WorkSHEET 13.2    Probability

1  In a class of 40 students, 12 liked both fish and meat. If there were a total of 25 who liked meat and a total of 21 who liked fish, construct a Venn Diagram of this situation.

   ![Venn Diagram](image)

This Venn diagram question is too easy. Make sure you do Q10 in Ex 13E ☺

2  Use your Venn diagram to determine the probability that a randomly selected student liked fish.

   
   \[ P = \frac{WO}{PO} = \frac{21}{40} \]

3  In a class of 30 students, 2 liked both science and maths. If there were 7 who just liked science and 1 who just liked maths, construct a Venn Diagram of this situation.

   ![Venn Diagram](image)

   ** Yes, this Venn diagram should have a box around it!

4  Use your Venn diagram to determine the probability that a randomly selected student liked maths.

   \[ P = \frac{WO}{PO} = \frac{3}{30} = \frac{1}{10} \]

5  Use your Venn diagram to determine the probability that a randomly selected student liked science.

   \[ P = \frac{WO}{PO} = \frac{9}{30} = \frac{3}{10} \]
WorkSHEET 13.2  Probability

6 In a class of 30 students, 2 liked both science and maths. If there were 9 in total that liked Science and 3 in total that liked maths, construct a Venn Diagram of this situation.

7 Use your Venn diagram to determine the probability that a randomly selected student liked science or maths.

\[ P = \frac{WO}{PO} \]
\[ = \frac{10}{30} \]
\[ = \frac{1}{3} \]

8 Jason enters the library and chooses a book at random from a shelf containing 5 fiction, 7 non-fiction and 9 science-fiction books. What is the probability of him:

(a) choosing a non-fiction book

(b) not choosing a fiction book

(c) choosing a science-fiction book or fiction book?

Answers:

(a) \( P(\text{choosing non-fiction}) = \frac{7}{21} \)

(b) \( P(\text{not choosing fiction}) = \frac{16}{21} \)

(c) \( P(\text{choosing science fiction or fiction}) = \frac{14}{21} = \frac{2}{3} \)

*** Always state the rule first \( P = \frac{WO}{PO} \)
A standard die is rolled, find the probability of getting:

(a) a 3

(b) an even number

(c) a 3 or an even number

(d) a 3 or an even number (using a rule)

Using \( P = \frac{\text{WO}}{\text{PO}} \) EVERY time!

(a) \( P(3) = \frac{1}{6} \)

(b) \( P(\text{odd}) = \frac{3}{6} = \frac{1}{2} \)

(c) \( P(\text{odd}) = \frac{4}{6} = \frac{2}{3} \)

(d) \( P(A \cup B) = P(A) + P(B) \)

\( P(3 \cup \text{even}) = P(3) + P(\text{even}) \)

\[ = \frac{1}{6} + \frac{3}{6} \]

\[ = \frac{4}{6} \]

\[ = \frac{2}{3} \]

(e) \( P(\leq 4) = \frac{4}{6} = \frac{2}{3} \)

(f) \( P(\text{4 or less}) = P(\text{4}) + P(3) + P(2) + P(1) \)

\[ = \frac{1}{6} + \frac{1}{6} + \frac{1}{6} + \frac{1}{6} \]

\[ = \frac{4}{6} \]

\[ = \frac{2}{3} \]
10 From a standard deck of cards, determine the probability of drawing:
   a) 6
   \[ P = \frac{\text{WO}}{\text{PO}} = \frac{4}{52} = \frac{1}{13} \]
   b) 7
   \[ P = \frac{\text{WO}}{\text{PO}} = \frac{4}{52} = \frac{1}{13} \]
   c) club
   \[ P = \frac{\text{WO}}{\text{PO}} = \frac{13}{52} = \frac{1}{4} \]
   d) diamond
   \[ P = \frac{\text{WO}}{\text{PO}} = \frac{13}{52} = \frac{1}{4} \]
   e) 6 or 7
   \[ P = \frac{\text{WO}}{\text{PO}} = \frac{4}{52} + \frac{4}{52} = \frac{8}{52} = \frac{2}{13} \]
   f) club or diamond
   \[ P = \frac{\text{WO}}{\text{PO}} = \frac{13}{52} + \frac{13}{52} = \frac{26}{52} = \frac{1}{2} \]

11 Wendy has an envelope containing seven 20-cent stamps, three 45-cent stamps and five $1.00 stamps. What is the probability that she randomly selects
   (a) a 45-cent stamp
   \[ P(\text{selecting 45-cent stamp}) = \frac{3}{15} = \frac{1}{5} \]
   (b) a $1.00 stamp
   \[ P(\text{selecting $1.00 stamp}) = \frac{5}{15} = \frac{1}{3} \]
   (c) a 20-cent or a 45-cent stamp?
   \[ P = \frac{\text{WO}}{\text{PO}} = \frac{10}{15} = \frac{2}{3} \]
   We can do this 2 ways:
   \[ P(A \cup B) = P(A) + P(B) = \frac{7}{15} + \frac{3}{15} = \frac{10}{15} = \frac{2}{3} \]
12 Two coins are tossed. Use a tree diagram to determine the probability of obtaining:

Answers:

\[ P(\text{HH}) = \frac{1}{4} \]

\[ P(\text{HT}) = \frac{1}{4} \]

\[ P(\text{HT or TH}) = \frac{2}{4} = \frac{1}{2} \]

(b) 1 Head, then a Tail

13 Two coins are tossed. Determine the probability of obtaining:

The Tree Diagram situation leads us to the Multiplicative rule of Probability:

\[ P(A \cap B) = P(A) \times P(B) \]

Probability of Heads and then a Heads

\[ P(H \cap H) = P(H) \times P(H) \]

\[ = \frac{1}{2} \times \frac{1}{2} = \frac{1}{4} \]

Probability a Heads and then a Tails

\[ P(H \cap T) = P(H) \times P(T) \]

\[ = \frac{1}{2} \times \frac{1}{2} = \frac{1}{4} \]

** Refer previous question as this verifies that both ways gets the same answer.**

14 If this was a multiple choice question with 5 possible answers, what would be the probability of you getting it correct if you guessed the answer?

\[ P = \frac{WO}{PO} = \frac{1}{5} \]

Lets hope you don’t just guess in the test!
15 If this was another multiple choice question with 5 possible answers, what would be the probability of you getting both this question and the previous question correct if you guessed the answer?

\[ P(A \cap B) = P(A) \times P(B) \]

\[ P(\text{Correct} \cap \text{Correct}) = P(\downarrow) \times P(\downarrow) \]

\[ = \frac{1}{5} \times \frac{1}{5} \]

\[ = \frac{1}{25} \]

Not the best strategy for your test!

16 If this was another multiple choice question with 5 possible answers, what would be the probability of you getting both this question and the previous question correct if you guessed the answer?

Do that last question again, but using a different technique!

There are 2 questions, so do a 2-way table;

<table>
<thead>
<tr>
<th>Q</th>
<th>Question 1</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>↓</td>
</tr>
<tr>
<td>↓</td>
<td>↓</td>
</tr>
<tr>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>x</td>
<td>x</td>
</tr>
</tbody>
</table>

Use;

\[ P = \frac{WO}{PO} \]

\[ = \frac{1}{25} \]

17 Refer to the 2-way table in the last question, what is the likelihood of you guessing 2 incorrect answers?

\[ P = \frac{WO}{PO} \]

\[ = \frac{16}{25} \]

That’s confirmation not to guess your answers!
18 Two coins are tossed. Use a 2-way table to determine the probability of obtaining:

<table>
<thead>
<tr>
<th></th>
<th>H</th>
<th>T</th>
</tr>
</thead>
<tbody>
<tr>
<td>H</td>
<td>HH</td>
<td>HT</td>
</tr>
<tr>
<td>T</td>
<td>TH</td>
<td>TT</td>
</tr>
</tbody>
</table>

(d) 2 Heads

\[ P(HH) = \frac{1}{4} \]

(e) 1 Head, then a Tail

\[ P(HT) = \frac{1}{4} \]

(f) one of each.

\[ P(HT \text{ or } TH) = \frac{2}{4} \]

Pr(HT or TH) = \frac{1}{2}

The text book likes Tree Diagrams, but if there are only 2 events, I’d use a 2-way table!

19 Two coins are tossed. Use a Probability Rule to determine the probability of obtaining:

\[ P(A \cap B) = P(A) \times P(B) \]

a) 2 Heads

\[ P(H \cap H) = \frac{1}{2} \times \frac{1}{2} = \frac{1}{4} \]

b) A Head and then a Tail

\[ P(H \cap T) = \frac{1}{2} \times \frac{1}{2} = \frac{1}{4} \]

20 For breakfast, Ben has a choice between cereal and toast and a choice between milk and juice. Prepare a tree diagram to determine the probability of him having:

\[ C = \text{Cereal} \quad T = \text{Toast} \quad M = \text{Milk} \quad J = \text{Juice} \]

Outcomes

<table>
<thead>
<tr>
<th></th>
<th>C</th>
<th>M</th>
<th>T</th>
<th>J</th>
</tr>
</thead>
<tbody>
<tr>
<td>C</td>
<td>CM</td>
<td>CJ</td>
<td>TM</td>
<td>TJ</td>
</tr>
</tbody>
</table>

(a) cereal and juice

\[ P(CJ) = \frac{1}{4} \]

(b) toast and milk

\[ P(TM) = \frac{1}{4} \]

(c) juice

\[ P(CJ \text{ or } TJ) = \frac{2}{4} = \frac{1}{2} \]
A die is rolled and a coin is tossed. Prepare a tree diagram to determine the probability of:

(a) Tails and a 3
(b) Head and an odd number?

Using the multiplicative rule of probability:

\[ P(A \cap B) = P(A) \times P(B) \]

a) Tails and a 3

\[ P(T \cap 3) = \frac{1}{2} \times \frac{1}{6} = \frac{1}{12} \]

b) Head and an odd number?

\[ P(H \cap Odd) = \frac{1}{2} \times \frac{1}{2} = \frac{1}{4} \]

** just check this agrees with the last question ☺️
23 A bag contains 1 black and 2 red marbles. Joe picks a marble, notes its colour and places it back into the bag. A second marble is then picked. What is the probability of getting:

**Answers:**

(a) 2 red marbles

(b) A black and then a red marble

(c) Different coloured marbles

- (a) \( P(\text{RR}) = \frac{4}{9} \)
- (b) \( P(\text{BR}) = \frac{2}{9} \)
- (c) \( P(\text{different colours}) = \frac{4}{9} \)
A bag contains 1 black and 2 red marbles. Joe picks a marble, notes its colour and places it back into the bag. A second marble is then picked. What is the probability of getting:

a) 2 red marbles

\[ P(R \cap R) = \frac{2}{3} \times \frac{2}{3} = \frac{4}{9} \]

b) a black then a red marble?

\[ P(B \cap R) = \frac{1}{3} \times \frac{2}{3} = \frac{2}{9} \]

c) Different coloured marbles?

** order matters with the multiplication rule **

\[ P(\text{diff colour}) = P(B \text{ then } R) \text{ or } P(R \text{ then } B) \]

\[ = P(B \cap R) + P(R \cap B) \]

\[ = \frac{1}{3} \times \frac{2}{3} + \frac{2}{3} \times \frac{1}{3} \]

\[ = \frac{2}{9} + \frac{2}{9} = \frac{4}{9} \]

** does this question seem familiar? … check this agrees with the last question 😊 **
25 A coin is tossed and a three-sector spinner is spun. What are the chances of getting:

(a) A Head and a 2
(b) A Tail and a 3
(c) A Head

Answers:

(a) \( P(H2) = \frac{1}{6} \)

(b) \( P(T3) = \frac{1}{6} \)

(c) \( P(H) = \frac{3}{6} = \frac{1}{2} \)

26 Ben has 2 red pens and 1 black pen that he can choose from his pencil case. If he reaches for 2 pens what are the chances of him obtaining:

(a) 2 blacks pens
(b) 1 red and 1 black pen
(c) 2 red pens?

Answers:

(a) \( P(BB) = \frac{1}{9} \)

(b) \( P(RB \text{ or } BR) = \frac{4}{9} \)

(c) \( P(RR) = \frac{4}{9} \)

** If anyone can spot the problem/error in this question, tell Mr Finney. A Merit will be award to the first person to spot the problem 😊
27 Jodie can either fail or pass her two exams. What is the probability of her:

\( F = \text{Fail} \)
\( P = \text{Pass} \)

(a) failing both exams
(b) passing both exams
(c) passing one and failing the other
(d) passing at least one exam?

\[ P(\text{FF}) = \frac{1}{4} \]
\[ P(\text{PP}) = \frac{1}{4} \]
\[ P(\text{PF or FP}) = \frac{2}{4} = \frac{1}{2} \]
\[ P(\text{passing at least one exam}) = P(\text{PF}) + P(\text{FP}) + P(\text{PP}) \]

This is a TERRIBLE Question as it assumes that Jodie only has a 50% chance of passing her exam … I’ll do the question the text Book should have asked next!

\[ P(\text{PF}) = \frac{1}{4} \]
\[ P(\text{FP}) = \frac{1}{4} \]
\[ P(\text{PP}) = \frac{1}{4} \]

28 Jodie has a 0.9 chance of passing her maths test and a 0.8 chance of passing her Science Test. What is the probability of her:

Using \( P(A) + P(A^\prime) = 1 \)
If pass maths is 0.9, then fail maths is 0.1
If pass science is 0.8, then fail science is 0.2

And use \( P(A \cap B) = P(A) \times P(B) \)

a) failing both exams
\[ P(F \cap F) = 0.1 \times 0.2 \]
\[ = 0.02 \]

b) passing both exams
\[ P(P \cap P) = 0.9 \times 0.8 \]
\[ = 0.72 \]

c) passing one and failing the other
we need to allow for passing maths and failing science, OR, passing science and failing maths
\[ P(\text{pass 1 & fail 1}) = P(PM \cap FS) + P(FM \cap PS) \]
\[ = 0.9 \times 0.2 + 0.1 \times 0.8 \]
\[ = 0.26 \]
A fair coin is tossed 50 times and Heads came up 15 times.

(a) Find the relative frequency of obtaining Heads, as a fraction.

(b) Calculate the relative frequency of obtaining Tails, as a decimal.

When tossing a coin, Heads came up 45 times. How many times was the coin tossed, given that the relative frequency of Heads is 0.3?

Answer:

Expected frequency = relative frequency × number in the sample

\[
RF = \frac{\text{# outcomes}}{\text{# trials}}
\]

\[
0.3 = \frac{45}{x}
\]

\[
3 \times \frac{10}{10} = \frac{45}{x}
\]

\[
x = 150
\]

The coin needs to be tossed 150 times.