

6

Taking a chance



There are lots of things that may happen and we have lots of ways of talking about them.

You must have heard one or two of these:

'Perhaps it will be fine tomorrow.'

'What chance have the Rovers got on Saturday?'

'Is it possible that the 42 will get here before the 19?'

'How likely is it that Jo will turn up?'

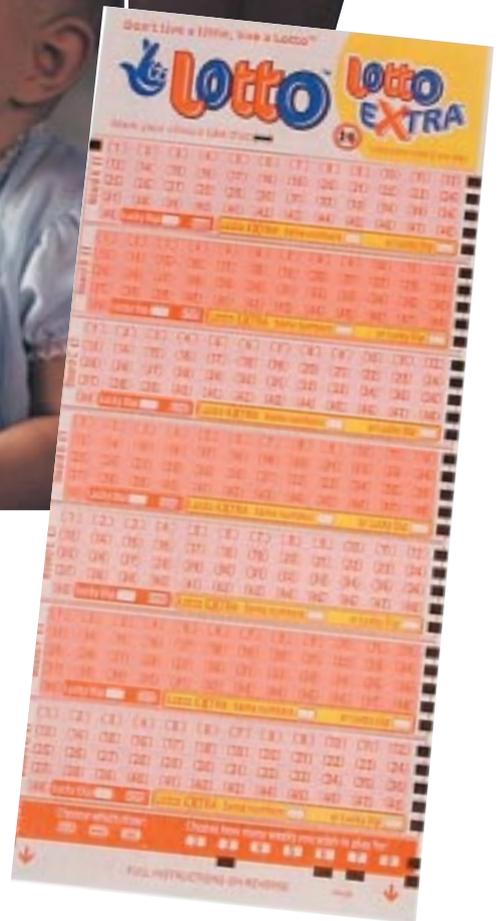
You may also have heard:

'Once in a blue moon' or

'Pigs will fly' or

'As sure as night follows day' or

'Chance would be a fine thing'.



Talk about it

Do you ever wonder about luck? Or chance? Or likelihood?

What is the likelihood of rain?

What is the chance that the baby will be a girl?

Have you been lucky enough to win the Lotto?

Just what do we mean when we say 'Pigs will fly'?

What maths is involved in these sorts of question?

It is called **probability**.

These are the skills you will practise in this unit.

Which are the most useful for you? Tick the boxes.

Showing that some events are more likely to happen than others

Writing the likelihood of an event using fractions, decimals and percentages

Skill code

HD2/L1.1

HD2/L1.2

What are the chances?

Talk about it

1

Have you ever won the Lotto? Do you know anyone who has? When we ask that question, are we talking about winning £10? No way! We mean winning a million pounds at least!

So is it possible to win a million or more on the Lotto? Discuss with another person how you would describe the **likelihood** of winning the Lotto.

As a group, decide where you think 'Winning the Lotto' goes on the line below and mark it with a cross (X).



2 Now discuss and mark on the line with a tick (✓) where you would put the **chance** that the Sun will rise tomorrow.

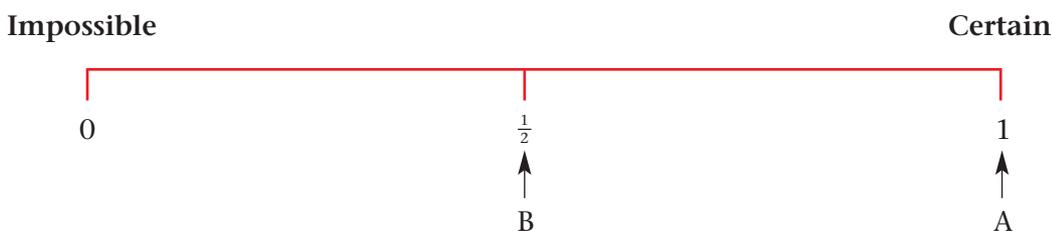
3 Now discuss and mark on the line with a large dot (●) where you would put the **probability** that a baby will be a girl.

If you put the last one in the middle, that's probably because you knew that a baby **had to be** either a boy or a girl.

It's not certain that the baby will be a girl, but it's not impossible either: so it feels like half-way!

If something is impossible, it has a probability of 0; if something is certain, it has a probability of 1. So, you never have a probability smaller than 0, or bigger than 1.

We can put numbers on the probability scale now.



A That February will follow January is **certain to happen** – the probability is 1.

B There is an **even chance** that a baby will be born a boy. The probability is $\frac{1}{2}$.

Another way of talking about this probability is to say there is a **fifty-fifty chance**.

C Pigs will **never** sprout wings and fly! The probability of this happening is 0. Mark this with an arrow on the line and label the arrow C. Discuss your answer with your teacher.



Activity 1

Draw your own probability scale here. Mark on 0, $\frac{1}{2}$ and 1. Label 'impossible' and 'certain'.

Mark these statements on the probability scale with arrows and label them with their question number.

- 1 The probability that this lesson will end.
- 2 The probability that I will die one day.
- 3 The probability that a man will give birth.
- 4 The probability of choosing which of two hands holds a sweet.

Remember

- Some things are **certain** to happen – the probability is 1.
- Some things are **impossible** – the probability is 0.
- All other 'events' fall somewhere in between.

Think of at least five things that could happen for each heading.

Impossible events	Events that come between (does not have to be half-way)	Certain events

Review

Do you need more practice with probability scales?

Yes No

For more work on this, go to H1 (page 9).

Heads or tails?



Why do we flip a coin to decide which team goes first or which direction they play?

When you flip a coin, there are two possible outcomes – heads or tails. There is only one head and the coin has only two sides, so what is the probability of getting a head?

We can write it like this:

$$p(\text{head}) = \frac{1}{2} = \frac{\text{Number of heads}}{\text{Total number of possible outcomes}}$$

The probability of a tail is the same:

$$p(\text{tail}) = \frac{1}{2} = \frac{\text{Number of tails}}{\text{Total number of possible outcomes}}$$

Since the probabilities are the same, there is an equal chance of either outcome. This is why we flip coins to decide who goes first in a game – because it's fair.

We can write the probability as a decimal or a percentage:

$$p(\text{head}) = \frac{1}{2} = 0.5 = 50\%$$

Experiment

- 1 If you flip a coin 20 times, how many heads would you **expect** to get?

Now try it and record your results.

Tails Heads

Did you get exactly what you expected? Yes No

If you did not, this is because probability only indicates how **likely** an event is to occur.

- 2 Do the experiment again but flip the coin 100 times. Tally your results below.

How many heads would you expect this time?

Tails

Heads

Did you get exactly what you expected? Yes No

Were you closer than last time? Yes No

Work out $\frac{\text{number of heads}}{100} = \dots\dots\dots$ (answer as a decimal)

Talk about it!

You will only get near the result you expected when you do an experiment a **large** number of times (100 is not considered a large number).

So that you get a large number of results quickly, combine the results from everyone in the group. Work out

$$\frac{\text{Total number of heads thrown by everyone}}{\text{Total number of throws made by everyone}} = \dots\dots\dots \text{ (as a decimal)}$$

The **probability** of getting a head is 0.5. The closest the experiment came to 0.5 was for throws.

Activity 2



1 Look at a die. List the numbers on it.

.....
.....

2 How many numbers are there?

3 List the odd numbers on the die.

4 How many odd numbers are there?

5 What is the probability of throwing an odd number? $p(\text{odd}) = \frac{\quad}{6} = \quad$

6 What is the probability of throwing an even number? $p(\text{even}) = \dots\dots\dots$

7 What is the probability of throwing a 6? $p(6) = \dots\dots\dots$

8 Is there a 'fair' way of using a die to start a game? Explain.

.....
.....

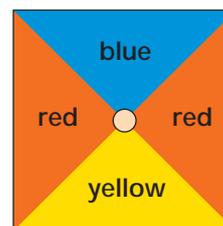
Activity 3

At the local primary school fair there is a spinner game.

1 How many sections are there on the spinner?

2 Which colour should I choose if I want to win?

3 Use probabilities to explain why.



.....

Review

Do you need more practice in working out probabilities?

Yes No

For more work on this, go to H2 (page 9).

Counters and cards

There are ten counters in a bag.

Seven are blue and three are yellow.



What is the probability of pulling out a blue counter?

$$p(\text{blue}) = \frac{\text{number of blue counters}}{\text{total number of counters}} = \frac{7}{10} = 0.7 = 70\%$$

$$p(\text{yellow}) = \frac{\text{number of yellow counters}}{\text{total number of counters}} = \frac{3}{10} = 0.3 = 30\%$$

$$p(\text{green}) = \frac{\text{number of green counters}}{\text{total number of counters}} = \frac{0}{10} = 0 = 0\%$$

We can only pull out blue or yellow counters, so the probability of other colours is 0.

Activity 4

Look at a pack of playing cards.

- 1 How many cards are there in the pack?
- 2 How many red cards are in a pack?
- 3 How many different suits are in a pack?
- 4 How many aces are in a pack?

The probability of pulling out a red card is

$$p(\text{red}) = \frac{26 \text{ red cards}}{52 \text{ cards in total}} = \frac{26}{52} = \frac{1}{2}$$

- 5 What is the probability of pulling out a black card?

$$p(\text{black}) = \frac{\text{..... black cards}}{52 \text{ cards in total}} =$$

Check your answer with your teacher before continuing.

- 6 What is the probability of pulling out a heart?

.....

- 7 What is the probability of pulling out an ace?

.....



Remember

$$\text{The probability of something happening} = \frac{\text{Number of ways it can happen}}{\text{Total number of ways}}$$

Activity 5



- 1 Work out the probability as a fraction, then use your calculator to work out the decimal and percentage.

Event	Probability		
	Fraction	Decimal	%
Flipping a coin and getting a head			
Rolling a die and getting an even number			
Rolling a die and getting a number under 3			
Rolling a die and getting a number from 1 to 6			
Pulling a diamond from a pack of cards			
Pulling the five of clubs from a pack of cards			
Pulling a black diamond from a pack of cards			

Check your fraction answers to make sure that they are in the simplest form. Write these into the table.

- 2 At the fair they had a raffle. They were really pleased because they sold 500 tickets altogether. Imagine that you bought ten for yourself and five for your cousin. Both of your children bought a ticket and you found out later that a friend bought a ticket.

- a What is the probability that you win first prize?
(answer as a fraction in simplest form)
- b What is the probability that one of your relatives wins first prize?
(answer as a decimal)
- c What is the probability that your friend wins first prize?
(answer as a fraction)
- d What is the probability that someone from your family (including you and your relatives) wins first prize?
(answer as a decimal)

Remember

- Probabilities are always written as fractions, decimals or percentages.



Review

Do you need more practice working with probabilities?

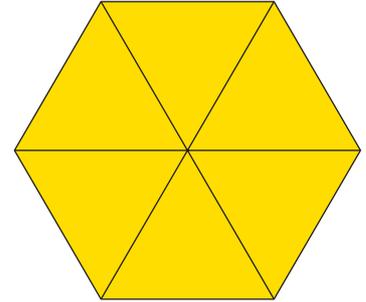
Yes No

For more work on this, go to H2 (page 9) and E1 (page 10).

This work links to mini-projects M2 and M3 (page 10).

Make a spinner

Make a spinner from cardboard. Divide it into six equal sections. Colour three sections blue, two sections red and one section green. Make a small hole in the centre and push a sharp pencil through it.



What is the probability of the spinner landing on blue?
.....

Now use the spinner to record the blues and complete the table below.

Number of times spun (A)	Number of blues (B)	B divided by A
30		
60		
90		
120		

Write down anything you notice about the numbers.



Activity 6

The questions in this activity are all about the word M A T H E M A T I C S.

I pick a letter from a bag containing all the letters in the word MATHEMATICS.

- 1 How many letters are there in the word MATHEMATICS?
- 2 What is the probability that I pick 'M'? (answer as a fraction)
- 3 What is the probability that I pick a vowel? (answer as a fraction)
- 4 What is the probability that I pick a consonant? (answer as a fraction)
- 5 Look at the last two answers. What can you say about them? Write down anything you notice.
Can you explain?
- 6 What is the probability that I pick a letter that is from the first half of the alphabet? (answer as a fraction)

Talk about it

Have you ever played 'Yahtzee'? Yahtzee is a commercial game that provides practice in probability.



Review

Do you need more practice in working out probabilities in fractions, decimals and percentages?

Yes No

For more work on this, go to H3 and H4 (page 9), E1 (page 10).

This work links to mini-projects M1 and M4 (page 10).

Help

Activity H1



Mark where you think these events go on the probability scale.

- A I will see a blue cow next week.
- B Somewhere in the world someone will cough tomorrow.
- C I will take the left shoe out of the box first.

Activity H2

The colours of the rainbow are: red, orange, yellow, green, blue, indigo and violet.

- 1 How many colours are there?
- 2 What is the probability that Jan's favourite rainbow colour is violet?
.....
- 3 What is the probability that a colour chosen begins with a vowel?
- 4 What is the probability that a colour chosen has six letters?

Activity H3

These questions are all about a standard pack of playing cards.



Write your answers as fractions and then change them to decimals and percentages. You may use a calculator.

- 1 What is the probability that a card chosen is a club?
- 2 What is the probability of choosing the queen of hearts?
- 3 What is the probability of choosing a red card?
- 4 What is the probability that the card chosen is a red ace of spades?

Activity H4

These questions are all about the word P R O B A B I L I T Y.



Write your answers as fractions, and then change them to decimals and percentages. You may use a calculator.

Pick one letter from a bag containing all the letters from the word PROBABILITY.

What is the probability that it is:

- 1 a 'p'?
- 2 an 'i'?
- 3 a vowel?
- 4 in the first half of the alphabet?



Extension

Activity E1

What is the probability that a card chosen from a standard pack of cards is:

- 1 a face card?
- 2 a number card of diamonds?
- 3 an even numbered black card?



Mini-projects



Activity M1

Predicting the weather is a difficult skill, even with modern technology.

Throughout the centuries, people have used different methods of predicting the weather.

Seaweed is thought to become softer when rain is expected.

People often look at the sky to get an idea of what the weather will do.

Investigate folklore and old sayings about the weather.

Choose one of the sayings and test how accurate a prediction it is.



Activity M2

Look at the attendance records for your class.

How many weeks have passed since the class started?

On how many weeks has there been 100% attendance?

Work out the probability of there being 100% attendance next week.



Activity M3

Think up your own ideas for probability and test them out.



Activity M4

Use the Lotto results. These can be found on teletext.

Work out if any number has a greater chance of coming up than others.



Check it

Activity C1

Which of these events is least likely to happen? Tick your answer.

- a Snow in July in England.
- b A boy will be born somewhere.
- c The sun will shine soon.

Activity C2

Which of these events has a fifty-fifty chance of happening? Tick your answer.

- a A baby will be a boy.
- b A mother will have triplets.
- c A baby will be born somewhere next Tuesday.

Activity C3

Using fractions, write down the probability of:

- 1 throwing a 6 with one roll of a die
- 2 throwing a head when tossing a coin
- 3 drawing an ace from a pack of cards

Activity C4

1 Do you have a better chance of throwing a 1 or a 6 with one roll of a die?

.....

Activity C5

Complete the table.

Chance	Fraction	%	Decimal
Flipping a head			0.5
Choosing the ace of clubs from the four aces		25%	
Choosing the number 7 from the digits 0–9			0.1

How am I doing?

Now look back at the skills listed on page 1.

Then complete the sentences below.

I am confident with

.....
.....

I need more practice with

.....

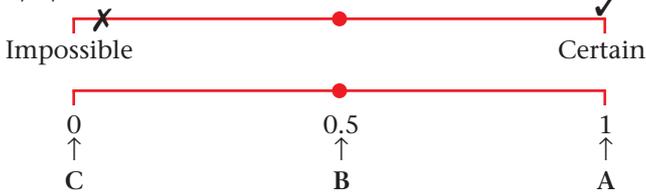
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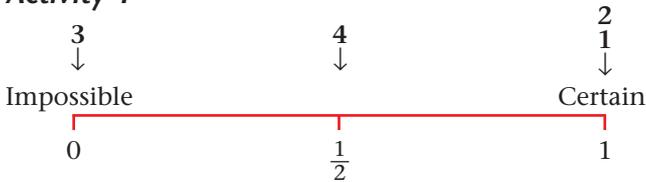
Answers

Talk about it (page 6)

1, 2, 3



Activity 1



Heads or tails?

Experiment

- Expect 10 heads in 20 throws.
 - Expect 50 heads in 100 throws.
- Other answers will vary.

Activity 2

- 1, 2, 3, 4, 5, 6
- 6
- 1, 3, 5
- 3 odd numbers
- $p(\text{odd}) = \frac{3}{6} = \frac{1}{2}$
- $p(\text{even}) = \frac{3}{6} = \frac{1}{2}$
- $p(\text{six}) = \frac{1}{6}$
- Check your answers with your teacher.

Activity 3

- 4
- Red
- More red so more chance of winning:
 $p(\text{red}) = \frac{2}{4} = \frac{1}{2}$

Activity 4

- 52 cards
- 26 red cards
- 4 suits (hearts, diamonds, clubs, spades)
- 4 aces
- $p(\text{black card}) = \frac{26}{52} = \frac{1}{2}$
- $p(\text{heart}) = \frac{13}{52} = \frac{1}{4}$
- $p(\text{ace}) = \frac{4}{52} = \frac{1}{13}$

Activity 5

1

Probability		
fraction	decimal	%
$\frac{1}{2}$	0.5	50%
$\frac{1}{2}$	0.5	50%
$\frac{1}{3}$	0.333	33.3%
1	1	1
$\frac{1}{4}$	0.25	25%
$\frac{1}{52}$	0.0192	1.92%
0	0	0

- $\frac{10}{500} = \frac{1}{50}$
 - $\frac{7}{500} = 0.014$
 - $\frac{1}{500}$
 - $\frac{17}{500} = 0.034$

Discuss the result of your spinner experiment with your teacher.

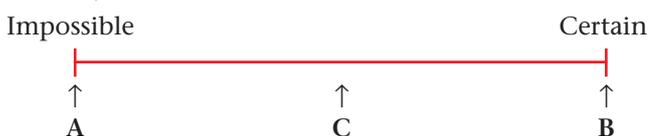
Activity 6

The probability of the spinner landing on blue is $\frac{3}{6}$, $\frac{1}{2}$ – or 50%, 0.5. Check the table with your teacher.

- 11 letters
- $\frac{2}{11}$
- $\frac{4}{11}$
- $\frac{7}{11}$
- They add up to 1 because all letters are vowels or consonants.
- $\frac{8}{11} = 72.72\%$

Help

Activity H1



Activity H2

- 7
- $\frac{1}{7}$
- $\frac{2}{7}$
- $\frac{4}{7}$



Activity H3

- 1 $\frac{1}{4}$, 0.25, 25%
- 2 $\frac{1}{52}$, 0.0192, 1.92%
- 3 $\frac{1}{2}$, 0.5 50%
- 4 0

Activity H4

- 1 $\frac{1}{11}$ 0.09091 9%
- 2 $\frac{2}{11}$ 0.18182 18%
- 3 $\frac{4}{11}$ 0.36364 36%
- 4 $\frac{6}{11}$ 0.54545 55%

Extension

Activity E1

- 1 $\frac{12}{52}$, $\frac{3}{13}$, 0.231, 23.1%
- 2 $\frac{10}{52}$, $\frac{5}{26}$, 0.192, 19.2%
- 3 $\frac{10}{52}$, $\frac{5}{26}$, 0.192, 19.2%

Mini-projects

Activities M1, M2, M3, M4

Check your work with your teacher.

Check it

Activity C1

a

Activity C2

a

Activity C3

- 1 $\frac{1}{6}$
- 2 $\frac{1}{2}$
- 3 $\frac{4}{52} = \frac{1}{13}$

Activity C4

The same, both $\frac{1}{6}$

Activity C5

Chance	Fraction	%	Decimal
Flipping a head	$\frac{1}{2}$	50%	0.5
Choosing the ace of clubs from the four aces	$\frac{1}{4}$	25%	0.25
Choosing the number 7 from the digits 0–9	$\frac{1}{10}$	10%	0.1