Unit #4: Expected Value and Continuous Random Variables

Content Area:	**Mathematics**
Course(s):	**Probability**
Time Period:	**Semester 1 & 2**
Length:	**6 weeks**
Status:	**Published**

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 cumulative distribution function is absolutely continuous with respect to the Lebesgue measure λ. If the distribution of X is continuous, then X is called a **continuous random variable**.

2. In probability theory, the expected value of a random variable 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 continuous probability distribution—a function that tells the probability that any real observation will fall between any two real limits or real numbers, as the curve approaches zero on either side. Normal distributions are extremely important in statistics and are often used in the natural and social sciences for real-valued random variables whose distributions are not known.

4. Multinomial distribution is a generalization of the binomial distribution. For *n* independent 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

numbers of successes for the various categories.

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.