Algebra 2
Probability Notes #2: The Addition Rule
Name ______________________________

MAFS.912.S-CP.1.1
Describe events as subsets of a sample space (the set of outcomes) using characteristics (or categories) of the outcomes, or as unions, intersections, or complements of other events (“or,” “and,” “not”).

MAFS.912.S-CP.2.7
Apply the Addition Rule, \( P(A \text{ or } B) = P(A) + P(B) - P(A \text{ and } B) \), and interpret the answer in terms of the model.

The **Addition Rule** is for finding probabilities such as \( P(A \text{ or } B) \), the probability that either event A occurs or event B occurs or that they both occur.

- The key word to note here is “or”, meaning one or the other, or both.

For Example:

1. Find \( P(\text{triangle or square}) = \frac{7}{20} + \frac{3}{20} = \frac{10}{20} = \frac{1}{2} \)

2. Find \( P(\text{circle or triangle}) = \frac{10}{20} + \frac{7}{20} = \frac{17}{20} \)

3. Find \( P(\text{black triangle or white circle}) = \frac{4}{20} + \frac{5}{20} = \frac{9}{20} \)

These examples are all \( \underline{\text{mutually exclusive}} \) events, which means they cannot both occur together. Another name for mutually exclusive is \( \underline{\text{disjoint}} \). In particular, events \( A \) and \( B \) are disjoint (mutually exclusive) if \( P(A \text{ and } B) = 0 \).

**Example 1:**

Let \( \text{Event } A = \) a student who takes Algebra 2
Let \( \text{Event } B = \) a student who takes Biology

A student can take both Algebra 2 and Biology, so these events are \( \underline{\text{not}} \) mutually exclusive. They can occur together, so they can be called \( \underline{\text{joint}} \) events.

**Example 2:**

Let \( \text{Event } A = \) a man who has never been married
Let \( \text{Event } B = \) a man who is divorced

A man cannot be divorced if he has never been married, so these events are \( \underline{\text{mutually exclusive}} \). They are \( \underline{\text{disjoint}} \) events because they can’t occur together.
Now let’s look at more probabilities that are NOT mutually exclusive, meaning they can be joint events (looking back at the previous page).

4. Find \( P(\text{circle or a white object}) = \frac{10}{20} + \frac{9}{20} - \frac{5}{20} = \frac{13}{20} \)

3. Find \( P(\text{triangle or a black object}) = \frac{7}{20} + \frac{12}{20} - \frac{4}{20} = \frac{15}{20} = \frac{3}{4} \)

The important thing to remember is to find the total in such a way that no outcome is counted more than once, just in case you have overlapping events!

The overall rule we use, then is: \( P(A \text{ or } B) = P(A) + P(B) - P(A \cap B) \)

1. The Cost Less clothing Store carries discount jeans. If you buy a pair of jeans in your regular size without trying them on, the probability that the waist will be too tight is 0.30 and the probability that it will be too loose is 0.10.

   a) Are the events “too tight” and “too loose” mutually exclusive? Explain your answer.
   Yes, because a pair of jeans can’t have a waist that is too tight and too loose at the same time.

   b) If you choose a pair of jeans at random in your regular size, what is the probability that the waist will be too tight or too loose?
   \( P(\text{too tight or too loose}) = 0.30 + 0.10 = 0.40 \)

2. Professor Mumbleton is in charge of a program to prepare students for a high school equivalency exam. Records show that 80% of the students need help in math, 70% need help in English, and 55% need help in both areas.

   a) Are the events “need help in math” and “need help in English” mutually exclusive? Explain your answer.
   No, because a student might need help in both areas at the same time.

   b) Find the probability that a student selected at random needs help in math \( \text{or} \) help in English.
   \( P(A) + P(B) - P(A \text{ and } B) = .8 + .7 - .55 = .95 \)

3. Use the following information to answer questions on the number of TV sets per household in the United States:

<table>
<thead>
<tr>
<th># TV Sets</th>
<th>0</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5 or more</th>
</tr>
</thead>
<tbody>
<tr>
<td>Probability</td>
<td>.092</td>
<td>.274</td>
<td>.102</td>
<td>.035</td>
<td>.303</td>
<td></td>
</tr>
</tbody>
</table>

   a) Find \( P(3) = 0.194 \) (they must have a sum of 1)
   d) Find \( P(2)^c = 0.898 \)

   b) Find \( P(3 \text{ or } 4) = 0.229 \)
   e) Find \( P(\text{at least one}) = 0.908 \)

   c) Find \( P(\text{less than 3}) = 0.468 \)
   f) Are these events mutually exclusive? Explain.
   Yes, each household can only fall into one category
4. A bag of gum balls consists of 5 different flavors, with the following counts:

<table>
<thead>
<tr>
<th>Flavor</th>
<th>Cherry</th>
<th>Grape</th>
<th>Orange</th>
<th>Lemon</th>
<th>Blueberry</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of each</td>
<td>15</td>
<td>8</td>
<td>12</td>
<td>13</td>
<td>7</td>
</tr>
<tr>
<td>Probability</td>
<td>0.2727</td>
<td>0.1455</td>
<td>0.2182</td>
<td>0.2364</td>
<td>0.1273</td>
</tr>
</tbody>
</table>

Fill in the probabilities of each in the chart above. Record your answers as decimals to 4 decimal places, then find each of the following probabilities:

a) \( P(\text{cherry}) = 0.2727 \)

b) \( P(\text{grape or orange}) = 0.3637 \)

c) \( P(\text{lemon})^C = 0.7636 \)

d) \( P(\text{cherry or grape or blueberry}) = 0.5455 \)

e) \( P(\text{lemon or blueberry})^C = 0.6364 \)

5. In a standard deck of cards there are 52 cards, with 13 of each suit (see above). Use this to find the following probabilities. Leave your answers in fraction form (simplified if possible)

a) \( P(\text{spade}) = \frac{13}{52} = \frac{1}{4} \)

b) \( P(\text{Queen or 5}) = \frac{4}{52} + \frac{4}{52} = \frac{8}{52} = \frac{2}{13} \)

Are these mutually exclusive? yes

c) \( (\text{Queen or 5})^C = \frac{44}{52} = \frac{11}{13} \)

d) \( P(\text{Club or Red Card}) = \frac{13}{52} + \frac{26}{52} = \frac{39}{52} = \frac{3}{4} \)

Are these mutually exclusive? yes

e) \( P(\text{Heart or Jack}) = \frac{13 + 4}{52} = \frac{17}{52} \)

Are these mutually exclusive? no

f) \( P(\text{Face Card or Club}) = \frac{12 + 13}{52} = \frac{25}{52} \)

Are these mutually exclusive? no

g) \( P(8, 9, \text{or } 10) = \frac{4 + 4 + 4}{52} = \frac{12}{52} = \frac{3}{13} \)

Are these mutually exclusive? yes

h) \( P(\text{Red Card or Face Card}) = \frac{26 + 12}{52} = \frac{38}{52} = \frac{19}{26} \)

Are these mutually exclusive? no
6. Find the probability of rolling a 5 or a 6 on a standard number cube. Express your answer as a fraction in simplest form.

\[ P(5 \text{ or } 6) = \frac{2}{6} = \frac{1}{3} \]

7. A spinner is divided into 10 equal parts and numbered from 1 to 10. Find the probabilities below expressed as a fraction in simplest form.

a) What is the probability of spinning a number less than 4 or greater than 8?

\[ P(<4 \text{ or } >8) = \frac{3}{10} + \frac{2}{10} = \frac{5}{10} = \frac{1}{2} \]

b) What is the probability that you spin a number that is odd or a multiple of 3?

\[ P(\text{odd or mult } 3) = \frac{5}{10} + \frac{3}{10} - \frac{2}{10} = \frac{6}{10} = \frac{3}{5} \]

8. A movie company surveyed 1000 people. 245 people said they went to see the new movie on Friday, 286 said they went on Saturday. If 24 people saw the movie both nights, what is the probability that a person chosen at random saw the movie on Friday or Saturday? Express your answer as a decimal to the nearest thousandth.

\[ \frac{245}{1000} + \frac{286}{1000} - \frac{24}{1000} = \frac{507}{1000} = 0.507 \]

9. A bag contains 5 red balls numbered 1, 2, 3, 4, 5 and four white balls numbered 6, 7, 8, 9.

a) If a ball is drawn at random, what is the probability the ball is red or even-numbered?

\[ \frac{5}{9} + \frac{4}{9} - \frac{2}{9} = \frac{7}{9} \]

b) If a ball is drawn at random, what is the probability the ball is white or odd-numbered?

\[ \frac{4}{9} + \frac{5}{9} - \frac{2}{9} = \frac{7}{9} \]

10. Events A and B are mutually exclusive. Find P(A or B) if P(A) = 0.30 and P(B) = 0.55.

\[ 0.30 + 0.55 = 0.85 \]

11. There are 82 students in the junior class at Westbrooke High. There are 29 students enrolled in Spanish class and 31 enrolled in history. There are 15 students enrolled in both Spanish and history. If a junior is selected at random to say the pledge of allegiance at the beginning of the school day, what is the probability that it will be a student enrolled in Spanish or history?

\[ P(\text{Spanish or History}) = \frac{29}{82} + \frac{31}{82} - \frac{15}{82} = \frac{45}{82} \]