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Project Maths
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Project Maths

Mathematics Resources for Students

Junior Certificate – Strand 1

Statistics and Probability

INTRODUCTION

This material is designed to supplement the work you do in class and is intended to be kept in an A4 folder. Activities are included to help you gain an understanding of the mathematical concepts and these are followed by questions that assess your understanding of those concepts. While there are spaces provided in some activities/questions for you to complete your work, you will also need to use your copybook/A4 pad or graph paper. Remember to organise your folder so that it will be useful to you when you revise for tests and examinations. As you add pages to your folder, you might consider dating or coding them in a way that associates them with the different topics or syllabus sections. Organising your work in this way will help you become personally effective. Being personally effective is one of the five key skills identified by the NCCA as central to learning (www.ncca.ie/keyskills). These key skills are important for all students to achieve their full potential, both during their time in school and into the future.

As you work through the material in this booklet and with your teacher in class, you will be given opportunities to develop the other key skills. You will frequently work in pairs or groups, which involves organising your time effectively and communicating your ideas to the group or class. You will justify your solutions to problems and develop your critical and creative skills as you solve those problems. As you complete the activities you will be required to process and interpret information presented in a variety of ways. You will be expected to apply the knowledge gained to draw conclusions and make decisions based on your analysis. The sequence in which the sections/topics are presented here is not significant. You may be studying these in a different order, or dipping in and out of various sections over the course of your study and/or revision.

The questions included in this booklet provide you with plenty of opportunities to develop communication skills and to promote mathematical discourse. When your teachers mark your work they will gain insights into your learning and will be able to advise you on what you need to do next.

The material in the booklet is suitable for Junior Certificate. It builds on the concepts learned in primary school and continues the investigative and experimental approach to learning about data, data handling, and probability (chance). Through completing the activities and questions contained in this booklet, you will develop a set of tools that will help you become a more effective learner and these tools can be used across the curriculum. Solving problems of this nature should also improve your confidence in doing mathematics, thus helping you to develop a positive attitude towards mathematics and to appreciate its role in your life.

The mathematics syllabus documents can be accessed at www.ncca.ie and you will find other relevant material on www.projectmaths.ie.

PROBABILITY 1

SYLLABUS TOPIC: CONCEPTS OF PROBABILITY

LEARNING OUTCOME

As a result of completing the activities in this section you will be able to

- decide whether an everyday event is likely or unlikely to happen
- recognise that probability is a measure on a scale of 0 - 1 of how likely an event is to occur.
- connect with set theory; discuss experiments, outcomes, sample spaces
- use the language of probability to discuss events, including those with equally likely outcomes

INTRODUCTION

The activities described below and the questions that follow give you the opportunity to reinforce your understanding of the basic concepts of probability. The activities are designed to build on previous experiences where you estimated the likelihood of an event occurring. Some of the activities will be done in class under the direction of your teacher; others can be done at home.

Activity 1.1

A probability describes mathematically how likely it is that something will happen. We can talk about the probability it will rain tomorrow or the probability that Ireland will win the World Cup.

Consider the probability of the following events

- It will snow on St Patrick's day
- It will rain tomorrow
- Munster will win the Heineken Cup
- It is your teacher's birthday tomorrow
- You will obtain a 7 when rolling a die
- You will eat something later today
- It will get dark later today

Words you may decide to use: certain, impossible, likely, very likely

Student Activity

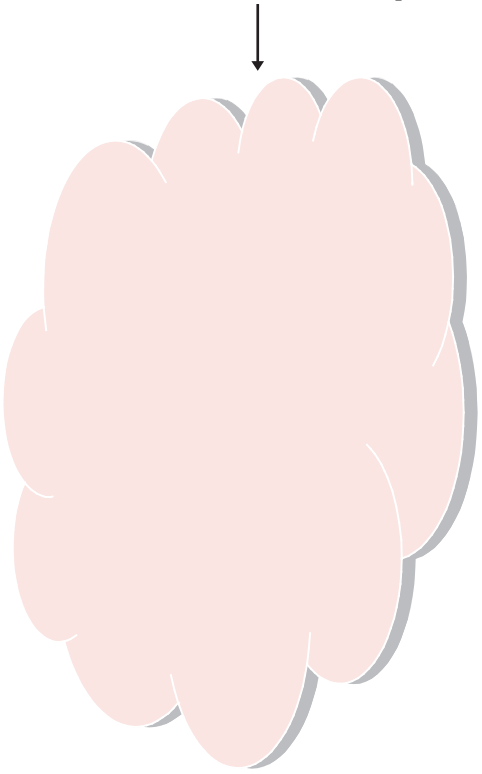
Certain not to happen

1.

2.

3.

Area of Uncertainty



Certain to happen

1.

2.

3.

Phrases used to describe uncertainty

1.

2.

3.

4.

5.

Use the table provided or mark your work page out in a similar way and place each of the events in the approriate section.Note the phrases you used to describe uncertainty.

Activity 1.2

The Probability Scale

Extremely unlikely	50/50	3/8	1 in 4 chance
Probability of getting an odd number when rolling a die	87.5%	Extremely likely	1/2
	0.125	3/4	Impossible
1/4	Certain	75%	1
Equally likely	0.25	0	

1. Place the above phrases, numbers and percentages at the correct position on the probability scale.
2. Find and write down instances from TV, radio, or in the newspaper which illustrate how probability affects people's lives.

Questions

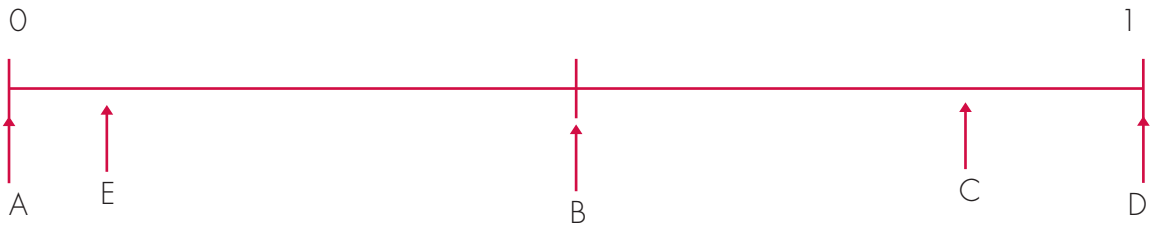
Q.1 For each event below, estimate the probability that it will happen and mark this on a probability scale.

- It will snow in Ireland on August 16th
- Your maths teacher will give you homework this week
- Your will eat fish later today
- You will go to bed before midnight tonight
- You will go to school tomorrow

Q. 2 Use one of the words certain, likely, unlikely, impossible to describe each of the events below. Give a reason for each of your answers.

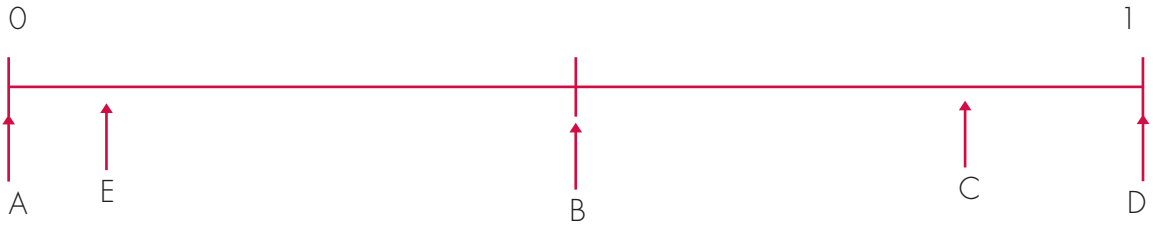
- You are more than 4 years old
- You will arrive on time to school tomorrow
- You will miss the school bus tomorrow
- Your county will win the Championship this year.

Q. 3 The probability line shows the probability of 5 events A, B, C, D and E



a. Which event is certain to occur?
b. Which event is unlikely but possible to occur?
c. Which event is impossible?
d. Which event is likely but not certain to occur?
e. Which event has a 50:50 chance of occurring?

Q. 4 The events A, B, C, D have probabilities as shown on this probability line;



i. Which event is the **most likely** to take place?

ii. Which event is the **most unlikely** to take place?

iii. Which event is **more likely than not** to take place?

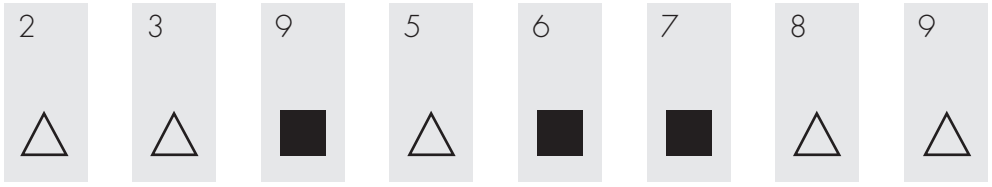
Q. 5 When you toss an unbiased coin the probability of getting a head is ½, because you have an equal (or even) chance of getting a head or tail. Name two other events that have a probability of ½.

Q. 6 The 'events' A, B, C, D are listed below;

A: You will live to be 70 years old
B: You will live to be 80 years old
C: You will live to be 100 years old
D: You will live to be 110 years old

Make an estimate of the probability of each event, and place it on a probability scale.

Q. 7 Sarah and Alex are exploring probability and Sarah has these cards:



Alex takes a card without looking. Sarah says

i. Explain why Sarah is wrong.

ii. Here are some words and phrases that can be associated with probability:

impossible	not likely	certain	likely

Choose a word or a phrase to fill in the gaps below.

It is ..... that the number on Alex's card will be smaller than 10.

It is ..... that the number on Alex's card will be an odd number.

Sarah mixes up the cards and places them face down on the table.
Then she turns the first card over, like this:

Alex is going to turn the next card over

iii. Complete the sentence:

On the next card, _____ is less likely than _____

The number on the next card could be higher than 5 or lower than 5

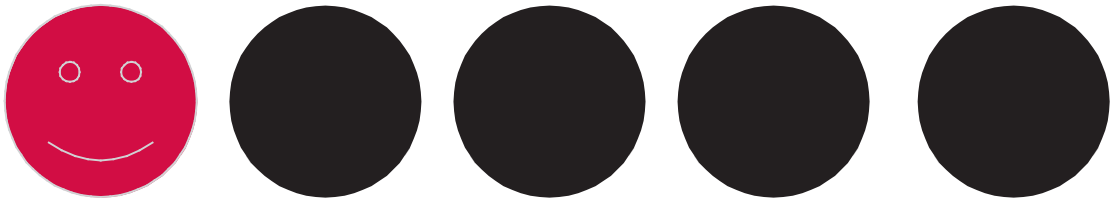
iv. Which is more likely? Tick the correct box below.

☐ Higher than 5 ☐ Lower than 5 ☐ Cannot tell

Explain your answer.

Q. 8 Lisa has some black counters and some red counters.

The counters are all the same size.
She puts 4 black counters and 1 red counter in a bag.



a. Lisa is going to take one counter out of the bag without looking.

She says:

> There are two colours, so it is just as likely that I will get a black counter as a red counter.

i. Explain why Lisa is wrong. What is the probability that the counter she takes out is black?

ii. How many more red counters should Lisa put in the bag to make it just as likely that she will get a black counter as a red counter?

b. Jack has a different bag with 8 counters in it. It is more likely that Jack will take a black counter than a red counter from his bag.

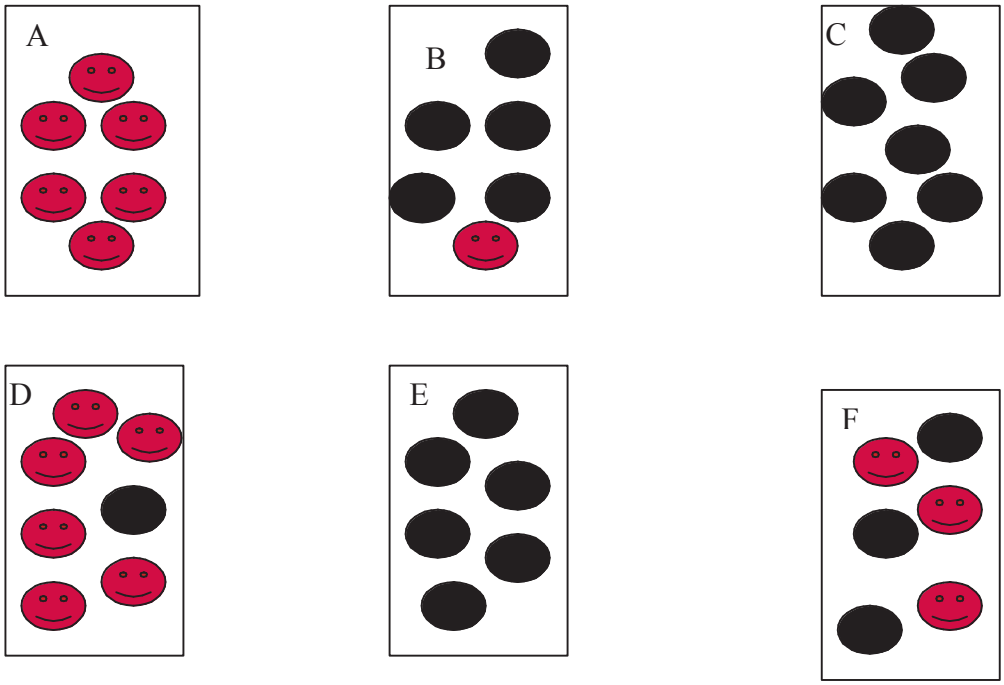
iii. How many black counters might there be in Jack's bag? Suggest a number and explain why this is a possible answer.

c. Jack wants the probability of taking a black counter from his bag to be the same as the probability Lisa had at the start of taking a black counter from her bag, so he needs to put extra counters into his bag.

iv. Assuming Jack had the number of black counters you have suggested at (iii) above, how many extra black counters and how many extra red counters (if necessary) should Jack put in his bag?

Explain your reasoning.

Q. 9 (a) Josh has some boxes containing red and black counters.



He is going to take a counter from each box without looking.

a. Match boxes (using the letters A-F) to the statements below. Explain your reasoning each time.

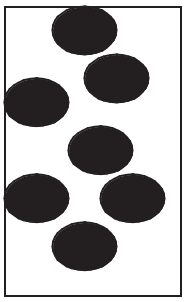
It is **impossible** that Josh will take a black counter from box……..because

It is **equally likely** that Josh will take a black or red counter from box……..because

It is **likely** that Josh will take a red counter from box……..because

It is **certain** that Josh will take a black counter from box……..because

Josh selects box C which has 7 black counters in it



He wants to make it **more likely** that he will take a red counter than a black counter out of the box.

How many red counters must he put into the box? Explain your answer.

b. In another box, there are 30 counters which are either red or black in colour.
It is **equally likely** that Josh will take a red counter or a black counter from the box.
How many red counters and how many black counters are there in the box?

c. Extension question
There are 40 counters in a box which are either red or black in colour.
There is a **75% chance** that Josh will take a red counter from the box.
How many black counters are in the box? Explain your answer.

PROBABILITY 2

SYLLABUS TOPIC: CONCEPTS OF PROBABILITY

LEARNING OUTCOME

As a result of completing the activities in this section you will be able to

- estimate probabilities from experimental data; appreciate that if an experiment is repeated, there will be different outcomes and that increasing the number of times an experiment is repeated generally leads to better estimates of probability
- associate the probability of an event with its long run relative frequency

INTRODUCTION

The activities described below and the questions that follow give you the opportunity to reinforce your understanding of the basic concepts of probability. You begin by rolling two coins and progress to playing a game involving rolling two dice. You will use a sample space to list all the possible outcomes and begin to consider the concept of expected value as you investigate the idea of fairness in relation to the game.

Activity 2.1

Toss two coins simultaneously about 30 times and record all the outcomes.
Do you notice any outcomes coming up over and over again?
Do some of these come up more frequently than others?
Use the grid below to show the 4 possible outcomes (the sample space) of heads (H) and tails (T).

		Coin 1	
		H	**T**
Coin 2	**H**		
	T		

Use the sample space to calculate the probability of each outcome occurring (i.e. the theoretical probability).
From the results you obtained in the 30 tosses, construct a table showing the number of times each outcome occurred and its relative frequency. Compare these to the theoretical probability.

Outcome	Tally	Relative Frequency

Activity 2.2

Working in pairs, roll a die 30 times (i.e. 30 trials) and enter your results into a table similar to the one outlined below

Number which appears on die (outcome of trial)	**How many times did this happen?** (Use tally marks to help you count.)	**Total** (frequency)
1		
2		

As you complete your own table compare it with that of another group.
Are there any similarities?

Your teacher may ask you to complete a Master sheet showing the results of all the groups in the class (a total of N trials).

Outcome of trial	**Frequency (group results)**	**Total of frequencies**	**Relative frequency)** $\frac{\textit{Total of frequencies}}{\textit{sample size (N)}}$	**% of total scores Rel. Freq × 100**	**Probability**
1	E.g. 5+6+5+…				
2					
3					
4					
5					
6					
		SUM			

The sum of all the relative frequencies is

The sum of all the percentages is

The sum of all the probabilities is

Conclusion:

What does your experiment tell you about the chance or probability of getting each number on the die you used?

Your die can be described as being unbiased. Can you explain why?

Activity 2.3

a. Each student tosses a coin 30 times and records their results for every 10 tosses.

No of tosses	No of Heads	Relative frequency
10		
10		
10		

b. What does the table you completed in (a) tell you about the probability of getting a head?

c. Now put all the results for the class together and obtain a new estimate of the probability of getting a head.

d. Is your new estimate closer to ½ than the estimate in (a)?

Activity 2.4

This is a game for two players, A and B. They take turns to roll two dice and add the two numbers shown on each toss. The winner is determined as follows:

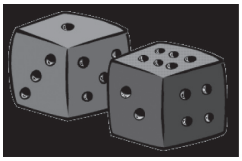
A wins if the sum of the numbers on the dice (i.e. outcome) is 2, 3, 4, 10, 11 or 12.

B wins if the sum of the numbers on the dice is 5, 6, 7, 8, 9.

Before you begin predict which player is most likely to win.

I think player _____ will win because _____

Play the game until one player reaches the bottom of the game sheet.



GAME SHEET

	A wins	**A wins**	**A wins**	B wins	B wins	B wins	B wins	B wins	**A wins**	**A wins**	**A wins**
1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**

Record the number of times each player wins in the table below. The relative frequency is the **total no. of wins divided by the total no. of games.**

	Total (frequency)	Relative frequency
Player A wins		
Player B wins		
Totals		

As a class exercise construct a Master Tally sheet and record the results of the whole class

	Total (frequency)	Relative frequency
Player A wins		
Player B wins		
Totals		

Does your predicted result agree with your actual result? Think about why this happens. Complete the table below showing all the possible outcomes for throwing two dice.

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

In the case of equally likely outcomes, the probability is given by the number of outcomes of interest divided by the total number of outcomes.

Construct a table to show the probability of each outcome above,
with the probability = $\frac{\text{no of outcomes in the event}}{\text{no of outcomes in the sample space}}$

Sum of two dice	Frequency	Probability
2	1	1/36
3	2	2/36

Look back at the rules of the game.

Original Rules: Player A wins when the sum is 2, 3, 4, 10, 11 or 12.

Player B wins when the sum is 5, 6, 7, 8 or 9.

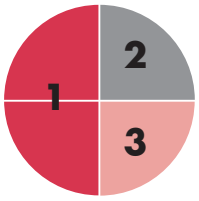
For how many outcomes will player A win?_____

For how many outcomes will player B win?_____

Does the game seem fair? If not, suggest a change to the rules which would make it fairer.

Create a mind map or a graphic organiser (http://www.action.ncca.ie) that will help you remember how to calculate the relative frequency of an event occurring.

Q. 1 Sophie and Andrew are playing a game with a fair, six-sided die and the spinner shown. They throw the die and spin the spinner simultaneously and note the total



Sophie I will carry your bag home if the total is **2, 3, 8** or **9**. You carry mine if the total is **4**, **5, 6** or **7**

Andrew said

Create a sample space showing the possible outcomes and use it to help Sophie decide whether or not she should play the game. Justify your advice to Sophie.

Q. 2 What is the probability of getting a head and a 6 when you simultaneously toss a fair coin and roll a fair, six-sided die?

How would this probability change if the die was replaced with:

a. A four-segment spinner (segments of equal area) numbered 1, 6, 6, 5?

or

b. A suit of spades from a deck of playing cards (and 1 card is chosen at random from the suit)?

Q. 3 A spinner has four unequal sections, red, black, pink and grey.

The probability that the spinner will land on red is 0.1 [P(red) =0.1]
The probability that the spinner will land on black is 0.2 [P(black) =0.2]
The probability that the spinner will land on pink is the same as the probability that it will land on grey.

Calculate the probability that the spinner will land on grey. Justify your answer.

Q. 4 A calculator can be used to generate random digits. Sandra generates 100 random digits with her calculator. She lists the results in the table below.

0	𝍸 II	**5**	𝍸 𝍸
1	𝍸 III	**6**	𝍸 𝍸 IIII
2	𝍸 I	**7**	𝍸 𝍸 II
3	𝍸 𝍸 II	**8**	𝍸 𝍸 I
4	𝍸 𝍸 II	**9**	𝍸 𝍸 IIII

Based on Sandra's results, estimate the probability that the calculator produces:
a) 9, b) 2, c) a digit that is a multiple of 3, d) a digit that is prime.

Q. 5 Four students each threw 3 fair dice.

They recorded the results in the table below.

Name	Number of throws	All different numbers	Exactly 2 numbers the same	All 3 numbers the same
Jane	50	36	12	2
Paul	150	92	45	13
Tom	40	18	20	2
Patti	120	64	52	4

a. Which student's data are **most likely** to give the best estimate of the probability of getting

All numbers the same ☐ Exactly 2 numbers the same ☐ All 3 numbers the same ☐

Explain your answer.

b. This table shows the students' results collected together:

Number of throws	All different	Exactly 2 numbers the same	All 3 numbers the same
360	210	129	21

Use these data to estimate the **probability** of throwing numbers that are **all different**.

c. The theoretical probability of each result is shown below:

	All Different	2 the same	All the same
Probability	5/9	5/12	1/36

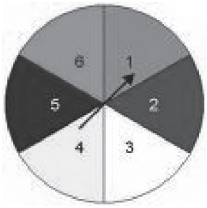
Use these probabilities to calculate, for 360 throws, **how many times** you would theoretically expect to get each result. Complete the table below.

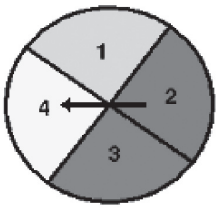
Number of throws	All different	2 the same	All the same
360			

d. Give a reason why the students' results are not the same as the theoretical results.

Think: How would this question be different if coins, spinners or playing cards were used?

Q. 6 Pierce and Bernie were investigating results obtained with the pair of spinners shown.





They used a table to record the total of the two spinners for 240 trials. Their results are given in one of the three tables A, B and C below.

Table A

Sum	Frequency	Relative frequency
2	10	1/24
3	20	1/12
4	30	1/8
5	30	1/8
6	60	1/4
7	40	1/6
8	20	1/12
9	20	1/12
10	10	1/24
Total	240	1

Table B

Sum	Frequency	Relative frequency
2	12	12/240
3	12	12/240
4	27	27/240
5	27	27/240
6	35	35/240
7	45	45/240
8	24	24/240
9	18	18/240
10	40	40/240
Total	240	

Table C

Sum	Frequency	Relative frequency
2	11	
3	19	
4	32	
5	30	
6	29	
7	28	
8	17	
9	14	
10	60	
Total	240	

Complete the relative frequency column in table C.
Use your results to decide which, if any, of these three tables might represent the results found by Pierce and Bernie. Explain your reasoning.

Q. 7 A spinner with 3 equal segments numbered 1, 2 and 3 is spun once.

i. Give the sample space of this experiment.

ii. What is the probability that the spinner stops on number 2?

iii. What is the probability that the spinner stops on a number greater than or equal to 2?

Q. 8 Pierce and Bernie were investigating the results given by the spinner shown, by spinning it 60 times and recording the results.

Their results are given in one of the three tables below, A, B and C

Table A

result	tally	count
red	𝍸 𝍸 𝍸 𝍸 𝍸 I	21
grey	𝍸 𝍸 𝍸 IIII	19
black	𝍸 𝍸 𝍸 𝍸	20

Table B

result	tally	count
red	𝍸 𝍸 𝍸 𝍸 𝍸 𝍸 𝍸 𝍸 𝍸 II	47
grey	𝍸 I	6
black	𝍸 II	7

Table C

result	tally	count
red	𝍸 𝍸 𝍸 𝍸 𝍸 𝍸 II	32
grey	𝍸 𝍸 𝍸	15
black	𝍸 𝍸 III	13

a. Which of the three tables above is most likely to be like the one that Pierce and Bernie made? Explain how you made your decision.

b. For each of the other two tables, draw a diagram of a spinner that is likely to produce results like those shown in each table.

PROBABILITY 3

SYLLABUS TOPIC: CONCEPTS OF PROBABILITY

LEARNING OUTCOME

As a result of completing the activities in this section you will be able to

- apply the principle that in the case of equally likely outcomes the probability is given by the number of outcomes of interest divided by the total number of outcomes
- use binary/counting methods to solve problems involving successive random events where only two possible outcomes apply to each event

Activity 3.3

Consider the following game

Players roll 2 four-segment spinners, which have equal segments numbered 1, 2, 3 and 4 . Player 1 wins if the sum of the spinner numbers is 3, 4, or 5,; player 2 wins if the sum is 2, 6, 7, or 8.

a. Predict whether player 1 or player 2 has the greater chance of winning. Play the game a few times to check your prediction. Now use the table below to help you decide in a more mathematical way. Write a sentence explaining why you think the game is, or is not, fair.

	1	2	3	4
1				
2				
3				
4				

b. Now consider this game

Players roll 3 four-segment spinners, which have equal segments numbered 1, 2, 3, and 4. Player 1 wins if the sum of the spinner numbers is 3, 4, 5, 6 or 12; Player 2 wins if the sum is 7, 8, 9, 10 or 11.

Is this game fair?

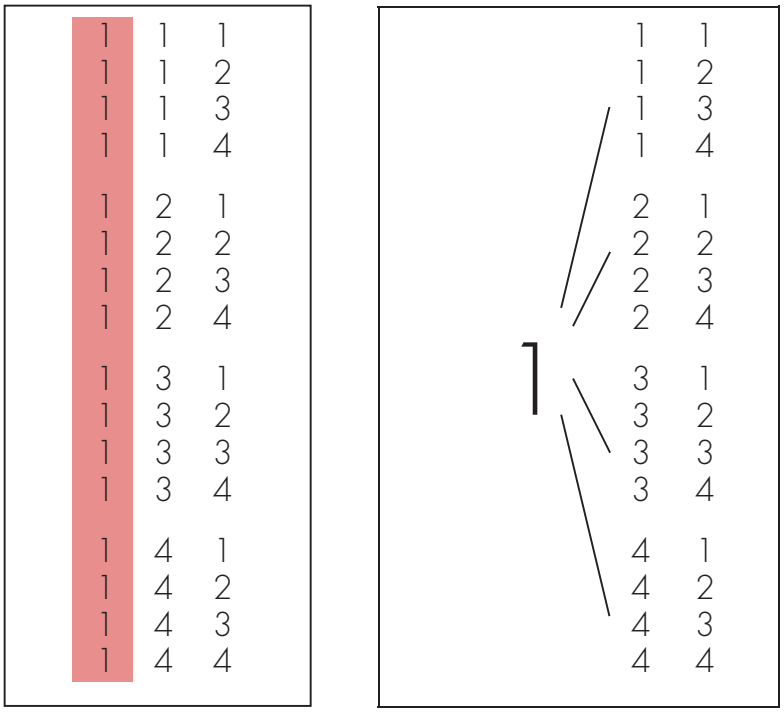
Can you represent the possible outcomes in the same way? It is difficult because there is an extra dimension – the 3rd spinner.

Consider all the possibilities when the first spinner shows a 1.

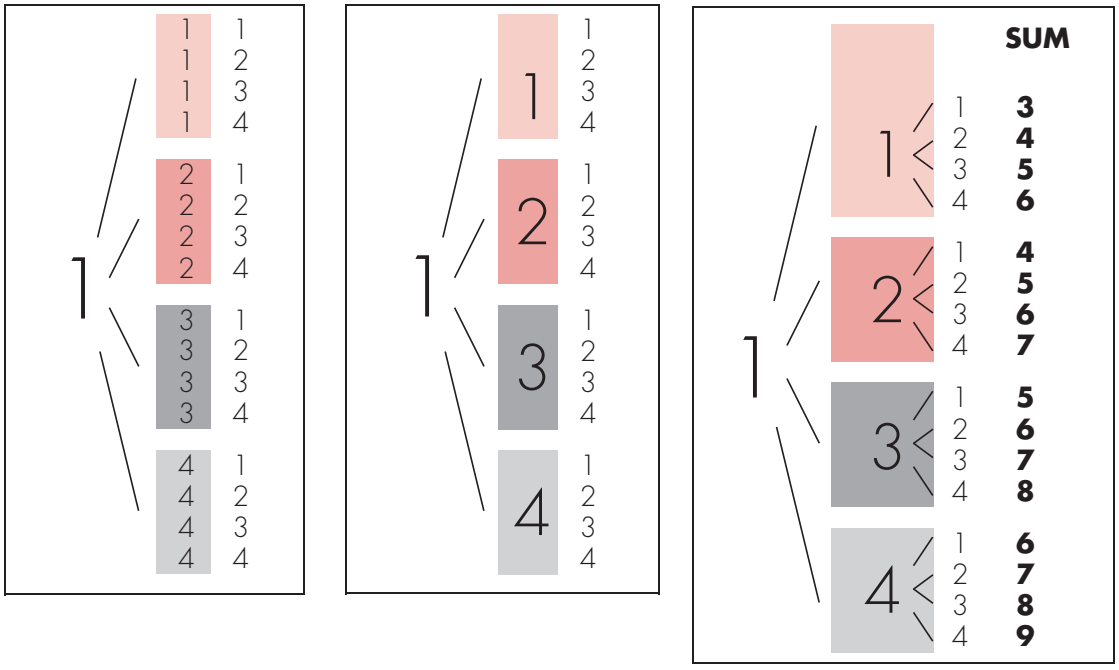
This is only ¼ the total number of outcomes and the process of completing the rest gets very repetitive.

1	1	1
1	1	2
1	1	3
1	1	4
1	2	1
1	2	2
1	2	3
1	2	4
1	3	1
1	3	2
1	3	3
1	3	4
1	4	1
1	4	2
1	4	3
1	4	4

We could get rid of the repetitions by replacing the first column of 1's with 1 big 1.



Can you get rid of any more repetitions?



Can you see a pattern forming?
This is called a tree diagram; can you see why? Can you see how the required outcome (sum of the three spinners) is calculated for each 'branch' of the 'tree'?

i. Draw tree diagrams showing the possible outcomes when the first spinner shows 2, 3, and 4.

ii. How many possible outcomes are there? Now use your diagrams to decide if the game is fair (see the rules at the start).

This is how one student explained why tree diagrams are very useful when counting outcomes such as in this question:

Well, tree diagrams are useful for counting the total number of outcomes. There are four 'trunks' (for the possible numbers on the first spinner), and each has four 'branches' (for the possible numbers on the second spinner), and each has four 'twigs' (for the possible numbers on the third spinner). An outcome is formed as we go from a trunk to a branch to a twig. There are as many outcomes as there are twigs: 4x4x4=64.

c. Draw a tree diagram showing the number of possible outcomes when three coins are tossed

Could you have answered this question without drawing the tree diagram?

Explain

i. Use your tree diagram to answer the following

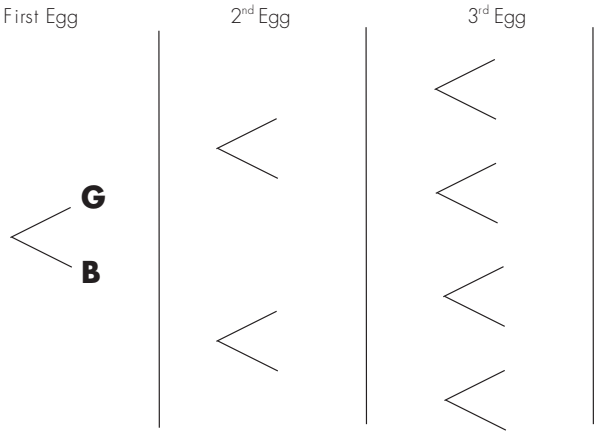
P (All tails) =

P (All heads) =

ii. Predict the number of possible out comes when two coins are tossed and 1 die is rolled. Check your prediction by drawing a tree diagram.

Q. 1 There are a dozen eggs in a box and 3 of them are 'bad'. 3 eggs are chosen at random from the box.

a. Complete the probability tree diagram below, showing good (G) and bad (B) eggs.



b. Work out the probability that

i. all three eggs are 'good'

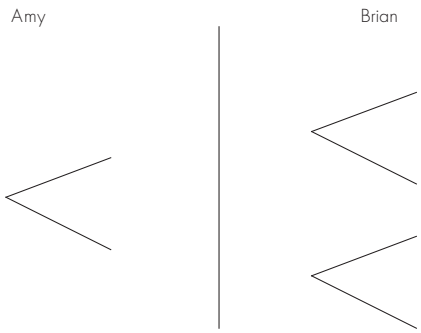
ii. 1 egg is 'bad'

iii. 2 eggs are 'bad'

iv. all three eggs are 'bad'

Q. 2 Jessica is taking part in a quiz. She is unsure of the answer to a question and needs to ask her team-mates, Amy and Brian. The probability that Amy will get it right is 0.7.The probability that Brian will get it right is 0.4.

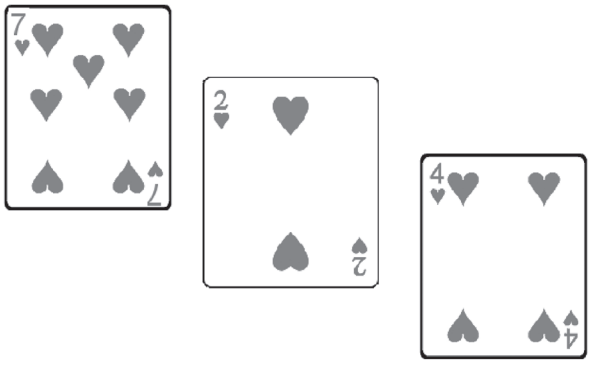
a. Complete the probability tree diagram below.



i. What is the probability that at least one of her two friends will give her the correct answer?

ii. What is the probability that neither of them will give her the correct answer?

Q. 3 John and Sophie each have three cards numbered 2, 4 and 7. They each select one of their own cards. They then add together the numbers on the four remaining cards. What is the probability that their answer is an even number? Explain how you arrived at your answer.



Q. 4 Suppose that every child that is born has an equal chance of being born a boy or a girl.

i. Write out the sample space for the situation where a mother has two children.

ii. What is the probability that a randomly chosen mother of two children would have two girls?

iii. What is the probability that this mother of two children would have two boys?

iv. What is the probability that this mother of two children would have one boy and one girl?

STATISTICS 1

SYLLABUS TOPIC: REPRESENTING DATA GRAPHICALLY AND NUMERICALLY

LEARNING OUTCOMES

As a result of completing the activities in this section you will be able to

- explore concepts that relate to ways of describing data, such as the shape of a distribution, what's typical in the data, measures of centre (mode, median, mean), and range or variability in the data
- use a variety of summary statistics to analyse the data: central tendency; mean, median, mode
- select appropriate graphical or numerical methods to describe the sample (univariate data only)
- evaluate the effectiveness of different displays in representing the findings of a statistical investigation conducted by others
- use pie charts , bar charts, line plots, histograms (equal intervals), stem and leaf plots to display data
- use back to back stem and leaf plots to compare data sets

There are links with Strand 3 (Number) where you will investigate models such as accumulating groups of equal size to make sense of the operation of multiplication.

INTRODUCTION

Being able to see a data set as a whole and so being able to use summary statistics such as averages to describe the 'big picture' or the overall shape of the data is an important learning intention of strand 1.

The activities described below allow you to investigate how the mean is constructed and the relationship of the mean to the data set it represents. You will also explore the different ways the median and mean represent the data - the median as a middle point in the data, and the mean as a 'point of balance' or the 'fair share' value of the data. Using two different representations of the mean gives you a chance to view the relationship between the mean and the data set through different models and so construct a firm understanding of the mathematical concept.

Prior learning

The idea that a set of data can be viewed and described as a unit is one of the key ideas about data that develops across primary school and is built on at second level. Initially, you looked at each individual piece of data. Gradually, you began to move away from a focus on individual pieces of data to looking at larger parts of the data. You learned to make general statements about the group of things or phenomena that the data represent, such as 'most people in our class have 1 or 2 siblings, and the range is from no siblings to 6 siblings.' Now you are ready to move away from making general statements and begin to make summary statements that describe the whole data set.

Activity 1.1

There are 5 bags of sweets, each of a different brand. All bags are the same size. The average price for a bag is €1.43

a. What could the individual prices of the 5 bags be? Think of at least two different sets of prices.

b. If both of your sets of prices included €1.43 as a price for at least one of the bags, price the five bags without using €1.43 as one of the prices.

c. Did you use €1.43 as the median? If so, what is the mean for your sets of prices? If you didn't use €1.43 as the median, what is the median for your sets of prices? Are the mean and median the same or different?

Discuss one of your lists of five prices with your group. How did you decide on your list of prices? How do you know what the average is in each example?
Note to each small group: Make sure you consider some lists that do not include a value of €1.43 as one of the prices.

d. There are seven bags of beads. Five of the bags have the following numbers of beads in them: 5, 7, 8, 9, and 12. Now work through parts (i), (ii) and (iii) with your group.

   i. Make a representation of the five bags by using small objects such as cubes, counters, marbles, etc. Make another representation of the five bags on a line plot.

   ii. Now use your representation to figure out how many beads could be in the other two bags so that 8 is the mean number of beads for all seven bags. Try to figure this out without adding up the beads in the five bags. Find at least two different sets of numbers for the two bags that will solve this problem.

   iii. Revise your two representations – counters and line plot – so that they show all 7 pieces of data. Can you 'see' the average in your representation?

e. What is the least number of beads there could be in one of the additional bags? What is the greatest number?

f. What numbers of beads could be in the two other bags if the mean number of beads was 7? What if the mean number was 10?

Q1. A teacher had some cards with groups of numbers displayed on them, as shown below

1, 7, -8, 0,	0, 0, 0	-2, 8, -6, 7, 11
0, 11, 8, 0, 13	-5, -4, -3, -2, -1 0, 1, 2, 3, 4, 5	2, 3, 4, 5, 6, 7, 8 9, 10

John was asked to calculate the mean of the numbers on each card and to put the cards that had a **mean of zero** into a box.

a. Circle the cards that John should put into the box.

The teacher has another card and tells the students that the mean of the numbers on this card is also zero.

b. Tick the correct box for each statement about this extra card.

Statement	Must be true	Could be true	Cannot be true
All of the numbers are *zero*			
Some of the numbers are *zero*			
There are as many negative numbers as positive numbers			
The sum of ***all*** the numbers is zero			
All of the numbers are positive numbers			
Some of the numbers are positive numbers			

Q.2 3 girls and 5 boys received text messages

The mean number of messages received by the 3 girls was **31**.

The mean number of messages received by the 5 boys was **27**.

Decide whether the following statements are true (T) or false (F), and justify your answer in each case:

i. The person who received the most messages must have been a girl.

ii. The mean number of messages for the 8 people was 29.

Q.3 Three girls and five boys were studying climate change in various countries around the world. They were examining the maximum daily temperatures in these areas

The mean daily temp of the locations studied by the 3 girls was 31° C
The mean daily temp of the locations studied by the 5 boys was 27 ° C

Decide whether the following statements are True or False, and justify your answer in each case.

i. The person who encountered the max daily temperature must have been a girl.
ii. The person who encountered the min daily temperature must have been a boy.
iii. The mean max daily temperature encountered by the 8 people was 29° C. .

Q.4 Sophie has six cards, each of which has a positive whole number printed on it. Four of the cards each have the number 9 on it.

a. Without knowing the numbers on the other two cards, can you give the value of the
   i. median
   ii. mode
   iii. range

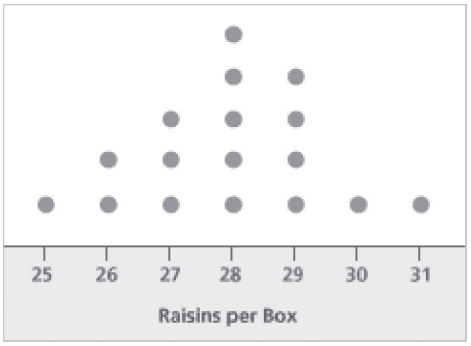
Explain your reasoning.

b. You are told that the six cards have a mean of 9. Give some possible whole numbers that could be on the other two cards. Which of your answers would give the greatest range? Why?

If the six cards have a mean of 9 and a range of 6 how many answers can you now find for the numbers on the remaining two cards?

Q.5 Students were investigating the number of raisins contained in individual mini-boxes of Sun-Maid raisins.

They recorded their results in the diagram shown.



a. Use the diagram to answer the following:

   i. How many boxes of raisins did they survey?

   ii. What was the modal number of raisins per box?

   iii. What is the median number of raisins per box? Explain how you found this answer.

b. If the students chose a box at random from all the boxes they surveyed what is the probability that the box contained 29 raisins?

Having done this activity, the students are asked to write down the answer they would give to the question: 'How many raisins are in a mini-box of Sun-Maid raisins?' Here are some of the answers they wrote down:

A 'There could be any number of raisins in a box.'
B 'There are about 28 raisins in a box.'
C 'There are almost always 28 raisins in a box.'
D 'You can be fairly sure there are 27, 28 or 29 raisins in a box.'
E 'Probably 28'.

c. Which of the answers above do you think is the best answer to the question? Explain why you think it's the best.

d. Which of the answers above do you think is the worst answer? Explain why you think it's the worst.

Activity 1.2

A good part of one's day is spent travelling from one place to another. How much time do you spend travelling to school? How much time do your classmates spend travelling to school?

Carry out a survey to find out how everyone in your class travels to school, and how long the journey takes, on a given day. Your survey should enable you to answer a series of questions.

Deciding to walk or to go by car may depend on the distance, but, after choosing the method of transportation, does everybody spend about the same amount of time travelling to school?
Do those who take the bus to school spend less time than others?
Does the time it takes to get to school depend on where you live?

To better understand the situation, consider the 'time travelling to school' variable. Analyse the data you collect based on the method of transportation used.
Do you think this situation varies from one region in Ireland to another?

Time to get to school

Enter the class data in a table, such as the one below, grouping them in intervals of ten minutes, for example. First write down the numbers as you collect them. Then put them in ascending order to create a stem and leaf plot, where the tens are the 'stems' and the units are the 'leaves'. For example, a time of 15 minutes is recorded by placing a '5' in the Units column in the row which corresponds to the '1' in the Tens column.

Time to get to school Raw data	
Tens	Units
0	
1	
2	
3	…
…	…

Now, try to get an overview.

1. Look at all the ordered data. Half the class takes less than how many minutes to get to school? This number is called the median; it's the central value that divides the list of ordered data into two equal sections.
2. What is the average time that students in your class spend travelling to school?
3. Which row contains the most data? In your opinion, what does this mean?
4. What is the shortest time? What is the longest? What is the difference between them?
5. What can you say about the time that students in your class spend to get to school?

To get a better picture of the situation, it would help to add a column to your table that shows the number of students.

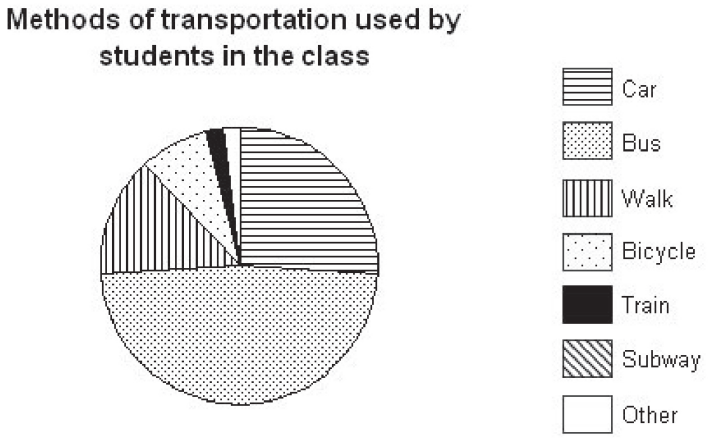
Time to get to school Raw data		
Tens	Units	No of Students
0		
1		
2		
3	…	
…	…	
	Total	

6. Now, can you create a graph that shows how much time the students in your class spend travelling to school? As you can see, everybody does not spend the same amount of time travelling to school.

You can now examine whether this time changes with the method of transportation.

Time spent by method of transportation

First, group together the students who use the same method of transportation. You can quickly determine the distribution of students by transportation method by creating a pie chart with a spreadsheet program. Your chart might look something like this:



From your chart, what are the most popular methods of transportation?
Approximately what fraction of the students in your class walk to school.

Now, for each method of transportation:

a. sort the time spent getting to school, from the shortest to the longest time.

b. determine the total time spent, which lets you calculate the average.

c. find the number of minutes or less that the faster half of the students spent travelling to school. This is the median or the value of the middle item of the ordered data.

d. add the minimum and maximum amount of time spent travelling to school.

Create a descriptive table that will look like this:

Method of Transportation	Time to get to school (mins)	No	Total Time	Average Time	Median	Min	Max
Car	5, 12, 12, 2, 32,	5	83	83/5	12	5	32

You can now examine the time by method of transportation.
Do you notice any significant differences?
Which method of transportation takes the longest?
Which method of transportation shows the biggest difference between the shortest time (minimum) and the longest time (maximum)? What might explain this?
Can you describe the overall situation for your class and present your point of view? What type of transportation do you think we should encourage? Under what conditions? Why?
Finally, use the data you have obtained to create a graph that properly conveys the information about your class that you feel is important.

Comparing your class to a sample of Irish students

Do you think the situation of your class resembles that of most Irish students?
Obtain a sample of 50 students from your school. Then do the same analysis that you did for your own class.
Is the time spent getting to school approximately the same for both groups? If not, how does it vary?
To help you better compare the data, create two tables side-by-side for each group.

Time to get to school				
Raw data for the school			**Raw data for our class**	
Students	**Units**	**Tens**	**Units**	**Students**
		0		
		1		
		2		
		3	…	…
		4	…	…
		5	…	…
50	Total	TOTAL	Total	

'A picture is worth a thousand words' and can certainly make it easier to read all these numbers. Create appropriate graphs to easily compare the time spent getting to school for both groups.

You can also compare the methods of transportation used.
For each group: create a pie chart to illustrate the distribution of students for the different methods of transportation used to get to school.
Use a descriptive table to examine the time spent by method of transportation used.
Do you arrive at the same observations for both groups? Are there any significant differences? If yes, what are they? Can you explain the differences taking into account the characteristics of your region?
Create a visual representation that properly illustrates and conveys your main conclusions.

STATISTICS 2

SYLLABUS TOPIC: FINDING, COLLECTING AND ORGANISING DATA

LEARNING OUTCOMES

As a result of completing the activities in this section you will be able to

- clarify the problem at hand
- formulate one (or more) questions that can be answered with data
- explore different ways of collecting data
- design a plan and collect data on the basis of above knowledge
- generate data, or source data from other sources including the internet
- discuss different types of studies: sample surveys, observational studies and designed experiments
- select a sample (Simple Random Sample)
- recognise the importance of representativeness so as to avoid biased samples
- design a plan and collect data on basis of above knowledge.

The activities described below and the questions that follow give you the opportunity to construct an understanding of the concept of finding, collecting and organising data in a statistical investigation. By carrying out a complete data investigation, from formulating a question through drawing conclusions from your data, you will gain an understanding of data analysis as a tool for learning about the world.

The activities are designed to build on your previous experiences with data, and to introduce you to the ideas you will work on as you progress through statistics in Strand 1.

During these activities you will work with categorical data, noticing how these data can be organised in different ways to give different views of the data.
As a result you should be able to

- gather data from a group
- classify the data
- write sentences that describe the 'Big Picture' of the data
- appreciate how the purpose of the research will affect how the data is gathered
- understand that the way data is represented can illuminate different aspects of the data.

Activity 2.1: A data Investigation

With what well-known person would you like to meet?

1. You will be working in groups on a data investigation. The first step is for each student to decide on his/her own how they would answer the survey question. Each student will need to write their answer a number of times on separate pieces of paper so that they can give their individual answers to each group, including their own.
2. Each group collects answers from everyone; make sure your group has a full class set of data that you can discuss.
3. Before you look at the data spend a few minutes discussing what might be interesting about them.
4. As a group sort the class data into three piles according to what they have in common. This is called classifying your data.
5. Choose one of your ideas for sorting and arrange your cards on a large piece of paper to show that classification
6. Write a sentence or two on your display that tells what you notice about the data
7. Post your display on the wall. If you finish before other groups, discuss issues about data that arose while you did this activity.
8. Can you represent this data in a chart?

Key Words: **Category, Data**

As you work through this activity reflect with your group on

- What issues came up for you as you tried to represent these data?
- What does the data tell you about the group?
- What questions arise for you while looking at this data? How might you modify the survey in order to address these?
- Did everyone interpret the original question in the same way?
- What were you thinking when you made your own decision?

Consider the following question

How many countries have you visited?

Elect a scribe to sketch a line plot with reasonable intervals on the board. Collect data on the line plot by marking an X for the value of each person's response. (Note: a line plot is a graph for numerical data that is similar to a bar chart. It is one of the plots in common use in statistics.) Try to form statements that describe the data. What can they say for the class as a whole about the number of countries that they have visited?

Activity 2.2

1. Note: You have 30 mins to complete this assignment and post a representation of your data for others to see. That means you will need to decide on a question and collect your data efficiently. You may need to design a data collection sheet. Think about how you will make sure you get a response from every person. After 15 mins you should be ready to start making a data representation. Your representation need not be decorative or elaborate. Focus on how well it communicates information about your data.
2. Select a question that will result in numerical data
3. Collect data from everyone in the class.
4. Create a line plot for your data
5. Write three to five sentences on your display that describe your data
6. When your display is complete, discuss issues that arose in your group as you defined your question
7. What further questions might you want to pursue based on these initial data?

Sample data collection sheet

Name	Name	Name	Name	Name
Name	Name	Name	Name	Name
Name	Name	Name	Name	Name
Name	Name	Name	Name	Name
Name	Name	Name	Name	Name
Name	Name	Name	Name	Name