arguments and critique the reasoning of others. 4. Model with mathematics. 5. Use appropriate tools strategically. 6. Attend to precision. 7. Look for and make use of structure. 8. Look for and express regularity in repeated reasoning.	Statistics and Probability Progression http://commoncoretools.me/wp-content/uploads/2012/06/ccss_progression_sp_hs_2012_04_21_bis.pdf

ENDURING UNDERSTANDINGS	ESSENTIAL QUESTIONS	KEY VOCABULARY
• Students learn about discrete random variables and their probabilities distributions. • Students calculate and interpret the mean (expected value) of a discrete random variable. • Students understand that mean is the expected value and calculate expected value.	• How can you identify and distinguish between discrete and continuous random variables? • How do you interpret the probability of a continuous random variable as the area under a density curve? • How do you compute the mean (expected value) of a discrete random variable from its probability distribution?	Expected value Independent trials Mean of a probability distribution Probability distribution Random continuous variable Random discrete variable

RESOURCES	INSTRUCTIONAL STRATEGIES	ASSESSMENT
• AP Stats Monkey: This site includes a wonderful collection of resources written by teachers and collected by Jason Molesky. http://apstatsmonkey.com/StatsMonkey/Statsmonkey.html • StatKey: Free resource for creating simulations http://lock5stat.com/statkey/ • Create your own theoretical and experimental probability spinner: https://illuminations.nctm.org/adjustablespinner/	• Remind students about the general definition of a distribution: a list of the possible values a variable can take and how often it takes those values. • Have students interpret the expected value as a long-run average. • Illustrate the difference between discrete and continuous random variables. ○ For example, a person's foot length is continuous while a person's shoe size is discrete. • Emphasize that the graphical display for a discrete random variable is a histogram while the graphical display for a continuous random variable is a density curve. Relate this back to the graphical displays learned in Unit 1. • Remind students that they already learned how to calculate probabilities under a Normal curve in Unit 1, which is a continuous distribution.	**Formative Assessment** SBAC - http://www.smarterbalanced.org/ **LAUSD Periodic Assessment** District assessments can be accessed through: http://achieve.lausd.net/math http://achieve.lausd.net/ccss Use your Single Sign On to access the Interim Assessments California will be administering the SMARTER Balance Assessment as the end of course for grades 3-8 and 11. The 11th grade assessment will include items from all High School Common Core strands, including Statistics and Probability. For examples, visit the SMARTER Balance Assessment at: http://www.smarterbalanced.org/.

LANGUAGE GOALS for **low achieving, high achieving, students with disabilities and English Language Learners**
• Students will exchange ideas to determine how to calculate probabilities of events involving random variables. *Example:* I think we should apply ____ principle in order to determine the correct probability. • Students will identify and interpret the expected value of a random variable. *Example:* The expected value, _____, of _____ (random variable) is the long-run average value of X, distributed over a very large number of trials. • Students defend their decision by quantifying the probability and explaining in context. *Example:* If I only guessed on a multiple-choice exam with ___ questions with ___ options, I would only have _____ probability of passing the exam.
PERFORMANCE TASK
In Roulette, 18 of the 38 spaces on the wheel are black. Suppose you decide to try your luck and bet $1 on black on the next 10 spins of a roulette wheel (recall that if you win, you win $1, and if you lose, you lose $1). Let X = the number of times you hit black in 10 spins. For each question, provide a mathematical path to your answer. a) Find *P*(you win $2). b) Find *P*(you lose money). c) Find *P*(you win money).

DIFFERENTIATION 🕮		
UDL/ FRONT LOADING	ACCELERATION	INTERVENTION

Statistics and Probability:
• Use a simulation activity to demonstrate the difference between an experimental and a theoretical probability distribution.
  ○ The website below allows you to create your own spinner. https://illuminations.nctm.org/adjustablespinner/
• Review how to calculate a weighted average and make the connection to the expected value of a discrete random variable.
	Acceleration for high achieving students:
	• Teach the binomial and geometric distributions and how to calculate probabilities using these distributions.
	• Teach students how to determine whether the conditions for the Normal approximation to a binomial distribution are met.
	• Show students how to calculate the mean (expected value) and standard deviation for sums and differences of independent random variables.
		• Re-emphasize the definition of probability and the basic probability rules.
		• Emphasize the idea of a sample space and how listing all possible outcomes may be helpful in creating a probability distribution.
		  ○ e.g. Show students how to create a sample space when rolling two different number cubes.