Probabilities

By Mark Gillan

Describe probabilities

Quite often we refer to probabilities in everyday life

- It is impossible to find someone over 30 feet tall
- It is likely to rain tomorrow
- It is an even chance of heads when tossing a coin
- It is unlikely for Partick Thistle to win the Champions League
- It is very unlikely for the moon to break in half

Describing and using the probability scale

Probabilities can be written in fractions, decimal or percentages.

We can describe the chance of something happening using words related to the event, we can also provide a score or scale for the event.

- Certain
- Quite likely
- Even chance
- Unlikely
- Highly unlikely

Event	Likelihood	Scale
New Years Day will be on the 1st January this year	Certain	1
It will snow in February next year	Quite Likely	
Toss a coin and get tails	Even chance	½ evens
Toss two coins and get tails on both coins	Unlikely	
Wake up in the morning with five legs and six arms	Highly Unlikely	0

Looking at probabilities

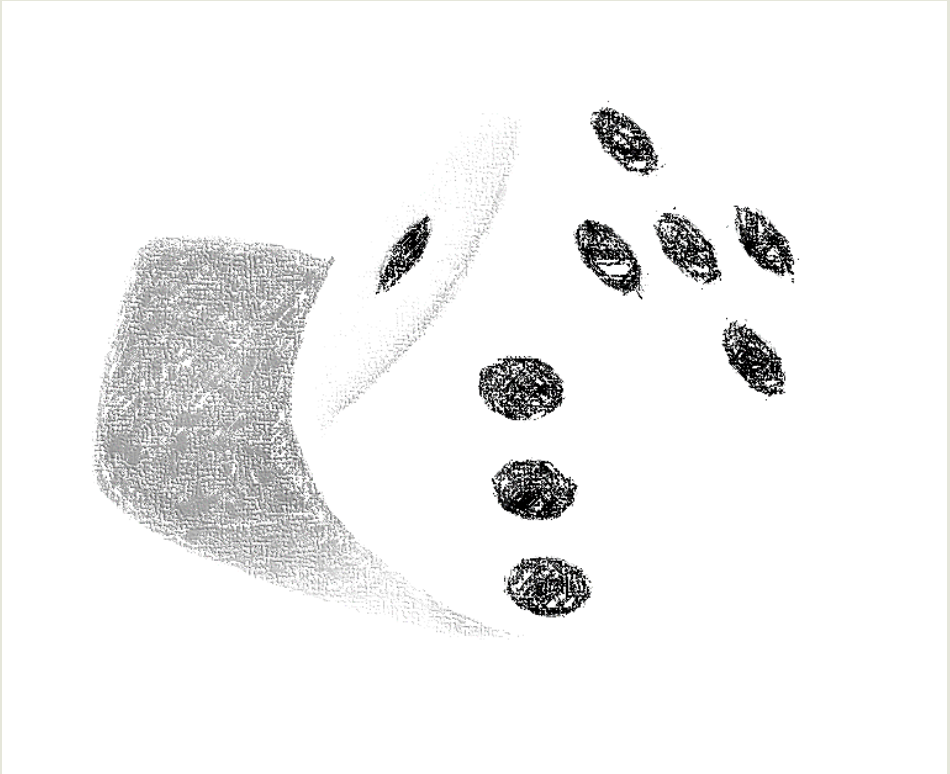
Throwing a die (singular of dice), there are SIX possible outcomes.

The die can display either a 1, 2, 3, 4, 5 or a 6

There is three possible ways of obtaining an even number (2,4,6)

We can mathematically state this probability of obtaining an even number as:
3/6 (which is ½ or 0.5 or 50%)

NOTE: If every possible outcome has the same chance of occurring, the probability of an outcome equals the number of ways the outcome can happen, divided by the total number of possible outcomes.



Consider these outcomes and use fraction, decimal, percentage to describe each possible outcome

Coin

- Tossing a coin to get heads

Sweets

- Choosing a sweet from a bag containing:
  1 Black Jack
  1 Fruit Salad
  1 Cola Cube
  1 Soor Ploom

Weekdays

- Choosing a day of the week at random

Scrabble

- Mixing up scrabble letters hidden side up, that form the word Mathematics, to then choose the letter M at random

Consider these outcomes and use fraction, decimal, percentage to describe each possible outcome

Coin

- Tossing a coin to get heads
- Evens, ½, 0.5, 50%

Sweets

- Choosing a sweet from a bag containing:
  1 Black Jack
  1 Fruit Salad
  1 Cola Cube
  1 Soor Ploom
- 1 out of 4, ¼, 0.25, 25%

Weekdays

- Choosing a day of the week at random
- 1 from 7, 1/7, 0.14, 14%

Scrabble

- Mixing up scrabble letters hidden side up, that form the word Mathematics, to then choose the letter M at random
- Total of 11 letters, but only 2 are an 'M'
- So: 2/11, 0.18, 18%

The problem with probabilities

If you ask 10 people whether they are meat eaters or non-meat eaters (vegetarian or vegan), you might have something like 9 out of 10 eat meat. Especially if you ask those people in McDonalds!

So, other factors can come into play

If you asked people at random in the street and increased the number of people, it might be more accurate or something that could be used

Sum of probabilities

If we toss a coin, the probability of getting tails is 1 out of 2, in other words, ½ or 0.5 or 50%

This is likewise for heads.

We can write the sum of probability as:

P(head) + P(tails) = ½ + ½ =1

Note: The sum of probabilities of all outcomes is 1

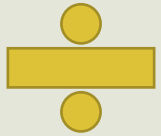
Sum of probabilities - more

- If we choose a letter at random from a word such as ‘SUMS’
- The probability of selecting an ‘S’ from the group of letters at random is 2 out of 4
- The possibility of selecting a ‘U’ is 1 out of 4
- And an ‘M’ as 1 out of 4
- Therefore, we can write the sum of probability in this instance as:
- **P(S) + P(U) + P(M) = $^{2}/_{4}$ + ¼ + ¼ = 1**

Combined events

If every possible outcome has the same chance of occurring, the probability of an outcome is:

Number of ways an outcome can happen



Total number of possible outcomes

However, what if there is more than one event, such as tossing TWO coins?

We can use a list or a table to analyse … (see next page)

Two ways of calculating the two events possible outcomes

A list

1st Coin	2nd Coin
H	H
H	T
T	H
T	T

A table

2nd Coin \ 1st Coin	H	T
H	(H,H)	(H,T)
T	(T,H)	(T,T)

The maths from the list or table

A list or table, the same outcome

1st Coin	2nd Coin
H	H
H	T
T	H
T	T

The sum of probabilities

Both methods allows us to see the FOUR possible outcomes

We can now calculate the probabilities

- There is only one way to get two heads, so ... P of 2 heads is ¼
- That is: P(two heads) = ¼
- Two ways of heads and tails
- So, P(heads and tails) = 2/4 = ½

Probabilities - summary

- ✓ Describing probabilities in words
  - Certain, quite likely, evens, unlikely, highly unlikely
- ✓ Use of a scale
  - From 1 certain, ½ being evens, to 0 impossible
- ✓ Fractions, decimal and percentage
  - Chance of 2 out of 4 would be ½ or 0.5 or 50%
- ✓ Sum of probabilities
  - e.g. P(head) + P(tails) = ½ + ½ =1
- ✓ Combined events
  - Use of a list or table to obtain a fraction