NCEA Level 1 statistical inference (AS91035): teacher guide

Resources to support statistical thinking and report writing. Featuring two road safety contexts: *How far until it stops?* and *Driven to distraction!*

Statistical enquiry tasks

How far until it stops?

Context: vehicle stopping distances in wet and dry conditions and at different speeds.

Dataset: 3 continuous and 2 categorical variables with 60 records.

PowerPoints:

Activity 1 understanding the context and variables

Activity 4A writing analysis statements

Activity 5A writing a conclusion

Driven to distraction!

Context: driver distraction and driver fatigue.

Dataset: 3 continuous and 2 categorical variables with 60 records.

PowerPoints:

Activity 1 understanding the context and variables

Activity 2A writing questions

Activity 4A writing analysis statements

Additional resources

HookED SOLO Hexagons stopping distances

HookED SOLO Hexagons distraction and fatigue

Curriculum connections

Mathematics and Statistics Achievement Objective at Level 6

In a range of meaningful contexts, students will be engaged in thinking mathematically and statistically. They will solve problems and model situations that require them to:

Plan and conduct investigations using the statistical enquiry cycle:

- justifying the variables and measures used
- managing sources of variation, including through the use of random sampling
- identifying and communicating features in context (trends, relationships between variables, and differences within and between distributions), using multiple displays
- making informal inferences about populations from sample data
- justifying findings, using displays and measures.

Key competencies

Participating and contributing.

Using language, symbols and texts.

Principles and values

This unit focuses on students being informed decision makers and effective communicators for their communities.

The following principle and values are foregrounded:

- Community engagement
- Innovation, inquiry, and curiosity by thinking critically, creatively, and reflectively.
- Equity through fairness and social justice.
- Community and participation for the common good.
- Respect themselves, others, and human rights.

Road safety education as a context for Statistics

Our choice of contexts in Statistics teaching can increase student engagement and activate prior knowledge. It helps to develop students' statistical thinking as they connect what they see in their analysis with their knowledge of the context. There is potential to develop citizenship skills and social competencies.

"...opportunities to explore authentic applications that arise out of real-life contexts can have a significant and sustained impact on student knowledge, attitude, self-esteem, independence, and confidence." (Alton-Lee, 2003)

Young drivers (aged 16-24) are over-represented in crashes in New Zealand. This is due to various factors, but a major contribution is lack of experience. At a time when students are becoming young drivers, or passengers of young drivers, these resources explore important topics.

- Relevant to students as they and their peers learn to drive.
- Accessible and engaging context.
- Develops citizenship skills as students consider their role in a wider community.
- Whanaungatanga – build relationships with your students by showing them that you care about what happens to them outside of the classroom.

A note of caution

Teachers should be aware that these resources might lead to discussion of road crashes or road trauma, although this is not the intended focus. Students may have first-hand experience of such issues and teachers should be discreet during discussions.

Guiding principles for the design of these resources

These resources are designed to be used by Mathematics and Statistics teachers with their classes to support the assessment of AS91035 in a meaningful context.

They are not intended to be 'something extra' the teacher is expected to do.

These resources align to evidence-based, effective road safety education strategies. These are outlined in the Good practice in road safety research summaries on the Waka Kotahi Education Portal.

Good practice in road safety

Importantly, these resources have been designed to empower students by developing their knowledge and competencies in road safety through the Statistics curriculum.

All resources avoid the use of fear tactics. Fear tactics have been shown to be at best ineffective and at times have negative unintended consequences by promoting the behaviour the intervention was designed to reduce.

Websites

Driver fatigue and distraction

Driver distraction (Waka Kotahi)

Let driving distract you (marketing campaign – Waka Kotahi)

The dangers of distraction (online lesson – Drive)

Diverted attention crash statistics (Ministry of Transport)

Driver fatigue (Waka Kotahi)

Feeling tired? (online lesson – Drive)

Fatigue crash statistics (Ministry of Transport)

Following distances and the 2-second and 4-second rules

Following distances module on Drive

Young drivers in New Zealand

Young driver safety statistics (Ministry of Transport)

Statistics education

Telling Data Stories: Essential Dialogues for Comparative Reasoning

Census at School New Zealand

Teaching activities

These activities and exemplars have been created to support the use of the practice internal assessment tasks to teach report writing for AS91035. They can be adapted to suit the teacher and students.

It assumes that the statistical concepts have been previously taught. However, the context and resources can be freely adapted to design teaching activities to develop the statistical concepts at this and other levels.

Understanding the context

Take time to work through the context with students. This supports them to complete the practice assessment by:

- removing barriers created by the context. This is especially important at this level as students are expected to be familiar with the context without having to carry out any research.
- increasing statistical thinking in the PPDAC process by allowing students to connect their analysis to the context in a meaningful way.
- providing an authentic learning opportunity as they experience the process a statistician would undergo to understand the context before defining the Problem and Plan (Pfannkuch & Wild, 2000).

Activities 1A and 1B give suggestions for various activities that can be used with students to understand the wider context and variables, and notes for teachers on common misconceptions with the context and variables.

These PowerPoints can be used to go through the context with students:

How far until it stops? Activity 1 Understanding the context and variables PPT

Driven to distraction! Activity 1 Understanding the context and variables PPT

Activity 1A – Brainstorming the context

Students' prior knowledge can be activated on the context using:

- Think-pair-share
- Whole class brainstorm
- Post it notes or SOLO hexagons (How far until it stops? hexagons and Driven to distraction! hexagons) so that ideas can be moved around to make connections.
- Online sticky notes or other collaborative tool, such as Padlet.

The following questions could be used for each context to guide discussion:

How far until it stops?	Driven to distraction!
What do you think affects the stopping distance of vehicles? Which of these factors are related to the driver, the vehicle, the conditions? What are the 2-second and 4-second rules? Why are they useful for drivers?	What do you think the biggest distractions to drivers are? How does this list compare to the top distractions identified here: Waka Kotahi Distraction Infographic How do you think tiredness affects your ability to carry out a task (reaction time, accuracy, speed)? How well do you think you can multitask?

Notes for teachers: Driven to distraction!

There are a number of simple activities to dispel the myth of multi-tasking.

15 Teacher-Tested Tips for Getting Kids to Stop Multitasking

The myth of multitasking exercise

Activity 1B – understanding the variables

Now that students understand the wider context it is important to understand the definitions of the variables. As there are only five variables in each context (three continuous and two categorical) it is worth unpacking all of them for the task being done.

Suggested activities for understanding the continuous variables:

How far until it stops?	Driven to distraction!
Draw a diagram which shows the three continuous variables: reaction distance, braking distance, total stopping distance, and be prepared to explain it to another person. Students could add in the factors affecting reaction distance (e.g. distractions) and braking distance (e.g. condition of the tyres). Note for teachers: reaction distance can be readily confused with reaction time and (although connected) students need to be clear before they start this task on the distinction.	Use the links provided in the task to experience the online reaction time test and the typing test. Reaction time test Typing test

A discussion on the categorical variables including their definitions and their limitations can be useful too.

Notes for teachers on the categorical variables:

How far until it stops?	Driven to distraction!
The Conditions (wet/dry) variable is the road surface. A common misunderstanding is this means that it is raining (wet) or not raining (dry). This can lead to interesting discussions and higher level thinking about what these results mean for real world driving conditions and how the data would be expected to change if it was raining.	The Texting variable (Text/NotText) is whether or not the student is reading a text message (not typing one). The Tiredness variable (Tired/NotTired) is a self-assessment by students. Students can discuss the limitation of this measurement.

Problem

Once students have unpacked the context and variables, they will need to write a question.

One approach is to let students explore the dataset informally using statistical software before they decide on the focus for their enquiry. This will allow them to test out their understanding of variables and their hypotheses before going further.

Activity 2A – Developing question writing

To develop question writing it is useful to have students critique questions against criteria.

Driven to distraction NCEA 1 activity 2A writing questions PPT

This PowerPoint goes through some sample questions for Driven to distraction! Students can use the criteria provided to critique the question before suggesting what could be improved. They are then encouraged to write their own question and swap with a peer to critique.

This PowerPoint can be adapted to include examples of typical question errors made by your students.

Plan and Data

Students are provided with a random sample of 60 for each task. The original dataset has 120 if you want them to have a different sample size or to have different samples to work with. The original dataset can be downloaded from:

Education Portal Mathematics and Statistics page

A useful revision video on sampling methods from Dr Nic's Maths and Stats Youtube channel:

Sampling

Analysis

After using software to produce the distributions and summary statistics, students identify key comparative features of the distributions to discuss in context, using contextual knowledge to link to the investigative question and the population. Comments should include numerical values and units.

Students are encouraged to discuss the following features of the distributions: shape, overlap, shift, spread, middle 50%, unusual or interesting features. Students should aim to write at least three comparative comments.

There are various mnemonics that have been developed to support students with their writing of analysis statements. OESM is one of these and this video from Dr Nic's Maths and Stats YouTube channel takes students through writing analysis statements:

Analysing and commenting on graphical output using OSEM

Other writing frameworks:

Census at School results for Achievement Standard 1.10

Activity 4A – Analysing distributions

The PowerPoints for the tasks How far until it stops? and Driven to distraction! encourage students to look at the distributions as a whole, note the features of interest, and connect these features to the context:

How far until it stops? NCEA 1 activity 4A writing analysis statements PPT

Driven to distraction! NCEA 1 activity 4A writing analysis statements PPT

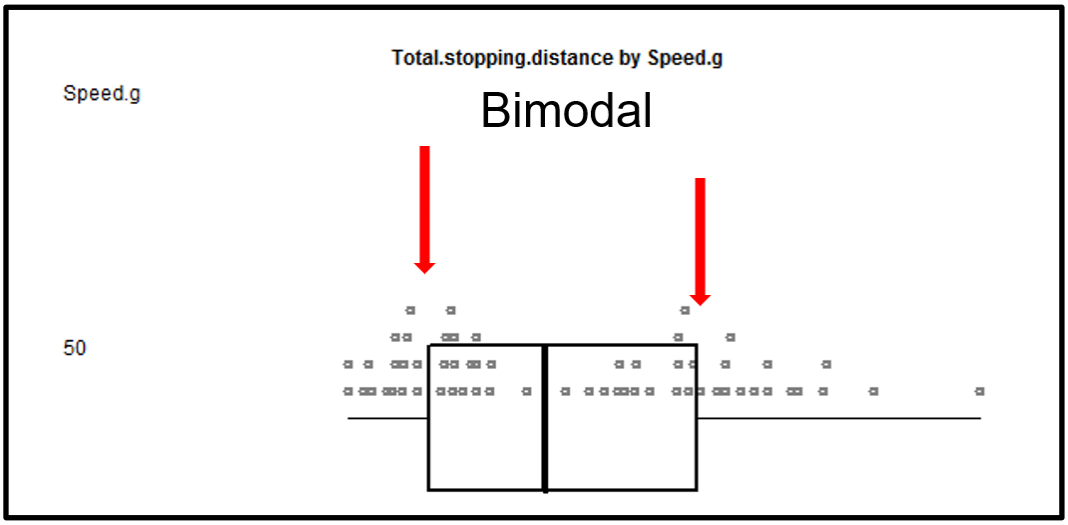
This could be done as a whole class brainstorm to model identifying important features in sample distributions.

Students are scaffolded through writing analysis statements based on the brainstorm of features they notice, with prompts that ask them to add in statistical terms, groups, the variable, and evidence.

While the focus of this activity is on analysing the distributions of samples, students could be asked to write the question to accompany the graphs they have been given. They could also be asked to write up some of their analysis statements based on the framework or structure previously provided to them in class.

Notes for teachers

Students noticing features like groups, clusters and bimodal distribution should be asked to explain why this might be given what they know about the context. They should be encouraged to consider the other categorical variables and whether this might explain what they see. For example, in the distribution below, for total stopping distances of vehicles with an initial speed of 50 km/h, the graph is bimodal. This can be attributed to the two road surfaces: Wet and Dry.



Students could be prompted to:

- justify based on contextual knowledge which modal group is likely to be the dry road surfaces and which is the wet road surfaces
- explain how they would test their hypothesis (this might include looking at the raw data or colour coding by the road conditions categorical variable in software)
- compare the distributions being analysed by their peers in the class to see if those analysing the total stopping distances by conditions see a difference.

In the How far until it stops? dataset the variable of initial speed (40 km/h and 50 km/h) needs to be converted to a categorical variable when using iNZight.

Conclusion

In this section students answer their investigative question, make an inference about the population, justify it with evidence from the sample, and reflect on the context and process.

The achievement standard allows for two approaches for making the call: the *¾-½ rule* or the *distance between the median as a proportion of "overall visual spread*". See:

Clarifications for AS91035 (NZQA)

These resources for Curriculum Level 5 use the ¾-½ rule for making the call. These rules and the curriculum progression are described further:

Guidelines for "How to Make the Call"

Activity 5A – Conclusion

The PowerPoint for the task How far until it stops? shows students examples of making the call and prompts them to justify their inference based on what they see in the sample distributions. Reflection questions on the context and enquiry process are given.

How far until it stops? NCEA 1 activity 5A writing a conclusion PPT

The justification for making the call is based on using the "¾-½ rule", but the slides can be edited to match the approach that students have been previously taught.

Responses for the reflection questions are not included in this PowerPoint. A whole class brainstorm could be used and then students could select 2-3 questions to write about in their Conclusion section. Some examples of possible student responses can be found in the assessment schedule for the task.

Many of the reflection questions on the process and context are also relevant for the task *Driven to distraction!*

References

Alton-Lee, A. (2003). Quality teaching for diverse students in schooling: Best evidence synthesis. Wellington: Ministry of Education.

Pfannkuch, M., & Wild, C. (2000). Statistical thinking and statistical practice: Themes gleaned from professional statisticians. Statistical Science, 15(2), 132–152.