Level 2 Statistical Reports Workbook



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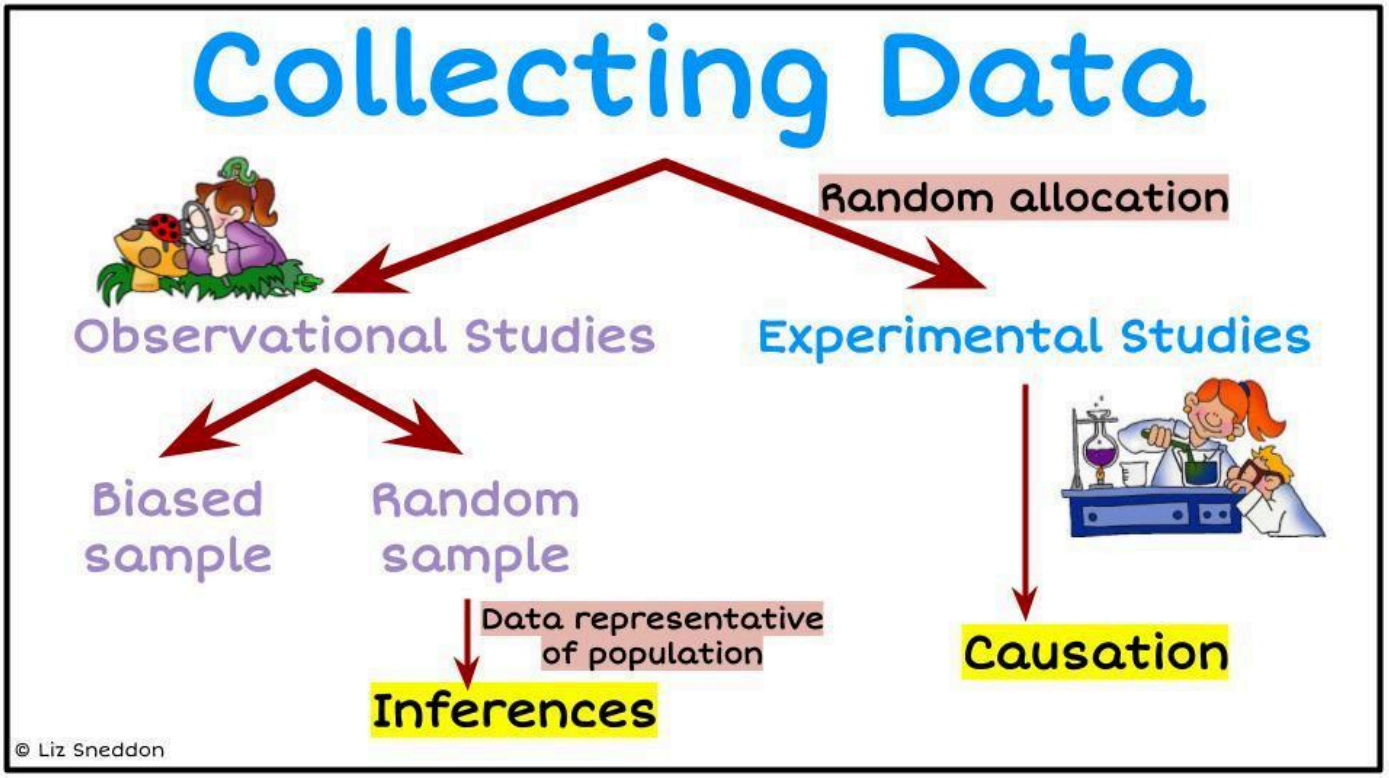


By Liz Sneddon

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Observational studies vs Experimental Studies

There are two types of studies that that statisticians do, observational studies and experimental studies.



A statistical report is a way to communicate the results of either an **observational study** from which we can make **inferences,** or an **experiment** from which we can show **cause and effect**.

Exercise 1:

Watch the video (**bit.ly/ObsExpt**) explaining the difference between an observational study and an experimental study.

1) What is an observational study?

2) What is an experiment?

3)

Ginger reduces the symptoms of motion sickness

Whether on a bumpy plane ride, the ferry to the South Island or a fishing trip, motion sickness can make travelling a misery. What is worse, many medications have severe side effects, such as sleepiness and drowsiness. A Danish study has now found a natural cure for motion sickness: ginger.

In a study on 80 cadets of the Danish navy, ginger showed a positive effect on the main symptoms of motion sickness. The participants, all of them inexperienced sailors, were randomly allocated into two groups. One group was given 1 g of powdered ginger and the other a placebo. After four hours on the same ship at high sea, the cadets were asked about any symptoms of motion sickness.

It was found that ginger reduced the tendency to cold sweat and vomiting much better than the placebo. There were also fewer symptoms of nausea and vertigo, but this was not found to be statistically significant.

Explain whether the study is an observational study or an experiment. Give an implication for this type of study for the relationship investigated for the claim made.

Sources

We need to think about how reliable and credible the source is of the report.

Here are some examples of who produces statistical reports:

Companies:



Governments:



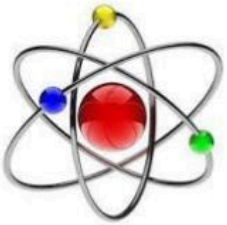
News Media:



Social Media:



Scientists:



Researchers:



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Credible sources

Purpose - what is the purpose of the article? To inform, teach, sell, entertain or persuade? Is it factual & unbiased or an opinion?

Author - are they qualified to write on this topic?

Timeliness - is the information recent?

Accuracy - is the evidence trustworthy, reliable and verified?

Relevant - is the information important to explaining WHY?

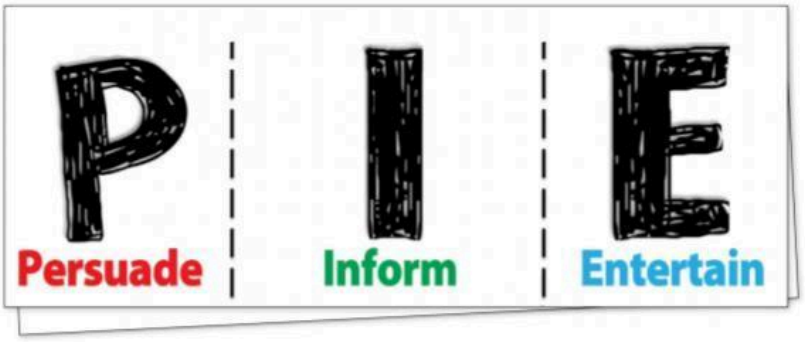
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Purpose & Audience

Before we can look at what the investigation question is, we need to know what the purpose and audience are for the study – either an observational study, or an experimental study.

Purpose

The reason or goal that you have for writing about your topic.



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Audience

The specific people you are writing for.



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Exercise 2:

1)

a) Why would someone write a statistical report?
(Hint: think about the people who write reports)



b) Why do we want to know who the author of a report is?



c) Why do we want to know who paid for the research?



2) Below are two contradicting headlines.

No evidence cell phone cause cancer: US Oncologist.	**Link found between cell phone use and increase in brain tumors.**
	
Article published in "The Hindu Business Line News"	Article published by WHO (World Health Organisation)

Who do you believe? Explain and justify.

Observational studies

After identifying the purpose and audience, the next step involves working out what data or information you want to collect. This is usually by writing a questionnaire and thinking about the wording of the questions etc.

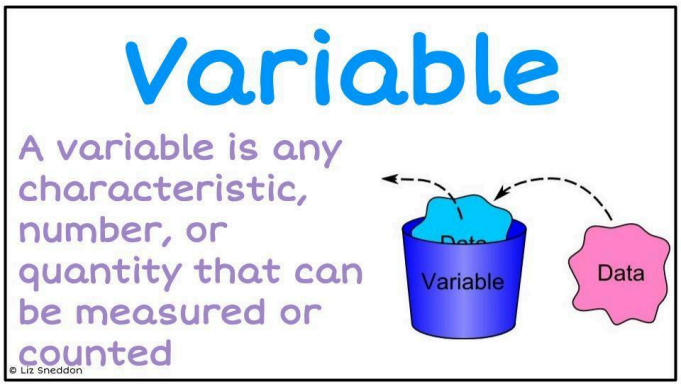
There are several things we need to consider:

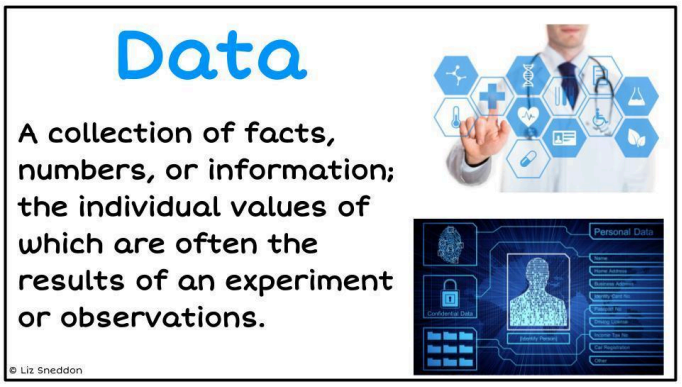
- Variables and measures,
- Survey method,
- Sampling method,
- Sample size,
- Sampling and non-sampling errors,

Variables and measures

In the statistical report you are given, you need to look through the findings, graphs, and information to work out what data was collected, what variables they used, and how they measured/counted these variables.

Here are a few reminders for you:





Focus Questions

- What variables were measured/collected?
- How was the data displayed in the report?
- What summary statistics were used?

Data types

- Numerical / Quantitative (Numbers)
  - Continuous (measurements)
  - Discrete (counts)
- Categorical / Qualitative (groups, words)
  - Nominal (Categories)
  - Ordinal (ordered)

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Numerical data



Numerical (numerical) data is data described by numbers.

E.g., height, age, number of apples, weight.

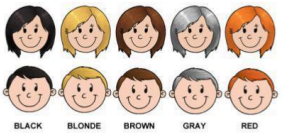


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Categorical data

Categorical data is data that cannot be described by numbers. The data will be groups of words.

E.g., gender, ethnicity, apple variety.





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Continuous data

Continuous data is data obtained by measuring.

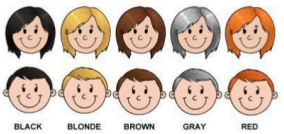


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Nominal data

Nominal data is categorical data (groups/words) where the categories have NO order.

E.g. Black, Blonde, Brown, Grey, Red, etc

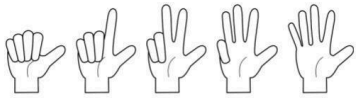


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Discrete data

Discrete data is data obtained by counting.





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Ordinal data

Orninal data is categorical data (groups/words) where the categories HAVE order.

E.g. 1st, 2nd, 3rd

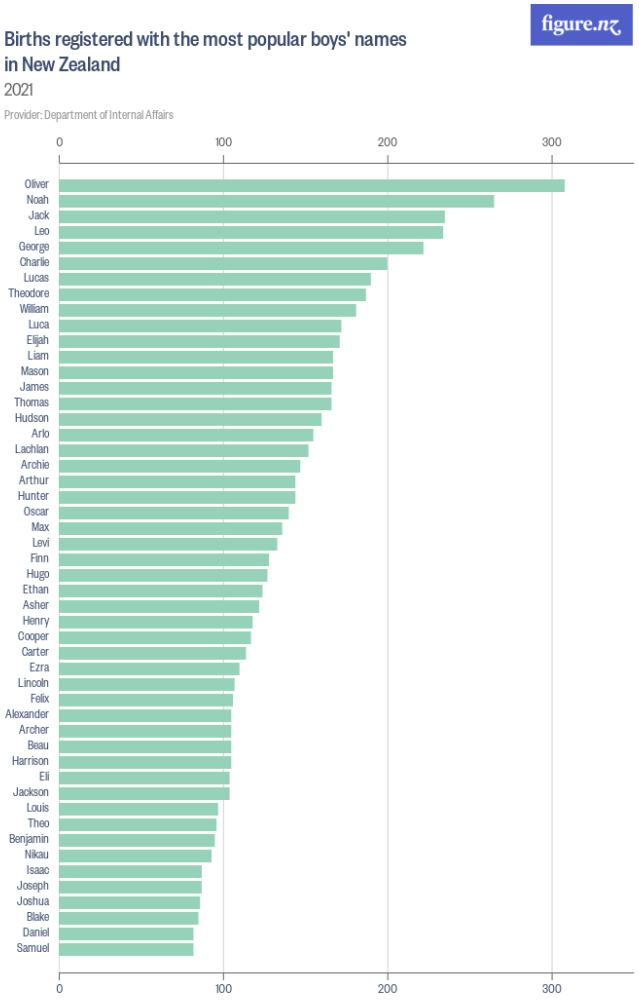




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Example 1:

Here is a graph of the most popular boys' names in NZ, from registered births in 2021.



Variables	Data types
Names	Categorical, nominal
Number of registered births	Numerical, discrete

Measures & possible issues:

Data was collected in terms of counting the number of births registered for each name. This is a useful discrete measure but turning this into percentages could be more useful to be able to compare, particularly if there are names that are similar, such as Jac and Jack, you could easily combine these percentages together in your head to make comparisons.

These results (names) were collected in 2021, and I wonder if the names in 2022 might be similar to or quite different from these. Some names might become more popular, e.g., if a celebrity names their child "Apple" then I would expect to see more people also copy this.

Example 2:[1]

Kiwi shoppers play it cool, survey finds

23 Oct 2014, Natalie Akoorie, NZ Herald (article link)

We're more wary than the Aussies in giving details to stores ... unless there's a discount.

Kiwis are careful when handing over personal information to retailers, but are more trusting than Aussies in signing up for a discount.

A survey of 1000 Australian and 500 New Zealand shoppers shows similar expectations of consumers in both countries, except when on personal details.

74% of Kiwis and 68% of Australians rate discount offers as the top reason for providing personal information to retailers.

More Kiwis than Aussies will reveal household structure details, ages of their children and hobbies and interests when joining mailing and loyalty programmes.

But only 6 per cent of New Zealanders compared to 11 per cent of Australians will tell retailers their income and 32 per cent compared to 36 per cent of Aussies will give their date of birth.

Possible Answers

The respondents have been asked several yes/no questions about the information they would provide to retailers. They have also been asked why they would reveal personal information, with both countries saying "discount offers" most often.

The percentages saying that they would give each type of information is given in the report, with comparisons between New Zealand and Australia. In some cases, the numbers are not provided, only that "more" Kiwis than Aussies will reveal the information, so more detail would be better in this sentence.

The summary statistics given are all percentages, because there was no quantitative data collected.

[1] https://sites.google.com/view/statsreports/features/1-measures#h.p_Y0bzj9MqUQP1

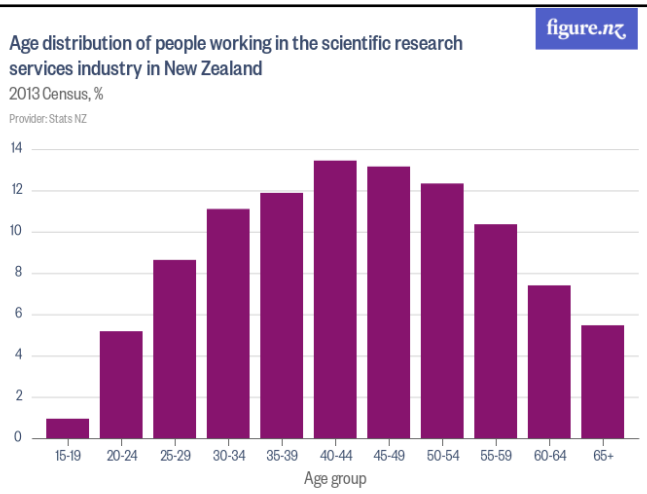
Exercise 3:

Look at each of the visualisations below and identify what variables and data types were used. Then describe the measures used (including units) and how this information may have been collected. Include an evaluation of the measures or variables.

a)

Variables	Data types

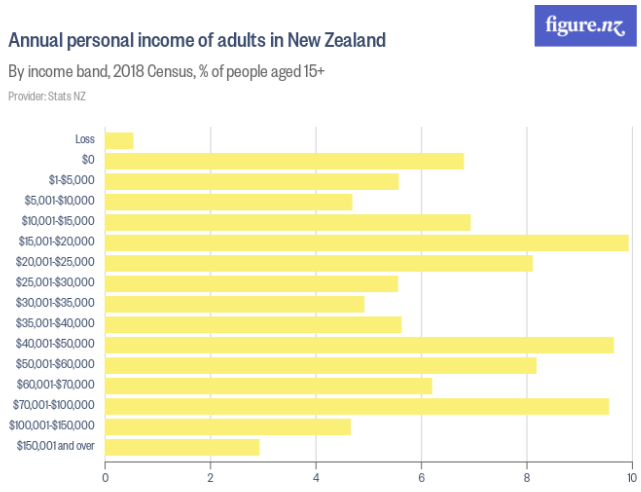
Measures and evaluation:



b)

Variables	Data types

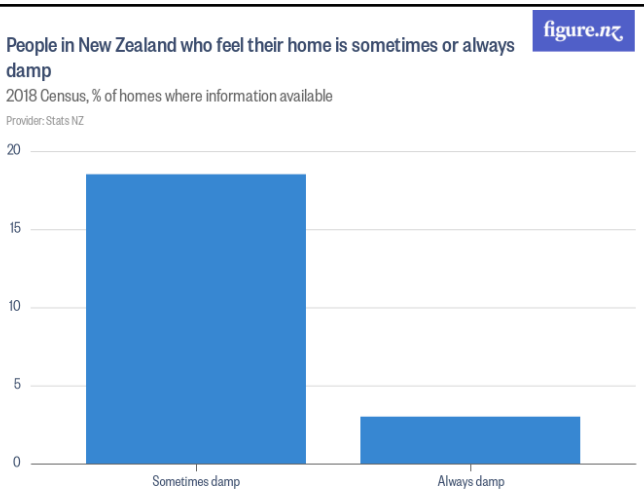
Measures and evaluation:



c)

Variables	Data types

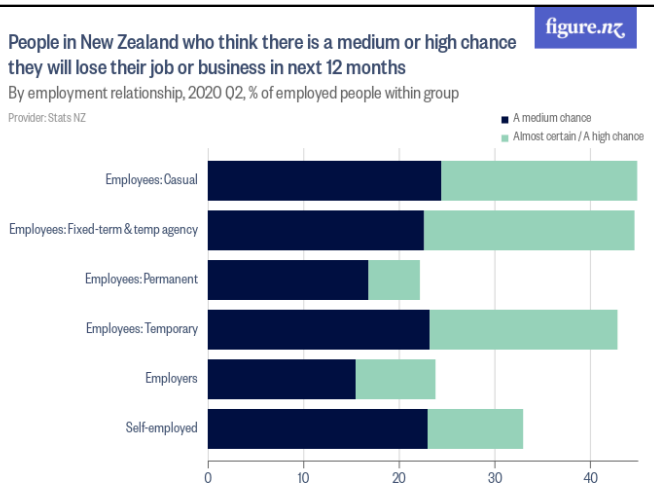
Measures and evaluation:



d)

Variables	Data types

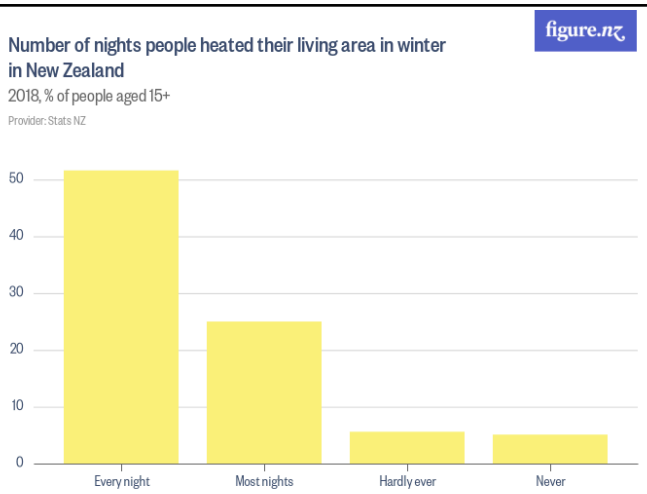
Measures and evaluation:



e)

Variables	Data types

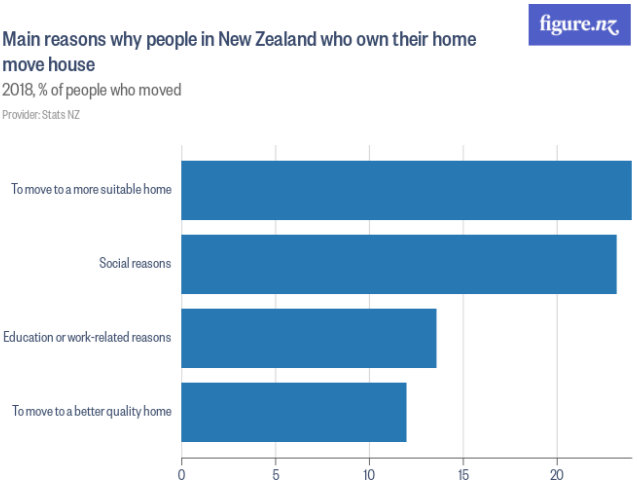
Measures and evaluation:



f)

Variables	Data types

Measures and evaluation:



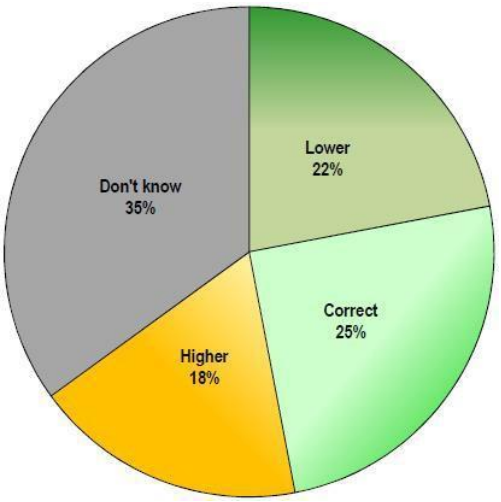
g)

Fushunchups Kai blog: Are Kiwis too relaxed about salt?

1 April 2011, wordpress.com food science blog, (user name fushunchups-kai)

Word is out. We all should know by now that too much salt is bad, but Kiwis don't really know the recommended daily limit. From a representative sample of 1000 people, only one quarter knew the correct daily limit (of 6 grams, or one teaspoon). Almost one in five thought the daily limit was higher, and 5% thought that the limit was three times higher, or more.

Figure 1 (left): Proportion of sample giving, lower, correct or higher recommended daily limits for salt intake.



Half of the people who did not know the recommended daily limit of salt intake thought they were having less than the daily limit. I wonder how they can know this?

New Zealanders have processed foods as their main source of salt – and we know it: 77% of the people surveyed knew this fact.

Only 15% of respondents thought they were consuming more than the recommended amount of salt – but 50% said they were cutting down on the amount of salt they eat.

When asked, 27% were "very" or "quite" interested in doing more to reduce their salt intake.

The study also 'tested' participants' knowledge, to see if they knew why salt is bad for us. When asked what medical conditions from a list could be made worse by too much salt, the top answers given were heart attack (86%), high blood pressure (83%) and stroke (72%). Relatively fewer mentioned kidney disease (58%), stomach cancer (26%) and osteoporosis (18%) despite these being some of the 'most correct' responses, according to doctors.

Worryingly, salt came fifth (and last) when compared with other less healthy food intakes. Combining "quite" and "very" concerned responses, 66% of participants were concerned about saturated fat, 51% about sugar, 47% about artificial colours, 46% about artificial flavours, and only 37% about salt.

Do we even know what we're eating. Respondents were asked, "Do you ever look at the packaging on the food you buy to find out about the salt content?". Half of the participants said "no", with 35% saying "Yes - sometimes" and 14% "Yes - always".

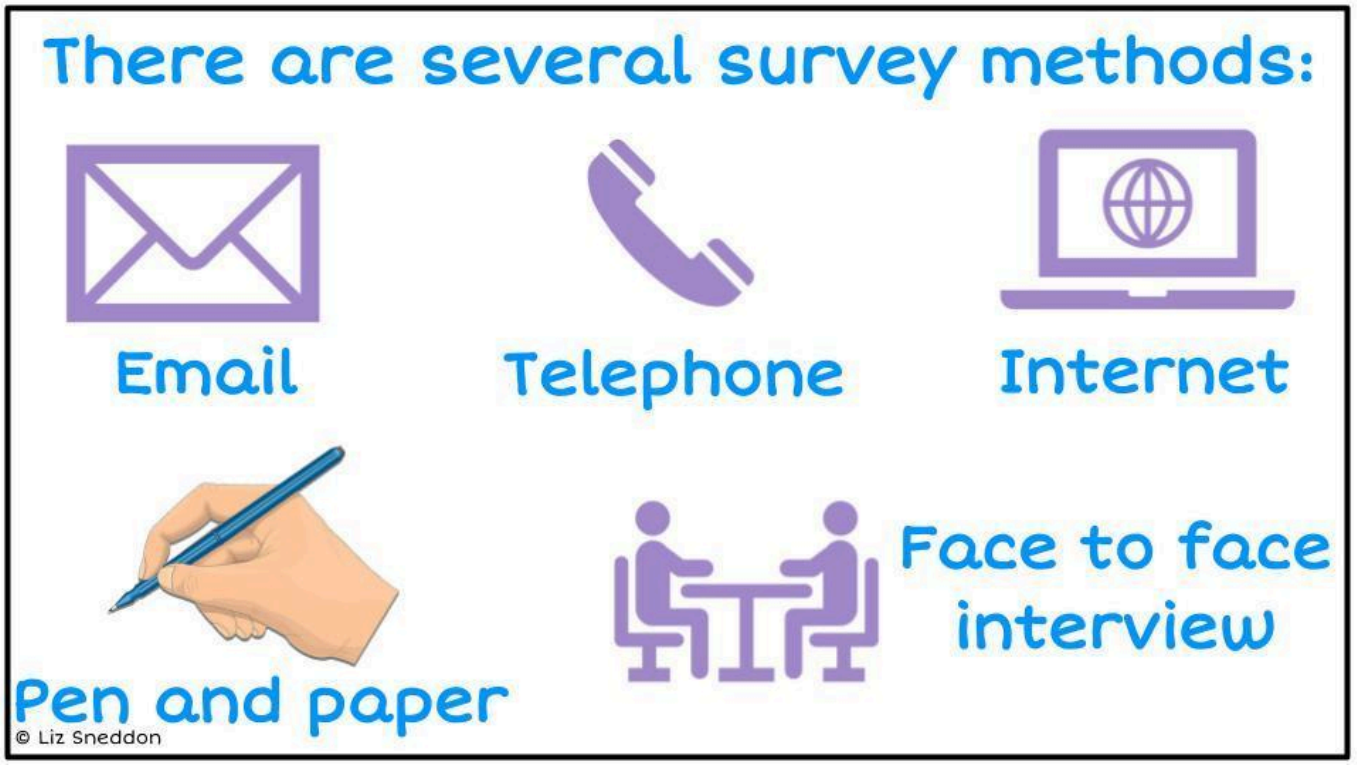
After a quick check, a large Big Mac combo from McDonald's contains slightly over 3 grams of salt – there's even some sodium in your Coke! I wonder if many people really know we're getting half of our daily limit of salt just from one take way meal.

It seems health authorities have got a lot of work to do convincing Kiwis to pay more attention to the amount of salt we eat.

Variables	Data types

Measures and evaluation:

Survey method



Each survey method has advantages and disadvantages in specific situations. You need to consider the factors below and discuss these in the context of the report you will be given.

Discuss the following factors:



Bias



Accuracy



Response rate



Cost



Time



Geographical coverage

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Design Bias

Bias is an inclination or prejudice for or against a person or group. We don't want our data to be biased. There are several forms of bias that may be present.



Interviewer



Self-selection



Accessibility

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Accuracy

We want the answers that respondents give to be as accurate as possible.

One way to improve accuracy is to make the survey anonymous or confidential.





Anonymous

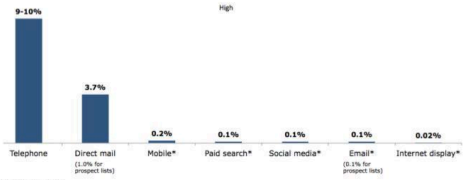


Confidential

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Response rate

$$\frac{\text{Number of complete survey responses}}{\text{Total number of survey respondents}} \times 100\%$$



Note: The graph doesn't show the response rate for face-to-face interviews, which are typically higher.

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Cost

Depending on your budget, you may choose different methods which have higher or lower costs.



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Time

Some survey methods take more time to send out and collect answers from.



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Geographical coverage

Depending on your target population, you may want a wide or small geographical coverage.



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Other factors:

If you want to gather information on sensitive subjects, such as alcohol use, drug use, sexual health etc., then a face-to-face interview is more likely to get detailed and honest answers. Whereas an email questionnaire on sensitive issues is likely to get little to no responses, or only surface information.

If you have a video or audio message that you want people to watch or listen to, then a postal survey is not the right method to use. Instead, an online survey - either using email or the internet allows video and audio to be used.

Depending on the demographics of your target population, it may be that one of the survey methods is better than others. For example, if your target population includes retired people, then a postal or phone survey may be better than either email or online surveys, as retired people are less likely to be regular users of the internet and email.

Example:

The school council is designing a questionnaire to determine students' satisfaction with the school canteen.

Survey method:

As my target population is staff and students at OSC, I will do a **online survey** as I can easily send out an email to all people at OSC using the mailing list. Below are some of the advantages and disadvantages of choosing this method:

- Bias - all students either have their own device or are able to access one at school. This means that the accessibility bias is minimised, which increases the validity of the answers we will get.
- Response rate - an online survey usually has quite a low response rate, which is a disadvantage. Ideally it would be best to have as high a response rate as possible, so that I gather the most information from as many people who use the school canteen, so that my data **represents** my target population. I will try to increase the response rate by asking my friends to fill in the survey for me.
- Accuracy - I am making the survey anonymous, so that it will encourage people to give truthful answers.
- Cost - an online survey has no actual cost associated with it, other than my time. This is a definite advantage.
- Time to administer - online surveys are very quick to send out. Google forms also very quickly collects the answers and displays them, so processing the data takes almost no time at all.
- Geographical area coverage - I am only wanting to send out the survey to staff and students at OSC, which is a small geographical area. Therefore, an online survey is fine for this as I have access to all staff and student emails.
- Sensitive questions - I do not intend to ask any sensitive questions, so an interview is not necessary.
- Videos, sound, graphics - if I want to include videos or audio recordings, then online surveys have a definite advantage here. Using google forms also makes the layout user friendly and nice to look at.
- Which method best suits the target population - online is a good method for busy staff and students, as they can do the survey when they have a moment free.

Exercise 4:

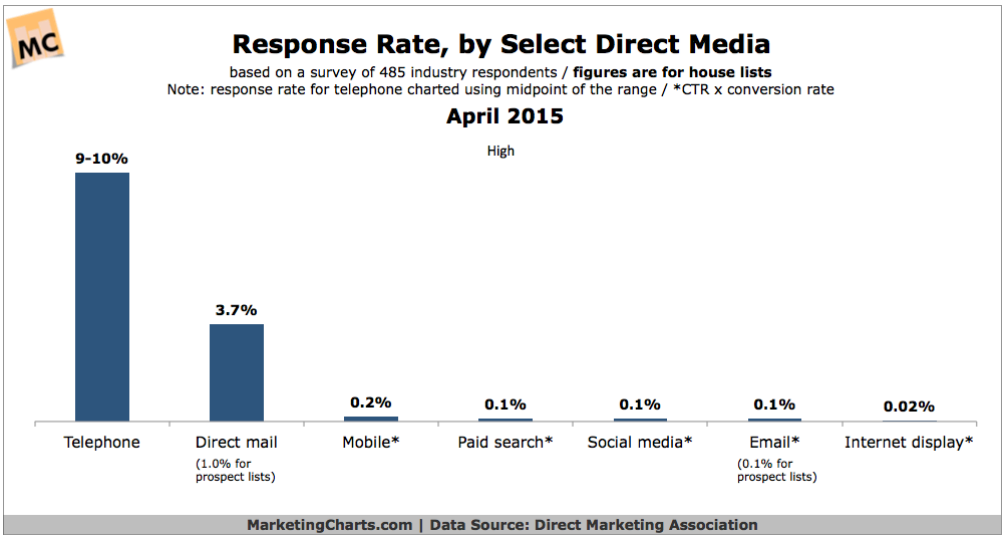
1) 100 people were asked to fill in my survey, and 50 filled it in. Calculate the response rate.

2) What does a response rate of 30% mean?

3) Is it better to have a high or low response rate? Explain.

4) If I have a low response rate, what does this say about how representative the data is of my target population?

5) What does this graph say about the response rates for different data collection methods?



6) How could you increase your response rate? Discuss the advantages and disadvantages of these options.

7) Fill in the table below.

Method	Advantages	Disadvantages
Written questionnaire		
Internet or email questionnaire		
Face-to-face interview		
Telephone interview		

8) A coffee shop at Botany Junction wants to give a free biscuit with each cup of coffee sold, as a promotion, and wants to survey customers to find out what sorts of biscuits their customers prefer.

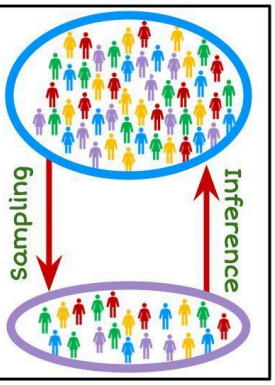
Suggest a survey method (not online) and discuss the advantages and disadvantages of this method.

Sampling method

If we collect data **randomly**, the data is likely to be **representative** of the population, which means that we can make **inferences** about the population. If the sample is **not randomly selected**, then we **CANNOT** make an **inference** about the population.

Inference

Drawing conclusions about the population based on a sample taken from the population.

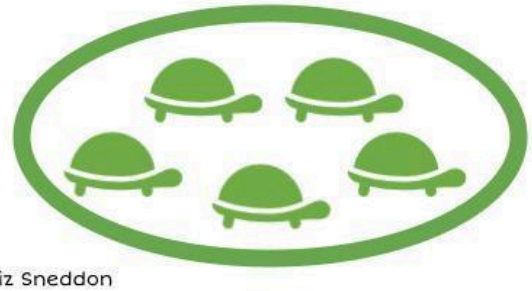


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Observational Studies



Biased sample



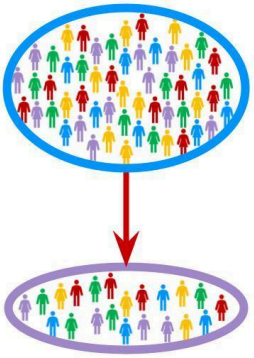
Random sample



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Sample

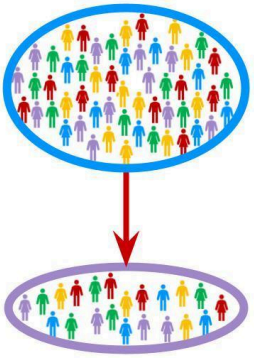
A sample is a group of individuals (or items) **selected** from the population.



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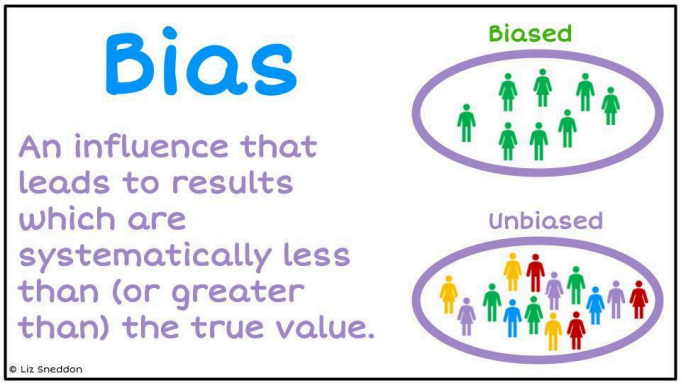
Sampling method

HOW you take a sample from the population

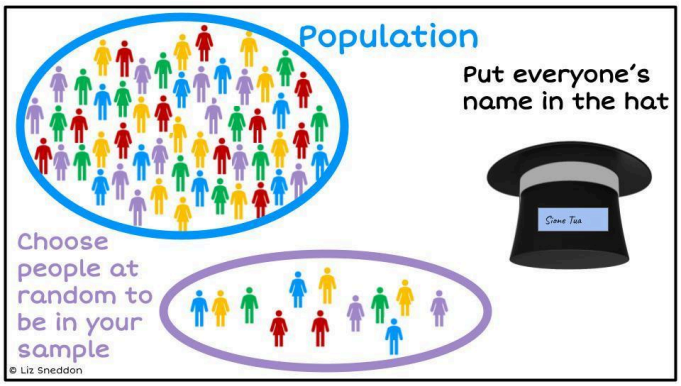
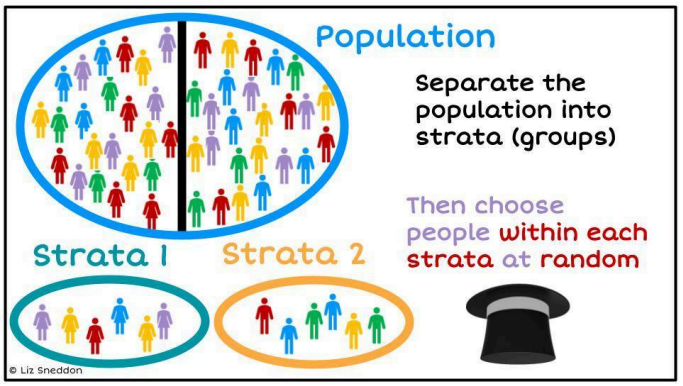
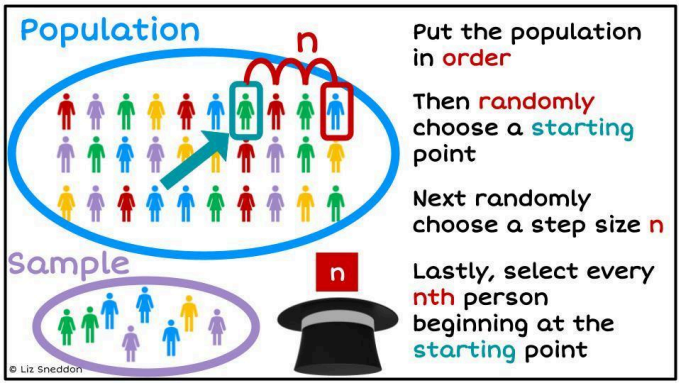
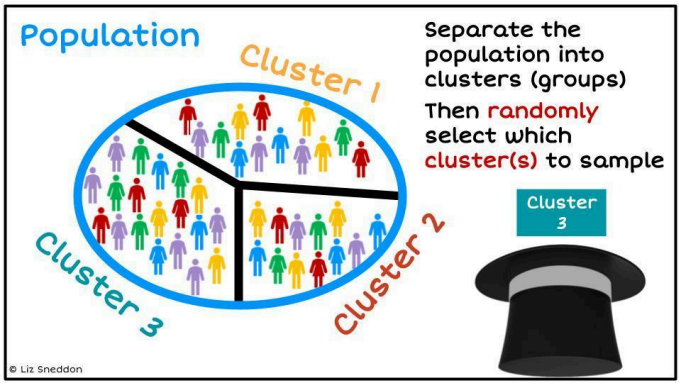


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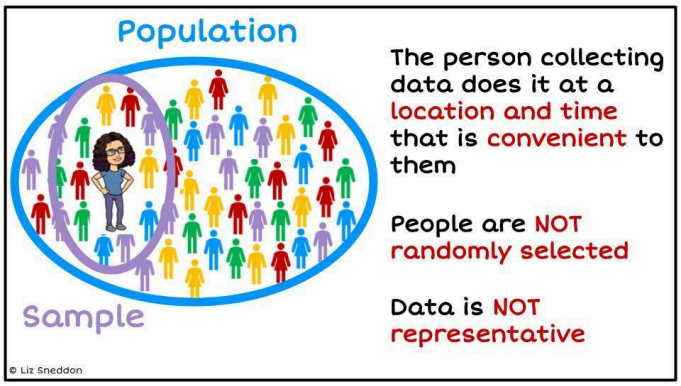


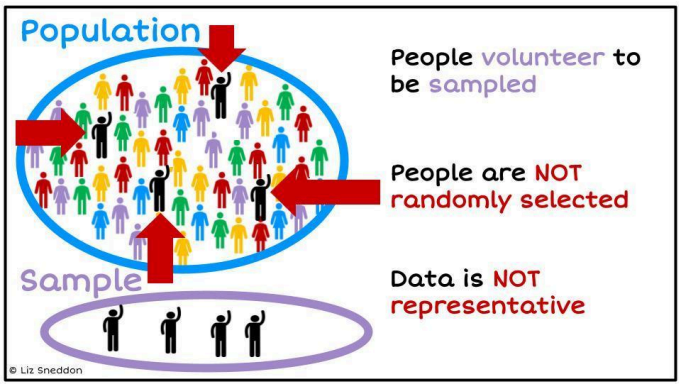
These are the different random sampling methods:

Simple random	Stratified
	
Systematic	**Cluster**
	

These are some biased sampling methods:

Convenience	Self-selected


Population
Sample
The person collecting data does it at a location and time that is convenient to them
People are NOT randomly selected
Data is NOT representative
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Population
Sample
People volunteer to be sampled
People are NOT randomly selected
Data is NOT representative
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Exercise 5:

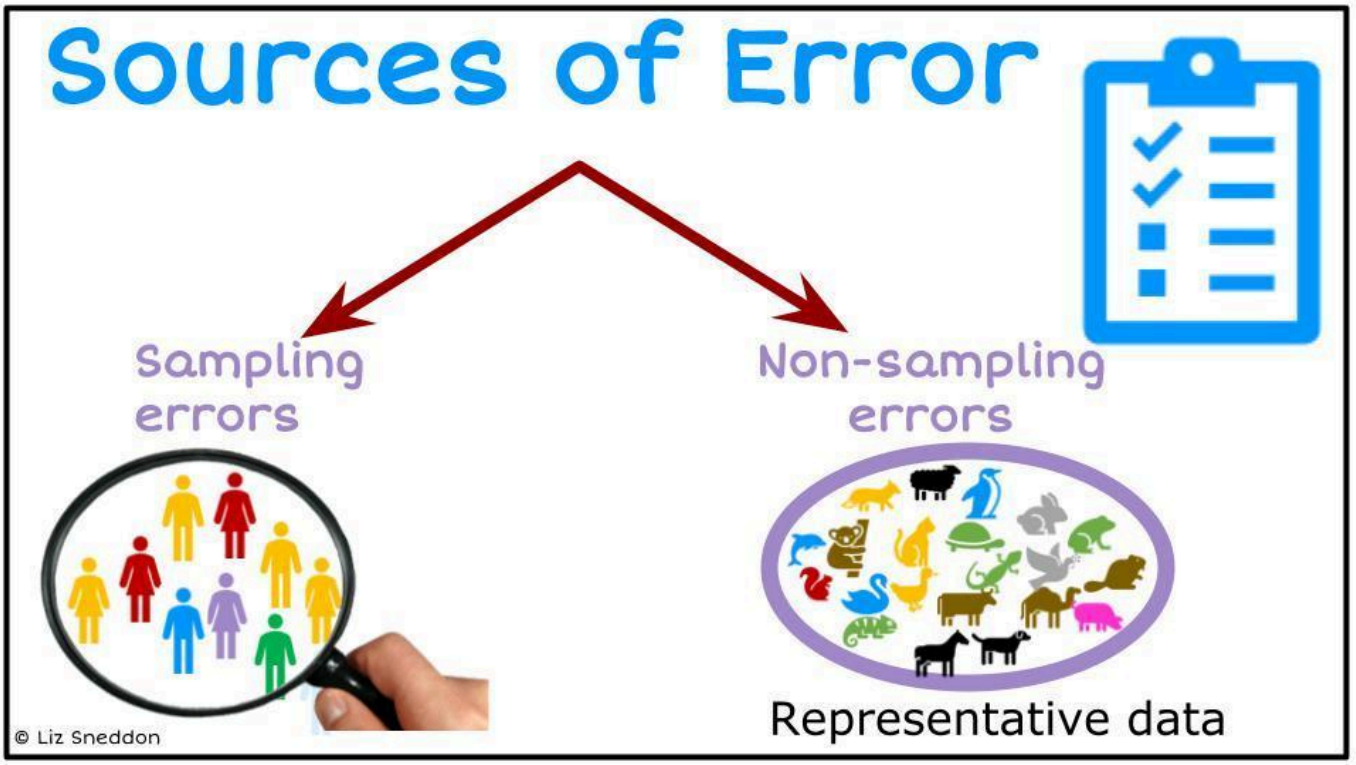
1) Below are a number of descriptions of sampling methods. Decide which sampling method has been described and write the name below the description.

	Situation	Sampling method	Random or biased
a)	Mrs Sneddon prints out her Year 12 class list. She randomly starts at the 10th person on the list, and then chooses every 4th person after that.		
b)	At assembly, the principal asks students who want to take part in the blood drive later this year to stand up.		
c)	Mrs Sneddon needs help setting up classrooms for an assessment and asks five students seated nearby to help.		
d)	Mrs Sneddon separates her class into boys and girls, and randomly choose 3 girls and 3 boys to participate in an experiment.		
e)	Mrs Sneddon was doing a survey of students' opinions on the canteen, randomly chose Elliot quad and she asked all the students in the quad their opinion.		
f)	Mrs Sneddon randomly chooses a student from her class to collect messages from the office.		

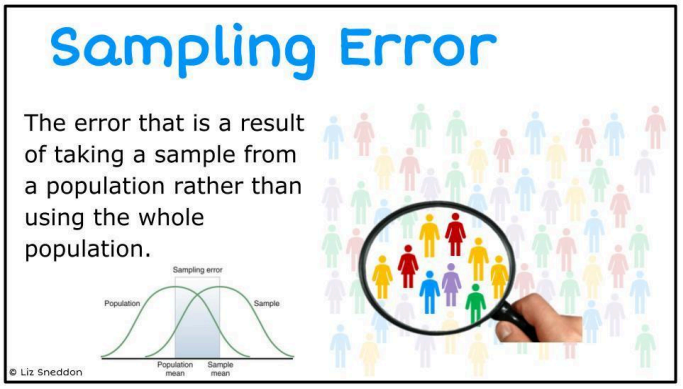
2) Your teacher gives you a list of students in your class. Describe how you could take a simple random sample.

3) Describe how you could take a stratified random sample from your Year 12 class, separating by gender.

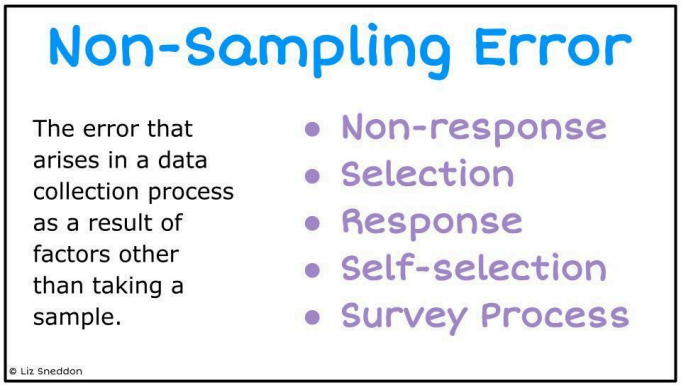
Sources of error



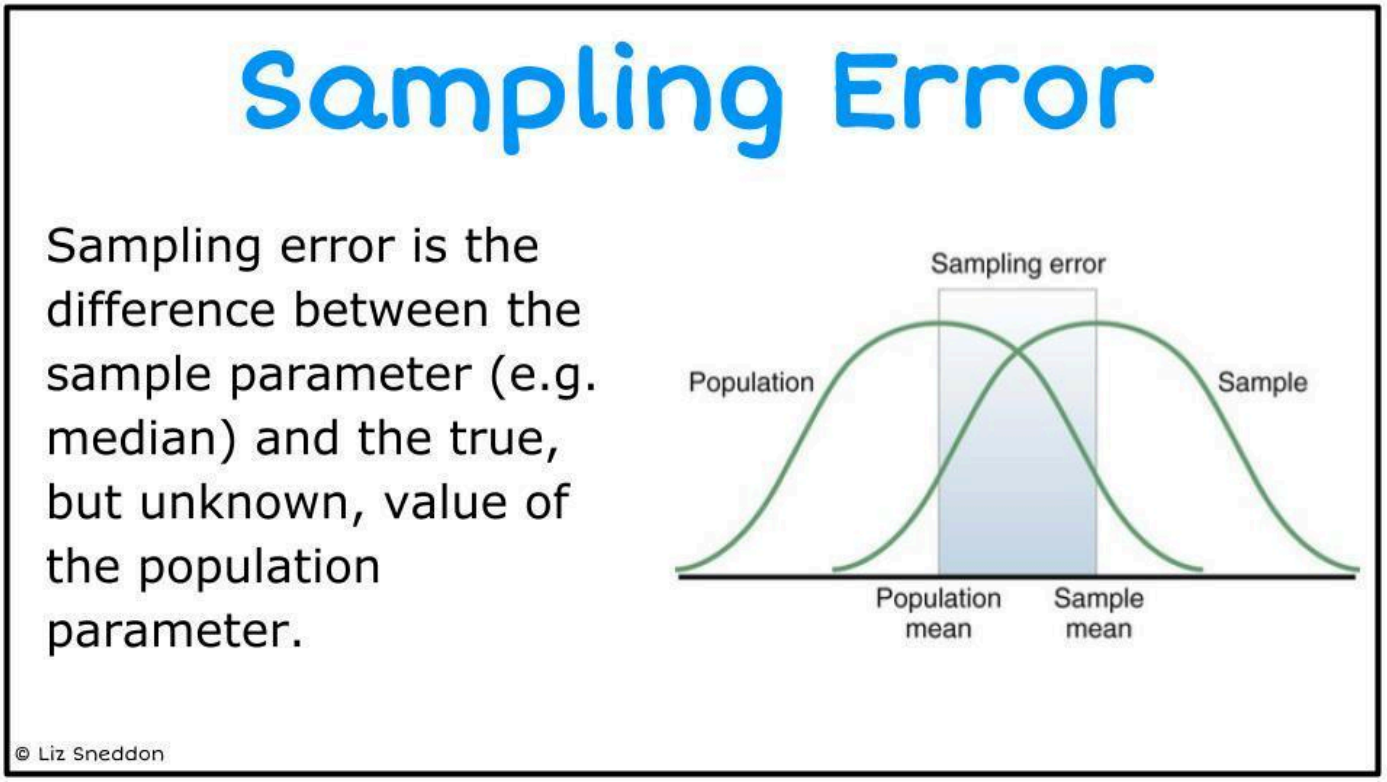
As soon as we take a **sample**, we **WILL** have sampling error. It cannot be avoided.
If we take a **census**, we **DO NOT** have sampling error.



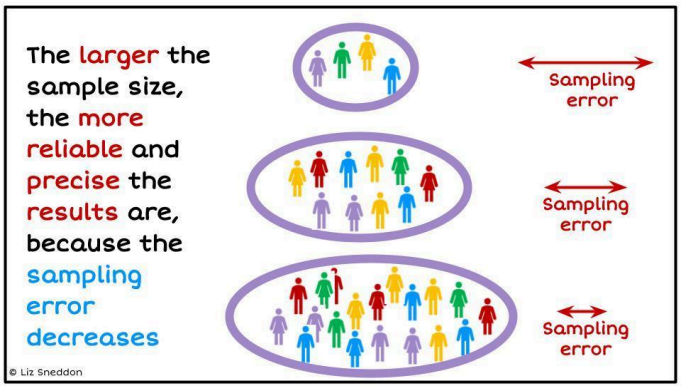
Non-sampling errors have the potential to cause bias in polls, surveys, or samples.

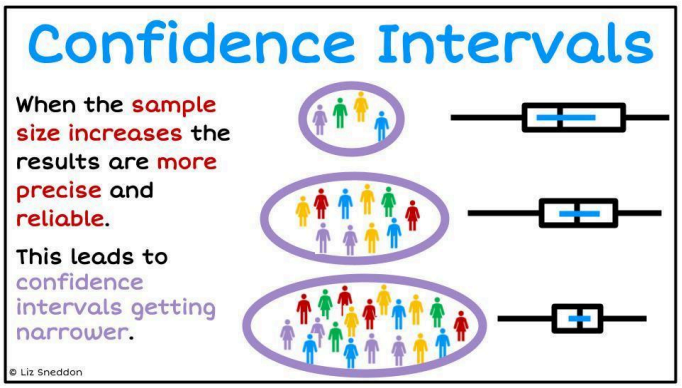


Sampling Error



Sampling error is affected by a number of factors including sample size, sample design, the sampling fraction, and the variability within the population. We will just consider how the sample size affects the sampling error.





Exercise 6:

1) Circle the words that complete the sentences below.

   a) Smaller sample sizes take a **shorter / longer** time to collect data, but results are **more / less** precise.

   b) Larger sample sizes take a **shorter / longer** time to collect data and results are **more / less** precise.

2) Mrs Sneddon is going to survey 20 girls and 55 boys to investigate their use of iPads at home. Explain why it is ok for the sample sizes to be different, and how these sample sizes affect the sampling error.

Non-sampling Errors

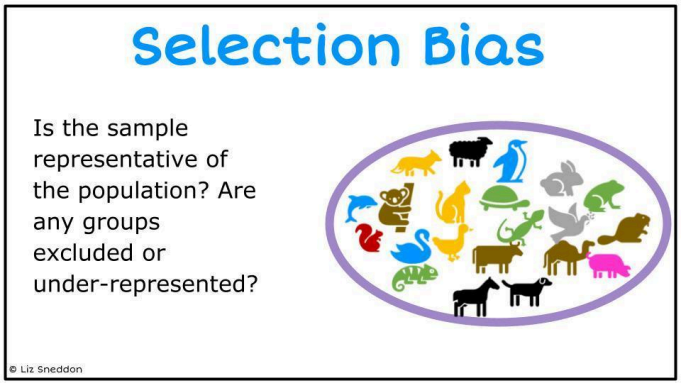
Here are some of the non-sampling errors that you may be able to identify and describe in any statistical report.

	Description
Selection bias	A specific group is excluded or under-represented in the sample, deliberately or inadvertently. If the excluded or under-represented group is different, with respect to survey issues, then bias will occur. Thinking about your sampling frame is useful to compare to your target population and identify any groups that are excluded. We want a sample that is representative of the population
Nonresponse bias	When there is a significant difference between respondents and non-respondents. Think about your response rate and consider whether those who responded and those who did not might have different data/opinions.
Response bias	Respondents answer inaccurately, which skews the data. Answers given by respondents do not always reflect their true beliefs because they may feel under social pressure not to give an unpopular or socially undesirable answer. Think about whether the questions are on sensitive topics or topics that connect to people's social status.
Self-selection bias	Respondents select themselves (volunteer). Individuals with strong opinions about the survey issues or those with substantial knowledge will tend to be over-represented, creating bias. Think about how people were selected for the investigation – did they volunteer?
Survey bias	The wording of questions, the order in which they are asked, and the number and type of options offered can influence survey results. Think back to the questionnaire design topic and connect to the design process and whether there are any biases present.

Selection bias

In order to identify any selection bias, we need to think about who our target population is, what the sampling frame is, and who is in the sample.

The sampling frame is a list of everyone in the population who can be sampled.



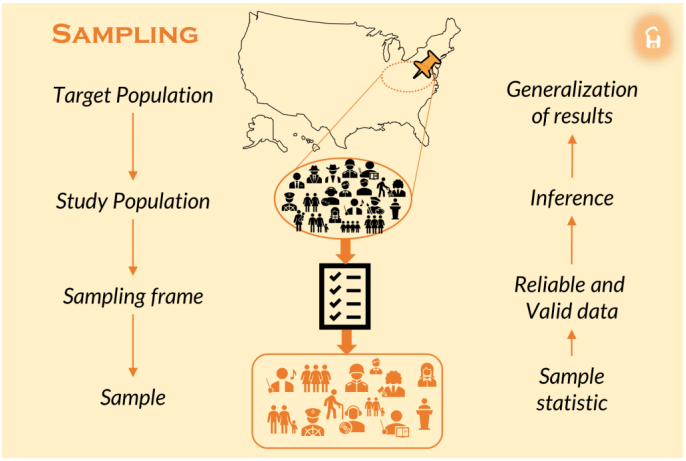


Example:

Examples of sampling frames include:

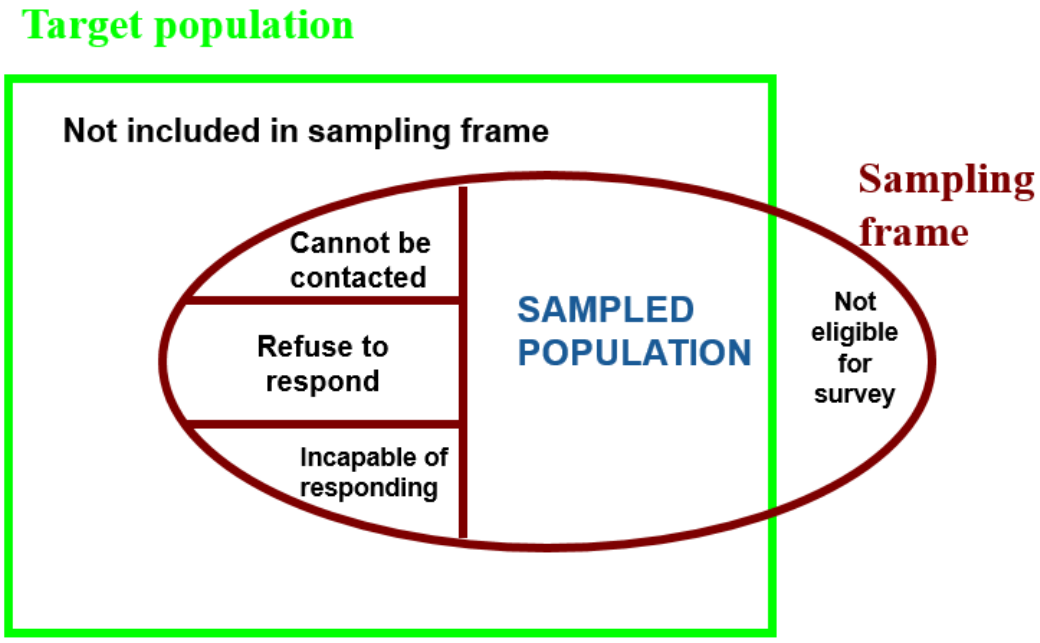
- List of student's names
- Phone numbers in the White pages
- List of customers,
- List of bank accounts,

The diagram below shows the connection between the sampling frame and the population, and why it is important to have a representative sample, otherwise you cannot form inferences or generalise results (extend them to other populations).



[2]

Some lists will include everyone in the target population, and some lists won't. You want to be able to identify who is and is not included in your sample, by comparing the target population to the sampling frame. Here are some categories to think about to help you identify missing groups from your sample frame.



Example:

Sampling frame: Phone numbers in the White pages.

Groups excluded:

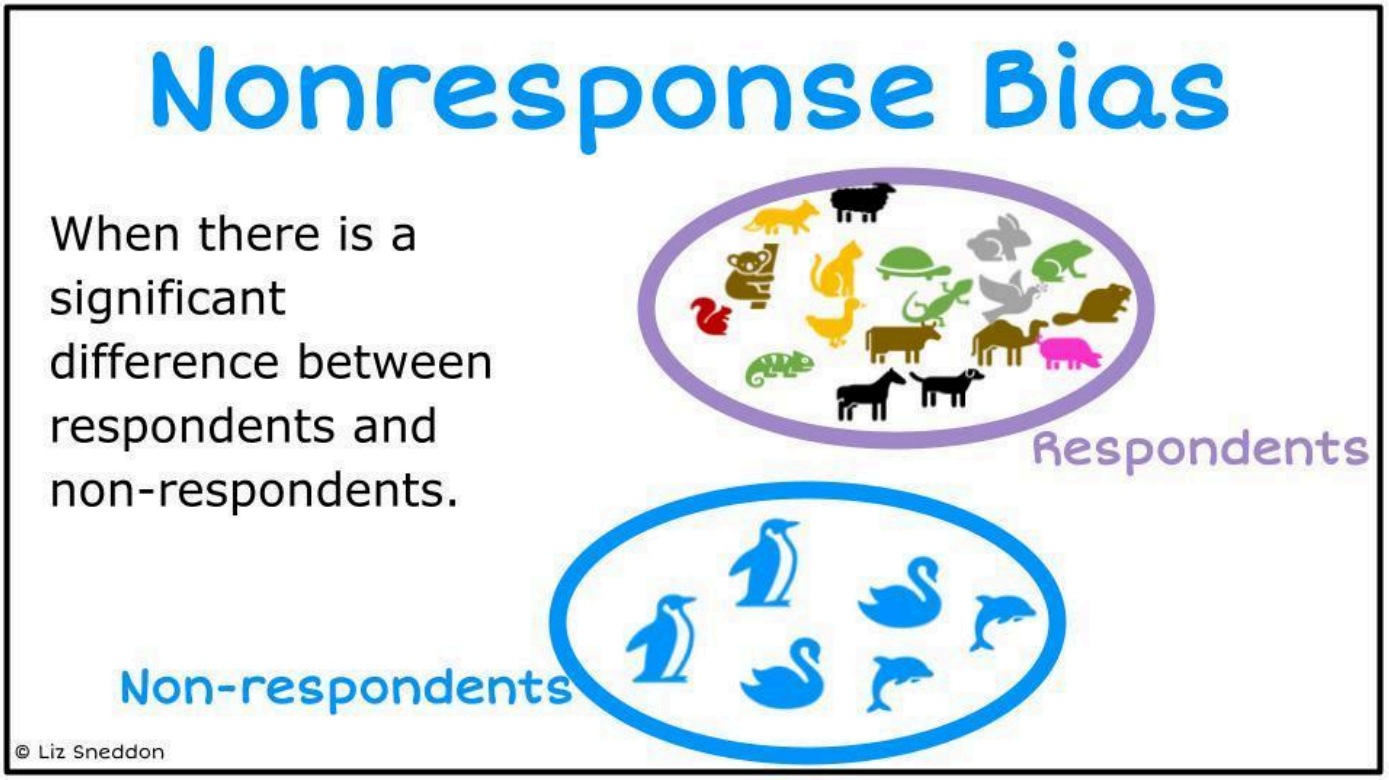
- Police officers,
- people without a landline,
- homeless people,
- people whose number is unlisted, etc.

These people are then excluded from the sample and will often mean your sample is not representative of the target population.

[2] https://conceptshacked.com/probability-sampling/

Nonresponse bias

People who cannot be contacted, refuse to respond, or are incapable of responding are called **non-Respondents**. They may have opinions, values, measurements, or information that is substantially different from our **Respondents.** This is why we try to maximise the **Response Rate**.



Example:

Target population	Adults in Aotearoa NZ
Sampling frame	Phone numbers in the White pages
Groups excluded from target population	• Police officers, • people without a landline, • homeless people, • people whose number is unlisted, • people who have moved within the last year, etc.
Respondents	Adults who are home when called on a landline, and who are willing to participate in the survey. They are more likely to be retired, young mums, etc.
Non-respondents	Adults who: • are not at home (could be at work or studying), • do not want to participate in the survey (could be busy mums, elderly), • have hearing or speaking difficulties, etc.

Exercise 7:

For each of the sampling frames listed below, identify any groups who may be excluded from the target population, respondents, and non-respondents.

1)

Target population	Students at Saint Kentigern College
Sampling frame	List of students in Mrs Sneddon's Year 12 Stats class
Groups excluded from target population	
Respondents	
Non-respondents	

2)

Target population	Teenagers in Aotearoa NZ
Sampling frame	List of students from NZQA
Groups excluded from target population	
Respondents	
Non-respondents	

3)

Target population	People who live near Pakuranga Plaza
Sampling frame	Address of houses in streets near Pakuranga Plaza
Groups excluded from target population	
Respondents	
Non-respondents	

4)

Target population	People in Auckland
Sampling frame	List of cellphone numbers
Groups excluded from target population	
Respondents	
Non-respondents	

Response bias

Response Bias

When the responses to the survey questions are inaccurate, skewing the data and results.



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You want your measurements (data) to be accurate.



Accurate, meaning how close your measurements are to the true value.

High Accuracy

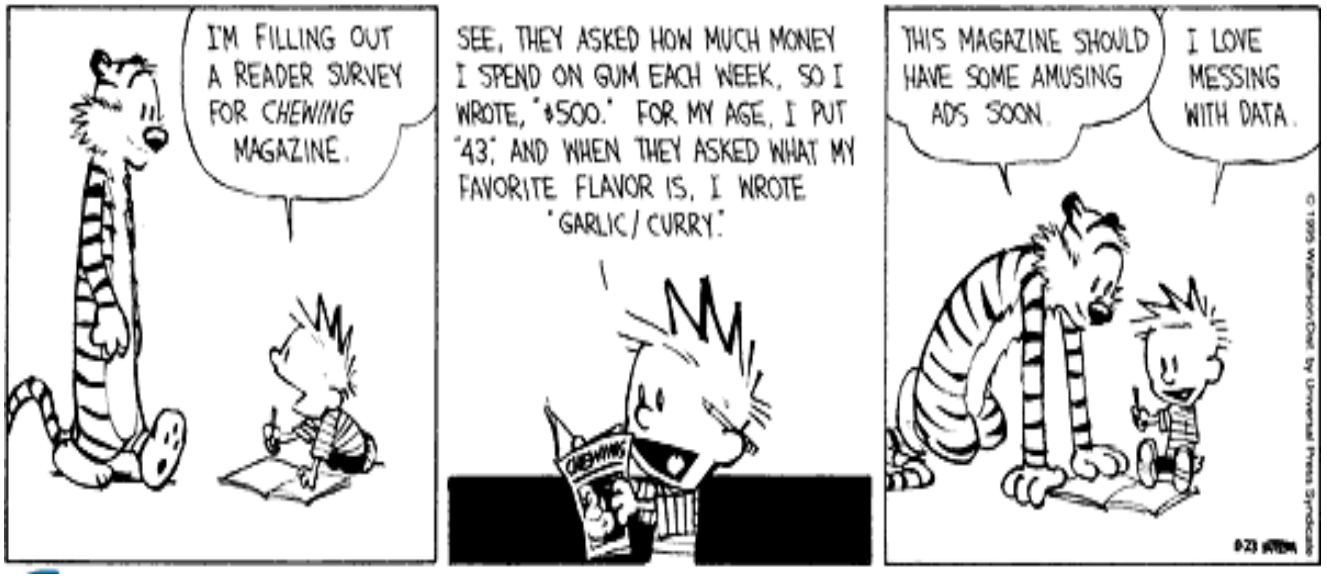


Low Accuracy



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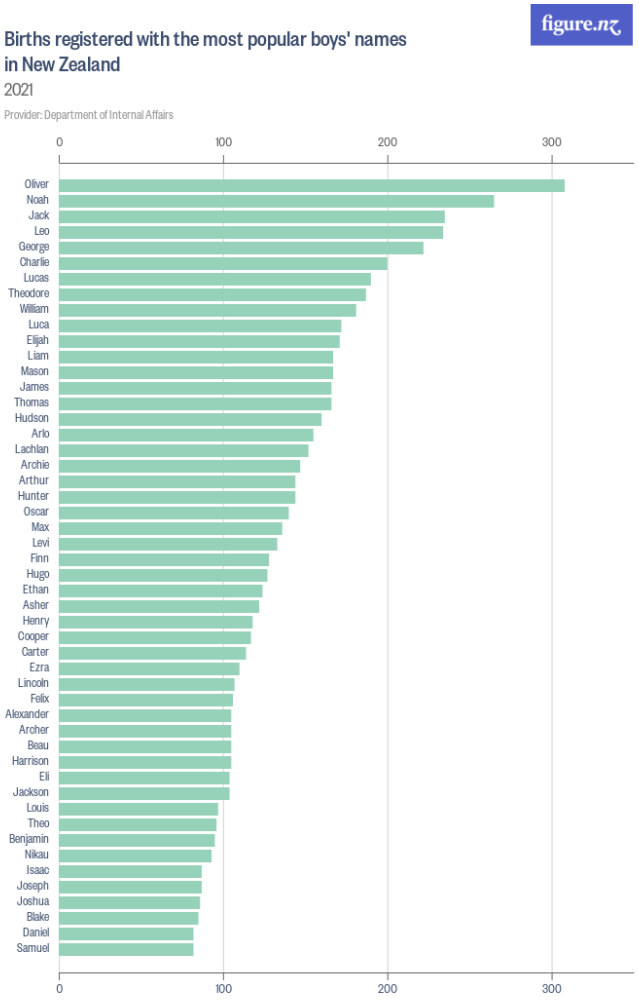
Example:



Example:

Here is a graph of the most popular boys' names in NZ, from registered births in 2021.

Variables
Names
Number of registered births



Measures & possible issues:

Nearly all births in NZ will be registered through the department of Internal Affairs, so I would expect that this data includes virtually the entire population, which leads me to think that the data is more accurate and reliable.

Parents fill in a birth notice where they write down their child's name(s), including the spelling they wish to use. This leads me to expect that the results are more reliable and valid, hence the boys' names of Oliver, Noah, Jack, Leo, and George were the top five boys' names in NZ in 2021.

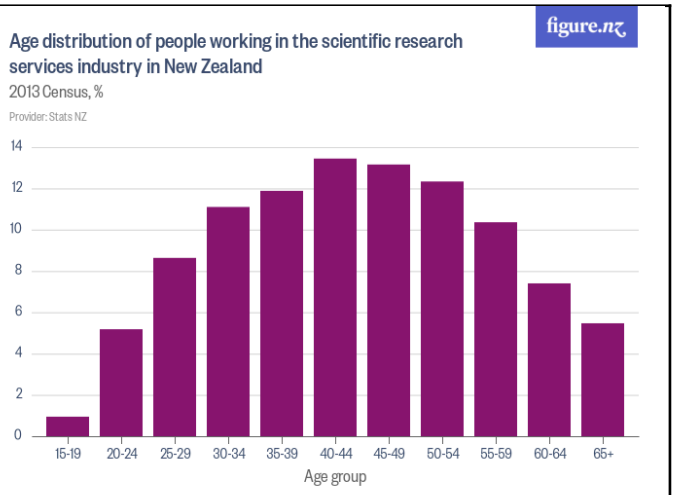
There are some names that are quite similar, but are counted as different names, such as Jack and Jackson. There could be other names with slightly different spelling such as Jac and Jack, but these would count as different names. But it might be more appropriate to count these as one name.

Exercise 8:

Look at each of the visualisations below and identify the variables. Describe how this information may have been collected and any possible issues the accuracy of the data. Give suggestions for possible improvements.

a)

Variables

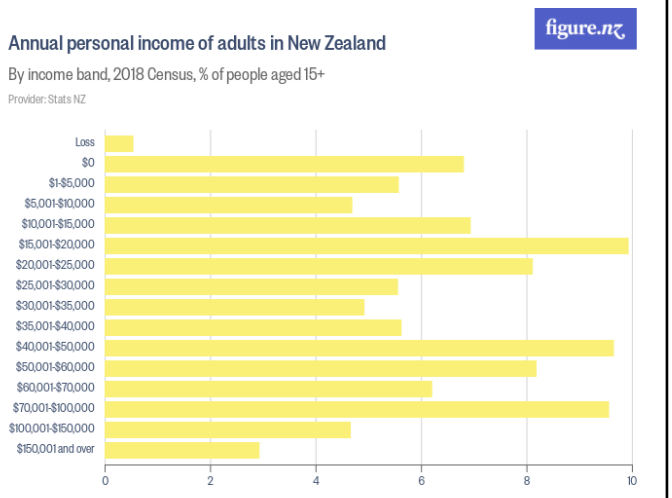


Response bias:

Improvements:

b)

Variables



Response bias:

Improvements:

c)

Variables

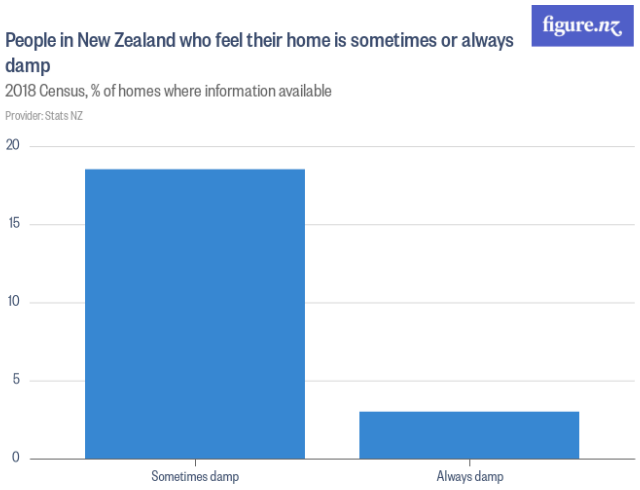


Response bias:

Improvements:

d)

Variables

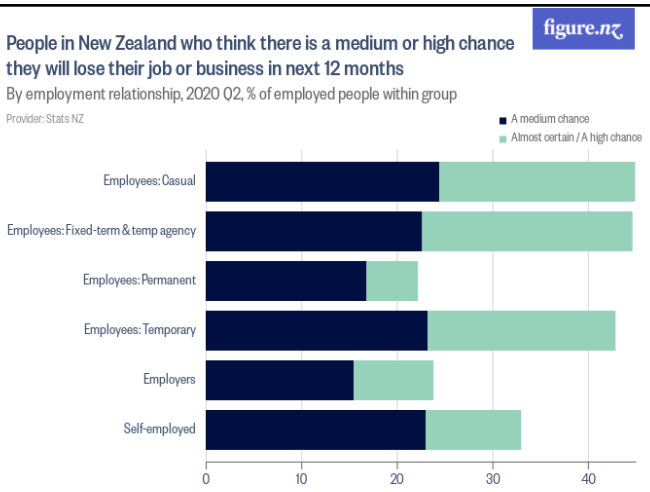


Response bias:

Improvements:

e)

Variables

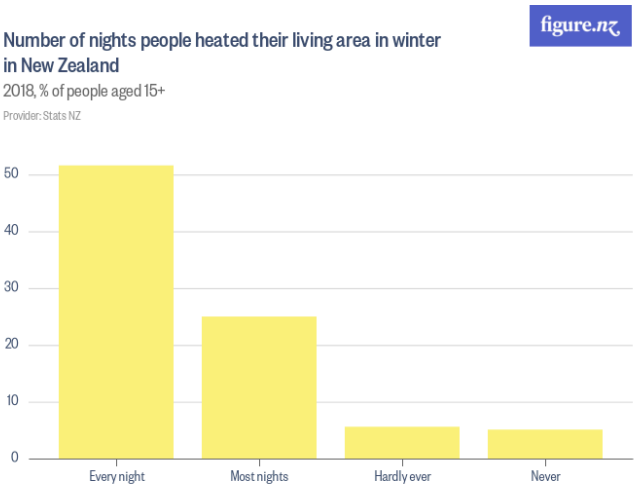


Response bias:

Improvements:

f)

Variables

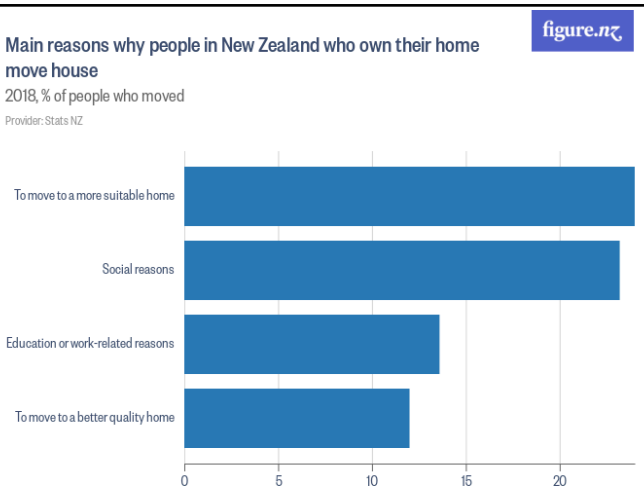


Response bias:

Improvements:

g)

Variables

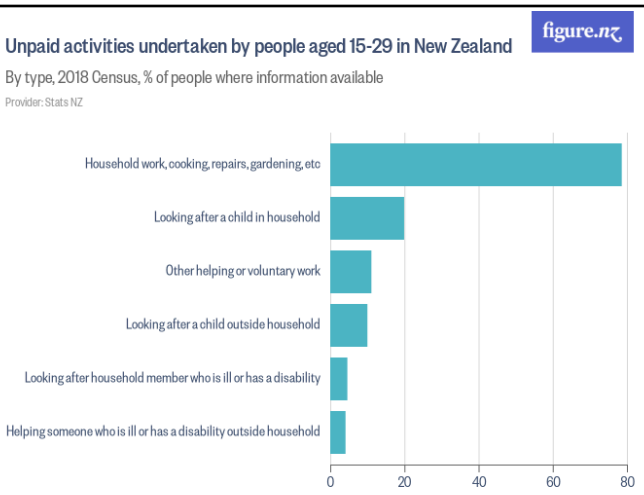


Response bias:

Improvements:

h)

Variables

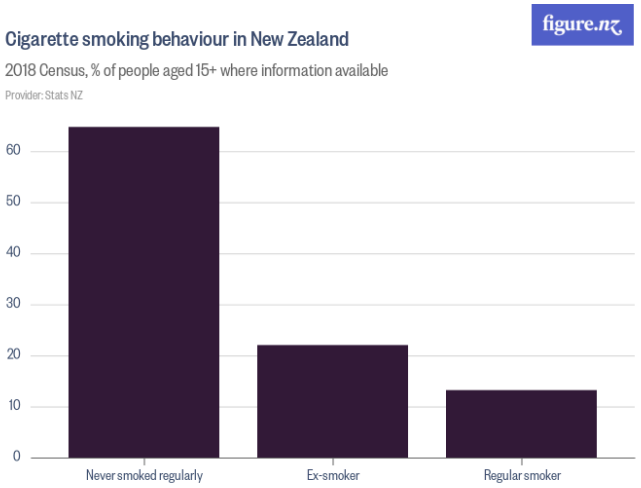


Response bias:

Improvements:

i)

Variables

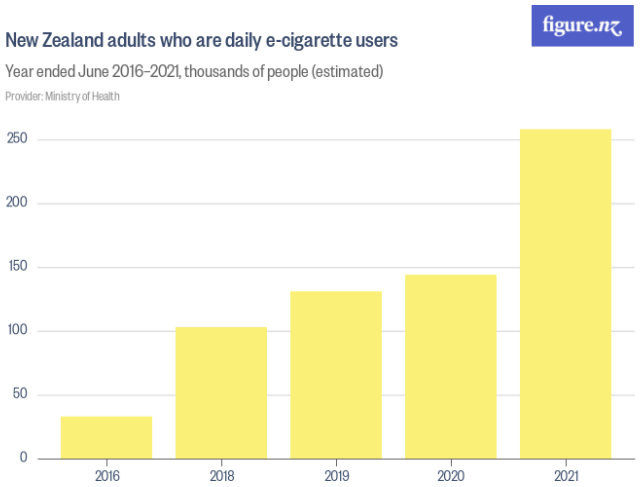


Response bias:

Improvements:

j)

Variables



Response bias:

Improvements:

Exercise 9:

For each situation below, identify possible concerns with the accuracy of the data that would be collected.

	Situation	Identifying concerns on accuracy of data
1)	Gathering information about vaping among teenagers.	
2)	Gathering information from teenagers about cyber-bullying.	

3)	Gathering information from adults about how much money they earn each week.	
4)	Gathering information from adults about their health and weight.	

Self-selection bias



Example:

Identify what data would be over-represented in the situation below.

Gathering information about the health of blood donors.	Blood donors are all volunteers and must meet certain criteria to be able to donate blood. Criteria include a minimum age, minimum weight, not having been sick within a certain time period of donating, not having been diagnosed with certain diseases (e.g., hepatitis), etc. This means that people who are able to donate blood, are likelier to be healthier than those who do not volunteer to donate blood. For example, it would not include people under the age of eighteen or who have diseases such as hepatitis, needing kidney dialysis etc.

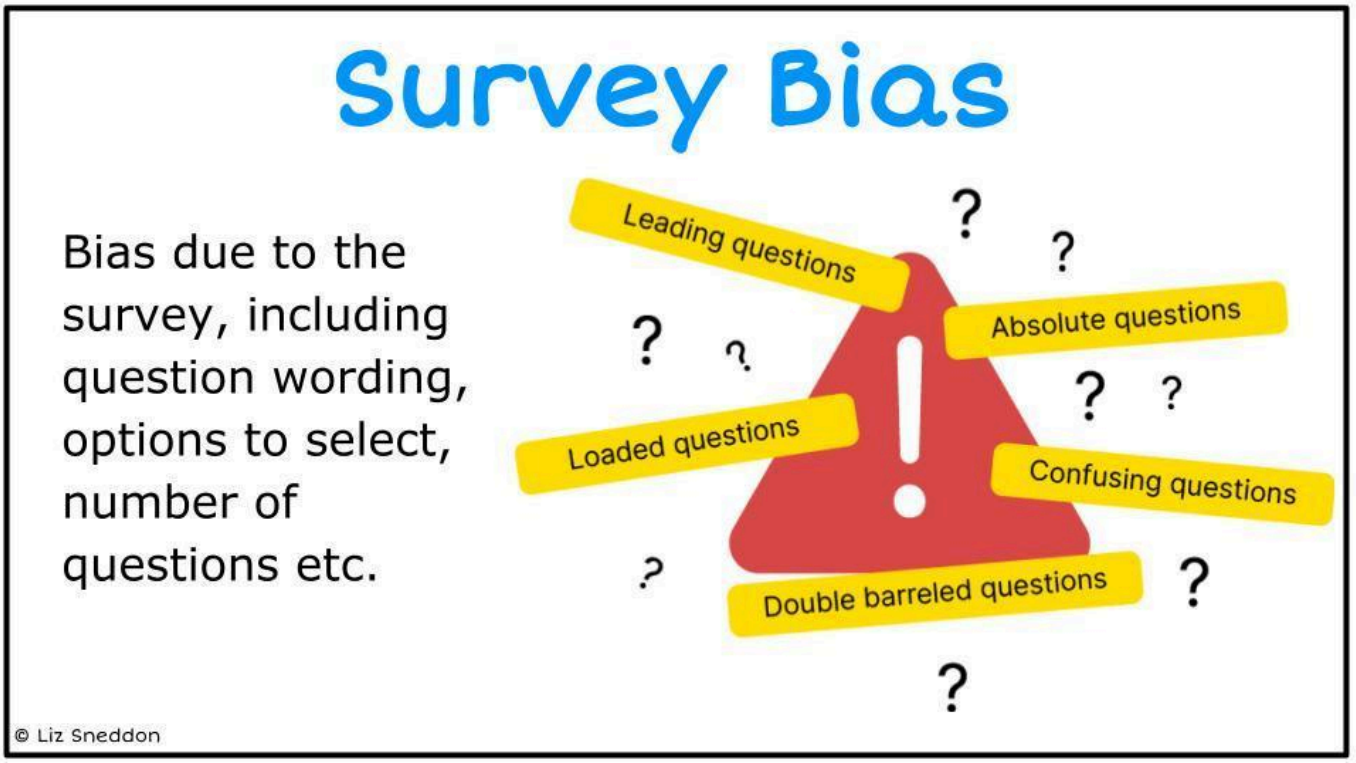
Exercise 10:

For each situation below, identify what data may be over-represented.

	Situation	Identifying data over-represented
1)	Gathering information from customers about the quality of their food and service.	
2)	Gathering information from the website *Rotten Tomatoes* about the rating of movies.	

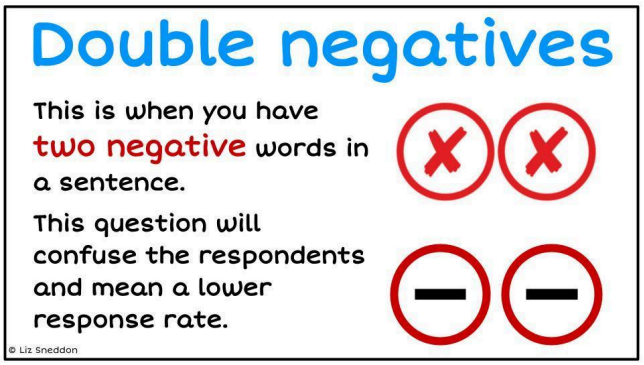
3)	Gathering information from lifeguards about their swimming ability.	
4)	Gathering information from orchestra’s at the KBB Music Festival about the amount of time spent practicing each week.	

Survey bias

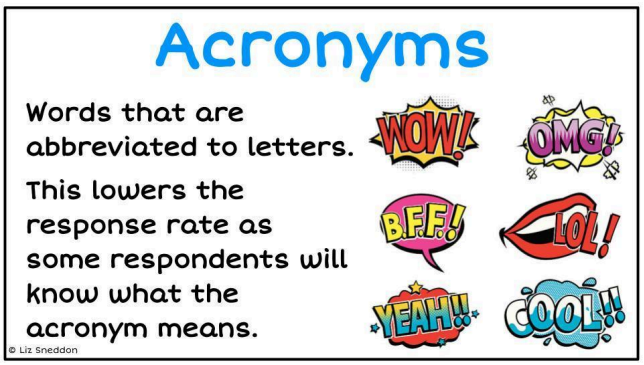


Here are a few things you want to look out for:









Double barrelled

This is a question which has 2 parts to it, but you can only give one answer.

This makes it hard to the respondents to know what the correct answer is.



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Leading question

This is a question that is biased not neutral, and prompts the answer wanted.

This leads to results that are biased and not accurate.

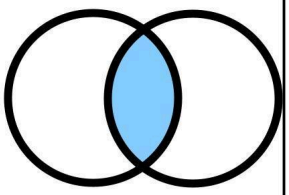


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Overlapping categories

This is when some of the answers overlap.

This makes it hard for the respondent to know which option to select.



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Offensive language

Words that offend respondents.

This lowers the response rate for the question and the questionnaire.



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Embarassing

Questions that are awkward or embarassing for respondents to answer.

This leads to lower response rates as respondents will often skip these questions.



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Too many questions

If there are too many questions, respondents get tired of answering and give up.

This leads to the response rate being lower.



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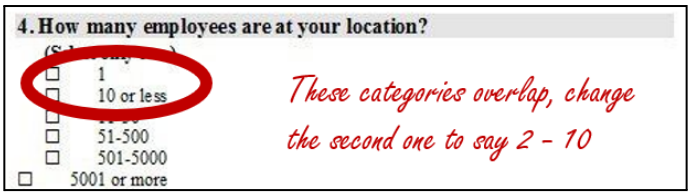
Example:

Please indicate how much you agree or disagree with each of the following statements about the childcare program. *I feel welcomed by staff and other youth at the centre.* *This is a double-barreled question as it asks about both staff AND other youth.*	More people have attended the movie, *Gone with the Wind*, than any other motion picture produced this century. Have you seen this movie? Yes No *Biased / leading question*

This question has a double negative which is confusing

Does it seem possible, or does it seem impossible to you that the Nazi extermination of the Jews never happened? Very possible Possible Impossible Very impossible	People grow up in all different types of families. What type of family did you grow up in? Mum as a single parent Dad as a single parent Both mum and dad *These are not all the possible categories.*

Exercise 11:



1) Identify what is wrong with the following questions, writing on the question, like the example on the right.

a)	Why didn't you fail your test?
b)	Did your teacher help you learn and make you feel comfortable in class?
c)	How much pocket money do you get each week? $0 - $5 $5 - $10 More than $10
d)	Did you make the right decision to save your money?
e)	Why did you #@%! off at lunchtime?
f)	What age did you start doing drugs?

g)	Did you go to the bach in the hols?
h)	I don’t see nobody left on the playground.
i)	What you made you ROFL yesterday?
j)	Explain why ice cream is the best dessert to eat?
k)	What classroom were you in for both period 1 and period 3?
l)	How much time did you spend studying for your test? 5 hours or less 5 hours or more.

Key Findings

Sometimes a statistical report will make claims that cannot be supported by the data collected. Unfounded claims could include the following:

Report Findings

What claims does the report make? Are the claims supported with the evidence in the data, along with an appropriate design?

- Experiment to causation
- Sample to population Inference
- Transfer of findings
- Misinterpretation

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Experiment to causation

Only a controlled experiment can truly show that one thing causes another.



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Sample to population Inference

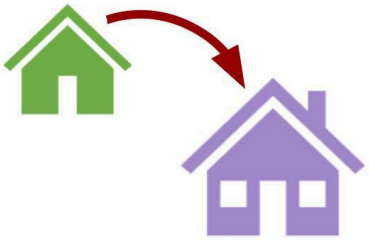
A sample to population inference can only be made if a random sample was used.



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Transfer of findings

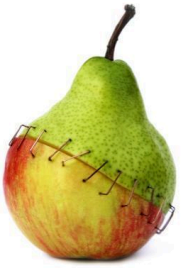
The target population should not be broadened to make the scope of the study seem wider than it really was.



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Misinterpretation

The wording of the findings should not be modified to change the focus of the study.



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Focus Questions

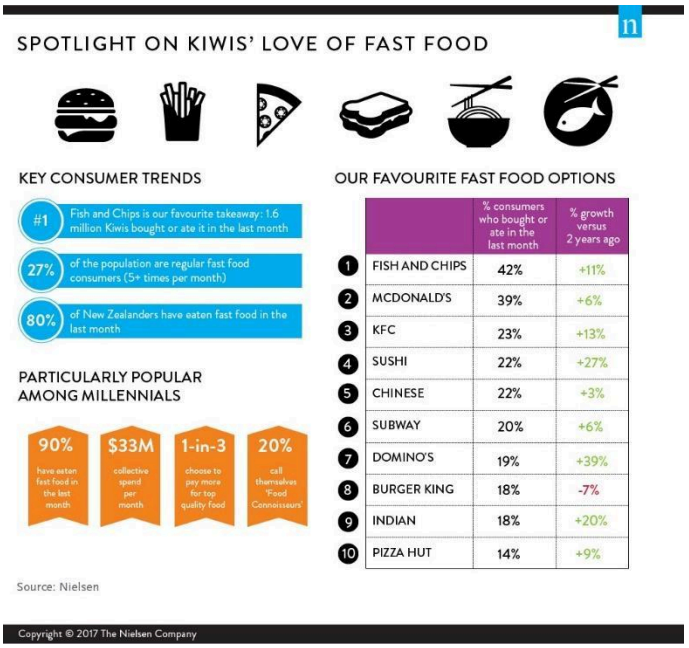
- What are the overall findings of the report?
- What further information is needed?
- Are the claims made in the statistically based reports valid and/or sensible?

Claims	Example
Experiment to Causation	If a study finds that college students with good short-term memories report enjoying classical music, the report should **NOT** claim that classical music **causes** improved short-term memory in college students.
Sample to Population Inference	If a study finds that college students with good short-term memories report enjoying classical music, but a biased sampling method was used, such as self-selection, the claim is **NOT** valid as the sample data **won't be representative of the population**.
Transfer of Findings	If a study finds that college students with good short-term memories report enjoying classical music, the report should **NOT** claim that this would be true of **all people** of enjoy classical music.
Misinterpretation	If a study finds that college students with good short-term memories report enjoying classical music, the report should **NOT** claim that enjoying classical music is related to college students being **more likely to pass**.

Example:[3]

Fish and chips are still top dog in New Zealand

31 Mar 2017, Carly Holloway, Nielsen



In an age where consumers say they are increasingly health aware, New Zealanders still regularly indulge in fast food. Research from Nielsen's Consumer and Media Insights (CMI) survey reveals that in the past month, as many as 80% of New Zealanders ate fast food and more than a quarter (27%) ate fast food more than five times. Fish and Chips continues to be our fast favourite, with 1.7 million Kiwis eating it in the last month - an increase of 11% over two years.

Domino's wins on growth. The number of people who have bought or eaten Domino's in the last month has jumped by 39% compared to 2014. This is largely due to an increase in the number of teen customers, perhaps due to their new value positioning.

The data was gathered via an independently audited survey of 11,000 New Zealanders aged 10+.

[3] https://sites.google.com/view/statsreports/findings#h.p_6-xdDpInSV_K

Possible Answers

The key findings of the report are that New Zealanders buy fish and chips more often than any type of takeaway. Domino's have improved their market share the most in the last two years.

The survey has asked which fast food was eaten in the last month, and used this to express a 'favourite'. It might be that some people have a favourite fast food, but only eat it infrequently due to price or accessibility. The claim that fish and chips is a 'fast favourite' cannot be justified.

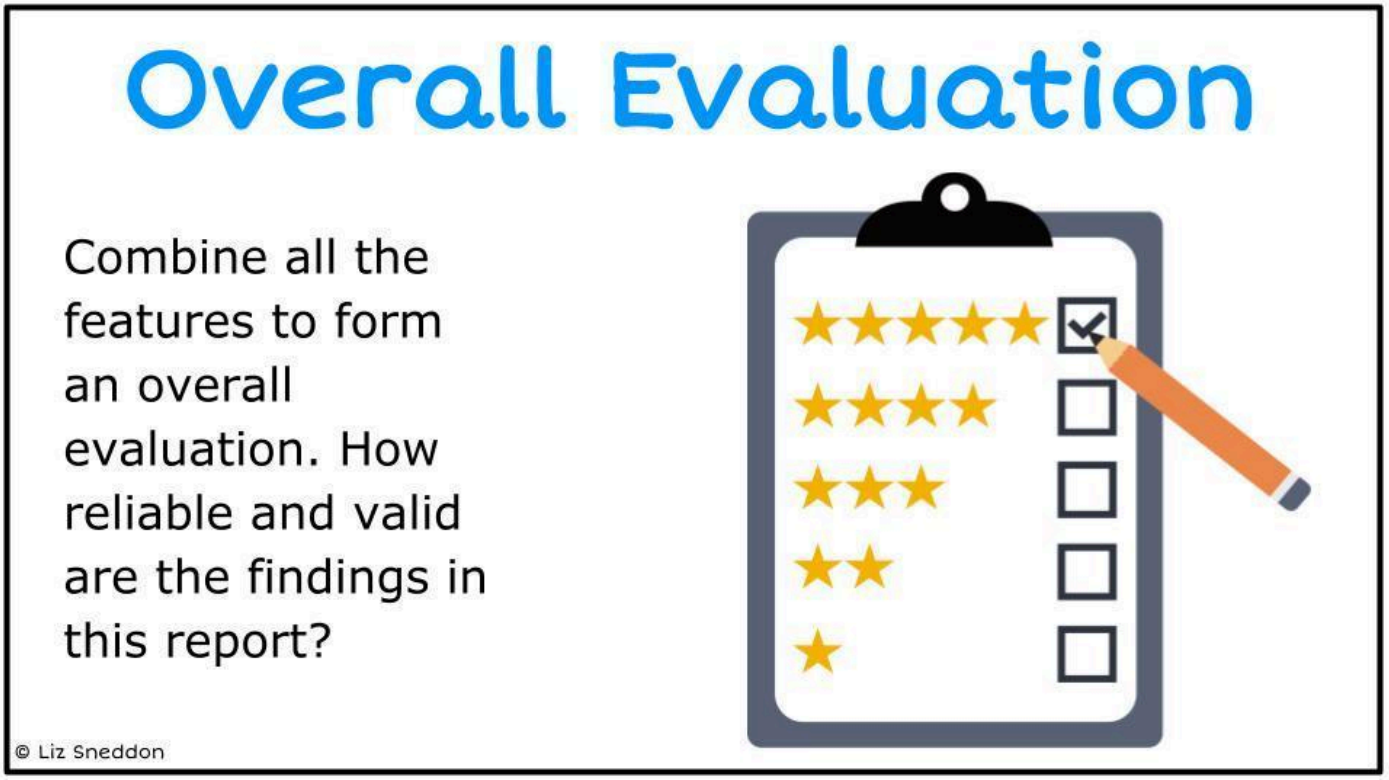
The way the responses have been structured includes some brands (like McDonald's and Domino's) and some types (like Indian and Sushi). If the brands were put together as types, then Burgers would be the 'favourite' choice for New Zealand consumers, with fish and chips in second, and pizza in third.

Overall evaluation

The final Evaluation considers the statistically based report as a whole. Do the Findings match the Purpose, and answer the questions raised there?

You should also give an overview of the biggest problems with the report and suggest improvements to the study.

DON'T evaluate the report's writing style, clarity or whether or not you believe it to be true.



PPDAC[4]

Thinking through how the report used the statistical inquiry cycle (PPDAC cycle) is another good way to evaluate a statistically based report. A lot of the features of a statistical report are related to the Plan.

Problem: what is the purpose of the investigation?

Plan: how was the survey (sampling and survey methods) designed?

Data: how was the data collected?

Analysis: how was the data analysed and summarised?

Conclusion: what findings were reported?

[4] https://sites.google.com/view/statsreports/evaluation#h.p_k4aQ-33YD-dg

Example 1:

Kiwis' grubby bathroom habits exposed - research[5]

8 July 2015, Fuseworks Media abridged



Kiwis don’t shower daily or wash their hands after using the loo, and are sick of their partners leaving the toothpaste in a mess and using all the hot water, according to a new survey.

The study, commissioned by Rinnai, investigated Kiwis’ attitudes to bathroom hygiene and toiletry etiquette, and showed some less-than-sparkling habits when it came to our showering schedule.

A quarter of Kiwis (25%) said they don’t shower or bathe every day.

The survey also revealed the things that annoy us the most when it comes to our partner using the bathroom.

It appears picking up the towels and bathmat off the floor is the secret to relationship harmony, with nearly one in three (27%) saying the bathroom being left in a mess bugs them.

However, the biggest annoyance is hopping into the shower to find your partner or flatmate has used up all the hot water and left you with a cold shower to start the day, with nearly one-third (30%) of people saying it’s the very worst habit someone can have.

Nearly half of all households (47%) have a shower time limit in place for their families, and a further 28% have reduced the temperature of their hot water to save.

Managing director for Rinnai NZ, Ray Ferner, says the figures reflect how much hot water supply and power bills impact on New Zealanders’ lives.

"Hot water accounts for around 30% of an average Kiwi household electricity bill, and is obviously in greater demand over the colder winter months, so it’s clearly an important concern for most homes," says Ferner.

Rinnai offers a new power saving hot water cylinder that works by learning household hot water usage patterns, and reducing its cylinder temperature when not in use.

Possible Answers

The purpose of this report seems to have been to inform New Zealanders of the proportion of the population who think that the worst bathroom habit is using up all the hot water. The study was probably commissioned by Rinnai to give them a reason to tell potential customers of how their new product will help solve this problem - so there is a potential conflict of interest. It would be better if an independent company had been commissioned to conduct the research.

If the 'bad bathroom habits' list was read to respondents in a certain way, it might have made it more likely for them to choose "using all the hot water" as the worst. Since Rinnai would have an interest in this response coming out on top, this cannot be discounted.

The survey does not seem to have asked about some important underlying variables, like whether they live alone; whether they have gas-heated hot water; and whether they shower in the morning or evening. All of these could affect the responses to the key question about the worst bathroom habit.

Depending on the sample size, 27% saying "leaving the bathroom in a mess" and 30% saying "using all the hot water" might not actually be different (due to the margin of error).

[5] http://www.voxy.co.nz/lifestyle/kiwis-grubby-bathroom-habits-exposed-research/5/225970

Full Example:

This article was printed in The Mercury on Saturday, 13th June 2009, page 3.

Aussies sweet on Cadbury when taste comes to trust

AUSTRALIANS have voted with their sweet tooth, naming Cadbury the most trusted brand in the nation for the sixth year running.

Panadol and Band-Aid ranked second and third respectively in *Reader's Digest*'s annual Most Trusted Brands survey, while the iconic flying kangaroo, Qantas, dropped 47 spots in consumer confidence.

Despite its fall in overall popularity, the national carrier flew to first place in the travel/airlines category.

The magazine employed research firm The Leading Edge to survey 750 Australians, who ranked 158 different brands on a scale of one to 10.

"The message to companies right now is to build trust, or bust," said Vanessa Hall, the author of a book entitled *The Truth About Trust In Business*.

"Stay free from scandal, be reliable, safe, and deliver on your promises," she advised.

Toyota took out first place in the car category while the Bendigo Bank beat the big banks to claim first place in difficult economic times.

Social trends commentator Bernard Salt said Australians were turning to tried and trusted brands more than ever.

"When the going gets tough, consumers take less risks and go for the safe options," he said.

THE BEST REGARDED

Brands most trusted by Australian consumers —

1. Cadbury
2. Panadol
3. Band-Aid
4. Sony
5. Colgate
6. Dairy Farmers
7. Nokia
8. Johnson & Johnson
9. Streets
10. Peters and Bunnings.



Category winners —
Food: Cadbury
Electronics: Sony
Health and Wellbeing: Panadol
Cars: Toyota
Whitegoods: Westinghouse
Retailers: Bunnings
Mobile phones: Nokia
Cosmetics/Skincare: Dove
Computers: Hewlett-Packard
Vitamins/Supplements: Blackmores
Kitchen brands: Glad
Travel/Airlines: Qantas
Pet Food: Whiskas
Credit cards: Visa
Banks: Bendigo Bank
Telcos: Vodafone
Iconic Aussie brands: Arnott's.

Purpose:
The purpose of the survey is to rate the brands that people in Australia trust the most. The company "Readers Digest" paid for the survey and employed an independent research company "The leading edge" to carry out and analyse the survey. This was done in 2009.

Evaluate Feature 1:
One thing that I noticed was that the survey asked 750 people for their ratings of which brand they trusted the most. I think that a sample size of 750 is quite good, as we have count data, and this is a good balance between the time it takes to collect the data and the reliability of a large sample size.

Evaluate Feature 2:

Another thing I noticed was that they didn't tell us how they collected the data. Did they do it over the phone, or in person face-to-face, or on the internet? If I knew this I would be better able to evaluate whether I trust the results or not.

Evaluate Feature 3:
A third thing I noticed was that there were 158 brands selected out of 17 categories. Some people will have become bored and not ranked all 158 brands, so there will be missing data.

Conclusion:

We don't completely trust the results from this survey because there wasn't enough information shown (e.g. sampling method) for us to be able to trust it.

Exercise 12:

1)

Extract from Newspaper article
"GRADUATING IS GOOD FOR YOUR HEALTH"

College graduates feel better emotionally and physically than their high-school drop-out counterparts, a study of over 400,000 US adults reveals. Participants were asked a series of questions including level of education and on how many of the past 30 days they felt physically and emotionally healthy.



Evaluate the following features:

Sample size(s)	
Evaluate	
Response bias	**Variables**
Evaluation • How accurate is the data? • Are there biases due to the situation/topic?	

2) Here is an article from The Scotswatch, May 3 2012[6]

Scots slimming down a wee bit

In the past year the percentage of Scottish people of normal weight has increased slightly but overweight people still command a solid majority, according to the Centre of Dietetics in Bigtown.

At the end of March 2012, 37.9 per cent of Scots were within the normal weight range, compared with 36.8 per cent a year ago, the Spratt-Good Health Index survey found.

Overweight and unhealthily obese Scots accounted for more than 60 per cent of the population, it said.

The study said that it is very encouraging to note that obesity rates are declining in Scotland even though most Scots are still considered obese or overweight.

Figures from March 2011 indicated that overweight people made up 34.7 per cent of the Scottish population, and obese people 26.7 per cent. The 2012 survey found 33.8 per cent of Scots to be overweight and 26.5 per cent obese.

The Centre of Dietetics offered some possible reasons for the change, although they stated the reasons were not clear cut. Amongst these were: the depressed economy meaning Scots tended to eat at home rather than eating higher calorie content take-away foods; their advertising campaign educating the population about health risks associated with obesity; and the increased availability of fresh fruit and vegetables with import restrictions having been lifted.

The decline in obesity rates could mean a decrease in healthcare costs, the study said. The spokeswoman for the Ministry of Health estimated medical costs associated with obesity were £1.73 billion ($NZ3.39 billion) in 2009.

The study used self-reported data of height and weight to determine a score of body mass index and was based on telephone interviews with a random sample of 1,583 people aged 18 and older. The margin of error was ±2.5%.

Carry out a full evaluation of the article, using the template below.

Purpose:

Study type	Experimental Observational
Purpose	
Audience	
Source	

[6] reproduced from Level 3 Statistics Learning Workbook.

Evaluation	

Features:

Population Measures & Variables	

Variables	Data types

Evaluation	

Survey method	Email Telephone Internet Pen and paper Face-to-face interview Other: _____
Evaluation • Bias • Accuracy • Response rate • Cost • Time • Geographical coverage	
Sampling method	Simple random Systematic Stratified Cluster Convenience Self-selected
Evaluation • Random or biased • Is the data representative of the population?	
Sample size(s)	
Evaluate	

Selection bias	
Evaluation • Is the sample representative of the population?	
Nonresponse bias	
Evaluation	

Target Population	
Sampling frame	
Groups excluded	

Respondents	
Non respondents	

Response bias	**Variables**
Evaluation • How accurate is the data? • Are there biases due to the situation/topic?	
Self-selection bias (Are there volunteers in this study?)	
Evaluation • Are data/opinions over-represented ?	

Survey bias (Are there issues with the question wording, options, etc)	
Evaluation	

Conclusion:

Key Findings	

Overall evaluation	
Link conclusion to the purpose	

3) Carry out a full evaluation of the article, using the template below.

" HEAVY DRINKING DURING PREGNANCY LEADS TO HYPERACTIVE KIDS"

A recent study of 11,500 UK children by the Department of Epidemiology and Public Health, showed that the children of mothers who drank heavily during pregnancy were more likely to suffer from hyperactivity and behavioural or emotional problems.



Extract from Journal Article
This study examines the relationship between light drinking during pregnancy and the risk of emotional or cognitive problems at age 5 years. 11513 UK children were selected from the UK Millennium Cohort study. *Participants were grouped according to the mothers' reported alcohol consumption during pregnancy. Children of these mothers were tested at age 5 years. Children born to mothers who drank 1 – 2 drinks per week or per occasion during pregnancy were not at increased risk of behavioural or cognitive difficulties compared with mothers who had not drunk during pregnancy. However, children born to mothers in the heavy/binge drinking category were more likely to have hyperactivity, behavioural or emotional problems compared to those born to mothers who did not drink during pregnancy.*

Purpose:

Study type	Experimental Observational
Purpose	
Audience	
Source	

Evaluation	

Features:

Population Measures & Variables	

Variables	Data types

Evaluation	
Survey method	Email Telephone Internet Pen and paper Face-to-face interview Other: _____

Evaluation • Bias • Accuracy • Response rate • Cost • Time • Geographical coverage	
Sampling method	Simple random Systematic Stratified Cluster Convenience Self-selected
Evaluation • Random or biased • Is the data representative of the population?	
Sample size(s)	
Evaluate	

Selection bias	
Evaluation • Is the sample representative of the population?	
Nonresponse bias	

Target Population	
Sampling frame	
Groups excluded	

Respondents	
Non respondents	

Evaluation	
Response bias	**Variables**
Evaluation • How accurate is the data? • Are there biases due to the situation/topic?	
Self-selection bias (Are there volunteers in this study?)	

Evaluation • Are data/opinions over-represented ?	
Survey bias (Are there issues with the question wording, options, etc)	
Evaluation	

Conclusion:

Key Findings	

Overall evaluation	
Link conclusion to the purpose	

4) Carry out a full evaluation of the article, using the template below.

Travel App makes Campers Happy

If you think that bringing a radio on a camping trip is too much technology, think again. A new breed of campers is using smartphone apps to make most of their holidays. And it seems campers using this technology are happier than those who don't.

"We use it all the time", a keen traveller from Auckland said. "I can see where my friends have been and whether they liked a place. And because we sort of have the same taste I usually like the place, too. It's like a personal recommendation."

In the study commissioned by New Zealand app maker TrApps, 73.2% of campers using travel apps while on holiday report that they are overall happy or very happy with their holiday, compared to only 61.7% of campers not using travel apps.

The study was conducted by an independent research company in January 2013 with 500 participants, aged 18 – 29, in New Zealand.

Additional information:

TrApps is a maker of social networking travel apps for smart devices. The survey was conducted with campers aged 18 – 29. In 2013, about 30% of campers in the age group used travel apps while on a camping holiday.

Purpose:

Study type	Experimental Observational
Purpose	
Audience	
Source	
Evaluation	

Features:

Population Measures & Variables

Variables	Data types

Evaluation

Survey method

Email
Telephone
Internet
Pen and paper
Face-to-face interview
Other: _____

Evaluation

- Bias
- Accuracy
- Response rate
- Cost
- Time
- Geographical coverage

Sampling method	Simple random Systematic Stratified Cluster Convenience Self-selected
Evaluation • Random or biased • Is the data representative of the population?	
Sample size(s)	
Evaluate	
Selection bias	**Target Population** **Sampling frame** **Groups excluded**

Evaluation • Is the sample representative of the population?	
Nonresponse bias	**Respondents** | **Non respondents** |
Evaluation	

Response bias	**Variables**
Evaluation • How accurate is the data? • Are there biases due to the situation/topic?	
Self-selection bias (Are there volunteers in this study?)	
Evaluation • Are data/opinions over-represented ?	

Survey bias (Are there issues with the question wording, options, etc)	
Evaluation	

Conclusion:

Key Findings	

Overall evaluation	
Link conclusion to the purpose	