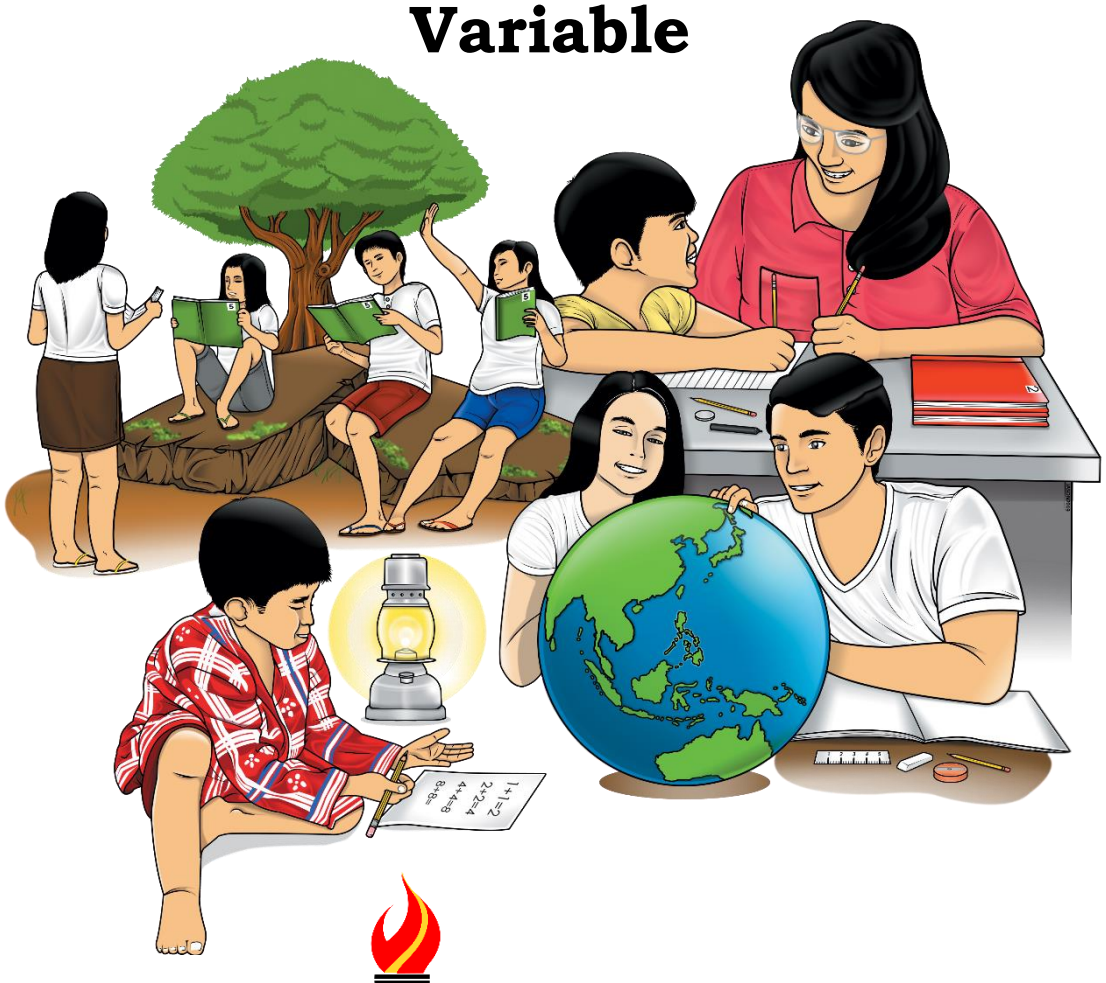
Senior High School

DepED
DEPARTMENT OF EDUCATION

Statistics and Probability

Quarter 3 – Module 2: Distinguishing Between a Discrete and a Continuous Random Variable



ALTERNATIVE DELIVERY MODE
ADM

Lesson 1 Distinguishing Between a Discrete and a Continuous Random Variable

Every day, we often read, hear, or even use the word *random*. You may hear someone say, "We randomly decided to go out for shopping yesterday." But is this really a random event? No, this is a decision that was made on the basis of other variables, such as desire and the lack of satisfaction with other options, such as TV viewing.

The word random has a different meaning in the field of statistics. Something is random when it differs by chance. For example, when a coin is tossed twice, the possible outcomes that can occur are {HH, HT, TT, TH} where H represents heads and T represents tails, the observed outcomes on any one toss is random.

This module will help you understand the process of distinguishing between a discrete and a continuous random variable.

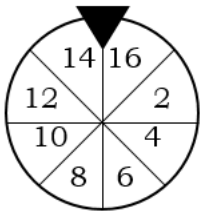
What's In

Remember that a *variable* is a quantity that may change within the context of a mathematical problem or experiment. Typically, we use a single letter to represent a variable. The letters x, y, and z are common generic symbols used for variables. In this lesson, we shall discuss variables that are associated with probabilities called *random variables*.

Notes to the Teacher

To be able to arrive in an accurate and similar answer, the teacher must advise the learners to browse their notes about experiment, outcomes, event, and sample space.

To find out if you are ready to learn this new lesson, do the following.

List the sample space of the following experiments.	
Experiment	Sample Space
1. Flipping a coin.	
2. Rolling a die.	
3. Drawing a card at random from a deck of 6 identical card suits labeled 1 to 6.	
4. Spinning the wheel shown, assuming that the arrow will never fall on the lines separating the 8 sectors. 	
5. Rolling a die and tossing a coin simultaneously.	

What's New

To understand how one distinguishes between a discrete and a continuous random variable, do the activity below.

Complete the following table. The first one is done for you.

Experiment	**Number X**	**Possible Value of X**
Two cards are drawn from a deck.	Sum of the numbers on the cards drawn.	4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20 (since, the least number in the card is 2 and the highest is 10; therefore, the smallest possible sum of the numbers on the cards when two cards are drawn is 4, while the highest possible sum of the numbers on the cards is 20)
Roll a pair of dice.	Sum of the number of dots on the top faces.	
Toss a fair coin repeatedly.	Number of tosses until the coin lands head.	
Height of individuals. (You must only use a meter stick or ruler and avoid using a carpenter's rule because you might accidentally get loss of it and will end up wounding your fingers or hand.)	Height of each member of the family.	

This time, you need to reflect on the following questions because it will help you to understand the appropriate way of classifying a random variable. Answer the following questions:

1. How do you find the activity?

2. Were you able to complete the table? If yes, how? If no, why?

3. If a random variable takes on values on continuous scale, it is a continuous random variable. If a random variable takes on outcomes that are countable then it is a discrete random variable. Now, will you be able to classify those experiments in activity 1 as discrete or continuous? If yes, how? If no, why?

4. In your own words, how will you differentiate discrete and continuous random variables?

What is It

In Algebra, "**variable**" means one thing - an unknown value. Meanwhile, you will come across different types of variables in statistics. Some of these are: *categorical variable* (variable that can be put into categories like tooth paste brands); *ordinal variable* (similar to categorical variable, but there is a clear order like socioeconomic status); *quantitative variable* (a broad category that includes any variable that can be counted or has a numerical value associated with it); q*ualitative variable* (a broad category that for any variable that can't be counted) and there's a lot more variable that you may encounter in the field of statistics, but our focused in this module, is on *random variable.*

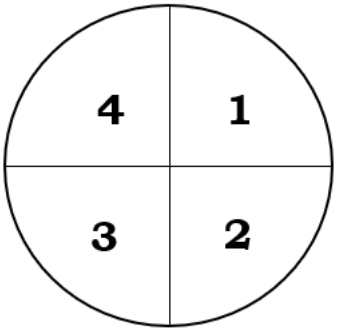
A **random variable** is a function that associates a real number with each element in the sample space. It is a variable whose values are determined by chance. Thus, in simple words, a *random variable* is a numerical quantity that is derived from the outcomes of a random experiment and commonly denoted by capital letters, such as X, Y, and Z.

In the experiment of tossing a coin, the number of times the coin turns up a head is an example of random variable. Below are some examples of random variable.

a. Suppose two dice are rolled. The sum of the two numbers that faced up is an example of a random variable. This variable may take on integers from 2 to 12.

b.

c. Suppose the spinner shown below is spun.



An example of a random variable for this experiment is the number of times that the spinner stops at number 3.

There are two types of random variables: the **discrete** and **continuous** random variables.

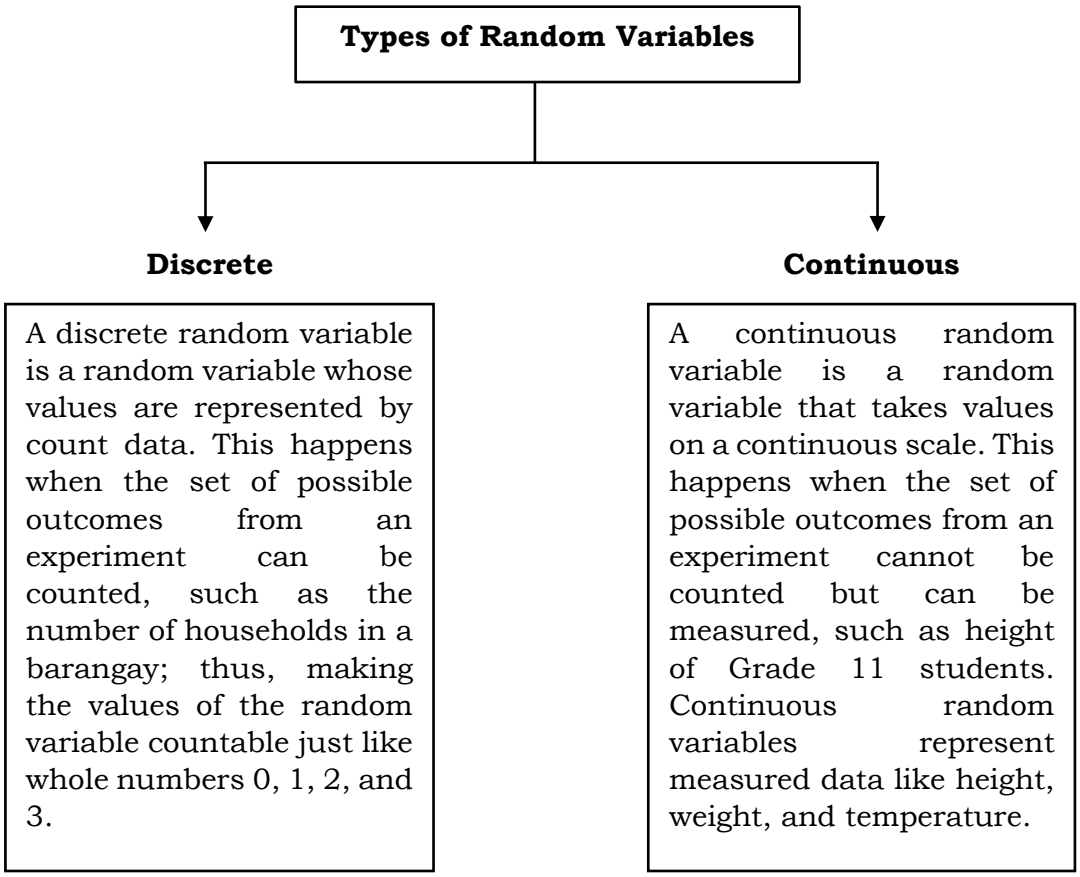


Figure 1. Diagram of the Types of Random Variables

Now, let us try to take a look at some examples of random variables from the table below.

Table 1. Examples of Random Variables

Experiment	Number X or the Random Variable X	Possible Values of Random Variable X
1. Flipping a pair of coin.	Number of heads in four flips of a coin.	0, 1, 2, 3, 4
2. Flipping a pair of coin repeatedly.	Number of tosses until the coin lands tails.	1, 2, 3, 4, …
3. Set of integers .	Integers from 2 to 6.	2, 3, 4, 5, 6
4. Set of real numbers.	Real numbers from 2 to 6.	$2 \leq x \leq 6$
5. Life span of your iPhone battery.	Time until your iPhone battery become defective.	$0 \leq x \leq \infty$

As shown in the table above, examples 1, 2, and 3 are all discrete while examples 4 and 5 are continuous.

Example 6. Brand Z is a company that manufactures batteries. They record the number of defective batteries that are contained in each box before it is sent out for delivery. If X is the number of defective batteries per box, then what type of random variable is X?

Solution. X is a discrete random variable, and X can be a set {0, 1, 2, …, *n*} where *n* is the total number of batteries in each box.

Example 7. Suppose Brand Z in example number 6 wants to check the average life span of their batteries. If Y is the average number of days that each battery lasts, then what can you conclude about the variable Y?

Solution. We can conclude from above, that Y is a continuous random variable. It may be assigned time intervals that corresponds to each battery's life span.

Because of the way the discrete random variable is defined, we can say that the range of values that can be assigned to it is confined to the set of whole numbers. That is, a discrete random variable may NOT take on non-integers.

What's More

Independent Activity 1.

Look back and reflect.

1. How do you determine the values of a random variable?
2. How do you know whether a random variable is continuous or discrete?
3. What is the difference between the two types of random variables?

Independent Assessment 1.

Classify the following random variables as discrete or continuous.

1. the speed of a tricycle.
2. the number of female students.
3. the time needed to finish the module.
4. the amount of sugar in a cup of coffee.
5. the number of defective mobile phones produced by a manufacturer.

Independent Activity 2.

Determine whether each of the following experiments/situations involves a discrete random variable or a continuous random variable.

1. Choosing an even number less than 150.
2. Gathering information about the average monthly electric consumption in a certain household.
3. Tallying the number of families in a certain barangay that has one child.

Independent Assessment 2.

Identify whether the given experiment involves a discrete random variable or a continuous random variable. Write your answer on a separate answer sheet.

1. Getting the temperature of a patient admitted in a hospital.
2. Collecting data about the weights of students in a certain school.
3. The number of patients admitted in the hospital due to COVID-19.
4. The number of no work, no pay workers in a certain municipality caused by pandemic.
5. The number of families that are members of 4P's in Quezon.
6. The number of Balikbayan OFWs who arrived in the Philippines.
7. The number of text messages received by a particular individual in a day.
8. The number of possible outcomes in rolling a die.
9. The amount of liquid in a 12-ounce can of soda.
10. The number of fouls committed by a basketball team during the games.

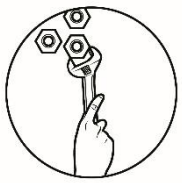
What I Have Learned

Give your answer in the following statements.

1. A well - defined function from a sample space to the set of real numbers is called a _____**.** It is commonly denoted by capital letters, such as X, Y, and Z. The specific values of a random variable are denoted by small letters, such as x, y, and z.

2. A random variable is a _____if its set of possible outcomes is countable. Mostly, discrete random variables represent count data, such as the number of enrolled students in a particular school.

3. A random variable is _____if it takes on values on a continuous scale. Often, continuous random variables represent measured data, such as heights, weights, temperatures, and lifespan.



What I Can Do

This time, it's your time to shine. Answer the following questions.

1. Eight students were asked to solve the Rubik's cube. The time it took for them to complete the puzzle is summarized in the table below.

Time (in min)	Less than 1 min	1 - 2 min	2 - 3 min	Greater than 3 min
Number of children who completed the Rubik's cube.	2	2	3	1

Classify what type of random variable is shown.

2. Suppose a Meter-man Apprentice was told by his superior to measure the voltage of a certain electric outlet. The voltage reading ranges from 118 V $\leq$ x < 122 V. Does the scenario represent a discrete or a continuous random variable?

Assessment

Let us test how far you understood the lesson on random variables. Answer the test below. Write your answers on a separate sheet of paper. I believe that with your effort and determination, you can do it once again!

1. A set of numerical values assigned to a sample space is called:
   A. Random sample.
   B. Random variable.
   C. Random Process.
   A. Random experiment.

2. Which of the following best describes a variable that can be counted?
   A. Categorical.
   B. Continuous.
   C. Discrete.
   D. Ordinal.

3. Which of the following best describes a variable that can be measured?
   A. Categorical.
   B. Continuous.
   C. Discrete.
   D. Ordinal.

4. You decided to order a pizza but you have to choose the type of crust and the toppings. If there are only six possible combinations of ordering a pizza, from which of the following should you choose?
   A. Crust: thin or deep dish
      Toppings: cheese or pepperoni
   B. Crust: thin or deep dish
      Toppings: cheese, bacon, or pepperoni
   C. Crust: thin or deep dish
      Toppings: cheese, bacon, sausages, or pepperoni
   D. Crust: thin or deep dish
      Toppings: cheese, bacon, sausage, pepperoni, or hotdog

5. A drawer has two red ties, three black ties, and five blue ties. A tie is picked at random. What is the total number of possible outcomes?
   A. 2
   B. 3
   C. 5
   D. 10

6. Which of the following statements describes a continuous random variable?
   A. The number of students present in a class.
   B. The average distance traveled by a jeep in a week.
   C. The number of correct guesses on a multiple-choice test.
   D. The number of women taller than 68 inches in a random sample of 5 women.

7. Which of the following is a continuous random variable?
   A. Height of sunflower as measured each day.
   B. Number of gadgets a business sells per day.
   C. Number of people attending mass every Sunday.
   D. Number of people eating at the restaurant every day.

8. Which of the following is a discrete random variable?
   A. Hipolito weighs 65 kg.
   B. Hipolito is 160 cm tall.
   C. Hipolito has two brothers.
   D. Hipolito ran 100 meters in 10.2 seconds.

9. Which of the following variables is a discrete random variable?
   A. Lifetime of an AAA battery.
   B. The amount of gasoline in a car.
   C. Number of goals of a football team.
   D. The time it takes to commute to work.

10. Which of the following is NOT a discrete random variable?
    A. Height of rose as measured each day.
    B. Number of appliances a business sells each day.
    C. Number of people went to church every Sunday.
    D. Number of students who comes late in going to school each day.

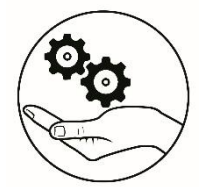
11. Which of the following statements DOES NOT describes a discrete random variable?
    A. The number of children who do household chores every day.
    B. The average amount of milk consumption of a baby each day.
    C. The number of students who excelled in mathematics in a certain grade level.
    D. The number of children who love to pray a rosary every 6 o'clock in the afternoon.

12. Which of the following statements DOES NOT describes a continuous random variable?
    A. The distance traveled by a truck in an hour.
    B. The average height of a coconut tree each day.
    C. The number of provinces belonging to Region IV-A.
    D. The intensity of an earthquake that happens last month.

13. Which of the following is NOT a continuous random variable?
    A. The amount of water in a jug.
    B. The length of time attending a webinar.
    C. The number of OFWs who traveled abroad each day.
    D. The height of the tallest mountain in the Philippines.

14. You decide to collect a bunch of cans of soda and measure the volume of soda in each can. Let x be the volume of soda in each can. What type of variable is x?
    A. x is a constant.
    B. x is a place holder.
    C. x is a discrete random variable.
    D. x is a continuous random variable.

15. You decided to conduct a survey of families with two children. You are interested in counting the number of girls (out of 2 children) in each family. Is this a random variable?
    A. Yes, it is a random variable.
    B. No, it is not a random variable.
    C. Maybe, it is a random variable.
    D. Cannot be determined.



Additional Activities

Answer the following.

Identify whether the given experiment involves a discrete random variable or a continuous random variable. Write D if discrete and C if continuous.

_____ 1. Getting the distance travelled by a car.
_____ 2. Collecting data about the weights of students in a certain school.
_____ 3. The temperature in Quezon at noon times.
_____ 4. Picking a multiple of 3 less than 200.
_____ 5. Tallying the number of PUI (Person Under Investigation) due to COVID-19 pandemic.