Chance and Data Activities:

The activities that follow are designed to be used with a larger-scale investigation. The topic to be investigated is explained below, but it can easily be altered and the lessons that follow will still be suitable.

Instead of writing a separate set of activities for each of the Essential Learning statements, the following activities aim to cover them all.

Investigation topic:  Risky behaviour and youth
Media often represents youth in terms of very negative stereotypes. Your job in this investigation is to determine how much truth there is to these opinions, by working out what the ‘average’ youth is like. You will need to examine the validity of common stereotypes relating to:

- Promiscuity
- Crime
- Drug and alcohol abuse
Assessment:

For each of the following activities, determine whether the activity is a novel problem for students. If so, it can be used to assess thinking and reasoning, communication, and reflection. If it is not a novel problem, it may still be used for assessing communication and reflection, but not thinking and reasoning. Novel problems are not appropriate for assessing a student’s knowledge and understanding as students must be given opportunities for practising skills prior to assessment.

Determine the quality of each student’s thinking and reasoning by deciding whether they worked out the answers/patterns by themselves or with help. The quality of their grade should be reflected by the following statements:

A. Student found the answers and determined the pattern by themselves or with minimal help/prompting,
B. Student found the answers and determined the pattern with some help, but without being shown a method or having the pattern pointed out to them,
C. Student could answer the questions only after being shown a method by someone else. They had the pattern pointed out to them by another person.
D. Student answered the questions inconsistently after being shown one or more methods.

Determine the quality of each student’s communication and reflection using the student’s answers to the questions in the grey box. The quality of their grade should be reflected by the following statements:

A. Student communicated how he/she worked out the patterns in a step-by-step manner. His/her explanations were detailed and logical. The pattern the student found did not have major flaws. The student was able to adapt the pattern to various situations, and suggest multiple uses for it.
B. Student communicated how he/she worked out the patterns in a clear, but not necessarily step-by-step manner. His/her explanations were logical. The student may have had some help to find the pattern, but was able to adapt the pattern to suit various situations and suggest several uses for it.
C. Student communicated how he/she worked out the answers, but the explanations were not detailed or particularly clear. Students were shown the pattern by someone else, but suggested another use for it.
D. The student attempted some explanation of the patterns, but it was not clear or logical. He/she reflected superficially on uses or adaptations of the pattern.
Teacher suggestions sheet

**Essential Learning Statements:**

1. Data can be gathered from samples and surveys, experiments and simulations, published data and databases, and used to estimate probabilities of events and to respond to claims and questions.
2. Sample spaces can be specified for single events and straightforward compound events using tables and tree diagrams, and probabilities can be determined using different methods, including counting, measuring and symmetry.
3. Data interpretation is simplified through the use of suitable representations and descriptive statistics.
4. Simple measures of spread and centre, distribution of responses, and the effect of bias and outliers on the measures of location are used to make inferences.

A. Introduce data collection via surveys, including initial grouping, sorting, analysing and interpreting.

**Before you start**

These activities will take considerable time to complete. Make sure that you are ready for students to begin their large investigation before beginning these.

**Teaching steps**

**Activity Ai**

Format: Individual work and class discussion

1. Give all instructions and hand out activity sheets. Students complete the questions individually.
2. Work in groups or as a whole class to attempt to classify the answers. Students will realise that some of the questions are ambiguous or that the answers are difficult to classify. These questions should be rewritten.
3. Repeat the process of taking the survey and revising the questions until a consensus has been reached.
4. Have students reflect on the process: what did they learn, what would they do differently next time, how could they use what they have learned in the larger investigation?

**Activity Aii**

Format: Individual or pairs work and class discussion

1. Give all instructions and hand out activity sheets. Students should be familiar with these forms of graphing already, so the first page is really a revision sheet.
2. Work in groups or as a whole class to attempt to define what an ‘average’ youth would be. Students will realise that some of the questions are difficult to define an average for. This should lead on to a discussion about what ‘average’ means (mean, median, mode). Encourage debate and discussion between class members.
3. Complete the reflection individually.

**Assessment**

Collect the sheets for the group, and mark each student individually using the criteria on the ‘Assessment’ cover sheet at the start of this activity set.
Introduction to data collection

People define ‘youth’ in a number of different ways: ages, stage of life, characteristics etc. The aim of this activity set is to try and come up with a statistical definition for the average youth. What are we like? How can we classify ourselves? We will be examining how statistics are gathered, displayed, classified and analysed, and using these techniques to help us define ‘youth’ statistically.

Begin by answering the questions below. You will then classify, display and analyse data for your class. This will form the basis for an initial school-wide survey that you will develop in the next activity.

Questions:
1. How old are you?
2. What grade are you in at school?
3. Are you male or female?
4. Who lives at your house?
5. Who is in your immediate family?
6. What are your main interests?
7. What religion are you (if any)? Are you practicing, or nominal?
8. What sports do you play?
9. Do you have a job? Give details.
10. What is your average weekly income? (pocket money, income)
11. How tall are you?
12. What job would you like to do after school?
13. Are you intending to go to university or tafe when you finish school? If so, what are you planning to study?
14. What is your cultural background?
15. How many hours per week do you watch TV?
16. How many hours per week do you spend at a computer?
17. What is your favourite food?
18. How many times per week do you eat take-aways? (out of a total of 21 meals – 3 per day for breakfast, lunch and dinner)
Counting and classifying your data:

Examine the answers for your whole class. Try to group the answers from each question into categories so that you could create a table or graph of the results. Write your categories for each of the questions in the space below, and also write any of the questions which had difficult answers to categorise. Reword any questions that were difficult so that classifying the answers is easier. You may want to think about giving them options to select from instead of having open-ended questions.

Our categories for the responses:

1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18

Classifying the data:
Put the data from all of your class together and try to group the answers into categories. Grouping the data will help you to work out how to find the ‘average’ answer to each question. Some of the answers may be difficult to group. You will probably need to rewrite these questions and redo the survey to get more specific answers.
Aii  Displaying our data:

Create a data table or a tally chart to summarise the answers to each of the questions. From this choose an appropriate data display from the list below, and create one graph for each question. You do not have to complete each type of graph for each question, but just decide on one appropriate display. Make sure that you show each display type at least once. Write a sentence for each question describing your results, and why you chose to use this particular data display. Attach your displays to this activity.

Display types:
1. Horizontal or vertical bar graph
2. Pie graph
Analysing and evaluating our data:

Now that you have classified and displayed your data, you need to try to define the ‘average’ or ‘normal’ answer for each question. Give your answer, and write a sentence to explain how you came up with this. After you have finished, write a sentence or two to describe how easy or difficult you found this process. How did you decide what ‘average’ meant in each case?

Considering your findings:

The issues and questions that you have struggled with in this activity are the same ones that statisticians everywhere find difficult. It is hard work to develop a question that is unambiguous and also easy to classify the answers for. Over the next few activities you will be learning about this process and attempting to define what the ‘average’ youth is.

Reflection:

What did I learn about data collection and analysis through these activities?

What will I do differently next time?

How will what I have learned help me with this investigation?
Essential Learning Statements:
1. Data can be gathered from samples and surveys, experiments and simulations, published data and databases, and used to estimate probabilities of events and to respond to claims and questions
2. Sample spaces can be specified for single events and straightforward compound events using tables and tree diagrams, and probabilities can be determined using different methods, including counting, measuring and symmetry
3. Data interpretation is simplified through the use of suitable representations and descriptive statistics
4. Simple measures of spread and centre, distribution of responses, and the effect of bias and outliers on the measures of location are used to make inferences

B. Developing a survey

Before you start
Make sure that you are ready for students to begin their large investigation before beginning these activities. You will need to make time over the next few weeks for students to gather data for this survey that they are designing.

Teaching steps
Format: Group work and discussion
1. Give all instructions and hand out activity sheets.
2. Students work in groups to describe what makes youth unique, and to develop questions to ask their school.
3. At some point over the next few weeks students will need to actually complete this survey of students in their school. The data is needed for later activities.
4. Have students reflect on the process: what did they learn, what would they do differently next time, how could they use what they have learned in the larger investigation?

Assessment
Collect the sheets for the group, and mark each student individually using the criteria on the ‘Assessment’ cover sheet at the start of this activity set.
B Developing a basic school survey

In the previous activity you answered some questions aimed at defining or describing the average youth in your class. In this activity you are to start developing a survey that you could ask students in your school to answer. Begin by brainstorming your ideas about what makes youth different to other people. These issues and characteristics are the ones that you need to survey people regarding.

What do I think makes youth different or unique?

Developing questions:
Write a series of questions below that you could ask people in your school to answer that would help you to define what the ‘average’ youth is like. Remember to include categories for answers if these are needed, and write your questions carefully to make them unambiguous and easy to classify answers for. You do not need to have people actually answering the questions at this stage, just write a list of good questions.
Teacher suggestions sheet

Essential Learning Statements:

1. Data can be gathered from samples and surveys, experiments and simulations, published data and databases, and used to estimate probabilities of events and to respond to claims and questions
2. Sample spaces can be specified for single events and straightforward compound events using tables and tree diagrams, and probabilities can be determined using different methods, including counting, measuring and symmetry
3. Data interpretation is simplified through the use of suitable representations and descriptive statistics
4. Simple measures of spread and centre, distribution of responses, and the effect of bias and outliers on the measures of location are used to make inferences

C. Introduce data collection via census

Before you start

Students will need access to the Australian Bureau of Statistics website for this activity or you will need to have downloaded a copy of the census to use. This activity has an at-home component, so cannot be completed in one lesson.

Teaching steps

Format: Individual work and class discussion

1. Give all instructions and hand out activity sheets. Divide students into small groups or pairs. Examine the questions from the census together.
2. Complete the census with your family members.
3. Discuss the questions and answers as a class.
4. Reflect: what have we learned about question construction and importance? How can we apply this in our investigation?

Assessment

Collect the sheets for the group, and mark each student individually using the criteria on the ‘Assessment’ cover sheet at the start of this activity set.
c  **Australia wide: the need for a census**

The major task for this investigation is to define what the ‘average’ youth is like. In order to do this we also need to consider how you fit into Australian society as a whole. Rather than attempting to question all Australians about what they are like, we are going to use the results from the last census, which is available free of charge from the Australian Bureau of Statistics (ABS).

A census is different from a sample survey because it asks all the members of a population the same set of questions. A sample survey only asks some of the population, and makes generalisations based on these. Although a sample survey is less accurate is it normally used instead of a census.

Why do you think this might be?

Every five years the Australian Government conducts a census to find out information about Australians. Across Australia every household is asked to answer a set of questions on the same night. The aim is to generate a snap-shot of exactly what is happening in Australia at that time. This data is used to inform a number of decisions made by the government, including the allocation of funding.

Your job is to go on line to the ABS website and download a copy of the most recent census questions. Tonight answer the questions with everyone who lives (or is staying temporarily at) your home. Bring your answers to class tomorrow to analyse. Be aware that some of the questions will be very personal, and you do not have to answer them if it makes your family uncomfortable (income etc.)
Analysing census questions

Developing and carrying out a census takes time and costs an enormous amount of money. This means that the Government needs to consider carefully which questions they want to include. They also can’t afford to include ambiguous questions or else they won’t have any information that they can use.

Examine the questions that are asked, and group these into categories. For example, one category might contain questions about occupations. Describe each of the categories in the space below, write the question numbers that fit into this category, and write a sentence to describe why this information might be important to the government.
Teacher suggestions sheet

Essential Learning Statements:

1. Data can be gathered from samples and surveys, experiments and simulations, published data and databases, and used to estimate probabilities of events and to respond to claims and questions
2. Sample spaces can be specified for single events and straightforward compound events using tables and tree diagrams, and probabilities can be determined using different methods, including counting, measuring and symmetry
3. Data interpretation is simplified through the use of suitable representations and descriptive statistics
4. Simple measures of spread and centre, distribution of responses, and the effect of bias and outliers on the measures of location are used to make inferences

D. Students can predict the likelihood of outcomes in events similar to previous experiments

Before you start

Students will need calculators for this activity

Teaching steps

Format: Pairs or small group work
1. Explain to students that in this activity they will be using pre-existing data that is similar to experiments they have conducted
2. Give all instructions, divide students into groups or partners and hand out activity sheets. Students should be able to work through this sheet with minimal teacher input if they successfully completed the previous activity.
3. Discuss students' findings as a class. Students should have determined approximate probabilities for each of the situations, and should be starting to comment on how accurate these can be considered.

Assessment

Collect the sheets for the group, and mark each student individually using the criteria on the ‘Assessment’ cover sheet at the start of this activity set.
D Predict outcomes in similar situations

Use the following pre-existing data to determine approximate probabilities. Use the same method as you used for determining numerical probabilities.

1. In a toss of the coin, the results were:

<table>
<thead>
<tr>
<th>Heads:</th>
<th>Tails:</th>
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How many heads? _____ How many altogether? _____

How do I work out the approximate probability of throwing heads?

What is the approximate probability of throwing heads?

What would you predict the likely outcome of the next 10 throws to be?

2. In races between Danielle, Stacey, Bec and Petrice the winners were:

<table>
<thead>
<tr>
<th>Danielle</th>
<th>Stacey</th>
<th>Bec</th>
<th>Petrice</th>
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</tbody>
</table>

What is the approximate probability of:

- Danielle winning _______________
- Stacey winning _______________
- Bec winning _______________

What would you predict the outcome of the next 10 races to be? Why?

3. In a pre-election poll to determine which candidate was likely to become the new Mayor, the results were as follows:

<table>
<thead>
<tr>
<th>Andrew Thomas</th>
<th>Robyn Kennedy</th>
<th>Sally Watson</th>
</tr>
</thead>
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</table>

Determine the approximate probability of each candidate being elected:

What would you predict the outcome of the next 10 votes to be? Why?
Teacher suggestions sheet

Essential Learning Statements:

1. Data can be gathered from samples and surveys, experiments and simulations, published data and databases, and used to estimate probabilities of events and to respond to claims and questions.
2. Sample spaces can be specified for single events and straightforward compound events using tables and tree diagrams, and probabilities can be determined using different methods, including counting, measuring and symmetry.
3. Data interpretation is simplified through the use of suitable representations and descriptive statistics.
4. Simple measures of spread and centre, distribution of responses, and the effect of bias and outliers on the measures of location are used to make inferences.

E. Students can use probability models to determine all possible outcomes of an event involving equally likely outcomes.
   1. lists,
   2. tables,
   3. tree diagrams,
   4. computer simulations,
   5. experiments

Before you start
You will need plenty of paper, and access to computers for the computer simulation part.

Teaching steps
Format: Group discussion and experimentation
1. Give all instructions, divide students into groups and hand out the activity sheets. Students determine how each of the probability models works and then apply this to the situations they are given on the following page.
2. You will need to work with the IT support teacher in your school to use the computer simulations as these can be difficult. Excel can be useful.
3. Discuss students' findings as a class. Examine each other’s models and check for accuracy. Discuss how with some experiments the outcomes can be the same, for example 1 scoop chocolate, 1 scoop vanilla is the same as 1 scoop vanilla, 1 scoop chocolate. Take out the double-ups where appropriate.

Assessment
Collect the sheets for the group, and mark each student individually using the criteria on the ‘Assessment’ cover sheet at the start of this activity set.
E use probability models for sample space

In this worksheet you will learn how to use lists, tables, tree diagrams and experiments to list all possible outcomes of an event.

Probability models:
Examples are given below for each of the different probability models. You are to work out how these are used, and then use them to model each of the situations below with each of the different models.

1. Lists:
The possible outcomes of throwing three coins are: HHH, HHT, HTH, THH, HTT, THT, TTH, TTT

2. Tables:
The possible outcomes of throwing three coins are illustrated in the table below:

<table>
<thead>
<tr>
<th>Possibilities</th>
<th>Coin 1 could be H</th>
<th>Coin 1 could be T</th>
</tr>
</thead>
<tbody>
<tr>
<td>Coin 2 could be H</td>
<td>HH</td>
<td>TH</td>
</tr>
<tr>
<td>Coin 2 could be T</td>
<td>HT</td>
<td>TT</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Possibilities</th>
<th>Throw 1 and 2 could have given HH</th>
<th>Throw 1 and 2 could have given TH</th>
<th>Throw 1 and 2 could have given HT</th>
<th>Throw 1 and 2 could have given TT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Coin 3 could be H</td>
<td>HHH</td>
<td>THH</td>
<td>HTH</td>
<td>TTH</td>
</tr>
<tr>
<td>Coin 3 could be T</td>
<td>HHT</td>
<td>THT</td>
<td>HTT</td>
<td>TTT</td>
</tr>
</tbody>
</table>

3. Tree diagrams:

<table>
<thead>
<tr>
<th>Coin 1</th>
<th>Coin 2</th>
<th>Coin 3</th>
<th>Result:</th>
</tr>
</thead>
<tbody>
<tr>
<td>H</td>
<td>H</td>
<td>HHH</td>
<td></td>
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<tr>
<td>H</td>
<td>T</td>
<td>HHT</td>
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<tr>
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<td>H</td>
<td>HTH</td>
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<td>T</td>
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<td>TTT</td>
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</table>

4. Experiments:
Throw three coins 50 times and write down all the different combinations that you get. Did you get them all? How many times would you have to throw to guarantee that you threw them all?
Use these models to model the following situations. Attach them to this sheet. Also try to work out how to model one of these using a computer simulation.

1. Two die being tossed
2. People can vote for two of Jenny, Adam and Greg
3. You can choose two scoops of ice cream from the following flavours: chocolate, strawberry, vanilla and coffee
4. Choose two numbers between one and ten

What patterns have I found? What was difficult? What did I find helpful? Which model/s did I prefer using or did it depend on the context?
Teacher suggestions sheet

Essential Learning Statements:
1. Data can be gathered from samples and surveys, experiments and simulations, published data and databases, and used to estimate probabilities of events and to respond to claims and questions.
2. Sample spaces can be specified for single events and straightforward compound events using tables and tree diagrams, and probabilities can be determined using different methods, including counting, measuring and symmetry.
3. Data interpretation is simplified through the use of suitable representations and descriptive statistics.
4. Simple measures of spread and centre, distribution of responses, and the effect of bias and outliers on the measures of location are used to make inferences.

F. Students can describe the similarities and differences between experimental and theoretical probabilities. Calculate theoretical probabilities.

Before you start
You will need to have calculators for this activity. You should also gather information about various lottery games. Having old ticket stubs and tapes of the lottery draws would be useful. You will need some differently shaped prisms and pyramids for the demonstration part of the second activity. One should be a cube or a dice.

Teaching steps
Activity Fi
Format: Class investigation
1. Introduce the concept of numerical (or theoretical) probability to the class by asking them if they knew how likely an outcome was would it change their actions. For example, if they knew that one horse was more likely to win than another, would they bet on that horse. If they knew an operation was likely to be a success, what level of risk would they be willing to take?
2. Have students look up what theoretical probability and experimental probability mean. Define these and describe how they are used in different situations.
3. Have each student pick a number from 1-50. Ask them to determine the probability that their number is correct \( \frac{1}{50} = 0.02 \).
4. Now ask them to pick a second number from the remaining ones. Ask them to determine the probability of that number being correct \( \frac{1}{49} = 0.020408 \).
5. Now ask them how you would determine the probability of them getting both numbers correct without knowing what the first number was. Show them how to multiply the two probabilities together to determine this \( 0.02 \times 0.020408 = 0.00040816 \). Discuss with students that this outcome is far less likely than choosing one number correctly. Instead of being a one in 50 chance, this is now approximately a 4 in 10000 chance, or a 1 in 2500 chance.
6. Watch the lottery tape if you have it. If not, discuss the game: how many numbers do you have to guess, from how many possibilities?
7. Give all instructions, divide students into groups and hand out activity sheets. Hand out calculators.
8. Students should be able to work through the first sheet with minimal teacher input.
9. Discuss question 13 as a class. You may need to teach students how to read calculators when they are written in scientific or powers notation.
10. Complete or attempt the questions on page two in groups. If the numbers become too difficult to manipulate, skip to the final question. Students should get the point even if they don’t do all the calculations.
11. Discuss students' findings as a class. Relate this back to the opening discussion. Discuss how some people choose to make decisions against the “odds” even when they know the likelihoods.

Activity Fii
Format: Class discussion and demonstration then group work
1. Hold up the cube. Discuss with students the likelihood of rolling any one side (1 in 6 or 0.1666). Ask students what could be done to alter these odds. They may suggest weighting the cube to one side or similar.
2. Hold up a rectangular prism that is not a cube. Ask students whether the likelihood of it rolling on any one side is the same as that for the cube. They should decide that it is not, and should be able to explain that because the faces are different sizes, the likelihoods change. Repeat with the other shapes. Ask students which shapes would have equal likelihood for each side and which would not. Shapes that have the same shape and size faces will have equal likelihood for each face being rolled. Tell students that this likelihood means that you can use “indifference” to determine the numerical likelihood of an outcome occurring. There is no need to explain what “indifference” means because it is on the sheet.
3. Give all instructions, divide students into groups and hand out activity sheets. Discuss the definition of indifference and the examples before setting groups to work.
4. Groups should be able to discuss the situations in the table, determine whether indifference occurs, and calculate the probability for cases when it does occur.
5. Discuss students' findings as a class. Some of the situations are deliberately confusing. For example, a light can only be on or off, but whether it is on or off is determined by whether someone wants it to be on or off. Each outcome is not equally likely, and the likelihood changes depending on the situation. Discuss these difficulties as a class. There are not many cases in real life where indifference can be used. Even babies can be born X or XXY not
just XX or XY. So the likelihood of being a girl or boy isn’t really 50% but it is very close to 50%.

6. Challenge students to think of situations in which indifference can be used to calculate a numerical probability. Discuss what can be done when a numerical probability can not be calculated (approximations with very large sample groups).

**Activity Fiii**

Format: Group discussion

1. Give all instructions, divide students into groups and hand out activity sheets. Students should be able to discuss these situations with minimal teacher input.

2. Discuss the pattern. Almost all situations involving human judgement do not fit into the category of “indifference”. Very few situations do.

3. Discuss students' findings and examples as a class.

**Assessment**

Collect the sheets for the group, and mark each student individually using the criteria on the ‘Assessment’ cover sheet at the start of this activity set.
Using theoretical probability for decisions

Below is an example of how to use numerical probability for decision making. Work through the example then answer the questions.

There are different kinds of probability that are used in different situations. Look up and describe the difference between experimental and theoretical probability:

Calculating the numerical probability of winning the lottery:

1. How many numbers are there to choose from?
2. What is the probability of getting the first number correct?
3. After you take out the first number, how many numbers are left to choose from?
4. What is the probability of getting the second number correct?
5. After you take out the first and second numbers, how many numbers are left to choose from?
6. What is the probability of getting the third number correct?
7. After you take out the first, second and third numbers, how many numbers are left to choose from?
8. What is the probability of getting the fourth number correct?
9. After you take out the first, second, third and fourth numbers, how many numbers are left to choose from?
10. What is the probability of getting the fifth number correct?
11. After you take out the first, second, third, fourth and fifth numbers, how many numbers are left to choose from?
12. What is the probability of getting the sixth number correct?
13. To calculate the probability of getting all six numbers correct, multiply each of the probabilities found so far. What is the probability of getting all six numbers correct?
14. For a lotto game that uses 50 numbers, what is the numerical probability of guessing all 6 numbers correctly?

15. If each Lotto game costs about $5 to play, how do the costs of playing match up with the likelihood of winning $10 million? In other words, use the numerical probability to work out how many games you would be likely to play to win one game, and then multiply the number of games by the cost per game. How does this match up to the prize money?

16. Use this information to make an informed decision about playing the lottery. Give your answer and justify it in the space below:

How is knowing the numerical probability of a situation occurring useful for decision making?
### Fii Determining probability with indifference

Indifference in probability refers to when there is no difference between the two possible outcomes that could make one more likely than the other. An example would be tossing a coin. There is nothing that would make a tail more likely to be the outcome than a head. For the following situations, determine whether indifference applies, and use this to calculate the probability. Use the examples to help you.

Examples where indifference applies:
- Tossing a coin
- Rolling a dice

Examples where indifference does not apply
- Tossing a loaded dice
- Most things involving a person’s decision

<table>
<thead>
<tr>
<th>Situation</th>
<th>Total number of possible outcomes</th>
<th>Does indifference apply?</th>
<th>Explain your answer:</th>
<th>If indifference applies, calculate the probability:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Choosing a red ball from a bag of 5 balls</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>A light switch being on or off</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Jamie winning a race with two other competitors</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>A politician winning an election from a total of 4 candidates</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>The weather being sunny</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Choosing a card with a heart on it from a deck</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>A child being born a girl</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

What have I learned about indifference?

Which situations above were difficult to work out? Why?

In what other circumstances would this knowledge be helpful?
Does indifference apply?

For the following situations determine whether indifference applies. Justify your decision by writing an explanation beneath each one.

1. Tossing a matchbox to land on a particular side

2. Tossing a cube to land on a particular side

3. Winning the lottery

4. Winning a poker game

What patterns have I found for when indifference does or does not apply?

Come up with three situations when indifference does apply:

Come up with three situations when indifference does not apply:
Teacher suggestions sheet

Essential Learning Statements:
1. Data can be gathered from samples and surveys, experiments and simulations, published data and databases, and used to estimate probabilities of events and to respond to claims and questions
2. Sample spaces can be specified for single events and straightforward compound events using tables and tree diagrams, and probabilities can be determined using different methods, including counting, measuring and symmetry
3. Data interpretation is simplified through the use of suitable representations and descriptive statistics
4. Simple measures of spread and centre, distribution of responses, and the effect of bias and outliers on the measures of location are used to make inferences

G. Students can comment on the probability of predictions based on the quantity and appropriateness of available data

Before you start
You will need coins to toss for each group of students. You will need newspapers or internet access for the final question in the second activity. Alternatively, set this task for homework.

Teaching steps

Activity Gi
Format: Group investigation
1. Tell students that they are going to test out the probability of throwing a tail when tossing a coin.
2. Divide the students into groups. Each group should throw a coin ten times and record how it lands using H for heads and T for tails. For example: H, T, T, H, H, T, T, T
3. Ask students what results they got. Discuss with students that only some of the groups had 5 heads and 5 tails. Were there any groups that got H T H T H T H T or the inverse? Discuss how using a small number of trials could not really be used accurately to determine the probability of an event occurring.
4. Put all of the groups’ data together. Calculate the approximate probability using all of the data. This number should be more close to 0.5. Ask students to explain why this number is closer to 0.5 than their individual groups’ data.
5. Give all instructions, divide students into groups and hand out activity sheets. Students should be able to work through the rest of the sheet without much teacher input.
6. Discuss students' findings as a class.

Activity Gii
Format: Group discussion and rotation
1. Give all instructions, divide students into groups and hand out activity sheets. Students should be encouraged to discuss each situation fully.
2. Once the students have considered each of the first four questions rotate the students so that they are in different groups. Repeat this rotation a number of times so that students are able to share opinions with multiple students.
3. Discuss each of the situations as a class. Ask students what a reasonable sample size would be for each situation.

4. Encourage further discussion. For example with the first situation: out of a trial of 200 women, only 100 would be given the drug and the other 100 would not. If 15% of women normally get breast cancer in their lifetimes, that is only 15 women from the “no drug” group. If an extra 3% of women contracted breast cancer in the “drug” group, that is only 3 more women. This could be an anomaly. Also, the study in not likely to have gone for the whole of these women’s lifetimes, so the number of women who contracted the cancer during the study was probably significantly smaller than this. In this case there may be only one more woman who contracted cancer. This is not statistically significant. Also, maybe the drug caused the cancer to grow more quickly in women who would otherwise contract it anyway. If this was the case then the cancer may be detected earlier than it otherwise would, and this may in fact be beneficial to the women as early detection often increases the likelihood of survival.

5. Hand out the newspapers, or have students search on line for examples of probabilities being used. Discuss these as a class and comment on the reliability of the calculations.

Assessment

Collect the sheets for the group, and mark each student individually using the criteria on the ‘Assessment’ cover sheet at the start of this activity set.
In the previous activities you will have begun to build up an understanding of probability. This activity will further your understanding.

An experiment was conducted to see whether the probability of tossing a tails in a coin was really 0.5. Here are the results:

After 10 trials the results were: H, H, T, T, H, H, T, H, H, H
The researchers decided that the possibility of the coin landing on tails was 0.3 not 0.5.

They decided to try again just to check that their results were correct. This time the researchers threw: H, T, T, T, T, H, H, T, T
They decided that the possibility of the coin landing on tails was not 0.3 but was 0.7.

They decided to try again to check the latest set of data. This time they threw: H, H, T, T, T, H, H, T, T, T
This time the probability of throwing a tails was 0.6.

1. What was wrong with the experiment that the researchers set up? Why didn’t their data over 10 trials seem to match up with the numerical probability?

2. Out of all the trials put together, the number of tails throws was: _______

3. So the probability that they found over all the trials was 16/30 or 0.53333333. Why was the probability out of all the trials closer to the numerical probability?

4. What should the researchers have done to make their trials more accurate?

5. What do you need to consider when designing trials to work out the probability of an outcome occurring?

What have I learned about numerical probability and the number of repetitions in an experiment?
Comment on approximate probabilities

In the previous activities you have learned about how the fraction of times an outcome will occur in a small number of repetitions might be quite different from the probability. In this activity you will comment on the reliability of a probability estimate, considering the amount of data used. You may also wish to comment on the reliability of the data used.

Comment on the reliability of the probability estimate for the following situations:

1. A medical study of 200 women showed that the incidence of breast cancer increased by 3% in women taking a particular form of hormone treatment

2. In a poll of 2500 people, James Darwin was shown to be the likely winner of the election for Prime Minister of Australia

3. “Nine out of ten people prefer Wheat bricks cereal”

4. A new study of 100 teenagers showed that 78% improved their result on a standard test after eating Brainy brand chocolate.

5. Find your own example to glue here. Comment on the reliability of the probability estimate.
Teacher suggestions sheet

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2. Sample spaces can be specified for single events and straightforward compound events using tables and tree diagrams, and probabilities can be determined using different methods, including counting, measuring and symmetry.
3. Data interpretation is simplified through the use of suitable representations and descriptive statistics.
4. Simple measures of spread and centre, distribution of responses, and the effect of bias and outliers on the measures of location are used to make inferences.

H. Developing questions to investigate

Before you start

Students will need time following this activity in which to conduct their survey.

Teaching steps

Format: Group work
1. Give all instructions and hand out activity sheets. Divide students into small groups or pairs.
2. Students work in groups to develop a series of questions to ask youth in their school. These questions need to concentrate on the negative representations of youth found in media reports.
3. Carry out the survey, making sure that your sample size is adequate and that your data is not compromised.
4. Have students reflect on how previous activities helped them to pose appropriate questions.

Assessment

Collect the sheets for the group, and mark each student individually using the criteria on the ‘Assessment’ cover sheet at the start of this activity set.
H Developing our questions

Now that you have examined the census questions and results your job is to write a survey to ask the students in your school. You will need to be finding out information regarding the negative stereotypes of youth, to find out if the problem is real or imagined.

Try out your questions on a few people before embarking on your complete school survey. This way you can rewrite any questions that you receive difficult answers for. Attach a copy of your final survey to this activity.
Teacher suggestions sheet

Essential Learning Statements:

1. Data can be gathered from samples and surveys, experiments and simulations, published data and databases, and used to estimate probabilities of events and to respond to claims and questions
2. Sample spaces can be specified for single events and straightforward compound events using tables and tree diagrams, and probabilities can be determined using different methods, including counting, measuring and symmetry
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I. Classifying data: two-way tables and stem-leaf plots

Before you start

Decide which of the students’ questions to use and develop a common survey

Teaching steps

Format: Group work and class discussion
1. Give all instructions and hand out activity sheets. Divide students into small groups or pairs.
2. Decide on the final question set and how many people each to ask.
3. Conduct the survey
4. Come together in small groups to determine how two-way tables and stem-leaf plots work.
5. Reflect on the patterns in the tables and how these could be used.
6. Complete the practice tables and plots to ensure that you have fully understood how they work
7. As a class, group and classify your data. Represent the data using any of the methods used so far, but make sure that some of it uses a two-way table and some uses a stem-leaf plot.
8. Using your data classification, write each of the grouped answers to the questions as a simple fraction, decimal fraction and percentage (if appropriate). Discuss what these show and the implications for your overall investigation.

Assessment

Collect the sheets for the group, and mark each student individually using the criteria on the ‘Assessment’ cover sheet at the start of this activity set.
1 classifying data

It is now time to carry out your survey. It makes more sense to select one survey from all of the students in your class to actually conduct, rather than making students answer 25 different sets of questions. Examine the survey questions that each student has developed and select the one that you think is the best.

Whose survey are you using? Why was this one chosen?

Decide how you will have students in your class ask youth at your school to answer the questions. Decide how you will make sure that no one is asked the questions twice, and how you will make sure that you include as many people as possible. Write a couple of sentences to describe your data collection strategy:

Conduct your survey and bring back the results. Put all of your data together as a class for each question, and categorise the results that you have gathered. Below is an activity about how to create a two-way table, and a stem and leaf plot. You will probably find this method very useful for recording your data. Complete the activity below to learn about these methods then complete your own data classification. Attach your results to this activity. In the following activity you will learn how to express these numbers as common fractions, decimal fractions and percentages.

Two way tables

Examine the table below and work out how it is constructed.

<table>
<thead>
<tr>
<th></th>
<th>Car</th>
<th>Truck</th>
<th>Bus</th>
<th>Motorbike</th>
<th>Bicycle</th>
</tr>
</thead>
<tbody>
<tr>
<td>Monday</td>
<td>34</td>
<td>2</td>
<td>1</td>
<td>6</td>
<td>17</td>
</tr>
<tr>
<td>Tuesday</td>
<td>36</td>
<td>1</td>
<td>1</td>
<td>5</td>
<td>18</td>
</tr>
<tr>
<td>Wednesday</td>
<td>33</td>
<td>3</td>
<td>1</td>
<td>6</td>
<td>16</td>
</tr>
<tr>
<td>Thursday</td>
<td>40</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>15</td>
</tr>
<tr>
<td>Friday</td>
<td>34</td>
<td>2</td>
<td>0</td>
<td>4</td>
<td>16</td>
</tr>
</tbody>
</table>

What can you tell about how the table is constructed?

How might a table like this be useful? In what situations would you use it?

Construct a two-way table to show the results for the age of your surveyed students with hours of TV that they watched.
Stem and leaf plots:

Stem and leaf plots are ways of representing data graphically, but with the detail of a table. Examine the stem and leaf plots below, and work out how to interpret them.

Example 1:
Ten students read the following numbers of books in a year: 6, 7, 10, 12, 12, 15, 19, 21, 23, 25

They decided to plot this data as a stem and leaf plot. The stems are the front digit or digits (tens place in this example). The leaves are the last digit (ones place in this example). They wrote the stems down in a column, and then added the leaves in rows depending on what the stem was. See the picture below and work out how they did this:

The raw data: 6, 7, 10, 12, 12, 15, 19, 21, 23, 25 was plotted as a stem and leaf plot:

<table>
<thead>
<tr>
<th>Stem</th>
<th>Leaf</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>6    7</td>
</tr>
<tr>
<td>1</td>
<td>0    2    2  5  9</td>
</tr>
<tr>
<td>2</td>
<td>1    3    5</td>
</tr>
</tbody>
</table>

1. How do you think the stem and leaf plot was made from the raw data?
2. Which stem had the most “leaves”?
3. What is the mode? (most frequently occurring)
4. Draw an arrow to show where “21” is on the stem and leaf plot. How did you know?

Example 2:
Students decided to examine how many chocolate chips were in each biscuit in a packet. They wanted to compare brands of biscuits to see which gave the best value. Their data for brand X was as follows: 4, 5, 6, 6, 7, 9, 10, 10, 12, 13, 14, 14, 14, 18, 21, 22, 26

They drew the following stem and leaf plot from this:

<table>
<thead>
<tr>
<th>Stem</th>
<th>Leaf</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>4    5    6    6    7    9</td>
</tr>
<tr>
<td>1</td>
<td>0    0    2    3    4    4    4    8</td>
</tr>
<tr>
<td>2</td>
<td>1    2    6</td>
</tr>
</tbody>
</table>

What patterns have I found?

Create a stem and leaf plot to show the income of students in your class per week.

Now complete your own data classification (using tally charts, percentages, stem and leaf plots or two way tables) and attach it to this activity.
Representing your data with fractions:

Using your survey data, represent each of the answers for each of your categories as a common fraction, a decimal fraction, and a percentage.
Teacher suggestions sheet

**Essential Learning Statements:**

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J. Displaying data – compound graphs

**Before you start**

Students will need access to the grouped data from their surveys for this activity.

**Teaching steps**

Format: Small group work

1. Give all instructions and hand out activity sheets. Divide students into small groups or pairs.
2. Students work through each of the graphs to determine how they have been constructed, and to discuss the usefulness or otherwise of this form of representation.
3. Now is a good time to bring up the potential uses for line graphs. Line graphs should really only be used to show trends in data (for data over a week, year, lifetime) not to show unrelated data. Discuss which of the compound graphs given is the best representation for the data displayed. Some other examples of compound line graphs include baby-growth charts.
4. Discuss which type of display should be used for each of your survey questions. Encourage debate and discussion amongst group members as they need to be able to decide when and why a graphical display would be effective, not just be able to create them.
5. Students work individually or in pairs to create their data displays. Students discuss and justify their decisions.

**Assessment**

Collect the sheets for the group, and mark each student individually using the criteria on the ‘Assessment’ cover sheet at the start of this activity set.
J. Displaying data

In the following activity you will learn about using compound graphs. Complete the activity below, and then create a data display for each of your questions from your survey. You may choose any display type that you think is suitable, but you need to justify your selection. Attach your displays to this activity, making sure that you have some that are hand-completed and some that are made using computer technology. For each display, include a sentence to describe why you chose this display type.

**Compound graphs:**

Examine the compound bar graph below and work out how it is constructed.

![Compound Bar Graph]

What can you tell about how the graph is constructed?

How might a graph like this be useful? In what situations would you use it?
Examine the compound line graph below:

What can you tell about how the graph is constructed?

How might a graph like this be useful? In what situations would you use it?

Construct a compound bar graph and compound line graph to show what students have for lunch in four different classes in your school. Classify the lunches into types eg: bread based, junk food, fruit/vegetable based, dairy based/ meat based. Attach a copy of your graph.
Teacher suggestions sheet

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**K. Analysing data: spread and centre**

**Before you start**
Most of the students should be familiar with using the mean as an average, but may not be familiar with median and mode. Students will need access to their survey data for this activity.

**Teaching steps**
Format: small group work and discussion
1. Give all instructions and hand out activity sheets. Divide students into small groups or pairs.
2. Students work through each of the measures for spread and centre to determine how they have been constructed, and to discuss the usefulness or otherwise of this form of representation.
3. Now is a good time to bring up the potential uses of different types of averages and in which situations these would be the most useful.
4. Discuss which type of average should be used for each of your survey questions. Encourage debate and discussion amongst group members as they need to be able to decide when and why a measure would be effective, not just be able to create them.
5. Students work individually or in pairs to create their measures of spread and centre. Students discuss and justify their decisions.

**Assessment**
Collect the sheets for the group, and mark each student individually using the criteria on the ‘Assessment’ cover sheet at the start of this activity set.
K. Analysing and evaluating data

When you are analysing your data to determine what is ‘normal’ or average, you need to consider both the data spread and the central tendency. Learn about what these are by completing the activities below, and include each of these for each of your data displays.

Data spread:

The range of the results refers to the difference between the two extremes in the responses. Some questions will not be able to have ranges. See below and work out the range of results for each of your questions.

Example 1: The youngest person surveyed was 7 and the oldest was 32. My range was 7 – 32 years old.

Example 2: The least amount of sport played was 0 hours per week. The greatest was 8 hours per week. My range was 0 – 8 hours.

Example 3: The people that I surveyed played cricket, soccer and netball. I can not write a numerical range for this so I would have to state all the categories.

For each of the questions that you asked, write the numerical range or all of the categories (if possible). Attach a separate sheet with your calculations.

Measures of central tendency:

Mean:
In previous activities you will have learned how to calculate the mean as a measure of central tendency, or an average. Briefly describe what this means in the space below:

If possible, calculate the mean for each of the questions that you asked. Include this with your data display.

Other averages:

When you were calculating the ‘average’ in the previous activity you were actually learning about calculating the mean. This activity will challenge you to think about other ways of representing what is “typical” from data.

Situation:
A company was recruiting for new graduates to come and work for them. They advertised that the average (mean) salary for their employees was $57 000 per year. This was enough to convince Michael to investigate further. Upon applying to the company he found that the following people were employed by the company:
- The CEO earned $450 000 per year
- The project manager earned $150 000 per year
- Two senior engineers earned $100 000 per year
- A senior soil technician earned $57,000 per year
- Three engineers earned $50,000 per year
- Four junior engineers earned $37,000 per year
- A foreman earned $30,000 per year, and
- 12 soil technicians and clerical staff earned $20,000 per year

Questions:
1. How many people were employed by the company?

2. How many people earned at least the “average” wage advertised by the company?

3. Is this a fair representation of a typical wage earned by an employee of the company? Explain your answer:

4. What is the wage that most of the employees earn? ________ This is called the **mode**. Find out what the term “mode” means and write an explanation for it on the lines below.

5. Write down on the lines below every wage from the highest to the lowest. For example, if two people earned $100,000 write 100,000 twice, if 12 people earned $20,000 write 20,000 twelve times.

6. Now look at the wages. Count in from the ends to find the middle wage. What was it? _____ This is called the **median**. Find out what the term “median” means and write an explanation for it on the lines below.

The mean, mode and median are all used to measure something called “central tendency”. Central tendency is a way of describing what is typical from a set of data. Different measures of central tendency show different things and are used in different circumstances.

1. In the previous example you found that the mean was $57,000, the mode was $20,000 and the median was $30,000. Which of these measures do you think best represents the centre or what is typical for the workers? Explain

2. Which of the measures of central tendency listed above would be the most helpful for Michael to know about when he is applying for a job with the company? Explain

3. Why do you think the company used the mean to advertise for new employees? Explain
4. Find the mean, median and mode for the following problem. Comment on each one and decide which best represents what is “typical”. Explain your reasons.

Students surveyed their class to find out how many hours of homework each student completed per week. They found the following:

- One person did 17 hours
- One person did 15 hours
- Three people did 10 hours
- One person did 6 hours
- Three people did 5 hours
- Four people did 4 hours
- Two people did 3 hours
- Ten people did 2 hours

a. Mean:

b. Median:

c. Mode:

d. Which is the best? Why?

What do the terms mean, median and mode mean?

Which measure do you think best represents what is “typical”? Is this different in different circumstances? Explain:

Decide whether the mean, median or mode is the most appropriate ‘average’ for each of your data displays. Calculate this, and include the information with your display.
Teacher suggestions sheet

Essential Learning Statements:

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L. Gathering data from external sources

Before you start
This activity will take a long time to complete and will require students to have access to the internet. You will need to check that the web links on the activity are still active, and are available on your school server before handing out the sheets. You may need to download some statistics and provide the students with these if they are not available online. Alternatively, speak with your librarian about making an online folder with resources for the students to access.

Teaching steps
Format: Pairs research
1. Give all instructions and hand out activity sheets. Divide students into small pairs to research the stereotypes stated.
2. Students research to determine the validity of the stereotypes stated. They need to analyse and present this data appropriately using the measures learned from previous activities.
3. Share useful data sites and findings as a class.
4. Students work individually or in pairs to complete the report described on the second page of the activity.

Assessment
Collect the sheets for the group, and mark each student individually using the criteria on the ‘Assessment’ cover sheet at the start of this activity set.
I. **Statistics for negative representations:**

As we have discussed so far in this unit, many negative representations of youth exist. In this activity you are to find statistics that support or oppose the representations listed below. Summarise your findings in a few sentences or a paragraph for each of the representations, and give reference for your data source. Use percentages, fractions, rates and ratios as appropriate to describe your data along with descriptions of data spread and central tendency.


You will need to examine the validity of common stereotypes relating to:

- Promiscuity
- Crime
- Drug and alcohol abuse
Report: Who are we as youth?

Use your results from the previous activities to come up with a way to describe a ‘normal’ youth. Write a summary report that describes your results for each of the different categories (income, likes, ages etc.), and attempts to define what ‘normal’ means. Include a discussion of any difficulties that you experienced, and anything that you would need to change in order to gain a more comprehensive understanding.

Make sure that your summary includes information regarding each of the different representations of youth that are examined in this unit. In the other activity sections you will find information from other sources to confirm or conflict with your data. If these are appropriate to include now do so, otherwise base your report solely on your survey results.

Please note: this report should focus on demographic statistics, not on beliefs, values and behaviours. Is should try to describe what an average youth is like using mean, median and mode, and also describe the range or spread of the different possibilities. For example: the average youth in our school comes from a family with a mother and two siblings. They are 14.3 years old, and have brown hair.