Unit #4: Expected Value and Continuous Random Variables

Content Area:	Mathematics
Course(s):	Probability
Time Period:	Semester 1 &
Length:	6 weeks
Status:	Published

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Standards

MA.S-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.
MA.S-MD.A.2	Calculate the expected value of a random variable; interpret it as the mean of the probability distribution.
MA.S-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.
MA.S-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.
MA.S-MD.B.5	Weigh the possible outcomes of a decision by assigning probabilities to payoff values and finding expected values.
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).

Enduring Understandings

1. A continuous probability distribution is a *probability distribution* that has a probability density function. Mathematicians also call such a distribution **absolutely continuous**, since its <u>cumulative distribution function</u> is <u>absolutely continuous</u> with respect to the <u>Lebesgue measure</u> λ . If the distribution of X is continuous, then X is called a **continuous random variable**.

2. In <u>probability theory</u>, the expected value of a <u>random variable</u> is intuitively the long-run average value of repetitions of the experiment it represents. For example, the expected value of a die roll is 3.5 because, roughly speaking, the average of an extremely large number of dice rolls is practically always nearly equal to 3.5.

3. normal (or Gaussian) distribution is a very commonly occurring <u>continuous probability</u> <u>distribution</u>—a function that tells the probability that any real observation will fall between any two real limits or <u>real numbers</u>, as the curve approaches zero on either side. Normal distributions are extremely important in <u>statistics</u> and are often used in the <u>natural</u> and <u>social sciences</u> for real-valued <u>random variables</u> whose distributions are not known.

4. Multinomial distribution is a generalization of the <u>binomial distribution</u>. For *n* <u>independent</u> trials each of which leads to a success for exactly one of *k* categories, with each category having a given fixed success probability, the multinomial distribution gives the probability of any particular combination of

Essential Questions

- 1. What is a continuous random variable, and how is it different than a discrete random variable?
- 2. How can we calculate the expected value of a random variable?
- 3. What is normal distribution and how can we use it to calculate probabilities?
- 4. How is multinomial distibution related to binomial distribution?

Knowledge and Skills

Students will be able to:

- Know what a continuous random variable is and how it can be used to calculate the probability of events within a random experiment
- Calculate expected value and use expected value to help determine the likely outcome of a random experiment
- Understand normal distribution and use a "Z-chart" to determine the probability of normally distributed events
- Use multinomial distribution as a generalization of the binomial distribution, and use it to calculate probabilities.

Resources

Online resources which include, but not limited to: Delta Math and Class Kick.