

Lesson 56: Probability Part 1

By the end of the lesson, you will be able to:

- ~ Find a probability of an event
- ~ Find a probability of two or more events.

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In this class, we will find probabilities for discrete random variables. These are variables or outcomes to a phenomenon where *all possible outcomes* can be counted (discrete) and there is no outcome that is systematically chosen over other possible outcomes (random).

Examples of discrete random variables: Flipping a coin, rolling a die,

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Example A: List the possible outcomes for the following discrete random variables.

~ Rolling a fair, six sided die. 1, 2, 3, 4, 5, 6

~ Flipping a fair coin. H, T

~ Picking two colored beads from a bag contain three beads (red, white, and blue) with replacement before the second pick.

BR, BB, BW, WR, WB, WW, RR, RB, RW

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Probability: is a measure of the likeliness of an event.

Probability is defined as the ratio of the number of successes to the total number of possible outcomes. It can be expressed as a fraction, decimal, or percent.

fraction
Probability
↓

Definition of Probability: $P(\text{success}) = \frac{\text{number of ways for success}}{\text{total possible outcomes}}$

$$P(\text{Heads}) = \frac{1}{2} = 50\%$$

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Example B: a bag of candy contains 12 red, 11 yellow, 5 green, 6 orange, 5 blue, and 16 brown candies.

total candies : 55

a.) What is the probability that you will randomly draw a yellow candy from the bag?

$$P(\text{yellow candy}) = \frac{11}{55}$$

$$= \boxed{\frac{1}{5}, .2000, 20\%}$$

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Example B: a bag of candy contains 12 red, 11 yellow, 5 green, 6 orange, 5 blue, and 16 brown candies.

b.) What is the probability that you will NOT draw an orange candy from the bag?

$$P(\text{not orange}) = \frac{49}{55}$$

$$\begin{array}{l} \text{not orange: } 55 - 6 \\ = 49 \end{array}$$

$$= \frac{49}{55}, .8909, 89.09\%$$

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Example C: Suppose 3 letters are selected from the word *ARRANGEMENTS*. Find the probability of randomly selecting three consonants.

Vowels: 4 Cons: 8 total: 12

In this situation, it would take too long to list all the outcomes. First, find how many 3 letter groups meet the condition. There are 8 consonants in the word, and we need a group of 3. Since order doesn't matter, use a combination: $C(8, 3)$

Next, find the total number of ways to choose 3 letters from the word. There are 12 letters in the word, and we are selecting a group of 3. $C(12, 3)$

Then find the ratio of successes to total outcomes: $\frac{C(8, 3)}{C(12, 3)}$

$$P(3 \text{ cons.}) = \frac{C(8, 3)}{C(12, 3)} = \frac{56}{220} = \frac{14}{55}, .2545$$

25.45%

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Example D: The committee to organize the school prom has 6 seniors and 5 juniors. A subcommittee of 4 students is selected at random to choose the music for the prom. What is the probability that the subcommittee will contain 2 seniors and 2 juniors?

$$\begin{aligned} P(2 \text{ Sen.} + 2 \text{ Jun.}) &= \frac{C(5,2) \cdot C(6,2)}{C(11,4)} \left\{ \begin{array}{l} \text{jun} \\ C(5,2) \cdot C(6,2) \end{array} \right. \\ &= \frac{10 \cdot 15}{330} \\ &= \frac{150}{330} \end{aligned}$$

$$= \frac{5}{11}, .4545, 45.45\%$$

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Example D: The committee to organize the school prom has 6 seniors and 5 juniors. A subcommittee of 4 students is selected at random to choose the music for the prom. What is the probability that the subcommittee will contain 2 seniors and 2 juniors?

Choosing 2 seniors out of 6: $C(6,2) = 15$ $\underline{15} \cdot \underline{10} = 150$

Choosing 2 juniors out of 5: $C(5,2) = 10$

There are 150 ways to choose 2 juniors and 2 seniors from the committee.

Total number of ways a group of 4 can be selected from the committee of 11 people: $C(11,4) = 330$

Then find the ratio of successes to total outcomes:

$$\frac{C(6,2) \cdot C(5,2)}{C(11,4)} = \frac{150}{330}$$

$$= \frac{150}{330} = \frac{5}{11} = .4545$$

45.45%

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Two events are independent if the outcome of one event has no impact on the outcome of the second event. (Independent events are sometimes called *unconditional*.)

Probability of Independent Events:

$$P(A \text{ and } B) = P(A) \cdot P(B)$$

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Two events are dependent if the outcome of one event affects the outcome of the other event. When calculating the probability of the second event, you assume that the first event did occur. (Dependent events are sometimes called conditional.)

Probability of Dependent Events:

$$P(A \text{ and } B) = P(A) \cdot P(B \text{ following } A)$$

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Example E: Two dice are rolled. Find each probability.

$$\begin{aligned} \text{a.) } P(1 \text{ and } 5) &= P(1) \cdot P(5) \\ &= \frac{1}{6} \cdot \frac{1}{6} \\ &= \boxed{\frac{1}{36}, .0278, 2.78\%} \end{aligned}$$

$$\begin{aligned} \text{b.) } P(\text{even and odd}) &= P(\text{even}) \cdot P(\text{odd}) \\ &= \frac{3}{6} \cdot \frac{3}{6} \\ &= \frac{1}{2} \cdot \frac{1}{2} \\ &= \boxed{\frac{1}{4}, .25, 25\%} \end{aligned}$$

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Example E: Two dice are rolled. Find each probability.

c.) $P(2 \text{ different \#s}) = P(\text{a number}) \cdot P(\text{diff. \# than the } \underset{\text{1st}}{\text{1st}})$

$= P(1) \cdot P(\text{not a 1})$ ex:

$= \frac{6}{6} \cdot \frac{5}{6}$

$= \frac{30}{36}$

$= \frac{5}{6}, .8333, 83.33\%$

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Example F: There are 3 quarters, 4 dimes, and 5 nickels in a purse. Suppose 3 coins are to be selected without replacement. Find the probability that you will select a quarter, then a dime, then a nickel.

total : 12 coin

There are 12 total outcomes for selecting a coin. Each time a coin is selected, the number of coins in the purse is reduced by 1. This changes the probability of the next coin selection. Use multiplication to find the probability. $P(Q \text{ and then } D \text{ and then } N) =$

$$= \frac{C(3,1)}{C(12,1)} \cdot \frac{C(4,1)}{C(11,1)} \cdot \frac{C(5,1)}{C(10,1)}$$

$$= \frac{\cancel{3}^1 \cancel{1}^1}{\cancel{12}^1 \cancel{1}^1} \cdot \frac{\cancel{4}^1}{\cancel{11}^1} \cdot \frac{\cancel{5}^1 \cancel{1}^1}{\cancel{10}^1 \cancel{2}^1} =$$

$$= \frac{1}{22}, .0455, 4.55\%$$

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When talking about probability, a lot of examples use decks of cards. So, here is what is contained in a deck of cards.

- There are 52 cards in a deck.
- 26 are red, 26 are black
- There are 4 suits with 13 cards each: clubs (black), spades (black), hearts (red), diamonds (red).
- Each suit contains: 2, 3, 4, 5, 6, 7, 8, 9, 10, Jack, Queen, King, Ace (1)

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Example G: From a deck of 52 cards, 3 cards are randomly chosen. They are a 10, jack, and another 10, in that order.

a.) Find the probability that this event occurs if each card is replaced each time.

$$P(10) \cdot P(J) \cdot P(10) \\ = \frac{4}{52} \cdot \frac{4}{52} \cdot \frac{4}{52} = \frac{1}{13} \cdot \frac{1}{13} \cdot \frac{1}{13} = \boxed{\frac{1}{2197} = .0005} \\ \quad .05\%$$

b.) Find the probability that this event occurs if each card is NOT replaced each time.

$$P(10) \cdot P(J) \cdot P(10) \\ = \frac{4}{52} \cdot \frac{4}{51} \cdot \frac{3}{50} \\ = \frac{1}{13} \cdot \frac{2}{17} \cdot \frac{3}{50} = \boxed{\frac{2}{5525} = .0004} \\ \quad .04\%$$

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By the end of the lesson, you will be able to:

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Can you?

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Homework:

Assignment 56

Remember to give answers in Fraction form, Decimal form (4 places), and Percentage (2 places)!!!