Different Ways to Express Probability

Focus Express probabilities as ratios, fractions, and percents.

When the outcomes of an experiment are equally likely, the probability of an event occurring is:

$$\frac{\text{Number of outcomes favourable to that event}}{\text{Number of possible outcomes}}$$

Explore

At the pet store, Mei buys 100 biscuits for her dog, Ping-Ping.
She buys 75 beef-flavoured biscuits, 15 cheese-flavoured, and 10 chicken-flavoured.
The clerk puts them all in one bag.
When she gets home, Mei shakes the bag and pulls out one biscuit.

- What is the probability that Mei pulls out a cheese-flavoured biscuit from the bag?
- How many different ways could you write this probability?
- What is the probability of pulling out a beef-flavoured biscuit? A chicken-flavoured biscuit?
  Write each probability 3 different ways.
- What is the probability of pulling out a vegetable-flavoured biscuit?
- What is the probability of pulling out a flavoured biscuit?

Reflect & Share

Compare your results with those of another pair of classmates.
How many different ways did you write a probability?
Are all of the ways equivalent?
How do you know?
What is the probability of an event that always occurs?
An event that never occurs?

A probability can be written as a ratio, a fraction, and a percent.

Sam buys a box of different flavours of food for his cat.
In a box, there are 14 packets of fish flavour, 2 of chicken flavour, and 4 of beef flavour.
Sam takes a packet out of the box without looking.
What is the probability that he picks a packet of chicken-flavoured food?

There are 20 packets in a box of cat food.
● Using words:
  Only 2 of the 20 packets are chicken.
  So, picking chicken is unlikely.
● Using a fraction:
  Two of the 20 packets are chicken.
  The probability of picking chicken is $\frac{2}{20}$, or $\frac{1}{10}$.
● Using a ratio:
  The probability of picking chicken is $\frac{1}{10}$.
  We can write this as the part-to-whole ratio 1:10.
● Using a percent:
  To express $\frac{2}{20}$ as a percent, find an equivalent
  fraction with denominator 100.

  $$\overset{\times 5}{\frac{2}{20}} = \overset{}{\frac{10}{100}}, \text{ or } 10\%$$
  $\times 5$

  The chance of picking chicken is 10%.

> Recall that you can also use a calculator to help you write a fraction as a percent.

> When we express a probability as a percent, we often use the word *chance* to describe it.

When *all* the outcomes are favourable to an event, then the fraction:

$$\frac{\text{Number of outcomes favourable to that event}}{\text{Number of possible outcomes}}$$

has numerator equal to denominator, and the probability is 1, or 100%.
For example, the probability of picking a packet of cat food is: $\frac{20}{20} = 1$

When *no* outcomes are favourable to an event, then the fraction:

$$\frac{\text{Number of outcomes favourable to that event}}{\text{Number of possible outcomes}}$$

has numerator equal to 0, and the probability is 0, or 0%.
For example, the probability of picking
a packet of pork-flavoured cat food is: $\frac{0}{20} = 0$

The probability that an **impossible event** will occur is 0, or 0%.

The probability that a **certain event** will occur is 1, or 100%.

All other probabilities lie between 0 and 1.

Example

Twenty-five cans of soup were immersed in water.

Their labels came off so the cans now look identical.

There are: 2 cans of chicken soup; 4 cans of celery soup;

5 cans of vegetable soup; 6 cans of mushroom soup;

and 8 cans of tomato soup.

One can is picked, then opened.

a) What is the probability of each event?

Write each probability as a ratio, fraction, and percent.

  i) The can contains celery soup.

  ii) The can contains fish.

  iii) The can contains celery soup or chicken soup.

  iv) The can contains soup.

b) State which event in part a is:

  i) certain   **ii)** impossible

A Solution

a) There are 25 cans, so there are 25 possible outcomes.

  i) Four cans contain celery soup.

   The probability of opening a can of celery soup is:

   4:25, or $\frac{4}{25} = \frac{16}{100}$, or 16%

  ii) None of the cans contain fish.

   The probability of opening a can of fish is: 0, or 0%

  iii) Four cans contain celery soup and two contain chicken soup.

   This is 6 cans in all.

   The probability of opening a can of celery soup or chicken soup is:

   6:25, or $\frac{6}{25} = \frac{24}{100}$, or 24%

  iv) Since all the cans contain soup, the probability of opening a can of soup is:

   20:20, or $\frac{20}{20}$, or 100%

b)   **i)** The event that is certain to occur is opening a can that contains soup.

   This event has the greatest probability, 1.

  ii) The event that is impossible is opening a can that contains fish.

   This event has the least probability, 0.

Practice

Use a calculator when you need to.

1. Write the probability of each event as many different ways as you can.
   a) Roll a 3 or 5 on a die labelled 1 to 6.
   b) January immediately follows June.
   c) Pick an orange out of a basket that contains 2 oranges,
      6 apples, and 8 peaches.
   d) The sun will set tomorrow.

2. A bag contains these granola bars: 12 apple, 14 peanut butter,
   18 raisin, and 10 oatmeal. You pick one bar at random.
   Find the probability of picking:
   a) a peanut butter granola bar
   b) an apple granola bar

3. Two hundred fifty tickets for a draw were sold.
   One ticket, drawn at random, wins the prize.
   a) Joe purchased 1 ticket.
      What is the probability Joe will win?
   b) Maria purchased 10 tickets.
      What is the probability Maria will win?
   c) Ivan purchased 25 tickets.
      What is the probability Ivan will *not* win?
   Express each probability three ways.

4. Thanh has 20 felt pens in a pencil case.
   He has 6 blue pens, 5 red pens, 2 yellow pens, 3 green pens,
   2 brown pens, 1 purple pen, and 1 orange pen.
   Thanh reaches into the case without looking and pulls out one pen.
   Write a ratio, fraction, and percent to describe
   the probability that Thanh picks:
   a) either a yellow or a green pen
   b) either a blue or a red pen
   c) a coloured pen
   d) a grey pen
   e) a purple pen

5. The names of 8 students are in a hat.
You pick one name without looking.
Find each probability.
Express each probability as many ways as you can.
a) Laura will be picked.
b) Jorge will *not* be picked.
c) A three-letter name will be picked.
d) A five-letter name will be picked.
e) A name with 4 or more vowels will be picked.
f) A boy's or a girl's name will be picked.

6. Think of an experiment for which an event occurs with each probability.
Explain your choice.
a) 100%　　　 b) $\frac{1}{2}$　　　　 c) 1:6　　　 d) 0

7. Assessment Focus　Construct a spinner with red, yellow, blue, and green sectors, so the following probabilities are true.
• The probability of landing on red is $\frac{1}{5}$.
• The probability of landing on yellow is 50%.
• The probability of landing on blue is 1:10.
• The probability of landing on green is $\frac{2}{10}$.
Explain how you drew your spinner.

8. Take It Further　A box contains 3 red, 2 green, and 4 white candies.
Carmen picked one candy, found it was white, and ate it.
She picked a second candy at random, found it was red, and ate it.
Carmen picked a third candy at random.
a) Which colour is the third candy most likely to be? Explain.
b) Write the probability that the third candy will be the colour named in part a. Use a ratio, fraction, and percent to write the probability.
c) What is the probability that the candy will *not* be the colour named in part a?

Reflect

The weather forecast shows a 90% chance of rain tomorrow.
How would this affect your plans for a class picnic? Why?