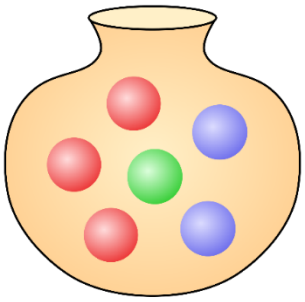
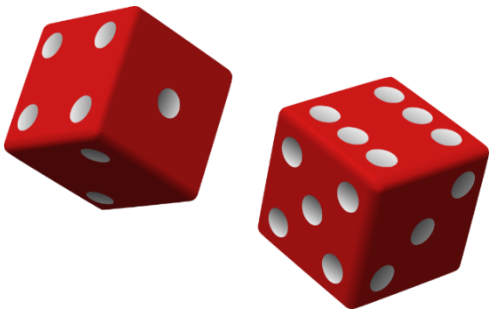
Year 10 Probability Concepts & Tables





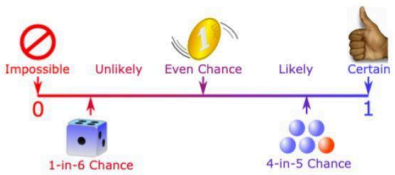
Name:

Written by Liz Sneddon

Language of probability

Probability

A number that describes the likely occurrence of an event, measured on a scale from 0 (impossible event) to 1 (certain event).



P(outcome A) =

"The probability of getting outcome A is ...:"

$$P(\text{event}) = \frac{\text{number of ways it can happen}}{\text{total number of outcomes}}$$

Event

Something which has a number of outcomes.

E.g. rolling a die

Outcome

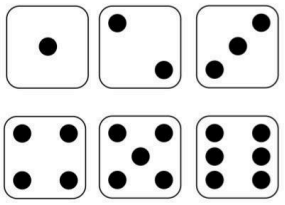
One possible result of an experiment.

E.g. rolling a 6

Sample space

A list of all the possible outcomes of an experiment.

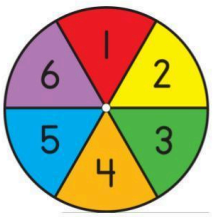
E.g. a dice



Equally likely

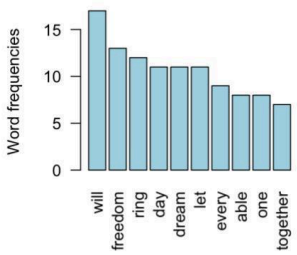
Outcomes with the same chance.

E.g. outcomes on this spinner



Frequency

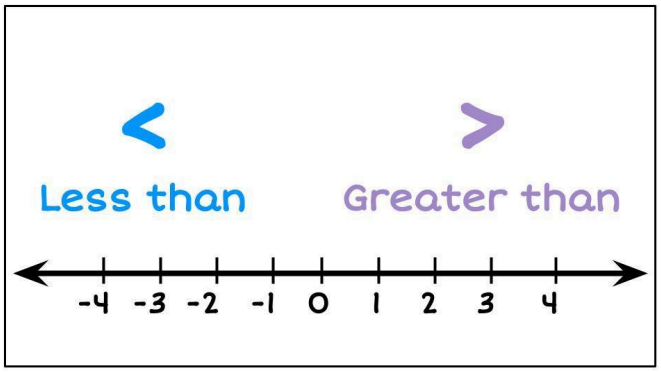
the number of times an event occurs

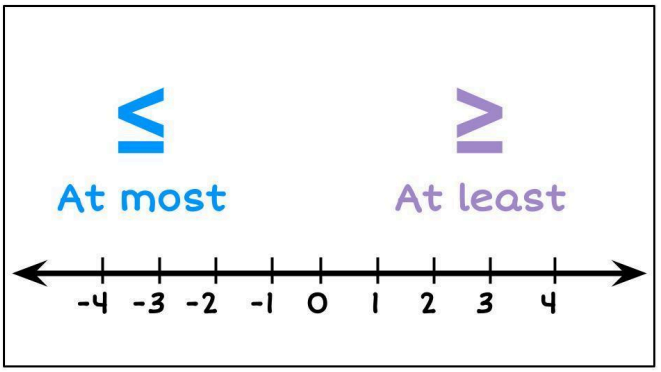


Independent

Events that do not affect or are not affected by another event.

Each coin toss is not affected by the previous coin toss.

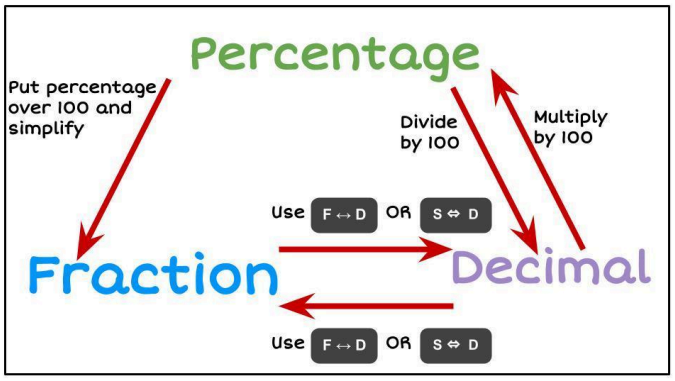


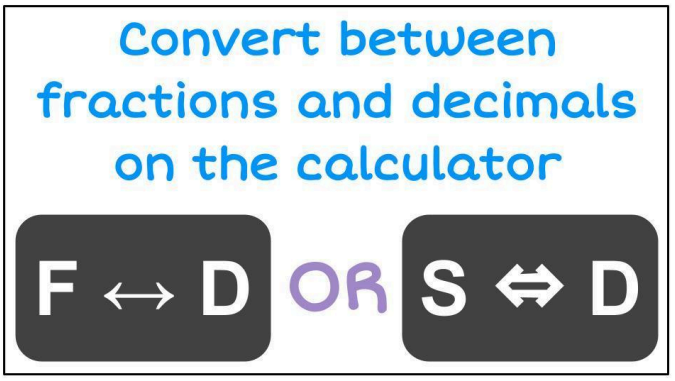


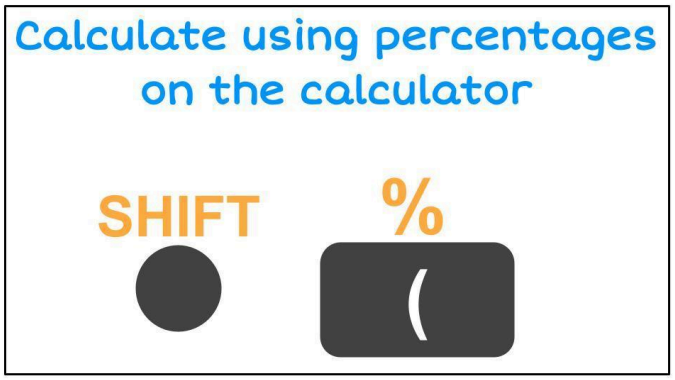
Probability is a measure of the chance of an event happening. Probabilities can also be called "proportions", or "chance".

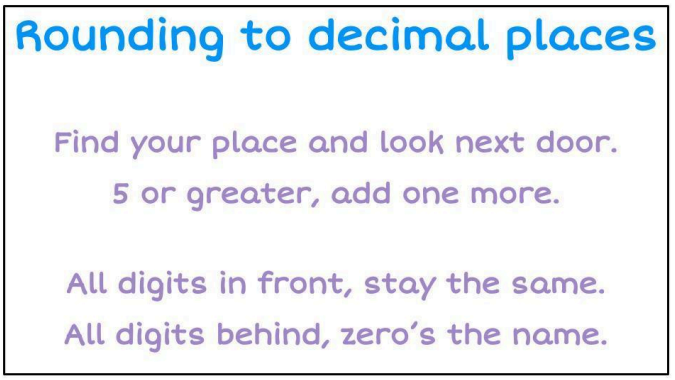
Sometimes the question will explicitly ask for a percentage, but if it just asks for a probability, then **ANY** of these forms is correct. Choose which form **YOU** prefer to use.

Here is a reminder about how to convert numbers between decimals, fractions and percentages. Know how to do this on whichever calculator you use. When rounding your answers, I suggest you round decimal answers to 4.d.p. and percentages to 2.d.p.









Example:

1) Rolling a die has the following outcomes: 1, 2, 3, 4, 5, or 6

The probability that the number 5 comes up when a die is rolled is:

$P(5\ on\ an\ die) = \frac{1}{6}$ *or* 0.1667 *or* 16.67%

2) A bag of marbles has 3 blue and 2 white marbles.

The probability that a blue marble is chosen randomly is:

$$P(blue) = \frac{3}{5} \quad or \quad 0.6 \quad or \quad 60\%$$

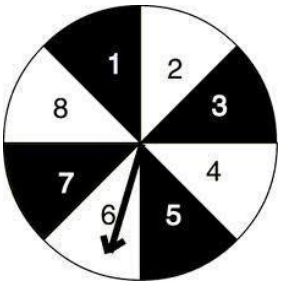
Theoretical Probability

A coin:

A coin has two sides, heads and tails.

A Spinner:

A spinner is a circle (usually) that has been divided up into any number of pieces.



A die (plural: dice):

A standard die has 6 sides, with the numbers 1 – 6 on each side. You can get die with 10, 12, or other numbers of sides.

Random number generator:

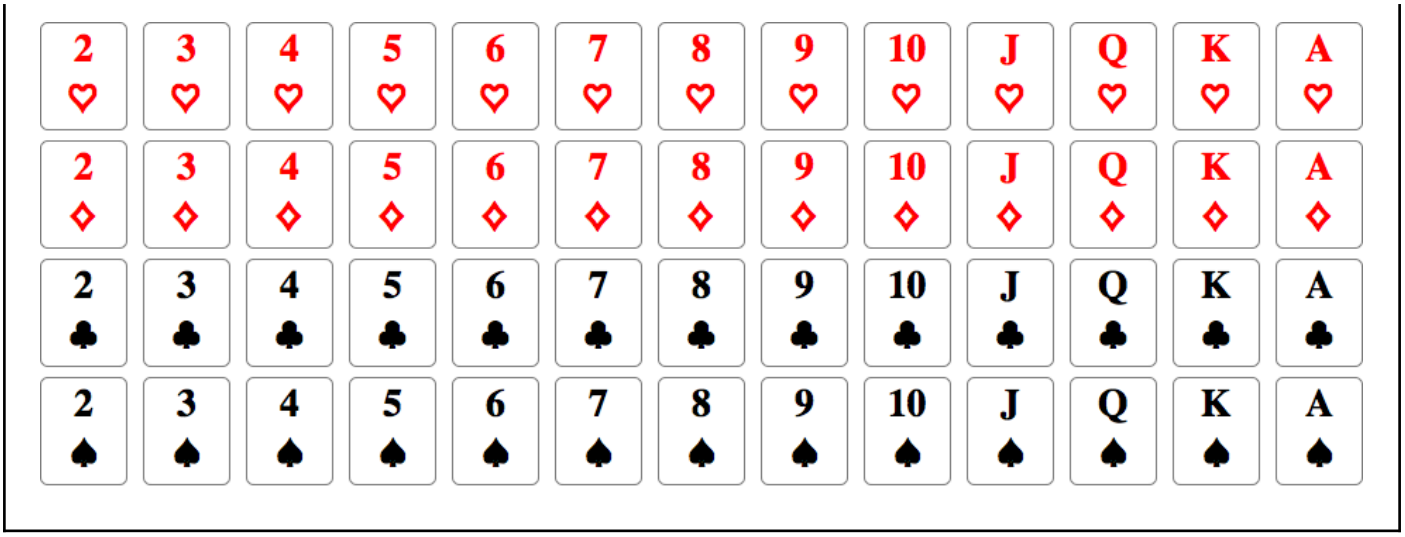
Your calculator has a random number generator, which can generate a random number between 0 and 1.

A pack of cards:

In a pack of cards there are 4 suites: Diamonds, Hearts, Clubs, Spades

Each suite has 13 cards:

Ace, King, Queen, Jack, 10, 9, 8, 7, 6, 5, 4, 3, 2



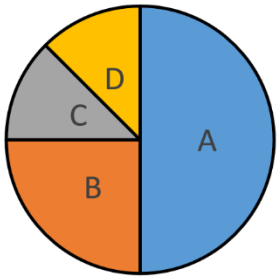
Example:

Write the sample space for the following:

1) A single dice

Sample space = 1, 2, 3, 4, 5, 6

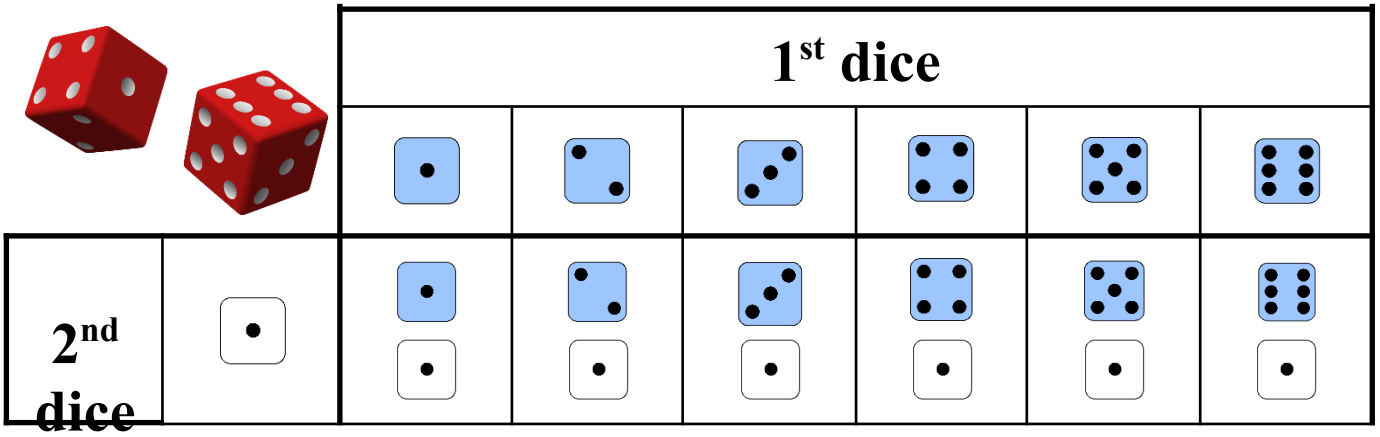
2) A spinner

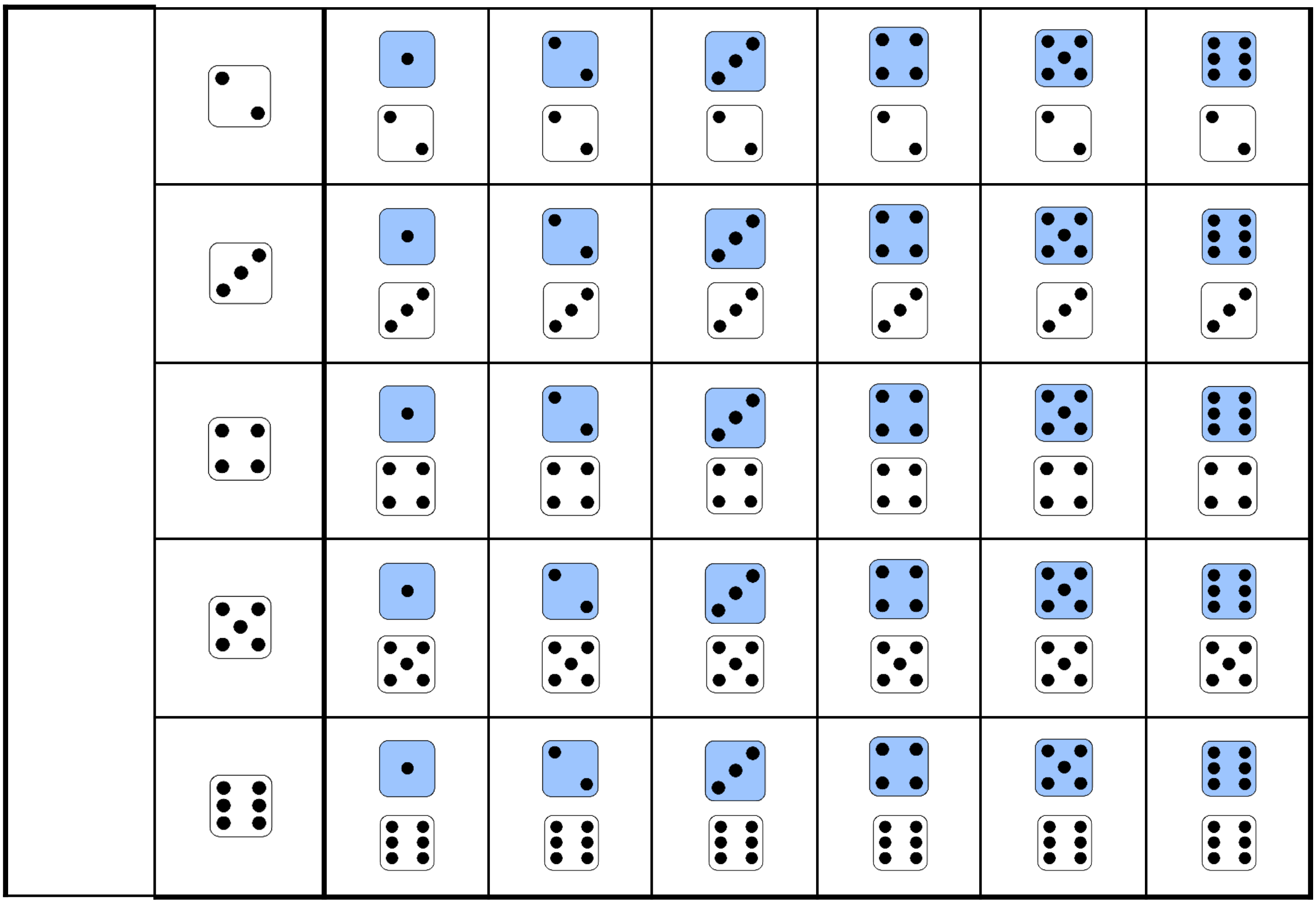


Sample space = A, B, C, D

3) Two dice

Sample space:

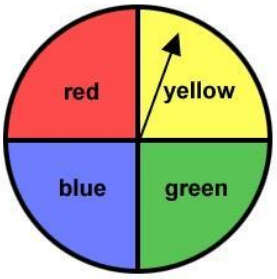




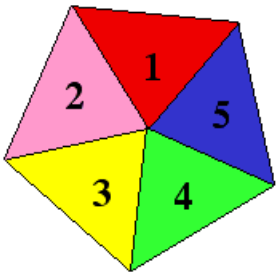
Exercise 1:

1) Write down the sample space for the following objects:

a)



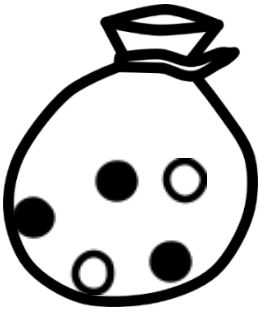
b)



c) A 20-sided dice

d) Lotto balls

e) A bag of black and white marbles



2) Write the sample space for each of the following.

a)	selecting a day of the week	
b)	selecting a month of the year	
c)	rolling a die once	
d)	tossing a coin once	
e)	choosing a letter from the alphabet	

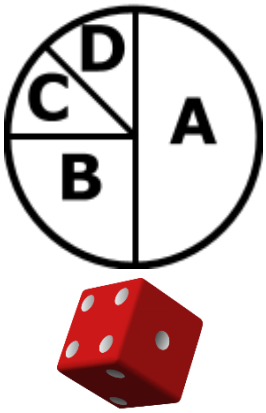
3) The letters of the word MATHEMATICS are written on cards and turned face down. A card is then selected at random.

a)	Write the sample space.	
b)	How many elements are in the sample space?	
c)	How many **different** elements are in the sample space?	

4) For each of the following, state whether **each element** of the sample space is **equally likely** to occur (circle your answer).

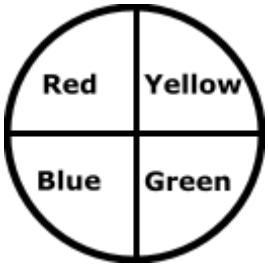
a)	tossing a coin	Equally likely / not equally likely
b)	rolling a die	Equally likely / not equally likely
c)	the result of a cricket game between two teams	Equally likely / not equally likely
d)	selecting a card from a normal pack of cards	Equally likely / not equally likely

5) Complete the table below for the sample space for a dice and a spinner.



		Dice					
		⚀	⚁	⚂	⚃	⚄	⚅
Spinner							

6) Complete the table below for the sample space for a dice and a spinner.



		Dice					
Spinner							

7) A card is chosen at random from a full pack of cards (see the diagram below).

a)	What is the probability that the card I select is a king?	
b)	What is the probability that the card I select is an Ace?	
c)	What is the probability that the card I select is a Diamond?	

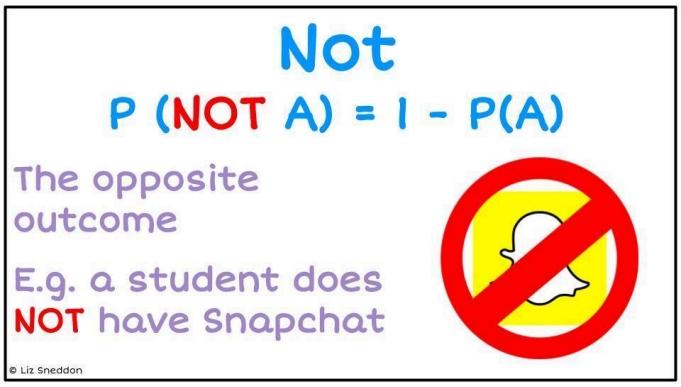
d)	What is the probability that the card I select is a Black card?	
e)	What is the probability that the card I select is a 5 (five)?	
f)	What is the probability that the card I select is the 8 of hearts?	

8) A bag contains 6 blue marbles, 10 orange marbles and 4 red marbles. If a marble is picked randomly, what is the probability of getting:

a)	A blue marble?	
b)	An orange marble?	
c)	A red marble?	

NOT probabilities

Let's take a moment to understand the terminology.



Example:

1)	The probability of having sunshine tomorrow is 75%. What is the chance that we do **NOT** have sunshine tomorrow?	$P(NOT\ sunshine) = 100\% - 75\%$ $= 25\%$

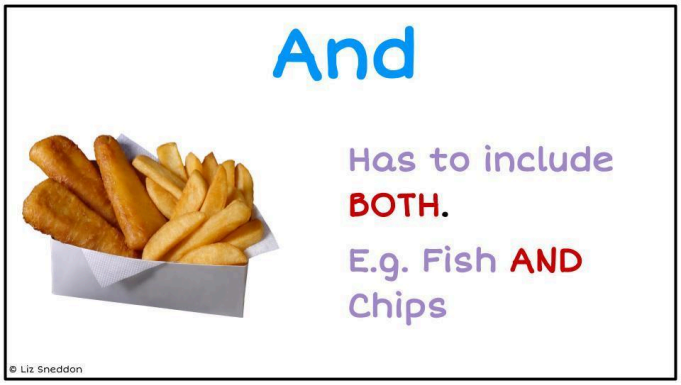
2)	The probability of being late to school is 0.2. What is the chance of **NOT** being late?	$P(NOT\ late) = 1 - 0.2$ $= 0.8$

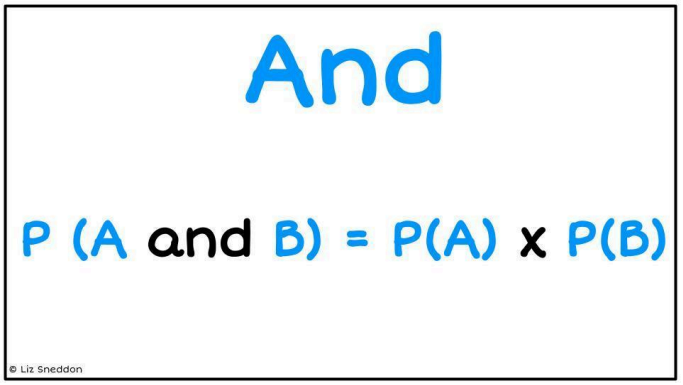
Exercise 2:

1)	What is the chance of tossing a coin and **NOT** getting a Head?	
2)	What is the probability of **NOT** getting a heart when you chose a card at random?	
3)	The chance of Mrs Sneddon having takeaways for dinner on Friday night is 34%. What is the chance that she does **NOT** have takeaways this coming Friday?	
4)	What is the chance of rolling a die and **NOT** getting a 3?	

AND probabilities

Let's take a moment to understand the terminology.





Remember to convert percentages into decimals or fractions before multiplying.

Example:

If a student has Instagram **AND** Snapchat, that means they have **BOTH** Apps.

Example:

1) The probability of having sunshine tomorrow is 75%. The probability that it is windy tomorrow is 20%. What is the chance that tomorrow is sunny **AND** windy?

$P(sunny\ AND\ windy) = P(sunny) \times P(windy)$

$= 75\% \times 20\%$

$= 0.75 \times 0.2$

$= 0.15$

$= 15\%$

2) The probability of being late to school is 0.2, and the chance of being late to class is 0.05. What is the chance of being late to school **AND** late to class?

$P(school\ AND\ class) = P(school) \times P(class)$

$= 0.2 \times 0.05$

$= 0.1$

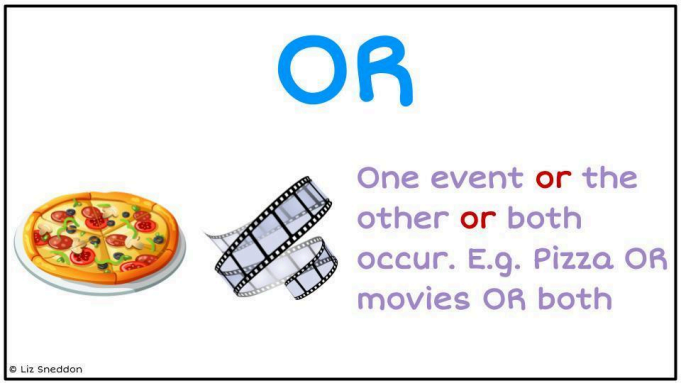
Exercise 3:

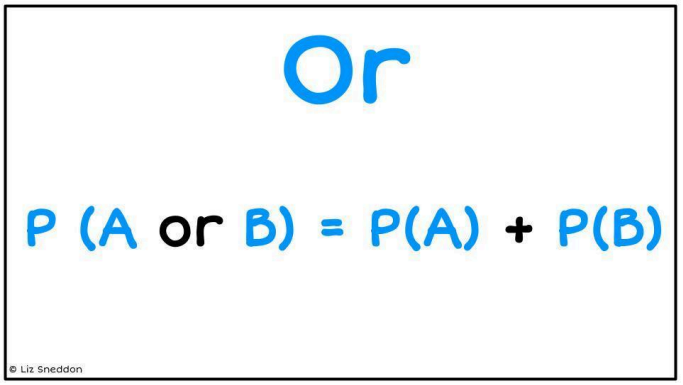
1)	What is the chance of tossing a coin twice and getting a head **AND** a Tail?	
2)	What is the chance of tossing a coin twice and getting **TWO** heads?	
3)	What is the probability of choosing two cards randomly (with replacement) and getting a Jack **AND** a heart?	

4)	Dr Sneddon has 2 pairs of shoes for work, a black pair and a brown pair. He has three pairs of work socks, one black, one blue and one red. Find the probability of him wearing brown shoes and red socks.	
5)	Seth, Anna and Zoe go to Kent's café and buy a drink each. They can choose from Coke, Sprite and L&P. It is equally likely as to which drink they buy. Find the probability that all 3 of them buying a Coke.	

OR probability

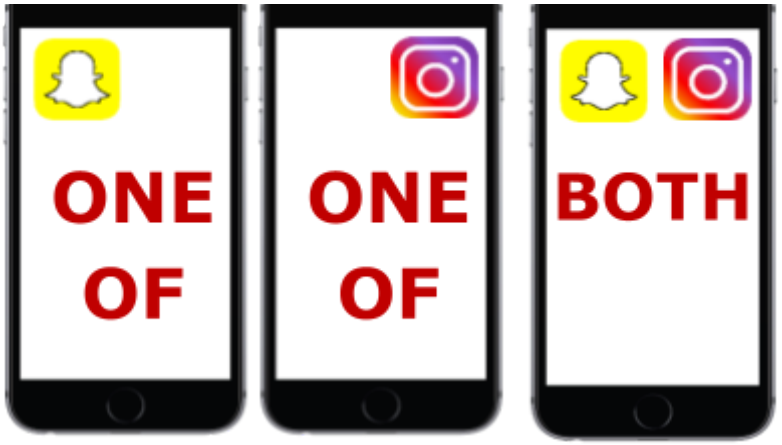
Let's take a moment to understand the terminology.





Example:

If a student has Instagram **OR** Snapchat, that means they have **ONE OR BOTH** of the Apps.



Example:

1) The probability of having sunshine tomorrow is 75%. The probability that it is windy tomorrow is 20%. What is the chance that tomorrow is sunny **OR** windy?

$$P(sunny\ OR\ windy) = P(sunny) + P(windy)$$
$$= 75\% + 20\%$$
$$= 90\%$$

2) The probability of being late to school is 0.2, and the chance of being late to class is 0.05. What is the chance of being late to school **OR** late to class?

$$P(school\ OR\ class) = P(school) + P(class)$$
$$= 0.2 + 0.05$$
$$= 0.25$$

Exercise 4:

1)	What is the chance of tossing a coin twice and getting a head **OR** a Tail?	
2)	What is the probability of choosing two cards randomly (with replacement) and getting a Jack **OR** a heart?	
3)	Dr Sneddon has 2 pairs of shoes for work, a black pair and a brown pair. He has three pairs of work socks, one black, one blue and one red. Find the probability of him wearing brown shoes **OR** red socks.	

4)	What is the probability that a card randomly removed from a pack is a heart **OR** a spade?	
5)	A bag contains 5 red marbles, 3 blue marbles, and 2 green marbles. What is the probability a red **OR** blue marble is drawn?	

Mixed Exercise 1:

1) A bag contains 5 red, 3 blue and 2 white balls. If a ball is drawn at random, find the probability that it is:

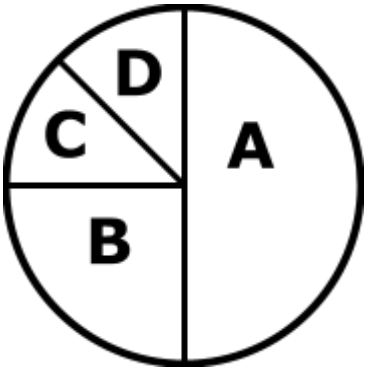
a)	P(blue) =
b)	P(red) =
c)	P(not red) =
d)	P(blue or red) =
e)	P(blue and red) =
f)	P(red and white) =
g)	P(red or white) =

h) P(blue or white) =

i) P(red and blue and white) =

j) P(red and blue or white) =

2) The spinner is spun once. Find the probability that:



a) P(A) =

b) P(B) =

c) P(C) =

d) P(D) =

e) P(A or B) =

f) P(A and B) =

g)	P(B and C) =
h)	P(A or D) =
i)	P(A and B and C) =
j)	P(A or B or C) =
k)	P(A and B or C) =

3) A number is chosen at random from 1 to 10. Find the probability that the number is:

a)	P(4) =
b)	P(even) =
c)	P(1 or 2) =
d)	P(not 5) =
e)	P(more than 7) =
f)	P(2 or 5) =

g)	P(1, 3, or 5) =
h)	P(at most 2) =
i)	P(at least 4) =
j)	P(less than 3) =
k)	P(more than 2) =

4) From the letters of the word '**PROBABILITY**', one letter is selected at random. What is the probability that the letter is:

a)	P(a vowel) =
b)	P(the letter P) =
c)	P(the letter P or B) =
d)	P(the letter M) =

5) A card is drawn at random from a normal pack of 52 cards.

Find the probability that the card is:

a)	P(a diamond) =
b)	P(a red card) =
c)	P(a king) =
d)	P(not a club) =
e)	P(a red ace) =
f)	P(a 5 of clubs) =
g)	P(an 8) =
h)	P(Jack, Queen or King) =
i)	P(less than 4) =
j)	P(not a 5) =
k)	P(not a red 3) =

Expected value

Let's take a moment to understand the terminology.

Expected value

Estimating the population mean based on sample data or theoretical probabilities.

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Expected value

$$E(X) = P(X) \times n$$

E(X) is the expected value

P(X) is the probability from the sample data or theoretical probability

n is the population size

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Expected value

When you get your answer, if the variable is discrete, round to a whole number.

E.g. number of people should be a whole number.

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Remember to convert percentages into decimals or fractions before multiplying.

Example:

1) In the last month 60% of days were sunny. There are 365 days in a year, how many sunny days do we **EXPECT** next year?

$E(sunny) = P(sunny) \times n$

$= 60\% \times 365$

$= 0.6 \times 365$

$= 219$ days

2) In Term 1, busses were late 6% of the time. Term 2 has 10 weeks, how many days should the school **EXPECT** busses to be late?

$E(late) = P(late) \times n$

$= 0.2 \times 10\ weeks \times 5\ days\ per\ week$

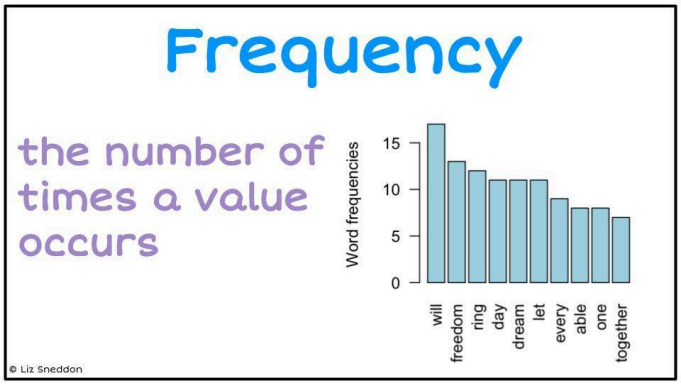
$= 10\ days$

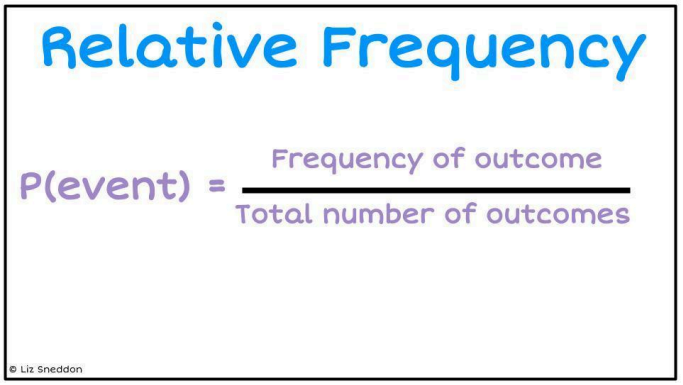
Exercise 5:

1)	If I toss a coin 100 times, how many should I **EXPECT** to be Tails?	
2)	If I randomly choose a card from a full deck 40 times with replacement, how many times should I **EXPECT** to get diamond?	
3)	When Mrs Sneddon ordered pizza for her tutor group in Term one, 6 of the 14 pizzas were Pepperoni. Next term she is sharing her classroom with a second tutor group, with a total of 28 boys. How many Pepperoni pizzas should she **EXPECT** to order?	
4)	Dr Sneddon likes coffee, and the chance that he has a coffee in a break is 1 out of 5. Teachers get a break before school, at morning tea and a lunch break each day. How many coffee's does he **EXPECT** to have each week?	
5)	Teachers have to do duty twice in our seven-day timetable. If the term has 10 weeks, how many times should a teacher **EXPECT** to have duty each term?	

Probabilities from Data in Tables

When we collect data we can display this in a table and calculate probabilities from this data.





Example:

A Year 9 student collected information about how many pets they have. The information is in the table below.

Number of pets	Frequency
0	7
1	6
2	14
3	9
4	5
5	4
6	1
Total	

a)	Work out the total frequency in the table above (which is the total number of students who were surveyed).	46
b)	What is the probability that a randomly selected student has no pets?	$\frac{7}{46}$
c)	What is the chance that a randomly chosen student has 2 pets?	$\frac{14}{46} = \frac{7}{23}$
d)	What is the probability that a randomly selected student has 4 or more pets?	$\frac{5+4+1}{46} = \frac{10}{46} = \frac{5}{23}$

e)	What percentage of students have less than 2 pets?	$\frac{7+6}{46} = \frac{13}{46} = 28.26\%$

Exercise 6:

1) Students were asked how many burgers that had eaten in the last week. Here are the results.

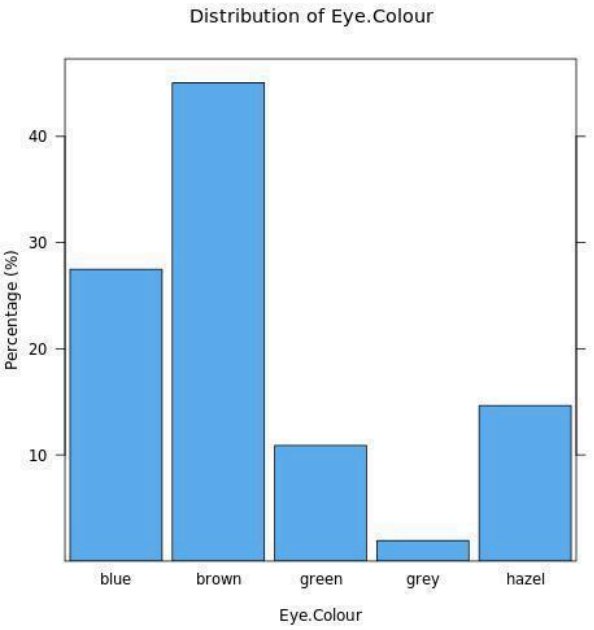
Number of burgers	Frequency
0	15
1	23
2	28
3	19
4	15
5	10
6	3
Total	

a)	Work out the total frequency.	
b)	What is the probability that a student had 4 burgers last week?	
c)	What is the probability that a student did not eat any burgers last week?	
d)	What is the probability that a student had at least 5 burgers last week?	
e)	What is the probability that a student had less than 3 burgers last week?	
f)	What is the probability that a student had 2 or 3 burgers last week?	

g)	SKC has around 2200 students, how many of these would you expect to have had 6 burgers last week?	

2) A survey was done on students in NZ and data on their eye colour was collected.[1] Here are the results.

Apps	Frequency
Blue	54
Brown	90
Green	22
Grey	5
Hazel	29
Total	200



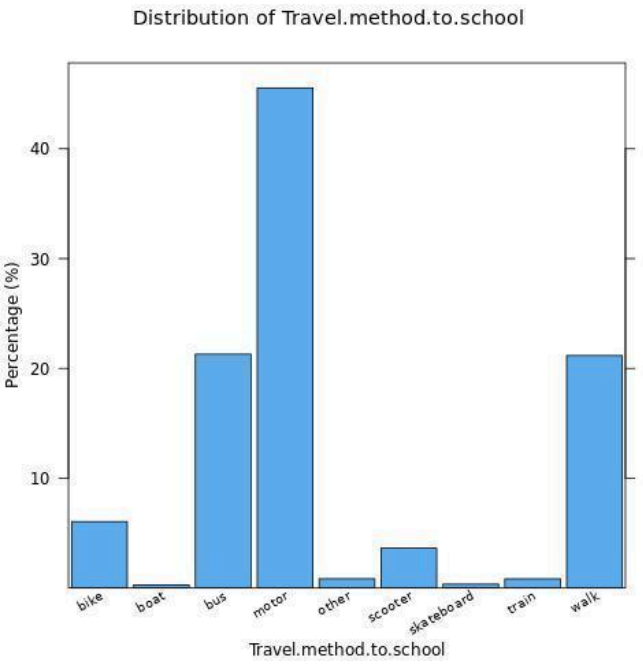
a)	What is the probability that a student has Blue eyes?	
b)	What is the probability that a student has Grey eyes?	
c)	What is the probability that a student has Brown or Hazel eyes?	
d)	What is the probability that a student doesn't have Green eyes?	

[1] Data from Census At School NZ 2021 Survey

e)	What is the probability that two students both have Blue eyes?	
f)	SKC has around 2200 students, how many of these would you expect to have Grey eyes?	

3) A survey was done on students in NZ and data on how they get to school in the morning was collected.[2] Here are the results.

Travel method	Frequency
Bike	18
Boat	1
Bus	64
Motorcar	137
Scooter	11
Skateboard	1
Train	3
Walk	63
Other	2
Total	300



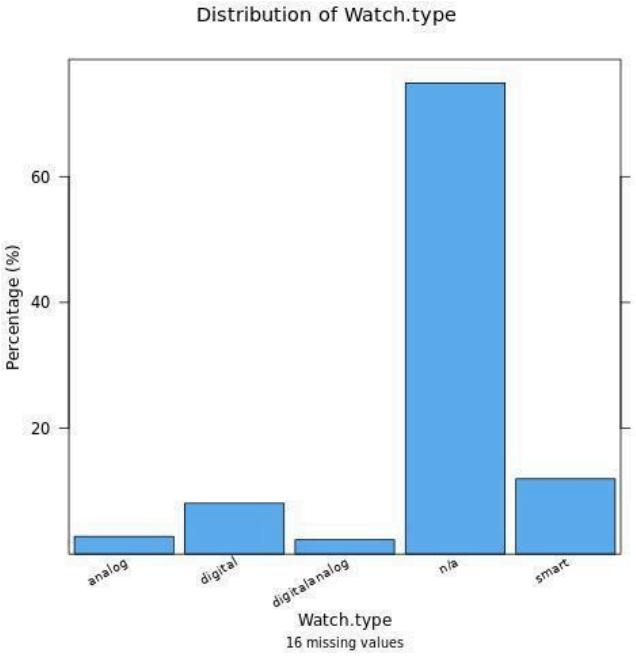
a)	What is the probability that a student came to school on the train?	

[2] Data from Census At School NZ 2021 Survey

b)	What is the probability that a student came to school on a boat?	
c)	What is the probability that a student came to school on a bus or train?	
d)	What is the probability that a student did not walk to school?	
e)	SKC has around 2200 students, how many of these would you expect came to school by car, based on this data?	

4) A survey was done on students in NZ and data on what type of watch students have was collected.[3] Here are the results.

Watch type	Count
Analog	3
Digital	8
Analog and Digital	2
Smart	12
Doesn't have a watch	75
Total	100



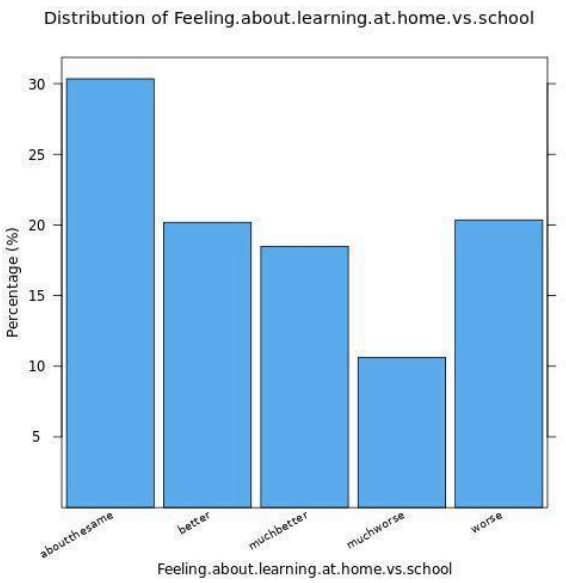
a)	What is the probability that a student doesn't have a watch?	

[3] Data from Census At School NZ 2021 Survey

b)	What is the probability that a student has a smart watch?	
c)	What is the probability that a student has some kind of digital watch?	
d)	What is the probability that two students chosen at random both have a smart watch?	
e)	SKC has around 2200 students, how many of these would you expect to have any type of watch?	

5) A survey was done on students in NZ and data on students' opinions about how they feel about learning at home versus learning at school was.[4] Here are the results.

Opinion	Count
Much worse	27
Worse	51
About the same	76
Better	50
Much Better	46
Total	250



[4] Data from Census At School NZ 2021 Survey

a)	What is the probability that a student feels about the same?	
b)	What is the probability that a student feels worse or much worse?	
c)	What is the probability that a student doesn't feel better?	
d)	What is the probability that three students' chosen randomly feel much better?	
f)	SKC has around 2200 students, how many of these would you expect to prefer learning at home?	

Two-way tables

When we collect categorical data, we can display this in a table format. When we have two categorical variables such as gender and ethnicity, we can display this as a two-way table.

Example:

	Categorical variable 1		
	B	**Not B**	**Total**

Categorical variable 2	**A**			
	Not A			
	Total			

Notice that we always need a column at the end for a total, and a row at the bottom for the total. If you get a table that doesn't have the totals, your first step is to make these.

Example:

If the two categorical variables are Gender and Ethnicity, then this is how the two-way table might look:

		Ethnicity					
		Maori	**Pasifika**	**Pakeha**	**Asian**	**Other**	**Total**
Gender	**Male**						
	Female						
	Other						
	Total						

We need to make sure that the sample space (all outcomes) for each variable is displayed on the table. This is why we have the "Other" categories for both Gender and Ethnicity.

Exercise 7:

1) If the two categorical variables are Gender and whether you like Statistics (Yes/No), complete the two-way table below:

		Gender			
					Total
Like Statistics?					

	Total				

2) If the two categorical variables are Year level at high school and whether you are right or left-handed, complete the two-way table below:

		Year level					
							Total
Handedness							
	Total						

Putting data into two-way tables

Once we have the table setup, the next step is to enter the data into the tables. Remember the total column and the total row, this is where you will put the sizes of each group.

The inside boxes are the combinations of the groups (the **AND** probabilities)

Example:

The cells that are shaded are the totals, and the white cells in the middle are the combination categories (AND probabilities).

Step 1: Here is the same table, but I have now filled in the total numbers of each gender and ethnicity.

		Ethnicity					
		Maori	Pasifika	Pakeha	Asian	Other	Total
Gender	Male						243
	Female						251
	Other						6
	Total	85	40	300	70	5	500

For example, there are 251 females from this sample of 500 people.

Step 2: Here is the same table, but I have now filled in the combinations of gender and ethnicity.

		Ethnicity					
		Maori	Pasifika	Pakeha	Asian	Other	Total
Gender	Male	38	18	152	33	2	243
	Female	46	21	145	36	3	251
	Other	1	1	3	1	0	6
	Total	85	40	300	70	5	500

For example, there are 46 Maori females in this sample of 500 people.

Exercise 8:

Answer the questions below about the table shown here.

		Ethnicity					
		Maori	**Pasifika**	**Pakeha**	**Asian**	**Other**	**Total**
Gender	**Male**	38	18	152	33	2	243
	Female	46	21	145	36	3	251
	Other	1	1	3	1	0	6
	Total	85	40	300	70	5	500

a)	How many people of Asian ethnicity were in this sample?	
b)	How many Pasifika males were in this sample?	
c)	How many people identified their gender as other?	
d)	How many males are there in this sample?	
e)	How many people were sampled in total?	
f)	What percentage of people were Maori?	
g)	What percentage of people were females?	

h)	What percentage of people were Asian males?	

2) Dr Sneddon did a survey of the Year 9 and Year 10 students and collected the following information.

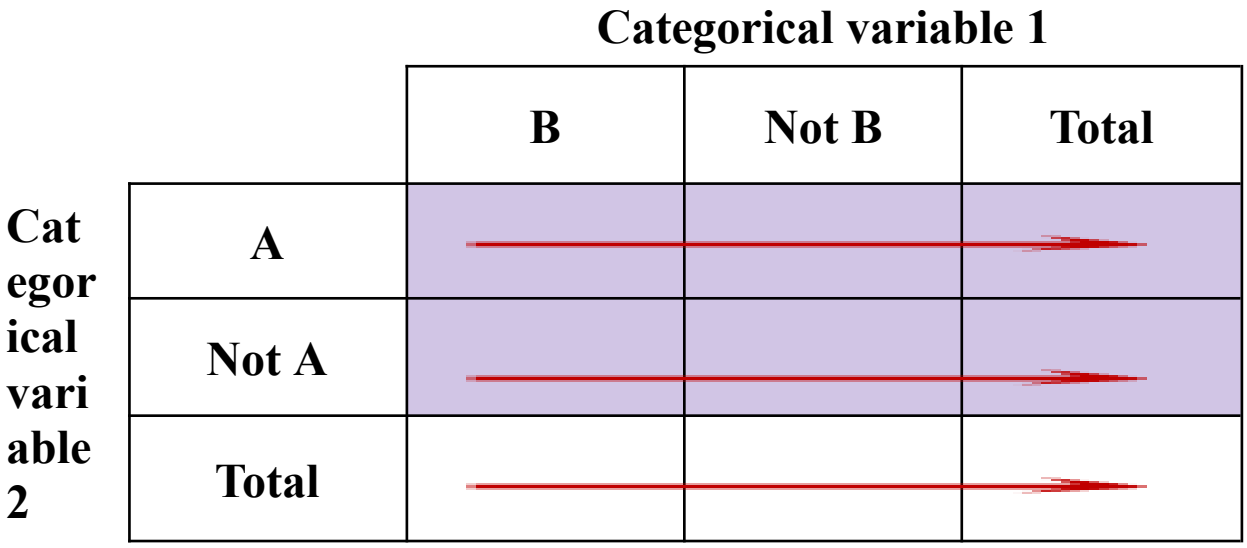
	Right-handed	Left-handed
Girls	188	32
Boys	203	37

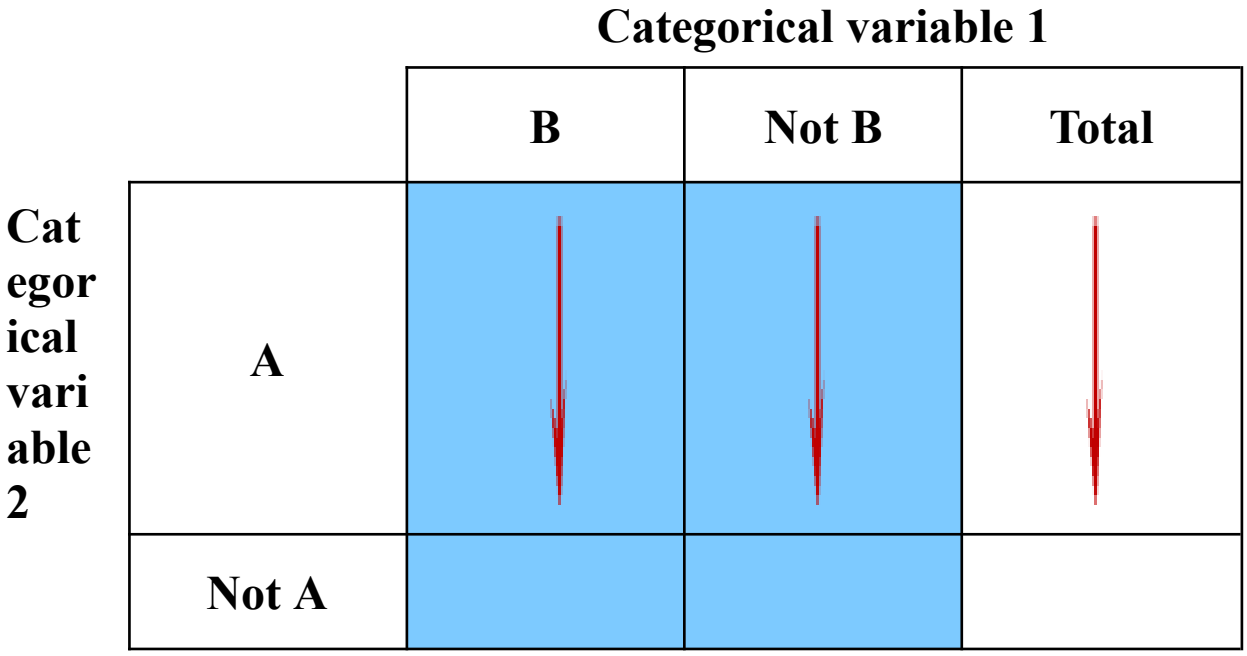
a)	What two questions do you think she asked?	
b)	What would the categorical variables be?	
c)	How many students are there in total?	
d)	How many students in Year 9 and 10 are left-handed?	
e)	How many boys are there?	

f)	What percentage of students are left-handed?	
g)	What percentage of students are girls who are left-handed?	

Rows and Columns

Each row adds up to its total, and each column adds up to its total. We can use this to help fill in the table if we haven't been given all the information.





Total			

Example:

Fill in the table below, using the information that is given.

Mrs Sneddon carried out a survey of her class with 22 students. There were 13 males and 2 students were left-handed. Of the males, one was left-handed.

		Handedness		
		Left	Right	Total
Gender	Male	1		13
	Female			
	Total	2		22

Once you have the information in the table, you can work out the empty cells by remembering that all rows add up and all columns add up.

		Handedness		
		Left	Right	Total
Gender	Male	1	12	13
	Female	1	8	9
	Total	2	20	22

Exercise 9:

1) Dr Sneddon did a survey of students and collected the following information. Complete the table below.

	Left-handed	Right-handed	Total
Girls	188	32	
Boys	203	37	
Total			

2) Mrs Sneddon did a survey of 100 of her students and found that of the 52 male students, 42 preferred dogs and the others preferred cats. There were 49 students who preferred cats. Complete the table below.

	Dog	Cat	Total
Males			
Females			
Total			

3) A survey was done asking people about whether they preferred their pizza to have a thick crust or thin crust. The pizza company also collected data on what children and adults preferred. They found that from the 120 people surveyed that 60 preferred thin crust. Of the 90 adults, 54 preferred thin crust. Complete the table below.

Two-way tables – putting it together

Once you have constructed the table, then we can extract information to find probabilities and expected values.

Remember that the inside cells are the combinations (the **AND** probabilities).

Example:

Mrs Sneddon carried out a survey of her class, here are the results.

	Left	Right	Total
Male	1	12	13
Female	1	8	9
Total	2	20	22

a)	What is the probability that a student chosen at random is left-handed?	$\frac{2}{22} = \frac{1}{11}$
b)	What is the probability that a student chosen at random is male?	$\frac{13}{22}$
c)	What is the probability that a student chosen at random is a female who is right-handed?	$\frac{8}{22}$
d)	What is the probability that a student chosen at random is a left-handed male?	$\frac{1}{22}$

e)	What is the probability that a student chosen at random is not a left-handed female?	$\frac{1+12+8}{22} = \frac{21}{22}$

Example:

Here are the results of a survey of New Zealanders:

	Maori	Pasifika	Pakeha	Asian	Other	Total
Male	38	18	152	33	2	243
Female	46	21	145	36	3	251
Other	1	1	3	1	0	6
Total	85	40	300	70	5	500

a)	What is the probability that a New Zealander chosen at random is Pakeha?	$\frac{300}{500} = \frac{3}{5}$
b)	What is the probability that a New Zealander chosen at random identifies their gender as “other”?	$\frac{6}{500} = \frac{3}{250}$
c)	What is the probability that a New Zealander chosen at random is a Maori Male?	$\frac{38}{500} = \frac{19}{250}$
d)	What is the probability that a New Zealander chosen at random is Maori or Pasifika ethnicity?	$\frac{85+40}{500} = \frac{125}{500} = \frac{1}{4}$

e)	What is the probability that a New Zealander chosen at random is not Female?	$\frac{500-251}{500} = \frac{249}{500}$
f)	What is the probability that a New Zealander chosen at random is a female who is Maori or Pakeha?	$\frac{46+145}{500} = \frac{191}{500}$

Exercise 10:

1) Students collected information about their favourite sport to watch on television, and what their gender is.

	Soccer	Basketball	Rugby	Total
Male	15	22	40	77
Female	12	16	45	63
Total	27	38	85	140

a)	What is the probability that a student chosen at random prefers Soccer?	
b)	What is the probability that a student chosen at random is Female?	
c)	What is the probability that a student chosen at random is a male who prefers Basketball?	
d)	What is the probability that a student chosen at random prefers Rugby or Soccer?	
e)	What is the probability that a student chosen at random does not like Soccer?	

f)	What is the probability that a student chosen at random is a male who likes soccer or basketball?	
g)	If there are 2200 students at our school, how many do you expect to like Rugby?	

2) Data was collected on what type of TV show people preferred to watch.

	Dance	Sports	Movies	Total
Women	16	6	8	30
Men	2	10	8	20
Total	18	16	16	50

a)	What is the probability that a person chosen at random likes to watch Sports?	
b)	What is the probability that a person chosen at random is a man?	
c)	What is the probability that a person chosen at random is a woman who likes to watch dancing?	
d)	What is the probability that a person chosen at random likes to watch sports or movies?	
e)	What is the probability that a person chosen at random is a woman that likes to watch dance or a movie?	

f)	What is the probability that a person chosen at random is not a man who likes to watch sports?	
g)	If there are 2200 students at our school, how many do you expect to prefer to watch movies?	

3) A survey was done on students about whether they eat breakfast or not and their age group.

	Eat breakfast	Skip breakfast	Total
Age 10 – 13	40	14	
Age 14 - 17	12	24	
Total			

a)	What is the probability that a student chosen at random eats breakfast?	
b)	What is the probability that a student chosen at random is aged 10-13?	
c)	What is the probability that a student chosen at random is aged 14-17 and skips breakfast?	
d)	What is the probability that a student chosen at random is aged 14-17 and eats breakfast or is aged 10-13 and skips breakfast?	
e)	What is the probability that two students chosen (with replacement) at random both skip breakfast?	

f)	What is the probability that a student chosen at random is not aged 14-17?	
g)	If there are 2200 students at our school, how many do you expect to skip breakfast each morning?	

4) A survey was done looking at how many drinks (Tea, coffee or water) were consumed each weekday (Monday – Friday) for staff at school during the term.

	Monday	Tuesday	Wednesday	Thursday	Friday	Total
Tea	34		28	36	41	
Coffee		32	38	24		167
Water	33	34	35		34	181
Total	109	101		105	106	522

a)	What is the probability that a randomly chosen staff member had tea during the week?	
b)	What is the probability that a randomly chosen staff member had coffee on Thursday?	
c)	What is the probability that a randomly chosen staff member had water during the middle of the week (Tuesday to Thursday)?	
d)	What is the probability that a randomly chosen staff member had tea or coffee during the whole week?	

e)	What is the probability that a randomly chosen staff member did not have a drink of water?	
f)	What is the probability that a randomly chosen staff member had coffee on Monday or Friday?	
g)	If there are 200 staff at our school, how many do you expect to be drinking coffee during the week?	

5) A survey was carried out exploring preferred flavours of ice-cream.

	Chocolate	Vanilla	Neither	Total
Children	40		15	77
Teens		16		
Adults	55		10	119
Total	107		70	269

a)	What is the probability that a person chosen at random prefers vanilla ice-cream?	
b)	What is the probability that a person chosen at random is a teenager?	
c)	What is the probability that a person chosen at random is a teenager who doesn't like either flavour?	
d)	What is the probability that a person chosen at random is an adult who prefers chocolate ice-cream?	

e)	What is the probability that a person chosen at random either likes vanilla or chocolate ice-cream?	
f)	What is the probability that a person chosen at random is either a child who likes chocolate ice-cream or a teenager who likes chocolate ice-cream?	
g)	In the local community there are 12,000 people. How many do you expect to prefer vanilla ice-cream?	

6) Data was collected about whether students played sports (or not) and whether they drank soft drinks (or not). There were a total of 43 people who said they played sports, and from these 19 drank soft drinks. There were 33 people who did not play sport but did drink soft drinks, and 22 people who did not play sports and did not drink soft drinks.

			Total
Total			

a)	Complete the table above.	
b)	What is the probability that a person chosen at random drinks soft drinks?	

c)	What is the probability that a person chosen at random plays sports?	
d)	What is the probability that a person chosen at random plays sports but does not drink soft drinks?	
e)	What is the probability that a person chosen at random does not play sport and does not drink soft drinks?	
f)	What is the probability that two people chosen (with replacement) at random both play sports and drink soft drinks?	
g)	If there are 2200 students at our school, how many do you expect to not play sports and not drink soft drinks?	

7) A group of Aucklanders were surveyed, asking whether they preferred McDonald's, Burger King or Wendy's. Their gender was also recorded. From the 40 people who preferred McDonalds, they were evenly split between males and females. From the 45 males in the survey, 10 preferred Wendy's. From the 100 people in the survey, 25 preferred Burger King.

				Total
Total				

a)	Complete the table above.	
b)	What is the probability that a person chosen at random prefers Wendy's?	

c)	What is the probability that a person chosen at random is a female who prefers McDonalds?	
d)	What is the probability that a person chosen at random is a male who prefers Burger King?	
e)	What is the probability that a person chosen at random is a male who either prefers McDonalds or Burger King?	
f)	What is the probability that a person chosen at random doesn't prefer Burger King?	
g)	What is the probability that two people chosen (with replacement) at random both prefer Wendy's?	
h)	If there are 2200 students at our school, how many do you expect to be females who prefer Wendy's?	

8) 42 Year Nine and Ten students were surveyed about how they get to school. Of the 24 who were in Year Nine, 10 came by car, 8 came by bus, and the rest walked to school. From the Year 10 students, 7 caught the bus, 5 walked, and the rest came in a car. There were 16 students altogether who came by car.

				Total
Total				

a)	Complete the table above.	
b)	What is the probability that a student chosen at random came by bus?	

c)	What is the probability that a student chosen at random was in Year 10 and came by car?	
d)	What is the probability that a student chosen at random was Year Nine and walked to school?	
e)	What is the probability that a student chosen at random either came by car or bus?	
f)	What is the probability that a student chosen at random did not come by car?	
g)	What is the probability that two students chosen (with replacement) at random were both Year 10's who came on the bus?	
h)	If there are 2200 students at our school, how many do you expect to be Year Nine's who walked to school?	

Conditional probability (Extension)

There is one final type of probability that we need to cover, conditional probabilities.

A conditional probability is when you want to focus on a **part** of the data. For example, if I have data on the results of all students at SKC, I might want to focus just on the girls, and find the percentage of who pass Statistics, **GIVEN** that they are a girl.

Conditional probability

An event that consists of the occurrence of one event based on the knowledge that another event has already occurred.

E.g. Given that you missed the school bus, what is the chance you are late to school?

$$P(A \mid B) =$$

"The probability of A GIVEN B is ...:"

where B is the known condition.

$$P(A \mid B) = \frac{P(AB)}{P(B)}$$

	A		
B			

Example:

Mrs Sneddon carried out a survey of her class, here are the results.

	Left	Right	Total
Male	1	12	13
Female	1	8	9
Total	2	20	22

Question:

Given that a female was chosen randomly, what is the chance that she is right-handed?

Step 1: The word **given** tells us the **condition: Female**.

Now we want to highlight and focus only on the row with females in it.

	Left	Right	Total
Male	1	12	13
Female	1	8	9
Total	2	20	22

This group total (9) is the denominator in your probability.

Step 2: Now find the combination of **Female** and **Right-handed**.

	Left	Right	Total
Male	1	12	13
Female	1	8	9
Total	2	20	22

This combination (8) is the numerator in your probability.

Step 3: Find the probability of **Right-handed given Female**.

$$P(Right\ -\ handed\ |\ Female) = \frac{P(Right-handed\ \&\ Female)}{P(Female)}$$

$$= \frac{8}{9}$$

Example:

Here are the results of a survey of New Zealanders:

	Maori	Pasifika	Pakeha	Asian	Other	Total
Male	38	18	152	33	2	243
Female	46	21	145	36	3	251
Other	1	1	3	1	0	6
Total	85	40	300	70	5	500

Question: **Given** that a person of **Pasifika** ethnicity was chosen randomly, what is the chance that the person is a **male**?

Step 1: The word given tells us the **condition: Pasifika**.

Now we want to focus only on the column with **Pasifika** in it.

	Maori	Pasifika	Pakeha	Asian	Other	Total
Male	38	18	152	33	2	243
Female	46	21	145	36	3	251
Other	1	1	3	1	0	6
Total	85	40	300	70	5	500

Step 2: Now find the combination of **Pasifika** and **Male**.

	Maori	Pasifika	Pakeha	Asian	Other	Total
Male	38	18	152	33	2	243
Female	46	21	145	36	3	251
Other	1	1	3	1	0	6
Total	85	40	300	70	5	500

Step 3: Find the probability of **Pasifika given Male**.

$$P(Male \mid Pasifika) = \frac{P(Pasifika \ \& \ Male)}{P(Pasifika)}$$

$$= \frac{18}{40}$$

$= \frac{9}{20}$

Exercise 11:

1) Students collected information about their favourite sport to watch on television, and what their gender is.

	Soccer	Basketball	Rugby	Total
Male	15	22	40	77
Female	12	16	45	63
Total	27	38	85	140

a)	Given that a person likes Basketball, what is the probability that they are male?	
b)	For a randomly selected Female, what is the probability that they prefer to watch Soccer?	
c)	What is the chance that a randomly selected male likes rugby?	
d)	From students who prefer Rugby, what percentage are male?	

e)	What is the chance that a randomly selected person is female, given they prefer Soccer?	

2) Data was collected on what type of TV show people preferred to watch.

	Dance	Sports	Movies	Total
Women	16	6	8	30
Men	2	10	8	20
Total	18	16	16	50

a)	For a randomly selected man, what is the chance that they prefer to watch sports?	
b)	Given that a person prefers to watch sports, what is the probability that they are a man?	
c)	What is the probability that a randomly chosen women prefers to watch Movies?	

d)	What is the probability that a randomly chosen person is female, given they prefer to watch dance?	
e)	For people who prefer to watch movies, what is the probability that they are male?	

3) A survey was done on students about whether they eat breakfast or not and their age group.

	Eat breakfast	**Skip breakfast**	**Total**
Age 10 – 13	40	14	
Age 14 - 17	12	24	
Total			

a)	What is the probability that a randomly chosen student who skips breakfast is aged between 14 and 17?	
b)	For a randomly selected student aged between 10 and 13, what is the chance that they eat breakfast?	

c)	Given that a student eats breakfast, what is the probability that they are aged between 10 and 13?	
d)	What is the probability that a randomly chosen student skips breakfast, given they are aged between 14 and 17?	
e)	For students who skip breakfast, what is the probability of them being between 14 to 17?	

4) A survey was done looking at how many drinks (Tea, coffee or water) were consumed each weekday (Monday – Friday) for staff at school during the term.

	Monday	Tuesday	Wednesday	Thursday	Friday	Total
Tea	34		28	36	41	
Coffee		32	38	24		167
Water	33	34	35		34	181
Total	109	101		105	106	522

a)	Given that a staff member drinks tea, what is the probability that they drank on Thursday?	

b)	What is the probability that a randomly chosen coffee drinker had a drink on Friday?	
c)	On a Monday, what is the chance that a randomly selected staff member drinks water?	
d)	For staff who drank on Tuesday, what is the probability of them drinking tea?	
e)	What is the probability that it is Thursday, given that a staff member is drinking water?	

5) A survey was carried out exploring preferred flavours of ice-cream.

	Chocolate	**Vanilla**	**Neither**	**Total**
Children	40		15	77
Teens		16		
Adults	55		10	119
Total	107		70	269

a)	Given that a person prefers Chocolate, what is the probability that they are a child?	
b)	What is the probability that a randomly chosen teenager prefers chocolate?	
c)	What is the probability that a randomly chosen person is an adult, given that they prefer vanilla?	
d)	For those people who don't like either chocolate or vanilla, what is the probability of them being an adult?	
e)	For a randomly selected child, what is the chance that they don't like chocolate?	

ANSWERS

Exercise 1:

1)

a) yellow, green, blue, red

b) 1, 2, 3, 4, 5

c) 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20

d) 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31, 32, 33, 34, 35, 36, 37, 38, 39, 40

e) black ball 1, black ball 2, black ball 3, white ball, 1, white ball 2

2)

a) Monday, Tuesday, Wednesday, Thursday, Friday, Saturday, Sunday

b) January, February, March, April, May, June, July, August, September, October, November, December

c) Heads, tails

d) 1, 2, 3, 4, 5, 6

e) a, b c, d, e, f, g, h, i, j, k, l, m, n, o, p, q, r, s, t, u, v, w, x, y, z

3)

a) M ,A, T, H, E, M, A, T, I, C, S

b) 11

c) 8

4)

a) Heads are tails are both equally likely

b) Each element (1, 2, 3, 4, 5, 6) are equally likely

c) Not equally likely

d) Equally likely

5)

Spinner	Dice: 					
A	1, A	2, A	3, A	4, A	5, A	6, A
B	1, B	2, B	3, B	4, B	5, B	6, B
C	1, C	2, C	3, C	4, C	5, C	6, C
D	1, D	2, D	3, D	4, D	5, D	6, D

6)

Spinner	Dice: 1	2	3	4	5	6
Yellow	Y, 1	Y, 2	Y, 3	Y, 4	Y, 5	Y, 6
Green	G, 1	G, 2	G, 3	G, 4	G, 5	G, 6
Blue	B, 1	B, 2	B, 3	B, 4	B, 5	B, 6
Red	R, 1	R, 2	R, 3	R, 4	R, 5	R, 6

7)

a) P(king) = 4/52 = 1/13

b) P(Ace) = 4/52 = 1/13

c) P(diamond) = 13/52 =¼=0.25

d) P(Black) = 26/52 = ½ = 0.5

e) P(5) = 4/52 = 1/13

f) P(8 of hearts) = 1/52

8)

a) P(blue) = 6/20 = 3/10 = 0.3

b) P(orange) = 10/20 = 0.5

c) P(red) = 4/20 = 1/5 = 0.2

Exercise 2:

1) $\frac{1}{2}$ 2) $\frac{3}{4}$ 3) 66% 4) $\frac{5}{6}$

Exercise 3:

1) $\frac{1}{2} \times \frac{1}{2} = \frac{1}{4} = 0.25$

2) $\frac{1}{2} \times \frac{1}{2} = \frac{1}{4} = 0.25$

3) $\frac{4}{52} \times \frac{13}{52} = \frac{1}{52} = 0.0192$

4) $\frac{1}{2} \times \frac{1}{3} = \frac{1}{6} = 0.1667$

5) $\frac{1}{3} \times \frac{1}{3} \times \frac{1}{3} = \frac{1}{27} = 0.0370$

Exercise 4:

1) $\frac{1}{2} + \frac{1}{2} = 1$

2) $\frac{4}{52} + \frac{13}{52} = \frac{17}{52} = 0.3269$

3) $\frac{1}{2} + \frac{1}{3} = \frac{5}{6} = 0.8333$

4) $\frac{1}{4} + \frac{1}{4} = \frac{1}{2} = 0.5$

5) $\frac{5}{10} + \frac{3}{10} = \frac{8}{10} = 0.8$

Mixed Exercise:

1)

a) $\frac{3}{10} = 0.3$

b) $\frac{5}{10} = \frac{1}{2} = 0.5$

c) $\frac{5}{10} = \frac{1}{2} = 0.5$

d) $\frac{3}{10} + \frac{5}{10} = \frac{8}{10} = \frac{4}{5} = 0.8$

e) $\frac{3}{10} \times \frac{5}{10} = \frac{3}{20} = 0.15$

f) $\frac{5}{10} \times \frac{2}{10} = \frac{1}{10} = 0.1$

g) $\frac{5}{10} + \frac{2}{10} = \frac{7}{10} = 0.7$

h) $\frac{3}{10} + \frac{2}{10} = \frac{5}{10} = \frac{1}{2} = 0.5$

i) $\frac{5}{10} \times \frac{3}{10} \times \frac{2}{10} = \frac{3}{100} = 0.03$

j) $\frac{5}{10} + \frac{3}{10} \times \frac{2}{10} = \frac{14}{25} = 0.56$

2)

a) $\frac{1}{2} = 0.5$

b) $\frac{1}{4} = 0.25$

c) $\frac{1}{8} = 0.125$

d) $\frac{1}{8} = 0.125$

e) $\frac{1}{2} + \frac{1}{4} = \frac{3}{4} = 0.75$

f) $\frac{1}{2} \times \frac{1}{4} = \frac{1}{8} = 0.125$

g) $\frac{1}{4} \times \frac{1}{8} = \frac{1}{32} = 0.0313$

h) $\frac{1}{2} + \frac{1}{8} = \frac{5}{8} = 0.625$

i) $\frac{1}{2} \times \frac{1}{4} \times \frac{1}{8} = \frac{1}{64} = 0.0156$

j) $\frac{1}{2} + \frac{1}{4} + \frac{1}{8} = \frac{7}{8} = 0.875$

k) $\frac{1}{2} \times \frac{1}{4} + \frac{1}{8} = \frac{1}{4} = 0.25$

3)

a) $\frac{1}{10} = 0.1$

b) $\frac{5}{10} = 0.5$

c) $\frac{2}{10} = \frac{1}{5} = 0.2$

d) $\frac{9}{10} = 0.9$

e) $\frac{3}{10} = 0.3$

f) $\frac{2}{10} = \frac{1}{5} = 0.2$

g) $\frac{3}{10} = 0.3$

h) $\frac{2}{10} = \frac{1}{5} = 0.2$

i) $\frac{7}{10} = 0.7$

j) $\frac{2}{10} = \frac{1}{5} = 0.2$

k) $\frac{8}{10} = \frac{4}{5} = 0.8$

4)

a) $\frac{4}{11} = 0.3636$

b) $\frac{1}{11} = 0.0909$

c) $\frac{3}{11} = 0.2727$

d) 0

5)

a) $\frac{1}{4} = 0.25$

b) $\frac{1}{2} = 0.5$

c) $\frac{1}{13} = 0.0769$

d) $\frac{3}{4} = 075$

e) $\frac{1}{26} = 0.0385$

f) $\frac{1}{52} = 0.0192$

g) $\frac{1}{13} = 0.0769$

h) $\frac{3}{13} = 0.2308$

i) $\frac{2}{13} = 0.1538$

j) $\frac{12}{13} = 0.9231$

k) $\frac{50}{52} = \frac{25}{26} = 0.9615$

Exercise 5:

1) $E = 100 \times \frac{1}{2} = 50$ tails

2) $E = 40 \times \frac{1}{4} = 10$ diamonds

3) $E = 28 \times \frac{6}{14}$

$= 12$ Pepperoni Pizza's

4) $E = 15 \times \frac{1}{5}$

$= 3$ coffee's

5) $E = 10 \times 5 \times \frac{2}{7}$

$= 14.3$

$= 14 \; or \; 15$ duties

Exercise 6:

1)

a) 113

b) $\frac{15}{113} = 0.1327$

c) $\frac{15}{113} = 0.1327$

d) $\frac{13}{113} = 0.1150$

e) $\frac{15+23+28}{113} = \frac{66}{113}$
$= 0.5841$

f) $\frac{28+19}{113} = \frac{47}{113} = 0.4159$

g) $E = 2200 \times \frac{3}{113}$
$= 58.4$
$= 58 \text{ or } 59$ students

2)

a) $\frac{54}{200} = 0.27$

b) $\frac{5}{200} = 0.025$

c) $\frac{90+29}{200} = \frac{119}{200} = 0.595$

d) $\frac{200-22}{200} = \frac{178}{200} = 0.89$

e) $\frac{54}{200} \times \frac{54}{200} = 0.0729$

f) $E = 2200 \times \frac{5}{200}$
$= 55$ students

3)

a) $\frac{3}{300} = 0.01$

b) $\frac{1}{300} = 0.0333$

c) $\frac{64+3}{300} = \frac{67}{300} = 0.2233$

d) $\frac{300-63}{300} = \frac{237}{300} = 0.79$

e) $E = 2200 \times \frac{137}{300}$
$= 1004.7$
$= 1004 \text{ or } 1005 \text{ students}$

4)

a) $\frac{75}{100} = 0.75$

b) $\frac{12}{100} = 0.12$

c) $\frac{8+2}{100} = \frac{10}{100} = 0.1$

d) $\frac{12}{100} \times \frac{12}{100} = 0.0144$

e) $E = 2200 \times \frac{25}{100}$
$= 550 \text{ students}$

5)

a) $\frac{76}{250} = 0.304$

b) $\frac{27+51}{250} = \frac{78}{250} = 0.312$

c) $\frac{27+51+76}{250} = \frac{154}{250} = 0.616$

d) $\frac{46}{250} \times \frac{46}{250} \times \frac{46}{250} = 0.00623$

e) $E = 2200 \times \frac{50+46}{250}$

$= 844.8$

$= 844 \text{ or } 845 \text{ students}$

Exercise 7:

1)

		Gender			
		Male	**Female**	**Other**	**Total**
Like Statistics ?	**Yes**				
	No				
	Total				

2)

		Year level					
		9	**10**	**11**	**12**	**13**	**Total**
Handedness	**Right**						
	Left						
	Total						

Exercise 8:

1)

a)	70	b)	18
c)	6	d)	243
e)	500	f)	$\frac{85}{500} \times 100 = 17\%$
g)	$\frac{251}{500} \times 100 = 50.2\%$	h)	$\frac{33}{500} \times 100 = 6.6\%$

2)

	Right-handed	Left-handed	Total
Girls	188	32	220
Boys	203	37	240
Total	391	69	460

a)	Question 1: whether they were right or left handed. Question 2: if they were a girl or a boy.	b)	Variable 1: Handedness. Variable 2: Gender.
c)	460	d)	69
e)	240	f)	$\frac{69}{460} \times 100 = 15\%$
g)	$\frac{32}{460} \times 100 = 6.96\%$		

Exercise 9:

1)

	Left-handed	Right-handed	Total
Girls	188	32	220
Boys	203	37	240
Total	391	69	460

2)

	Dog	Cat	Total
Males	42	10	52
Females	9	39	48
Total	51	49	100

3)

	Thick crust	Thin crust	Total
Child	24	6	30
Adult	36	54	90
Total	60	60	120

Exercise 10:

1)

a) $\frac{27}{140} = 0.1929$

b) $\frac{63}{140} = \frac{9}{20} = 0.45$

c) $\frac{22}{140} = \frac{11}{70} = 0.1571$

d) $\frac{85+27}{140} = \frac{112}{140} = \frac{4}{5} = 0.8$

e) $\frac{140-27}{140} = \frac{113}{140}$
$= 0.8071$

f) $\frac{15+22}{140} = \frac{37}{140}$
$= 0.2643$

g) $E = 2200 \times \frac{85}{140}$
$= 1335.7$
$= 1335 \text{ or } 1336 \text{ students}$

2)

a) $\frac{16}{50} = \frac{8}{25} = 0.32$

b) $\frac{20}{50} = \frac{2}{5} = 0.4$

c) $\frac{16}{50} = \frac{8}{25} = 0.32$

d) $\frac{16+16}{50} = \frac{32}{50} = 0.64$

e) $\frac{16+8}{50} = \frac{24}{50} = 0.48$

f) $\frac{50-10}{50} = \frac{40}{50} = 0.8$

g) $E = 2200 \times \frac{16}{50}$
$= 704\ students$

3)

	Eat breakfast	Skip breakfast	Total
Age 10 – 13	40	14	54
Age 14 - 17	12	24	36
Total	52	38	90

a) $\frac{52}{90} = \frac{26}{45} = 0.5778$

b) $\frac{54}{90} = \frac{3}{5} = 0.6$

c) $\frac{24}{90} = \frac{4}{15} = 0.2667$

d) $\frac{12+14}{90} = 0.2889$

e) $\frac{38}{90} \times \frac{38}{90} = \frac{361}{625} = 0.5776$

f) $\frac{54}{90} = \frac{3}{5} = 0.6$

g) $E = 2200 \times \frac{38}{90}$
$= 928.9$
$= 928\ or\ 929\ students$

4)

	Monday	Tuesday	Wednesday	Thursday	Friday	Total
Tea	34	35	28	36	41	174
Coffee	42	32	38	24	31	167
Water	33	34	35	45	34	181
Total	109	101	101	105	106	522

a) $\frac{174}{522} = \frac{1}{3} = 0.3333$

b) $\frac{24}{522} = \frac{4}{87} = 0.0480$

c) $\frac{34+35+45}{522} = \frac{114}{522}$
$= 0.2184$

d) $\frac{174+167}{522} = \frac{341}{522}$
$= 0.6533$

e) $\frac{522-181}{522} = \frac{341}{522}$
$= 0.6533$

f) $\frac{42+31}{522} = \frac{73}{522} = 0.1398$

g) $E = 200 \times \frac{167}{522}$
$= 63.98$

$= 63 \; or \; 64 \; staff$

5)

	Chocolate	Vanilla	Neither	Total
Children	40	22	15	77
Teens	12	16	45	73
Adults	55	54	10	119
Total	107	92	70	269

a) $\frac{92}{269} = 0.3420$

b) $\frac{73}{269} = 0.2714$

c) $\frac{45}{269} = 0.1673$

d) $\frac{55}{269} = 0.2045$

e) $\frac{107+92}{269} = \frac{199}{269}$
$= 0.7398$

f) $\frac{40+12}{269} = \frac{52}{269} = 0.1933$

g) $E = 12,000 \times \frac{92}{269}$
$= 4104.1$
$= 4104 \text{ or } 4105 \text{ people}$

6) a)

	Sports	No Sports	Total
Soft drink	19	33	52
No Soft drink	24	22	46
Total	43	55	98

b) $\frac{52}{98} = \frac{26}{49} = 0.5306$

c) $\frac{43}{98} = 0.4388$

d) $\frac{24}{98} = 0.2449$

e) $\frac{22}{98} = \frac{11}{49} = 0.2245$

f) $\frac{19}{98} \times \frac{19}{98} = \frac{361}{9604}$
$= 0.0376$

g) $E = 2200 \times \frac{22}{98}$
$= 493.9$
$= 493 \text{ or } 494 \text{ students}$

7) a)

	McDonalds	Burger King	Wendy's	Total
Male	20	15	10	45
Female	20	10	25	55
Total	40	25	35	100

b) $\frac{35}{100} = \frac{7}{20} = 0.35$

c) $\frac{20}{100} = \frac{1}{5} = 0.2$

d) $\frac{15}{100} = \frac{3}{20} = 0.15$

e) $\frac{20+15}{100} = \frac{35}{100} = 0.35$

f) $\frac{100-25}{100} = \frac{75}{100} = 0.75$

g) $\frac{35}{100} \times \frac{35}{100} = \frac{49}{400}$
$= 0.1225$

h) $E = 2200 \times \frac{25}{100}$
$= 550 \; students$

8) a)

	Car	Bus	Walk	Total
Year 9	10	8	6	24
Year 10	6	7	5	18
Total	16	15	11	42

b) $\frac{15}{42} = 0.3571$

c) $\frac{6}{42} = \frac{1}{7} = 0.1429$

d) $\frac{6}{42} = \frac{1}{7} = 0.1429$

e) $\frac{16+15}{42} = \frac{31}{42} = 0.7381$

f) $\frac{42-16}{42} = \frac{26}{42} = 0.6190$

g) $\frac{7}{42} = \frac{1}{6} = 0.1667$

h) $E = 2200 \times \frac{6}{42}$
$= 314.3$
$= 314 \; or \; 315 \; students$

Exercise 11:

1)	a)	$\frac{22}{38} = \frac{11}{19} = 0.5789$	b)	$\frac{12}{63} = 0.1905$
	c)	$\frac{40}{77} = 0.5195$	d)	$\frac{40}{85} \times 100 = 47.06\%$
	e)	$\frac{12}{27} = \frac{4}{9} = 0.4444$		
2)	a)	$\frac{10}{20} = \frac{1}{2} = 0.5$	b)	$\frac{10}{16} = \frac{5}{8} = 0.625$
	c)	$\frac{8}{30} = \frac{4}{15} = 0.2667$	d)	$\frac{16}{18} = \frac{8}{9} = 0.8889$
	e)	$\frac{8}{16} = \frac{1}{2} = 0.5$		
3)	a)	$\frac{24}{38} = \frac{12}{19} = 0.6316$	b)	$\frac{40}{54} = \frac{20}{27} = 0.7407$
	c)	$\frac{40}{52} = \frac{10}{13} = 0.7692$	d)	$\frac{24}{36} = \frac{2}{3} = 0.6667$
	e)	$\frac{24}{38} = \frac{12}{19} = 0.6316$		
4)	a)	$\frac{36}{174} = \frac{6}{29} = 0.2069$	b)	$\frac{31}{167} = 0.1856$
	c)	$\frac{33}{109} = 0.3028$	d)	$\frac{35}{101} = 0.3465$
	e)	$\frac{45}{181} = 0.2486$		
5)	a)	$\frac{40}{107} = 0.3738$	b)	$\frac{12}{73} = 0.1644$
	c)	$\frac{54}{92} = \frac{27}{46} = 0.5870$	d)	$\frac{55+54}{107+92} = \frac{109}{199} = 0.5477$
	e)	$\frac{22+15}{77} = \frac{37}{77} = 0.4805$		