Statistics and Probability – UNIT 3
Probability Rules

Introduction: Instructional time is spent on the concepts of randomness and probability. Students will learn about the Law of Large Numbers and how to calculate the likelihood of random events and outcomes. Students will learn about the counting principle, permutations, and combinations prior to learning how to apply the basic rules of probability.

CLUSTER	COMMON CORE STATE STANDARDS
Use the rules of probability to compute probabilities of compound events.	HSS.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"). 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.
Understand independence and conditional probability and use them to interpret data.	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.4 Construct and interpret two-way frequency tables of data when two categories are associated with each object being

CLUSTER	COMMON CORE STATE STANDARDS
	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.* HSS.CP.A.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.* 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 answer in terms of the model.
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 understand the concept of probability and the Law of Large Numbers. • Students interpret probability as a long-run relative frequency. • Students apply the counting principle, permutations, and combinations to solve problems. • Students understand when and how to apply the basic probability rules. • Students understand conditional probability and independence.	• How do you apply probability rules? • How do you define the sample space for a random phenomenon? • What is independence and how do you determine whether given events are independent? • What is the difference between permutations and combinations? • How do you compute probabilities for mutually exclusive (disjoint) or overlapping events? • How do you compute conditional probabilities?	Addition rule of probability Combination Complement Conditional probability Disjoint/Mutually exclusive events Event Factorial (!) Fundamental counting principle Independent events Law of large numbers Multiplication rule of probability Permutation Sample space

RESOURCES	INSTRUCTIONAL STRATEGIES	ASSESSMENT
• Graphing calculators: factorials (!), nPr, cPr • Graphic Organizer such as Venn Diagram, tree diagram, two-way tables, etc. • Geogebra applets for simulating randomness • **resource for combinations/permutations • *Against All Odds: https://www.learner.org/resources/series65.html* • 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	• Help students use Venn diagrams, tree diagram, or two-way tables to visualize probability calculations. • When introducing the idea of conditional probability, display the entire two-way table and then physically cover up the rows or columns that are not part of the "given." This will help students focus on only the row or column that represents the event that we know has occurred. • Use Venn Diagrams and formulas to demonstrate the difference between mutually exclusive/disjoint events and independent events.	**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 justify verbally or in writing whether two events are independent.

  Example Stem: Justify whether ____ and _____ are independent.

- Students will comprehend a written scenario and be able to apply the appropriate probability rules.

  Example Stem: Given the probability of _____, what is the probability of _____.

- Students will apply the general multiplication rule and interpret the answer.

  Example: Find the probability of choosing two face cards from a standard deck without replacement and interpret what this probability means.

PERFORMANCE TASK

A psychologist is interested in the relationship between handedness (left or right) and IQ scores. He collected the following data from a random sample of 259 high school students.

	<55	55-<70	70-<85	85-<100	100-<115	115-<130	130-<145	>145
Left	1	2	6	25	32	15	14	3
Right	4	7	15	44	51	23	15	2

1. What is the probability that a student from this group has an IQ greater than 130?
2. What is the probability that a student has an IQ greater than 130, given that she is left-handed?

DIFFERENTIATION 🕮

UDL/ FRONT LOADING	ACCELERATION	INTERVENTION
Statistics and Probability: • As an opening activity, allow students to play a game of chance. For example, Two Dice Sum game (http://www.mathwire.com/data/dicetoss2.html). Students will develop a strategy for winning that can later be quantified with probabilities. • Clearly define the difference between a sample and a population. This is a very important idea for students to understand early in the unit and throughout the rest of	Acceleration for high achieving students: • Students could use Bayes's theorem to solve probability questions that require "backward" in a tree diagram. • Present the birthday problem: Ask students to predict the probability that any two people in the class share the same birthday. Then ask them to justify their predictions using probabilities. • The Monte Hall problem: Discuss how probability can be applied to making decisions.	• Students will make layered books to learn key vocabularies related to probabilities. • Students will learn about using graphic organizers and understand the meaning of mutually exclusive/disjoint. • Students need to understand the conversion between fractions and decimals.

DIFFERENTIATION 🕮		
UDL/ FRONT LOADING	ACCELERATION	INTERVENTION
the course. • Review components of combinations and permutations, specifically factorials. • Understand the meaning of statistics and probability. • Understand vocabulary words such as sample space, events, etc. • Students should have basic knowledge of fractions that they learned in previous math classes and make connection to the basic rule of probability. $P(A) = \frac{Number\ of\ Outcomes}{Total\ Number\ of\ Outcomes}$		