# Methods of sampling

Students explore different sampling methods and the impact that sample size can have on predictions.

Students will need at least one digital device per pair to interact with Desmos during this lesson.

## Visible learning

This lesson incorporates Path content.

### Learning intention

* To understand the difference between sampling techniques.

### Success criteria

* I can graph a line of the form .
* I can explain the impact of changes in the gradient.
* I can describe different sampling techniques.
* I can evaluate a choice in sampling technique.

### Syllabus outcomes

A student:

* develops understanding and fluency in mathematics through exploring and connecting mathematical concepts, choosing and applying mathematical techniques to solve problems, and communicating their thinking and reasoning coherently and clearly **MAO-WM-01**
* displays and interprets datasets involving bivariate data **MA5-DAT-C-02**
* graphs and interprets linear relationships using the gradient/slope-intercept form   
  **MA5-LIN-C-02**
* plans, conducts and reviews a statistical inquiry into a question of interest **MA5-DAT-P-01**

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Table 1: lesson summary

|  |  |  |  |
| --- | --- | --- | --- |
| Section | Summary of activity | Teaching strategies | Teaching points |
| Launch | Students draw a line of best fit by eye on the scatter plots in [Appendix A](#_Appendix_A) before discussing their graphs with their partners. | Think-Pair-Share  Notice and wonder | Students recognise there can be inconsistencies in how data is interpreted, particularly when samples are small. |
| Explore | Students discuss different approaches to finding a sample suggested in [Appendix B](#_Appendix_B). Students use [Appendix C](#_Appendix_C_1) to consider results from an investigation completed in a prior year to develop preconceptions around sampling techniques and to review graphing a straight line from an equation. | Think-Pair-Share  Pose-Pause-Pounce-Bounce  Finger vote | Students should be able to graph a straight line from an equation and show an understanding of what changes in the gradient mean in context. |
| Summarise | In [Appendix D](#_Appendix_D), students are given definitions of sampling techniques and match them to corresponding examples. | Think-Pair-Share | Students should be able to identify and describe the different sampling techniques. |
| Apply | Students justify using a particular sampling technique using an investigation related to Electric vehicle (EV) chargers in the State of NSW in [Appendix E](#_EV_Chargers). | Notice and wonder  Pose-Pause-Pounce-Bounce  Think-Pair-Share | Students consolidate their understanding of a range of aspects of this topic. |

## Activity structure

### Launch

1. Distribute Appendix A ‘A collection of scatter plots’ to each student in a plastic sleeve.
2. Ask students to use a marker to draw a line of best fit by eye on each scatter plot.
3. In pairs, ask one student to carefully remove Appendix A from their plastic sleeve and overlay the plastic sleeve on top of their partner’s plastic sleeve, taking care not to erase any markings.
4. Initiate a Think-Pair-Share ([bit.ly/thinkpairsharestrategy](https://bit.ly/thinkpairsharestrategy)) by asking students what they notice and wonder ([bit.ly/noticewonderstrategy](https://bit.ly/noticewonderstrategy)) about the lines of best fit drawn by each person.

Students could notice their line is similar in the top left scatter plot but slightly different in the remaining scatter plots. Students may wonder if the differences were due to the limited data in each graph or the association strength.

### Explore

1. Explain to the class that when a previous set of students in a prior year completed the investigation from Lesson 7 – mobile phone battery, 4 groups compared the number of days of exercise per week with a self-reported happiness rating out of 10.

If a class has not completed Lesson 7 – mobile phone battery, the activity is to be described more generically with students having completed a statistical investigation last year.

1. In a Think-Pair-Share, ask students to discuss what the hypothesis of this investigation could have been.
2. Explain to the students the interesting thing about each group was that they collected the data in different ways. Distribute Appendix B ‘Examples of sampling methods’ to each pair.
3. In a Think-Pair-Share, ask students:

* What do you think are the possible issues with how each group collected their data?
* Order the 4 groups' strategies from least to most effective method to collect accurate data.

Students may suggest that the location of the first 2 groups may create bias in the results, how much work must go into the third group’s survey and that only friends of people in the fourth group may answer the survey.

1. Distribute Appendix C ‘Scatter plots from last year’ to each pair of students. Using a finger vote, ask students which graph they think best represents what they would expect from the data.
2. Use the Pose-Pause-Pounce-Bounce questioning strategy (PDF 557 KB) ([bit.ly/posepausepouncebounce](https://bit.ly/posepausepouncebounce)) discuss which graph best represents the data.
3. Ask the students to use the equation of each line written below the graphs on Appendix C to graph the line of best fit for each graph.
4. In a Think-Pair-Share, ask students to discuss whether it makes sense to extrapolate this data.

The data would not make sense as both variables have a discrete maximum value.

1. In a Think-Pair-Share, discuss what the gradient of the line of best fit represents in this investigation and what impact a sample underestimating or overestimating the gradient would have on predictions.

Students should identify that a larger gradient suggests that increased exercise has an impact on happiness. A smaller gradient may indicate that other factors may need to be considered.

### Summarise

1. Distribute Appendix D ‘Sampling methods matching activity’ to each student and ask them to read the definitions and match the descriptions to the examples.
2. In a Think-Pair-Share, discuss why different sampling methods may be used and how they may impact the results.

### Apply

This activity can alternatively be completed digitally using the Desmos classroom activity ‘NSW EV chargers’ ([bit.ly/DesmosEVchargers](https://bit.ly/DesmosEVchargers)) and one device per pair of students.

1. Tell the students the following information:

As Electric Vehicles (EVs) become more prevalent, EV charging infrastructure quality and accessibility must evolve. The NSW State government can collect and use data about EV charging infrastructure to support planning.

1. Use a Pose-Pause-Pounce-Bounce questioning strategy to discuss what census and sample mean in this context and what would be the benefit of taking a census compared to a sample.
2. In a Think-Pair-Share, students discuss which sampling method should be used to collect data on each local government area and why they would choose that method.
3. Distribute Appendix E ‘EV chargers’ to each pair of students. In a Think-Pair-Share, ask students what they notice and wonder about each scatter plot.

Some students might notice that each scatter plot appears to be different. Some students may wonder how each sampling technique was performed. For reference, each sample was selected with the following methods:

* **Random sample**: a random number generator was used to identify 10 local government areas to investigate.
* **Stratified sample**: the State of NSW has 25 local government areas that are considered urban, and a further 105 that are considered rural. In this stratified sample, 2 urban and 8 rural councils have been randomly selected using a random number generator.
* **Systematic sample**: all of the local government areas were listed A to Z and every 13th area was selected.
* **Self-selected sample**: ten local government areas were selected.

1. Ask the students to draw a line of best fit by eye on each scatter plot. Ask students to calculate the gradient of each line.
2. In a Think-Pair-Share, ask students what the gradient represents in this context and how could the different gradients of each line be potentially interpreted or misinterpreted.
3. Ask students to consider the Sutherland Shire Council which has a population of 235 029 people and 43 EV chargers, and to plot that point on each of their scatter plots.
4. In a Think-Pair-Share, ask students how the Sutherland Shire Council data point compares to their expectations and what this would mean practically.

The approximate gradient of the random sample is , the stratified sample is , systematic is and the self-selected sample is There are a lot more EV chargers in Sutherland Shire than is expected from the data.

1. In a Think-Pair-Share, ask students to discuss the appropriateness of each sample and the confidence it gives them in making conclusions from the data.

## Assessment and differentiation

### Suggested opportunities for differentiation

**Launch**

* A notice and wonder strategy is used where there is no correct answer so all students can participate in the discussion.

**Explore**

* Students may need to be reminded of the different methods they can use to graph a straight line from an equation, including constructing a table of values.

**Summarise**

* Devices could be distributed earlier in the lesson and students could find definitions and examples of the different sampling methods.
* Students could complete the matching activity in pairs.

**Apply**

* Throughout the discussion, challenge students to explain the difference between each sampling method and provide clear language around how to ensure samples are random.
* Students may need to be reminded how to calculate the gradient when the scale of each axis is different.
* Noticing and wondering are used throughout the discussions in this lesson to allow all students to participate in a risk-free environment.

### Suggested opportunities for assessment

**Launch**

* Students have opportunities to contribute to and hear from pair and class discussions. These act as opportunities for self- and peer-reflection.

**Explore**

* The teacher should observe how students approach the graphing of lines in Appendix A and could collect this as evidence of student understanding of graphing a straight line.
* Monitor responses in class discussions to check for student understanding of the terminology ‘extrapolate’ and ‘interpolate’, as well as whether the students understand what ‘gradient’ means in the context of these examples.

**Summarise**

* When students share ideas, the teacher could observe students’ reasoning and justification in response to the different sampling techniques.

**Apply**

* When discussing with students, teachers can encourage their students to think about the impacts of each sampling technique and monitor how students consider each method of sampling.
* The teacher could facilitate class discussions and observe students’ reasoning and justification in response to the information in each scatter plot.

## Appendix A

### A collection of scatter plots

|  |  |
| --- | --- |
| A scatter plot showing 5 data points in a strong positive correlation. | A scatter plot showing 5 data points in a weak negative correlation. |
| A scatter plot showing 5 data points in a weak negative correlation. | A scatter plot showing 5 data points in a moderate positive correlation. |

## Appendix B

### Examples of sampling methods

|  |
| --- |
| One group asked 10 random students during weekly sports. |
| One group asked every third person who entered the library at lunchtime. |
| One group asked 15 students from each year group at school. |
| One group just shared a survey with their class and used the data people gave them. |

## Appendix C

### Scatter plots from last year

|  |  |
| --- | --- |
| A scatter plot showing points clustered on the top right of the graph. | A scatter plot with some data spread over 0–2 days of exercise and some other data spread over days 6 and 7. |
|  |  |
| A scatter plot with data points everywhere. | A scatter plot with data clustered in the top left of the graph. |
|  |  |

## Appendix D

### Sampling methods matching activity

Read the definitions of each sampling method.

|  |  |
| --- | --- |
| **Random sample** | A subset of a larger population where each member has an equal chance of being chosen. |
| **Stratified sample** | A population is divided into distinct groups, or ‘strata’, based on specific characteristics (like age, gender or income). Then, random samples are taken from each stratum. |
| **Systematic sample** | Members from a population are selected at regular intervals. |
| **Self-selected sample** | Individuals choose to participate in a survey or study on their own. |

Match each example to the appropriate sampling method.

|  |  |
| --- | --- |
| 1. A researcher divides a city’s population into age groups and randomly selects participants from each age group. |  |
| 1. A school surveys students by randomly selecting names from a hat. |  |
| 1. A fitness app asks users to voluntarily share their workout habits through an online survey. |  |
| 1. A company sends a questionnaire to every fifth person on a mailing list. |  |
| 1. A teacher surveys every third student who enters the classroom. |  |
| 1. A political poll randomly selects voters from across the entire state. |  |
| 1. A social media platform invites users to participate in a survey and only those who choose to respond are included. |  |
| 1. A health study recruits participants based on specific health conditions and then randomly selects individuals from each condition group. |  |

## Appendix E

### EV chargers

|  |  |
| --- | --- |
| Random sample | Stratified sample |
| A scatter plot showing the data distribution from the random sample of local government areas and their number of EV chargers. | A scatter plot showing the data distribution from the stratified sample of local government areas and their number of EV chargers. |
| Systematic sample | Self-selected sample |
| A scatter plot showing the data distribution from the systematic sample of local government areas and their number of EV chargers. | A scatter plot showing the data distribution from the self-selected sample of local government areas and their number of EV chargers. |

## Sample solutions

### Appendix A – a collection of scatter plots

|  |  |
| --- | --- |
| A scatter plot showing 5 data points in a strong positive correlation with a line of best fit. | A scatter plot showing 5 data points in a weak negative correlation with a line of best fit. |
| A scatter plot showing 5 data points in a weak negative correlation with the line of best fit drawn. | A scatter plot showing 5 data points in a moderate positive correlation and its line of best fit. |

### Appendix C – scatter plots from last year

|  |  |
| --- | --- |
| A scatter plot showing points clustered on the top right of the graph. The line of best fit is drawn. | A scatter plot with some data spread over 0–2 days of exercise and some other data spread over days 6 and 7. The line of best fit is drawn. |
|  |  |
| A scatter plot with data points everywhere. The line of best fit is drawn. | A scatter plot with data clustered in the top left of the graph. The line of best fit is drawn. |
|  |  |

### Appendix D – sampling methods matching activity

Random sample (2, 6)

Stratified sample (1, 8)

Systematic sample (4,5)

Self-selected sample (3,7)

## References

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