GRADE 12 APPLIED PROBABILITY
ADDITION AND SUBTRACTION RULES

Name: _____

Date: _____

Probability Rules:
(See Graphic Organizer; Venn Diagram) at the end of this assignment)

For events **A** and **B**:

- P(A OR B) ≡ P(A ∪ B) = P(A) + P(B) – P(A ∩ B)

Corollary: P(A OR B) ≡ P(A ∪ B) = P(A) + P(B) if A and B are mutually exclusive so that they have no common elements.
Corollary: $P(A_1 \cup A_2 \cup A_3 \cup \ldots \cup A_n)$ if A_1 , A_2, ,,, A_n are mutually exclusive.

- P(A) = 1 – P(not A) (The event "not A" is often represented also as: **~A**, **A'**, or $\overline{A}$)

Consequently P(~A) = 1 – P(A)

Recall:

- P(A AND B) ≡ P(A ∩ B) = P(A) • P(B | A) for dependent events
- P(A AND B) ≡ P(A ∩ B) = P(A) • P(B) for independent events

1. If A and B are mutually exclusive events and P(A) = 0.3 and P(B) = 0.5, find

   a. P (A ∪ B)
   b. P(~A)
   c. P(~A ∩ B)

Hint: Construct Venn Diagrams

a. 0.8 b. 0.7 c. 0.5

2. If A, B, C are mutually exclusive events and P(A) = 0.2 and P(B) = 0.3, and P(C) = 0.2 find:

a. $P(A \cup B \cup C)$
b. $P[\sim A \cap (B \cup C)]$
c. $P[\sim (B \cup \sim C)]$

a. 0.7 b. 0.5 c. 0.2

3. If P(A) = 0.5, P(B) = 0.3, and $P(A \cap B) = 0.1$, find $P(A \cup B)$

0.7

4. The probability that a vehicle entering Banff National Park has Manitoba plates is 0.12, the probability that it is a camper is 0.28, and the probability that it is a camper with Manitoba Plates is 0.09.

a. Calculate the probability that a vehicle entering Banff National Park is either a camper or has Manitoba plates?
b. Calculate the probability that a vehicle entering Banff National Park does not have Manitoba plates or is not a camper?
c. Calculate the probability that a vehicle entering Banff National Park has Manitoba plates?

a. 0.31 b. 0.91 c. $\frac{9}{28}$

5. The probability that a patient visiting his dentist will have a tooth extracted is 0.06, the probability that he will have a cavity filled is 0.20, and the probability that he will have a tooth extracted and a cavity filled is 0.03. Calculate the probability that a patient visits his dentist and has either a tooth extracted or a cavity filled?

0.23

6. The probability that a married man watches a certain TV show is 0.4, and the probability that his wife watches the same show is 0.5. The probability that a man watches the show, given that his wife does, is 0.7. Find the probability that:

a. a married couple watches the show;
b. a wife watches the show **given that** her husband does; and
c. **at least** one person of the married couple will watch the show.

a. 0.35 b. 0.875 c. 0.55

7. One bag contains four white marbles and three black marbles, and a second bag contains three white marbles and five black marbles. One ball is drawn at random from the second bag and is placed unseen in the first bag. What is the probability that a ball now drawn from the first bag is white?

$\frac{35}{64}$

8. A town has two fire engines operating independently. The probability that a specific engine is available when needed is 0.96.

a. what is the probability that neither is available when needed.
b. what is the probability that a fire engine is available when needed?

a. 0.0016 b. 0.9984

9. Two cards are drawn in succession from a deck of cards without replacement. Calculate the probability that:

a. both cards are red
b. both cards are greater than 3 but less than 8

a. $\frac{25}{102}$ b. $\frac{20}{221}$

10. The probability that Tom will be alive in 20 years is 0.7 (life style issues!), and the probability that Nancy will be alive in 20 years is 0.9. If we assume independence of death occurrence for both Tom and Nancy, calculate the probability that that neither will be alive in 20 years.

0.03

11. A coin is biased (unfair) so that a head is three times more likely to occur as a tail. If the coin is tossed twice, calculate the probability of getting:

a. two heads.
b. a tail and a head.

a. $\frac{9}{16}$ b. $\frac{3}{8}$

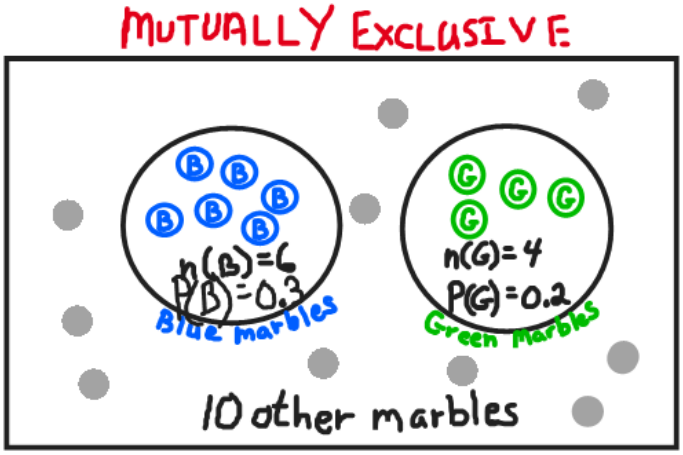
12. From a box containing six black marbles and four green marbles, three marbles are drawn in succession, with each marble returned to the box before the next draw is made. Calculate the probability of:

a. all three marbles are the same colour?
b. each colour is represented

a. $\frac{7}{25}$ b. $\frac{18}{25}$

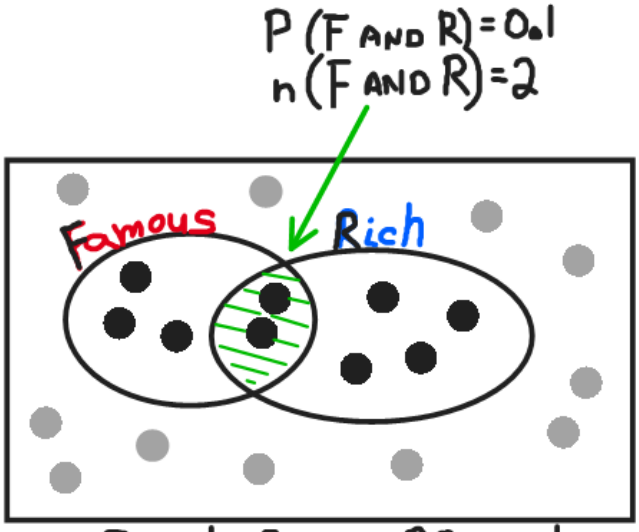
VENN DIAGRAMS

A useful way to show how your events relate to each other



n(Sample Size) = 20

$$P(\text{Blue OR Green}) = \frac{n(B)}{20} + \frac{n(G)}{20}$$
$$= P(B) + P(G)$$
$$= 0.3 + 0.2$$
$$= 0.5$$



Sample Space 20 people

Non-Mutually Exclusive

$$n(R \text{ OR } F) = n(R) + n(F) - n(R \text{ AND } F)$$
$$P(R \text{ OR } F) = \frac{n(R) + n(F) - n(R \text{ AND } F)}{20}$$
$$= P(R) + P(F) - P(R \text{ AND } F)$$
$$= 0.25 + 0.3 - 0.1$$
$$= 0.45$$