Independent/Dependent Events

Probability (Unit 9) – Day 3: Independent and Dependent Events

Name: ____________________

Independent Events: Two events are said to be indep. when one event has no effect on the other occurring.

Dependent Events: First event DOES have an effect on the second event.

Determine whether the events are independent or dependent:

1. Selecting a marble from a container and selecting a jack from a deck of cards. indep.
2. Rolling a number less than 4 on a die and rolling a number that is even on a second die. indep
3. Choosing a jack from a deck of cards and choosing another jack, without replacement. dep
4. Picking a red marble from a bag and then picking a blue marble, without replacement. dep

Example 1: Suppose a die is rolled and then a coin is tossed.

- Are these events dependent or independent? independent, die has no effect on coin

Fill in the table to describe the sample space:

	Roll 1	Roll 2	Roll 3	Roll 4	Roll 5	Roll 6
Head	1H	2H	3H	4H	5H	6H
Tail	1T	2T	3T	4T	5T	6T

- How many outcomes are there for *rolling the die*? 6 How many outcomes are there for *tossing the coin*? 2
- How many outcomes are there in the *sample space* of rolling the die and tossing the coin? 12
- Is there another way to decide how many outcomes are in the sample space? Multiply # of outcomes for each event

Example 2: Use the Die/Coin Table above to find the following probabilities:

a. P(3) = $2/12 = 1/6$

b. P(tails) = $6/12 = 1/2$

c. P(3 AND tails) = $1/12$

d. P(even) = $6/12 = 1/2$

e. P(heads) = $6/12 = 1/2$

f. P(even AND heads) = $3/12 = 1/4$

g. What do you notice about the answers to c and f?

$$P(3 \text{ AND tails}) = P(3) \cdot P(\text{tails})$$
$$\frac{1}{6} \cdot \frac{1}{2} = \frac{1}{12}$$
$$P(\text{even AND heads}) = P(\text{Even}) \cdot P(\text{heads})$$
$$\frac{1}{2} \cdot \frac{1}{2} = \frac{1}{4}$$

Name: ____________________

Probabilities of Independent Events: $P(A \cap B)$

The probability of both events occurring

Multiplication Rule of Probability:
The probability of two independent events occurring can be found by the following formula:

$$P(A \cap B) = P(A) \cdot P(B)$$

- Can use to determine if events are independent

Examples:

1. The following table represents data collected from a grade 12 class in KHS High School.

Plans after High School

Gender	University	Community College	Total
Males	28	56	84
Females	43	37	80
Total	71	93	164

Two Way Table

- Suppose 1 student was chosen at random from the grade 12 class.

(a) What is the probability that the student is female? $80/164 = 49\%$

(b) What is the probability that the student is going to university? $71/164 = 43\%$

- Now suppose 2 people both randomly chose 1 student from the grade 12 class. Assume that it's possible for them to choose the same student. (independent)

(c) What is the probability that the first person chooses a student who is female and the second person chooses a student who is going to university? $P(F \cap U) = P(F) \cdot P(U) = (.49)(.43) = \boxed{21\%}$

2. Suppose a card is chosen at random from a deck of cards, replaced, and then a second card is chosen. Would these events be independent? How do we know? independent, card was replaced.

What is the probability that both cards are 7s?
$P(7) = 4/52$ $P(7 \cap 7) = \frac{4}{52} \cdot \frac{4}{52} = .59\%$

Probabilities of Dependent Events

- We cannot use the multiplication rule for finding probabilities of dependent events because the first event affects the probability of the other event occurring.
- Instead, we need to think about how the occurrence of the first event will affect the sample space of the second event to determine the probability of the second event occurring.
- Then we can multiply the new probabilities.

Indepe... / Dependent Events

dependent

Name: ______________________

Examples:

1. Suppose a card is chosen at random from a deck, the card is NOT replaced, and then a second card is chosen from the same deck. What is the probability that both will be 7s?

   - This is similar the earlier example, but these events are dependent? How do we know?

     cards are not replaced

   - How does the first event affect the sample space of the second event?

     1 one less 7, 1 less card

   Now find the probability that both cards will be 7s.

   $\frac{4}{52} \cdot \frac{3}{51} = \frac{1}{221} = .0045 = .45\%$

2. A box contains 5 red marbles and 5 purple marbles. What is the probability of drawing 2 purple marbles and 1 red marble in succession *without replacement*?

   10 total marbles

   $\frac{5}{10} \cdot \frac{4}{9} \cdot \frac{5}{8} = \frac{5}{36} = .139 = 13.9\%$

3. In Example 2, what is the probability of first drawing all 5 red marbles in succession and then drawing all 5 purple marbles in succession *without replacement*?

   $\frac{5}{10} \cdot \frac{4}{9} \cdot \frac{3}{8} \cdot \frac{2}{7} \cdot \frac{1}{6} \cdot \frac{5}{5} \frac{4}{4} \frac{3}{3} \frac{2}{2} \frac{1}{1} = .4\%$

More Examples (Mixed)

1. Pooja is tossing coins. What is the probability of her tossing 3 coins one after the other and getting heads on the first two coins and tails on the third?

   $\frac{1}{2} \cdot \frac{1}{2} \cdot \frac{1}{2} = 1/8 = 12.5\% = .125$

2. Randall bought a bag of Sour Patch Kids that contained 6 red, 18 blue, and 9 green. What is the probability of Randall reaching into the bag and pulling out a blue or green Sour Patch Kid and then reaching in again and pulling out a red one? Assume that the first candy is replaced.

   33 candies

   $\frac{27}{33} \cdot \frac{6}{33} = \frac{18}{121} = .1488 = 14.88\%$

3. Alex has a similar bag of candy (6 red, 18 blue, and 9 green). What is the probability of him reaching into his bag and pulling out a red candy and then without replacing it, pulling out a blue or green one?

   $\frac{6}{33} \cdot \frac{27}{32} = \frac{27}{176} = .1534 = 15.34\%$

Take it one event at a Time!!