Probability and Statistics - Unit 5 Probability Distribution	20 - 25 Days Established 14-15 Revised 20-21 Revised Nov 2021

Standard – NJSLS: S.IC and S.MD.
Probability Distributions

Strand:
S-IC: Making Inferences and Justifying Conclusions
Understand and evaluate random process underlying statistical experiments.

1. Understand statistics as a process for making inferences about population parameters based on a random sample from that population.

S-MD: Using Probability to make decisions
Calculate expected values and use them to solve problems.

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.
2. (+) Calculate the expected value of a random variable; interpret it as the mean of the probability distribution.
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 examples, 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.*
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.

5. (+) Weigh the possible outcomes of a decision by assigning probabilities to payoff values and finding expected values.
   a. Find the expected payoff for a game of chance. *For example, find the expected winnings from a state lottery ticket or a game at fast-food restaurant.*
   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.*
6. (+) Use probabilities to make fair decisions (e.g., drawing by lots, using a random number generator).
7. (+) Analyze decisions and strategies using probability concepts (e.g., product testing, medical testing, pulling a hockey goalie at the end of the game).

Probability and Statistics - Unit 5 Probability Distribution	20 - 25 Days Established 14-15 Revised 20-21 Revised Nov 2021

Curriculum aligned with: 2009 New Jersey Core Curriculum Content Standards for 21st Century Skills (9.1 A-F)

21st Century Theme: *Global Awareness ☐, Financial, economic, business and entrepreneurial literacy , , Civic literacy ☐, Health literacy ☐ Environmental Literacy ☐,*

21st Century Skills: *Critical Thinking & Problem Solving , Creativity and Innovation ☐, Collaboration, Teamwork and Leadership ☐, Cross-Cultural Understanding and Interpersonal Communications ☐, Communication and Media Fluency ☐, Accountability, Productivity and Ethics ☐*

Interdisciplinary Connection: Math=MA, English=ELA, Science=SCI, Social Studies=SS, Physical Education=PE, Art=ART, Music=MU, Technology=TECH, World Language=WL, Business = BU

Essential Questions	Enduring Understandings	Activities, Investigation, and Student Experiences
1. How can modeling predict the future? 2. To what extent does our world exhibit binomial phenomena? 3. What are real life examples of discrete probability distributions?	*Students will understand….* ● A random variable has a single value for each outcome of a trial. ● A random variable has values that are determined by chance. ● A random variable can be discrete or continuous. A discrete random variable is one that can be counted; a continuous random variable has values	***Task 1:*** **Interdisciplinary BU** A financial advisor suggests that his client select one of two types of bonds in which to invest $5000. Bond *X* pays a return of 4% and ahs a default rate of 2%. Bond *Y* has a 2.5% return and a default rate of 1%. ● Find the expected rate of return and decide which bond would be a better investment. When the bond defaults, the investor loses all the investment. ***Answer:*** ● The return on bond *X* is $5000*4% = $200. The expected return then is E(x) = $200(0.98) - $5000(0.02) = $96. The return on bond *Y* is $5000(2.5%) = $125. The expected return then is E(x) = $125(0.99) -$5000(0.01) = $73.75. Therefore bond *X* would be a better investment since the expected return is higher. ***Task 2:*** Based on past results found in the *Information Please Almanac,* there is a 0.1818 probability that a baseball World Series contest will last four games, a 0.2121 probability that it will last five games, a 0.2323 probability that it will last six games, and a 0.3738 probability that it will last seven games.

	associated with measurements on a continuous scale without gaps. ● A probability distribution describes the probability for each value of a random variable. ● A probability distribution has to have probability values between 0 and 1 inclusive. ● The sum of the probabilities in a probability distribution must be 1. ● Unusual results with probabilities can be identified by applying the rare event rule and the range rule of thumb. ● The expected value of a discrete random variable is	● Determine whether a probability distribution is described. ● If a probability distribution is described, find its mean and standard deviation. If a probability distribution is not described, identify the requirements that are not satisfied. ● Is it unusual for a team to "sweep" by winning in four games? ***Answer:*** ● A probability distribution is described because the sum of the probabilities equals one (0.1818 + 0.2121 + 0.2323 + 0.3738 = 1) ● To find the mean and standard deviation enter L1 into the graphing calculator as: 4, 5, 6, and 7 and L2 as: 0.1818, 0.2121, 0.2323, 0.3738). Then run one variable statistics and select L1 and L2. The mean will by 5.8 and the standard deviation is 1.1. ● It is not unusual for a team to "sweep" because the probability of winning in four games is 0.1818 which is high and greater than 0.05. ***Task 3:*** Twenty-six percent of couples who plan to marry this year are planning destination weddings. In a random sample of 12 couples who plan to marry, find the probability that ● Exactly 6 couples will have a destination wedding. ● At least 6 couples will have a destination wedding. ● Fewer than 5 couples will have a destination wedding. ***Answer:*** ● 0.047 ● 0.065 ● 0.821 **Modifications and/or Accommodations:** ● **Special Education:** Utilize a multi-sensory (VAKT) approach during instruction, provide alternate

	the average of the probability distribution. ● A binomial probability distribution is used when there are two outcomes, acceptable/defective or survived/died. ● The mean of a binomial distribution is found by multiplying the number of trials times the probability of success of each trial. ● The standard deviation for a binomial distribution is found by taking the square root of the product of *npq*. ● The Poisson probability	presentations of skills by varying the method (repetition, simple explanations, additional examples, modeling, etc.), modify test content and/or format, allow students to retake test for additional credit, provide additional times and preferential seating as needed, review, restate and repeat directions, provide study guides, and/or break assignments into segments of shorter tasks. ● **English Language Learners:** Extend time requirements, preferred seating, positive reinforcement, check often for understanding/review, oral/visual directions/prompts when necessary, supplemental materials including use of online bilingual dictionary, and modified assessment and/or rubric. ● **Students at Risk of School Failure:** Deliver instruction utilizing varied learning styles including audio, visual, and tactile/kinesthetic, provide individual instruction as needed, modify assessments and/or rubrics, repeat instructions as needed. ● **Gifted Students:** Create an enhanced set of introductory activities, integrate active teaching/learning opportunities, incorporate authentic components, propose interest-based extension activities, and connect student to related talent development opportunities. **Teacher Resources** online achievethecore resource online learnzillion resource online khanacademy resource online desmos resource online ixl resource

	distribution is used to evaluate occurrences of an event over an interval	
Content Statements	**Cumulative Progress Indicators**	
Students will know… ● How to construct a probability distribution for a random variable ● How to calculate the expected value of an event ● How to calculate the probability of *x* successes among *n* trials can be found by using the binomial probability formula ● How to use the Poisson probability distribution of occurrences of some event over a specific interval ● How to distinguish between outcomes that are usual and those that are unusual	● Tests ● Quizzes ● Practice problems for homework ● Workbook pages ● Worksheets	

- How to find the mean and standard deviation of a binomial distribution

Desired Results

- **Random Variable**
- **Expected value**
- **Binomial probability**
- **Poisson probability**
- **Standard Deviation**

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.**

Standards for Mathematical Practices

8. **Look for and express regularity in repeated reasoning.**

Probability and Statistics - Unit 5 Probability Distribution	20 - 25 Days Established 14-15 Revised 20-21 Revised Nov 2021

LGBT and Disabilities Law: *N.J.S.A. 18A:35-4.35*

Troy Lee Hudson - openly gay engineer at NASA's Jet Propulsion Laboratory

The mission is to ensure that every student is able to see themselves in our rich and diverse history.

Social and Emotional Learning: ***Competencies***	**Social and Emotional Learning:** ***Sub-Competencies***
Self-Awareness Social Awareness Self-Management Relationship Skills Responsible Decision-Making	• Recognizing the importance of self-confidence in handling daily tasks and challenges. • Demonstrate an awareness of the expectations for social interactions in a variety of ways.

	• Demonstrate an understanding of the need for mutual respect when viewpoints differ. • Recognize the skills needed to establish and achieve personal and educational goals. • Utilize positive communication and social skills to interact effectively with others. • Develop, implement, and model effective problem solving and

	critical thinking skills.