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Teaching and learning guide for statistical and probability investigations

NCEA Level 1

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Statistical enquiry cycle

[Mathematics and Statistics | NCEA]

Statistical Investigations

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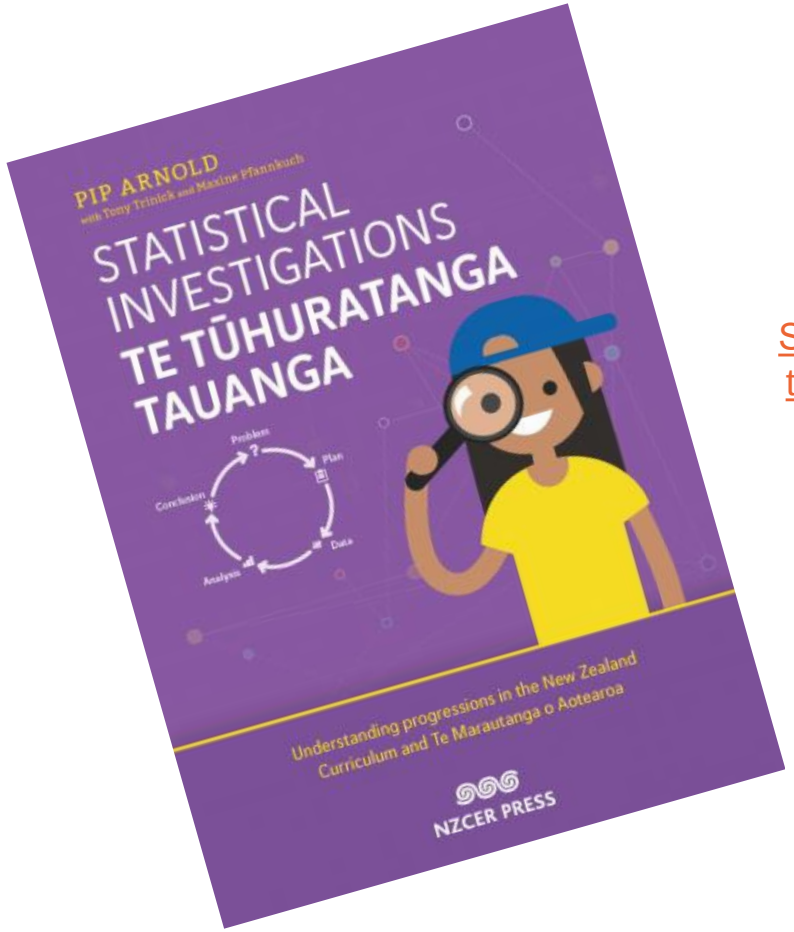
This book is available in all New Zealand secondary schools. It is referenced throughout this presentation.



[Statistical investigations | Te tūhuratanga tauanga: Understanding progressions in the New Zealand Curriculum and Te Marautanga o Aotearoa (NZCER)]

Going deep: PPDAC

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PPDAC phase	Progressions within	Page
Kaupapa | Problem	Situations for statistical investigations Investigative questions Thinking about what the data might show	28 36 55
Whakamahere | Plan	Methods of data collection Ethics “Who” to measure What to measure	82 95 100 111
Raraunga | Data	Collecting/considering data Data management Cleaning data	152 178 190
Tātari | Analysis	Data visualisations Describing distributions Reasoning with data	211 291 342
Whakatau | Conclusion	Answering the investigative question Communicating findings and writing reports	376 393

PPDAC: Probability

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PPDAC phase	Probability activities
Kaupapa | Problem	Investigative questions Thinking about what the data might show
Whakamahere | Plan	Assumptions Sample space Model construction Designing probability experiments
Raraunga | Data	Running simulations Recording data
Tātari | Analysis	Data visualisations Describing probability distributions
Whakatau | Conclusion	Comparing with others' findings and findings from probability experiments with associated theoretical probability Answering the investigative question Proposing new theoretical models Communicating findings and writing reports

Investigative questions versus purpose

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Is there a problem with the problem in the PPDAC cycle? (AMA)

1. The variable(s) of interest is/are clear and available or can be collected
2. The group* or population* of interest is clear
3. The intent is clear (e.g., summary, comparison, relationship, time series)
4. The investigative question can be answered with the data (e.g., sample size sufficient, question is specific, data can be collected, ethics)
5. The investigative question is one that is worth investigating, that it is interesting, that there is a purpose*
6. The investigative question allows for analysis to be made of the whole group*.

Arnold, 2022, p. 36

Investigative questions versus purpose

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The purpose drives the nature of the statistical analysis that is done.

- The purpose identifies the variable or variables of interest.
- The purpose identifies who we will collect or source data about (the group or population).
- The purpose identifies the intent (summary, comparison, relationship, time series situation).
- The purpose must be able to be realised with data that can be collected or sourced.
- The purpose should be about the whole of the ‘who’ (the group).
- The purpose should be meaningful and interesting.

There is no shortcut

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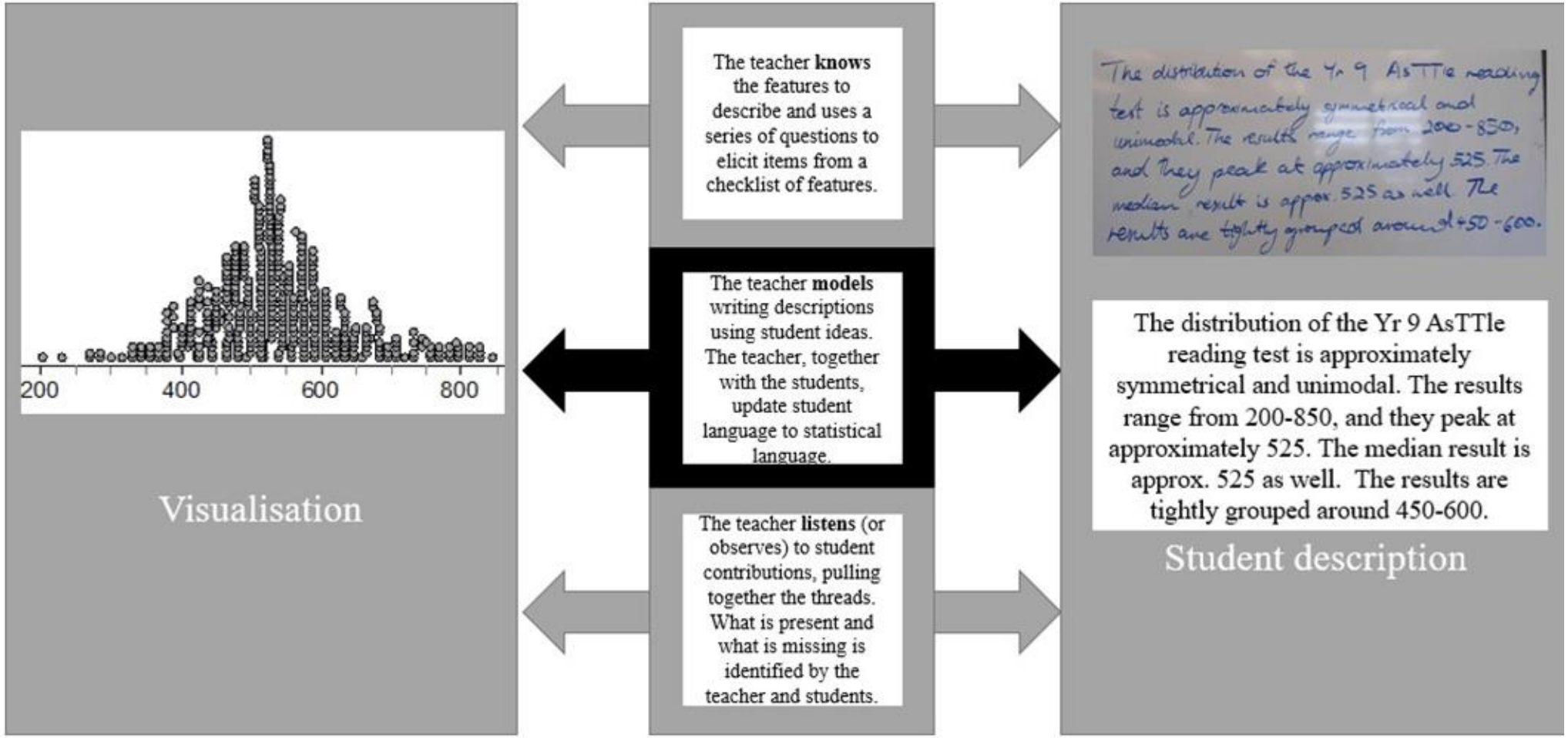
- Students need to engage in statistical (and probability) enquiry.
- We are always somewhere in the PPDAC cycle when teaching (and learning) statistics and probability. Be explicit about it.
- Teachers need to model their thinking out loud, so students get more experience with this.
- Actively reflect on student responses with the class out loud, using interrogative prompts, for example:
  - turn criteria into interrogative questions
  - check statements for context — variable, values, units, group/population (Arnold, 2022, p.382).

Know, model, listen



Arnold, P., & Pfannkuch, M. (2022). Engaging novice statisticians in statistical communications. *Mathematics Education Research Journal*, 1-27.

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Common Online Data Analysis Platform (CODAP)

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Exploring Investigative Solutions

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Make a copy of the workbook "Exploring Investigative Solutions" using the link. below.

Year 11 — Exploring investigative situations *

The following slides unpack activities using this free workbook.

**These are teacher created resources. They provide an example of activities you* could *do in class.*

CODAP exploration 1

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Where would you go to find out about the variables?

Make graphs to answer the investigative questions:

- Click on Text icon to get a text box. Write about what you notice.
- Add a box plot to the *comparison inv question* using the ruler menu.
- Change the colour of the dots using the paintbrush menu.
- Add a legend to the *hair type. C*hoose a categorical variable to use, and drag and drop into the middle of the graph.
    - Add counts using the ruler menu.
    - Convert to a bar graph using the configuration menu.

(Continued next slide)

CODAP exploration 2

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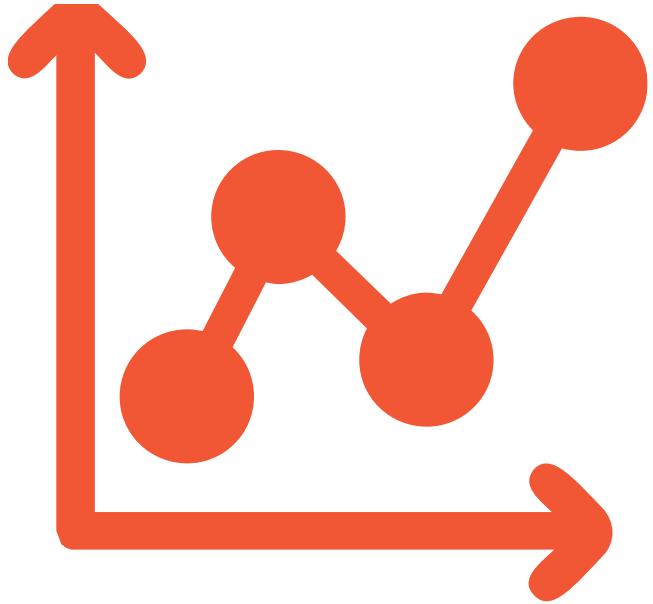
- Make a graph bigger or smaller.
- Change the scale on one of the axes.
- Rearrange categorical variables, eg hair types.
- Add a movable line to the *right foot lengths* (ruler menu). Add counts and percentages. Move the line to find the median and plot the median to check (ruler menu).
- Add another movable line to the *right foot lengths* (ruler menu). Move the two lines to find the middle 50% of values and add a box plot to check (ruler menu).



Comparison investigative situations

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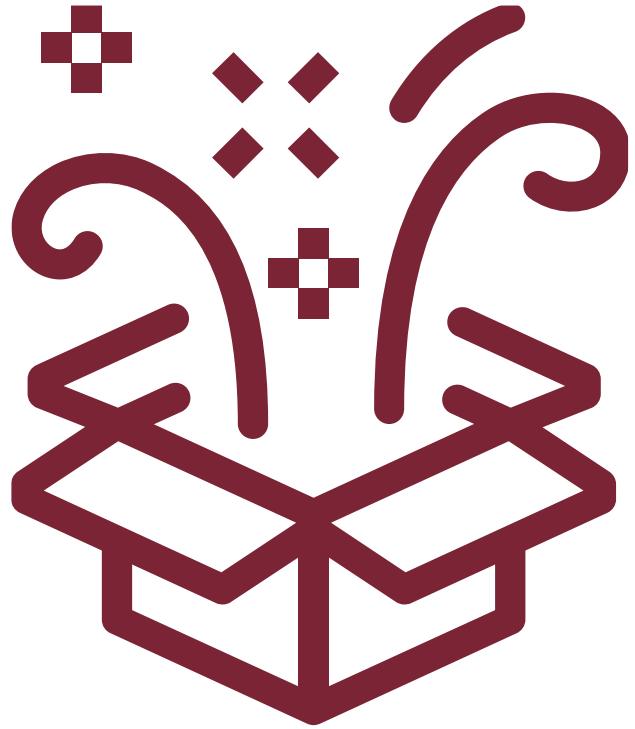
Rich array of variables.

- We want students to be exploring multivariate datasets.
- Sometimes things pop up and we wonder further. Without other variables it is hard to do much more than wonder.
- Encourage students to collect or source more than just what they need for their narrow investigative question. Collect or source for the problem area/topic.



CensusAtSchool as a data source

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The *CensusAtSchool* database provides information on all students in Aotearoa New Zealand at different year levels. You can use this database to ask and answer investigative questions.

Identifying the specific year of the *CensusAtSchool* is not a requirement for when posing the investigative question or identifying the population of interest. It is also not necessary to identify that the data is from the *CensusAtSchool* database. This is true for both in-class learning and assessment purposes.

(Arnold, 2022, p.36)

Note: For summary and comparison situations only — sample to population inferences.

Comparison investigative situations using CODAP

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Example activities that are in the Year 11 investigation booklet from slide 10.

- Sample to population inferences — Making the call in Year 11 (pp. 352-355)
- Downloading data and importing into CODAP.
- Using CODAP to make the call using the Year 11 guide.
- Using CODAP to gather evidence, including:
  - text boxes and importing images
  - story builder
  - saving and sharing documents.

Probability experiments using CODAP

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Probability experiments: Introducing Simmer

Using Simmer software, you can use block programming to simulate probability experiments, among other things.

Probability experiments using CODAP

Using CODAP for statistics and probability - a very quick start guide

Getting to know how to use CODAP for probability experiments through to using dice

Experiments with playing cards

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Te Mahau

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He mea **tārai** e mātou te **mātauranga** kia **rangatira** ai, kia **mana taurite** ai ōna **huanga**

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