

Teacher guide:

NCEA Level 2 statistical inference (AS91264)

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

Resources and their road safety contexts

Practice Assessments with assessment schedules	Datasets	Teaching resources
<p><i>How far until it stops?</i></p> <p>Context: vehicle stopping distances in wet and dry conditions and at different speeds</p> <p>Download task</p> <p><i>Driven to distraction!</i></p> <p>Context: driver distraction and driver fatigue</p> <p>Download task</p> <div style="border: 1px solid black; padding: 5px; margin-top: 10px;"> <p>Note: Direct links in this guide go to associated files on the Education Portal. However, if you have downloaded the Level 1 bundle you already have all these files.</p> </div> <p>Download the complete Level 1 bundle here: Mathematics and Statistics (Education Portal)</p>	<p><i>How far until it stops?</i></p> <p>3 continuous and 2 categorical variables with 120 records</p> <p>Download csv file</p> <p><i>Driven to distraction!</i></p> <p>3 continuous and 2 categorical variables with 120 records</p> <p>Download csv file</p>	<ul style="list-style-type: none"> • How far until it stops? Activity 1A Understanding the context ppt • How far until it stops? Activity 1C Lotus diagram • How far until it stops? Activity 4A Writing analysis statements ppt • How far until it stops? Activity 5A Conclusion ppt • Driven to distraction! Activity 2A Writing a question ppt • HookED SOLO Hexagons Stopping Distances • HookED SOLO Hexagons Driver distraction and fatigue • Activity 1C Lotus diagram template

The New Zealand Curriculum links

Mathematics and Statistics Achievement Objective at Level 7

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:

Carry out investigations of phenomena, using the statistical enquiry cycle:

- conducting surveys that require random sampling techniques, conducting experiments, and using existing data sets
- evaluating the choice of measures for variables and the sampling and data collection methods used
- using relevant contextual knowledge, exploratory data analysis, and statistical inference.

Make inferences from surveys and experiments:

- making informal predictions, interpolations, and extrapolations
- using sample statistics to make point estimates of population parameters
- recognising the effect of sample size on the variability of an estimate.

(Highlighted statements are the ones covered by these resources)

Key Competencies

The following key competencies are foregrounded:

Participating and contributing

This competency is about being actively involved in communities. Communities include family, whānau, and school and those based, for example, on a common interest or culture. They may be drawn together for purposes such as learning, work, celebration, or recreation. They may be local, national, or global. This competency includes a capacity to contribute appropriately as a group member, to make connections with others, and to create opportunities for others in the group.

Students who participate and contribute in communities have a sense of belonging and the confidence to participate within new contexts. They understand the importance of balancing rights, roles, and responsibilities and of contributing to the quality and sustainability of social, cultural, physical, and economic environments.

Using language, symbols, and texts

Using language, symbols, and texts is about working with and making meaning of the codes in which knowledge is expressed. Languages and symbols are systems for representing and communicating information, experiences, and ideas. People use languages and symbols to produce texts of all kinds: written, oral/aural, and visual; informative and imaginative; informal and formal; mathematical, scientific, and technological.

Students who are competent users of language, symbols, and texts can interpret and use words, number, images, movement, metaphor, and technologies in a range of contexts. They recognise how choices of language, symbol, or text affect people's understanding and the ways in which they respond to communications. They confidently use ICT (including, where

appropriate, assistive technologies) to access and provide information and to communicate with others.

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

The curriculum has meaning for students, connects with their wider lives, and engages the support of their families, whānau, and communities.

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. While supporting students to develop their skills in carrying out a statistical enquiry and report writing, the students will also develop competencies for citizenship and well-being outside of the classroom in a road safety context.

So why road safety education as a context for AS91264?

- Relevant to students as they and their peers learn to drive
- An accessible and engaging context
- Develops citizenship skills as students consider their role in a wider community

- Foregrounds the key competency of *Participating and Contributing*
- Helps them make sense for themselves about their world
- Empowers them to make decisions using evidence
- Builds social competencies
- Potential for cross-curricular themes using [NZTA's Education Portal secondary curriculum resources](#) in a range of learning areas
- Whanaungatanga – Build relationships with your students by showing them that you care about what happens to them outside of the classroom
- Because young drivers in NZ are over-represented in death and serious injury crashes

A note of caution on the context for teachers

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

Guiding principles for the design of these resources

There are two guiding principles underpinning the design of these resources.

1. Resources fully align to the New Zealand Curriculum and NCEA standards

These resources are designed to be used by Mathematics and Statistics teachers with their subject classes to support the development of statistical thinking and report writing for AS91264 in a meaningful context. They are not intended to be 'something extra' the teacher is expected to do.

2. Resources fully align to NZTA's Good Practice in Road Safety fact sheets

These fact sheets describe evidence-based, effective road safety education strategies.
<https://education.nzta.govt.nz/guidelines-and-research/fact-sheets/>

Importantly, the teaching resources are 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 are ineffective, and, at times, have negative unintended consequences by promoting the behaviour the intervention was designed to reduce.

Useful background reading

Driver fatigue and distraction

Resource type	Driver distraction	Driver fatigue
 drive.govt.nz	The dangers of distraction unit	Feeling tired? unit
Infographics	Distraction infographic	Fatigue infographic
NZ Transport Agency driver education resources	Driver distraction website	Driver fatigue website

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

[Following distances module on Drive.govt.nz](#)

Young drivers in New Zealand

Overview of young drivers crash statistics

<https://www.transport.govt.nz/mot-resources/new-road-safety-resources/young-drivers/>

Young driver crash report

<https://www.transport.govt.nz/assets/Uploads/Research/Documents/31ad77c71e/young-drivers-2017.pdf>

Statistics education

Telling Data Stories: Essential Dialogues for Comparative Reasoning

By Chris Wild, Matt Regan, Maxine Pfannkuch, N. Horton

<https://new.censusatschool.org.nz/resource/telling-data-stories-essential-dialogues-for-comparative-reasoning/>

Census at School New Zealand website

<https://new.censusatschool.org.nz/>

Teaching activities

These activities and exemplars have been created to support the use of the practice internal assessment tasks to teach report writing for AS91264. 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.

1. Understanding the context

Taking time to work through the context with students supports them to complete the practice assessment by:

- Removing barriers created by the context.
- Increasing statistical thinking in the PPDAC enquiry process by allowing students to connect their analysis to the context in a meaningful way.
- Modeling strategies for understanding unknown contexts (such as in an assessment).
- 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, 1B, and 1C 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.

Activity 1A - Brainstorming the context

Students prior knowledge can be activated on the context using a brainstorm:

- Think-pair-share
- Whole class brainstorm
- Using 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 (<https://padlet.com/>)

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

<i>How far until it stops?</i>	<i>Driven to distraction!</i>
<ul style="list-style-type: none"> ● 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 	<ul style="list-style-type: none"> ● What do you think the biggest distractions to drivers are?

<p>rules? Why are they useful for drivers?</p>	<ul style="list-style-type: none"> • How does this list compare to the top distractions identified in NZTA's resources? • How do you think tiredness affects your ability to carry out a task (reaction time, accuracy, speed)? • How well do you think you can multi-task?
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After an initial brainstorm of ideas, students can use the provided weblinks in each resource to add to their knowledge, challenge misconceptions (for example around multi-tasking), or to add in sources to back up their knowledge.

This PowerPoint presentation goes through factors affecting vehicle stopping distances for the *How far until it stops?* task:

- [How far until it stops? Activity 1A Understanding the context ppt](#)

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. Students could make notes, write post-it notes with ideas, or create SOLO hexagons to capture their thinking on the variables.

Suggested activities for understanding the continuous variables:

<i>How far until it stops?</i>	<i>Driven to distraction!</i>
<ul style="list-style-type: none"> • 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). <p>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.</p>	<ul style="list-style-type: none"> • Use the links provided in the task to experience the online reaction time test and the typing test. <p>Reaction times: http://www.bbc.co.uk/science/humanbody/sleep/sheep/reaction_version5.swf (requires Flash) https://www.humanbenchmark.com/tests/reactiontime</p> <p>Typing test: http://10fastfingers.com/typing-test/english</p>

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

Notes for teachers on the categorical variables:

<i>How far until it stops?</i>	<i>Driven to distraction!</i>
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.	<p>The Texting variable (Text/NotText) is whether or not the student is reading a text message (not typing one).</p> <p>The Tiredness variable (Tired/NotTired) is a self-assessment by students. Students can discuss the limitation of this measurement.</p>

Activity 1C - Putting it altogether

Using a graphic organiser is an effective tool to allow students to make connections between the various ideas on the context and variables from Activities 1A and 1B. Some ideas described below to choose from are: Lotus diagram, Mindmap, and Hexagonal thinking.

Lotus diagram

A lotus diagram puts the central ideas about a topic at the centre and encourages students to expand on these (see below).

	Continuous variable 1			Continuous variable 2			Continuous variable 3	
			Continuous variable 1	Continuous variable 2	Continuous variable 3			
	Categorical variable 1		Categorical variable 1	Topic	Categorical variable 2		Categorical variable 2	
			Purpose	Population	Reflections on the context			
	Purpose			Population			Reflections on the context	

To find out more about Lotus diagrams:

<https://www.virtuallibrary.info/mind-maps-for-note-taking-and-brainstorming1.html>

<https://vimeo.com/28799678?ref=em-share%E2%80%8B>

You can do this with students working in a spreadsheet or as a paper copy by printing:

- [Activity 1C Lotus diagram template](#)

In the spreadsheet by updating the variables in the centre, the variables about the outside will auto-update.

An exemplar has been created for the *How far until it stops?* task:

- [How far until it stops? Activity 1C Lotus diagram](#)

Students could be given prompts for what to write around each subtopic. For example:

- Variables: definition, units, what factors affect it, what they would expect to see in the data (hypotheses), limitations, etc.
- Reflections on the context: limitations, who might be interested in the investigation and why, etc.

Not all boxes need to be filled in. Students can also write questions in the boxes with things they are unsure about.

In an assessment, students may have more variables but they could still use this to understand a subset of them. This allows students to understand more deeply about the context and make an informed selection of variables for their investigation.

Mindmap

Mindmaps work in a similar way to the Lotus diagram to support students to organise their ideas from Activities 1A and 1B.

To find out more about Mindmaps, including links to free online software for developing editable Mindmaps:

<https://www.virtuallibrary.info/mind-maps-for-note-taking-and-brainstorming1.html>

Hexagonal thinking

Students organise their SOLO hexagons with single ideas on the context and variables on each hexagon and start to explain the connections (relational thinking) and generalise (extended abstract thinking). These ideas are annotated and students can explain their thinking to their peers and teacher.

To find out more about hexagonal thinking:

<https://socialstudiesoutloud.com/2017/02/16/the-awesome-six-sided-world-of-hexagonal-thinking/>

https://www.activehistory.co.uk/Miscellaneous/menus/A_Level/Late_Modern/Stalin_Rise/index.php

<https://www.youtube.com/watch?v=UKq69ANaOLM>

SOLO hexagons can be downloaded from here:

<http://pamhook.com/solo-apps/hexagon-generator/>

Or Word documents with the contexts of these tasks have been created:

- [HookED SOLO Hexagons Stopping Distances](#)

- [HookED SOLO Hexagons Driver distraction and fatigue](#)

2. Problem

Once students have unpacked the context and variables, they need to think about the problem they will investigate, how it links to the purpose of the investigation set out in the task, and write a question.

One approach is to let students explore the dataset informally using statistical software before they decide on the focus for 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. This PowerPoint goes through some sample questions for *Driven to distraction!*

- [Driven to distraction! Activity 2A Writing a question ppt](#)

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

3. Plan and Data

Students must take a random sample for this standard but for these practice assessments, since the dataset is small, you might tell them the sample has already been taken.

Students should still practise writing up this section. Ideally students should be able to justify their choice of both sampling method and sample size in context of the task.

A useful revision video on sampling methods from Dr Nic's Maths and Stats YouTube channel: <https://www.youtube.com/watch?v=be9e-Q-jC-0>

4. Analysis

After using software to produce the distributions and summary statistics, students should be identifying 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:

<https://www.youtube.com/watch?v=L-ur3pRYKfK>

Other writing frameworks can be found on the [Census at School New Zealand website](#).

Another structure to use is:

- 'I notice...' (what you see)
- 'This means that...' (what it means in the sample)
- and 'I wonder...' or 'I expect...' (linking back to the investigative question and population)

Activity 4A - Analysing distributions

This PowerPoint for the task *How far until it stops?* encourages students to look at the distributions as a whole, note the features of interest, and connect these features to the context:

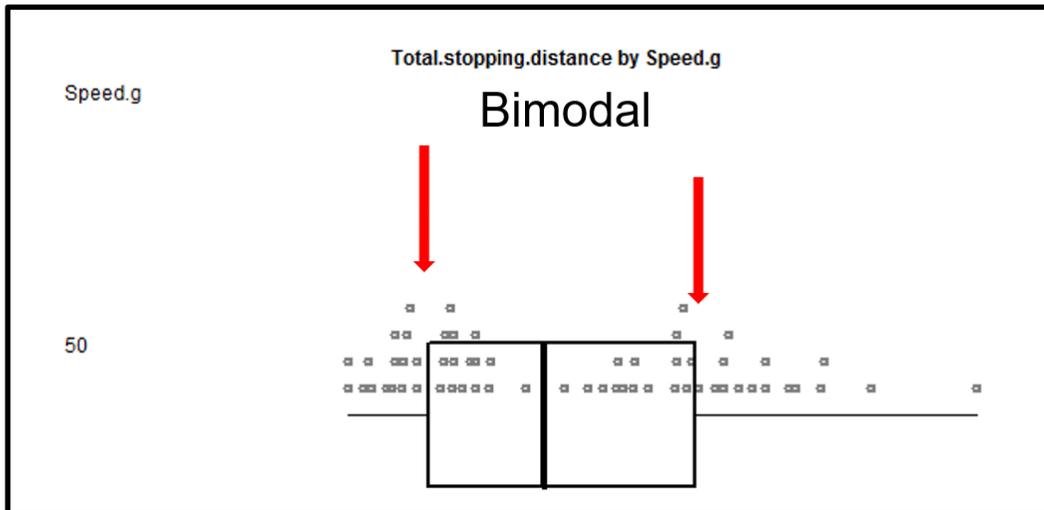
- [How far until it stops? Activity 4A Writing analysis statements ppt](#)

The above resource, includes printable slides without the PowerPoint annotations at the end which can be given to students to discuss and annotate.

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 formally write up some of their analysis statements based on the framework or structure previously provided to them in class.

Notes for teachers

1. Students noticing features like groups/clusters/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.
2. 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.

5. Conclusion

In this section interpreting informal confidence intervals is included, although students may do this in the Analysis section.

Activity 5A - Conclusion

This PowerPoint for the task *How far until it stops?* task models how to interpret informal confidence intervals, write a conclusion, and provides reflection questions on the inquiry process and context

- [How far until it stops? Activity 5A Conclusion ppt](#)

The slides can be edited to match the wording that students have been previously taught.

Responses for the reflection questions are not included in this PowerPoint. Students can be encouraged to form their own responses to some of the questions and discuss with peers.

Some examples of possible student responses can be found in the assessment schedule for the task.

Many of the reflection questions on the process 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.