13.4 Honors Advanced Algebra DATE: _______________

Compound Events

Compound event: an event that is made up of two or more events.
Independent events: events that have no affect on the outcome of each other. If two events, A and B, are said to be independent, they follow this formula: $P(A \text{ and } B) = P(A \cap B) = P(A) \bullet P(B)$

Dependent events: events that affect the outcome of each other.
Mutually exclusive events: events that cannot happen at the same time. If events A and B are mutually exclusive, they must follow this formula: $P(A \cap B) = 0, \quad and \quad P(A \text{ or } B) = P(A \cup B) = P(A) + P(B)$

Overlapping events: events that have outcomes in common. If events A and B are overlapping, they follow this formula:
$P(A \cup B) = P(A) + P(B) - P(A \cap B)$

Identifying Independent and Dependent Events

Are the outcomes of each trial independent or dependent events?

A **Choose a number tile from 12 tiles. Then spin a spinner.**

The choice of number tile does not affect the spinner result. The events are independent.

B **Pick one card from a set of 15 sequentially numbered cards. Then, without replacing the card, pick another card.**

The first card chosen affects the possible outcomes of the second pick, so the events are dependent.

Finding the Probability of Independent Events

A desk drawer contains 5 red pens, 6 blue pens, 3 black pens, 24 silver paper clips, and 16 white paper clips. If you select a pen and a paper clip from the drawer without looking, what is the probability that you select a blue pen and a white paper clip?

Step 1 Let A = selecting a blue pen. Find the probability of A.

$P(A) = \frac{6}{14} = \frac{3}{7}$ 6 blue pens out of 14 pens

Step 2 Let B = selecting a white paper clip. Find the probability of B.

$P(B) = \frac{16}{40} = \frac{2}{5}$ 16 white paper clips out of 40 clips

Step 3 Find $P(A \text{ and } B)$. Use the formula for the probability of independent events.

$P(A \text{ and } B) = P(A) \cdot P(B) = \frac{3}{7} \cdot \frac{2}{5} = \frac{6}{35} \approx 0.171$, or 17.1%

The probability that you select a blue pen and a white paper clip is about 17.1%.

Using Probabilities to Test for Independence

Manufacturing A factory foreman determines that on any given day there is a 15% chance that Machine A will malfunction, a 45% chance that Machine B will malfunction, and a 6.75% chance that both machines will malfunction. Are the events "Machine A malfunctions" and "Machine B malfunctions" independent events? Explain.

A What are the zeros of the function?

Let A = Machine A malfunctions, and
B = Machine B malfunctions.

Step 1 Write each probability as a decimal.

$P(A) = 15\% = 0.15 \quad P(B) = 45\% = 0.45$

$P(A \text{ and } B) = 6.75\% = 0.0675$

Step 2 Check whether the relationship $P(A \text{ and } B) = P(A) \cdot P(B)$ is true.

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

$0.0675 \stackrel{?}{=} 0.15 \cdot 0.45$

$0.0675 = 0.0675$ ✔

Because $P(A \text{ and } B) = P(A) \cdot P(B)$, the events "Machine A malfunctions" and "Machine B malfunctions" are independent.

Finding the Probability of Mutually Exclusive Events

Athletics Student athletes at a local high school may participate in only one sport each season. During the fall season, 28% of student athletes play basketball and 24% are on the swim team. What is the probability that a randomly selected student athlete plays basketball or is on the swim team?

Because athletes participate in only one sport each season, the events are mutually exclusive. Use the formula $P(A \text{ or } B) = P(A) + P(B)$.

$P(\text{basketball or swim team}) = P(\text{basketball}) + P(\text{swim team})$

$= 28\% + 24\% = 52\%$ Substitute and Simplify.

The probability of an athlete either playing basketball or being on the swim team is 52%.

Finding Probabilities of Overlapping Events

What is the probability of rolling either an even number or a multiple of 3 when rolling a standard number cube?

Know	Need	Plan
You are rolling a standard number cube. The events are overlapping events because 6 is both even and a multiple of 3.	You need the probability of rolling an even number and the probability of rolling a multiple of 3.	Find the probabilities and use the formula for probabilities of overlapping events.

$$P(\text{even or multiple of } 3) = P(\text{even}) + P(\text{multiple of } 3) - P(\text{even and multiple of } 3)$$
$$= \frac{3}{6} + \frac{2}{6} - \frac{1}{6}$$
$$= \frac{4}{6}, \text{ or } \frac{2}{3}$$

The probability of rolling an even or a multiple of 3 is $\frac{2}{3}$.

Practice

1) Determine whether the outcomes of each trial are independent or dependent events?
a. A card is randomly chosen from a standard deck of cards, the replaced; another card is chosen at random.
b. Asking a student's age, and asking what year he or she expects to graduate.

2) You spin a spinner (circle divided into 4 equal sections labeled 1, 2, 3, and 4), without looking. You also choose a tile from a set of tiles numbered from 1 to 10. Find each probability.
a. P(spinner lands on an odd number, and you choose an even number)
b. P(spinner lands on a number less than 4, and you choose a 9 or 10)

3) Use the given probabilities below to determine whether events A and B are independent.
a. $P(A) = 0.3, \ P(B) = 0.4, \ P(A \ and \ B) = 0.7$ **b.** $P(A) = \frac{2}{3}, \ P(B) = \frac{4}{5}, \ P(A \ and \ B) = \frac{8}{15}$

4) A bag contains 3 blue chips, 6 black chips, 2 green chips, and 4 red chips. Find the probability of each.
a. P(green chip or red chip) **b.** P(blue, black, or red chip)

5) A set of cards contains four suits (red, blue, green, and yellow). In each suit there are cards, numbered from 1 to 10. Find each probability.
a. P(green or yellow card, or card numbered 1) **b.** P(red or blue card, or card less than 6)

6) Suppose A and B are independent events. What is $P(A \cap B)$ if P(A) = 50% and P(B) = 25%?

7) Suppose A and B are mutually exclusive events. What is $P(A \cup B)$ if P(A) = 0.6 and P(B) = 0.25?

8) Suppose A and B are overlapping events. What is $P(A \cup B)$ if P(A) = $\frac{1}{3}$, P(B) = $\frac{1}{2}$, and $P(A \cap B)$ = $\frac{1}{5}$?