SOLUTIONS

THE ADDITION LAW OF PROBABILITY WORKSHEET

Question 1
A jar contains 11 red, 13 blue 16 white and 10 yellow marbles. A marble is selected at random from the jar. What is the probability that it is either blue or white?

$$Pr(B \cup W) = Pr(B) + Pr(W) = \frac{13}{50} + \frac{16}{50} = \frac{29}{50}$$

(B = selects blue
W = selects white
B & W are mutually exclusive).

Question 2
A set of cards is numbered {1, 2, 3 … 16}.
A card is selected at random. Find:

(a) P(multiple of 5 or a multiple of 6)

Multiples of 5 = $\{5, 10, 15\}$
Multiples of 6 = $\{6, 12, 18\}$
Pr (Multiples of 6 or Multiples of 5) $= \frac{6}{16} = \frac{3}{8}$

(b) P(a number less than 7 or greater than 8).

$L = \{1, 2, 3, 4, 5, 6\}$
$G = \{9, 10, 11, 12, 13, 14, 15, 16\}$
$Pr(L \cup G) = \frac{14}{16} = \frac{7}{8}$

(c) Pr (a multiple of 3 or a multiple of 5)

T = Multiples of 3 = $\{3, 6, 9, 12, 15\}$
F = Multiples of 5 = $\{5, 10, 15\}$
$T \cup F = \{3, 6, 9, 12, 15, 5, 10\}$ $\therefore Pr(T \cup F) = \frac{7}{16}$

Question 3
A card is selected at random from a pack of 52 playing cards. Find:
(a) P(a heart or a black card)

H = a Heart
B = a black card

$$Pr(H \cup B) = Pr(H) + Pr(B) - Pr(H \cap B) = \frac{1}{4} + \frac{1}{2} - 0 = \frac{3}{4}$$

(b) Pr (an Ace or a card from Clubs).

A = an Ace
~~B~~ C = clubs

$$Pr(A \cup C) = Pr(A) + Pr(C) - Pr(A \cap C) = \frac{4}{52} + \frac{13}{52} - \frac{1}{52} = \frac{16}{52} = \frac{4}{13}$$

(c) Pr (Queen or a Red card)

Q = A queen
R = A red card

$$Pr(Q \cup R) = Pr(Q) + Pr(R) - Pr(Q \cap R) = \frac{4}{52} + \frac{1}{2} - \frac{2}{52} = \frac{28}{52} = \frac{14}{26} = \frac{7}{13}$$

Question 4

In a chess tournament, the probability that Kevin Knight wins is $\frac{2}{11}$ and the probability that Bobby Bishop wins is $\frac{1}{44}$. What is the probability that either Kevin Knight or Bobby Bishop wins the tournament?

K = Kevin wins $\quad K \cap B = \emptyset$

B = Bobby wins

$$Pr(K \cup B) = Pr(K) + Pr(B)$$
$$= \frac{2}{11} + \frac{1}{44}$$
$$= \frac{8}{44} + \frac{1}{44} = \frac{9}{44}$$

Question 5

In a harness race, the odds of two horses winning are, respectively, 5–1 and 2–1. What is the probability that either horse wins?

$Pr(\text{Horse 1 wins}) = \frac{1}{6} \quad Pr(\text{Horse 2 wins}) = \frac{1}{3}$

$Pr(\text{Horse 1 wins} \cup \text{Horse 2 wins}) = \frac{1}{6} + \frac{1}{3}$

$= \frac{1}{2}$ Required probability $= \frac{1}{2}$

Question 6

In a population of foxes, the probability that any randomly selected fox has a silver tip on its tail is 0.2. The probability that a randomly selected fox has grey eyes is 0.4. The probability that any randomly selected fox has grey eyes and a silver tip on its tail is 0.12.

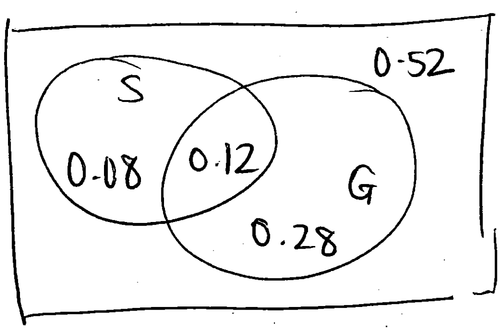
a. Find the probability that any fox selected randomly from this population has either a silver tip on its tail or grey eyes.

S = has silver tip

G = has grey eyes

$$Pr(S \cup G) = Pr(S) + Pr(G) - Pr(S \cap G)$$
$$\therefore Pr(S \cup G) = 0.2 + 0.4 - 0.12$$
$$= 0.48$$

b. Illustrate this information on a Venn Diagram and calculate the probability that a Fox has grey eyes but no silver tip on its tail.



$Pr(G \cap S') = 0.28.$

Question 7

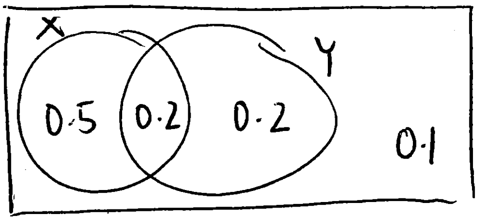
Given that: Pr (X) = 0.7, Pr (Y)= 0.4 and Pr ($X \cup Y$) = 0.9:

a. Calculate Pr ($X \cap Y$)

$Pr(X \cup Y) = Pr(X) + Pr(Y) - Pr(X \cap Y)$

$\therefore\ 0.9 = 0.7 + 0.4 - Pr(X \cap Y)\quad \therefore Pr(X \cap Y) = 0.2$

b. Illustrate this information on a Venn Diagram, and calculate Pr ($X \cap Y'$)



$Pr(X \cap Y') = 0.5$

Question 8

At Nowhere University, the probability that a first year student studies Mathematics is 0.55. The probability that a first year student studies IT is 0.72. The probability that a first year student studies both Mathematics and IT is 0.4.

a. Calculate the probability that a first year student from Nowhere University studies either Mathematics or IT.

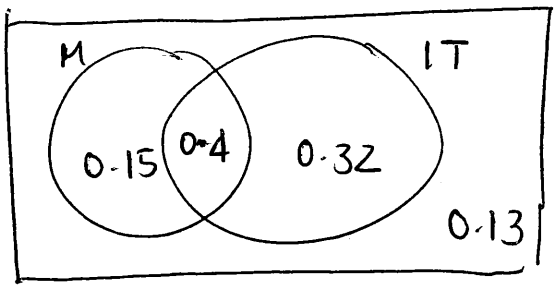
$Pr(M \cup IT) = Pr(M) + Pr(IT) - Pr(M \cap IT)$

$Pr(M \cup IT) = 0.55 + 0.72 - 0.4 = 0.87 \therefore$ Required probability = 0.87

b. Illustrate on a Venn Diagram and calculate the probabilities that:

i. A first year student studies Mathematics but not IT

ii. A first year student studies neither Mathematics nor IT.



(i) $Pr(M \cap IT') = 0.15$

(ii) $Pr(M' \cap IT') = 0.13$

Question 9

When a person contracts a type of influenza, the probability that he or she will either have a cough or a headache is 0.92. The probability that any person with this type of flu will have a headache is 0.8 and the probability that he or she will have a ~~headache~~ cough is 0.5. What is the probability that any person who gets this type of flu will have both a cough and a headache?

C = has a cough

H = has a headache

$Pr(H \cup C) = Pr(H) + Pr(C) - Pr(H \cap C)$

$\therefore\ 0.92 = 0.8 + 0.5 - Pr(H \cap C)$

$0.92 = 1.3 - Pr(H \cap C)\quad \therefore Pr(H \cap C) = 0.38$

Required probability = 0.38.