**NZQA**

**Approved**

Achievement standard: 91265 Version 2

Standard title: Conduct an experiment to investigate a situation using statistical methods

Level: 2

Credits: 3

Resource title: Investigating pasture growth

Resource reference: Mathematics and Statistics VP-2.10 v2

Vocational pathway: Primary Industries

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| Quality assurance status | These materials have been quality assured by NZQA.  NZQA Approved number A-A-02-2015-91265-02-8196 |
| Authenticity of evidence | Assessors/educators must manage authenticity for any assessment from a public source, because learners may have access to the assessment schedule or exemplar material.  Using this assessment resource without modification may mean that learners’ work is not authentic. Assessors/ educators may need to change figures, measurements or data sources or set a different context or topic to be investigated or a different text to read or perform. |

Vocational Pathway Assessment Resource

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Learner instructions

# Introduction

This assessment activity requires you to undertake a statistical investigation for an experiment involving the effects of different factors on pasture growth.

You are going to be assessed on how you conduct an experiment to investigate a situation using statistical methods, with statistical insight. This involves integrating statistical and contextual knowledge throughout the investigation process, which may involve reflecting on the process or considering other relevant variables.

The following instructions provide you with a way to structure your work so you can demonstrate what you have learnt and achieve success in this standard.

Assessor/educator note: It is expected that the assessor/educator will read the learner instructions and modify them if necessary to suit their learners.

# Task

You will pose an investigative question, plan an experiment, gather and analyse data, and draw conclusions. Your final product will be the presentation of a report, describing your experimental design process, data gathering, analysis and conclusions.

## Part 1: Select an experimental situation

As a group, use the information about pastures in Resource A to select an experimental situation to investigate, based on the effects of different factors on pasture growth. Identify the variables you think are important and write a question to investigate.

Use these situations as a basis for your experiment:

* the effect of irrigation on pasture growth
* the effect of soil preparation on pasture growth
* the effect of light (sunlight) on pasture growth.

You may use another experimental situation involving effects of different factors on plants, as agreed with your assessor/educator.

## Part 2: Plan and conduct the experiment

Write a plan for the experiment. The plan should:

* describe the variables and measures you have chosen and why you have chosen them
* explain how you will collect your data and record your results
* link to relevant knowledge about the situation
* describe any related variables and their possible effects
* describe the experimental method.

Submit the plan to your assessor/educator for feedback and adjust as necessary.

As a group, conduct the experiment according to the plan. Record the data and make notes about your observations of the data collection and experimental process. (These notes will be useful for your discussion and reflection on the process when you write your individual report.)

## Part 3: Prepare a report

Working on your own, complete the investigation and prepare a report.

Your report should contain the following:

* Introduction – the investigative question and purpose of the investigation
* Method – the plan and process used to collect the data
* Analysis – selection and discussion of appropriate displays and measures
* Discussion – discussion of findings and any reflections on the process
* Appendix – evidence of how you conducted the experiment (e.g. the original plan and any modifications, raw data from your experiment, and any notes from Part 2).

The quality of your report, including discussion and reasoning about the experimental process and your findings and how well you link this to the context, will determine your overall grade.

# Resource A

Pastures are the fields on farms where animals feed. Grasses aren’t the only plants in pastures – there are many other kinds of plants that livestock eat. Farmers choose the plants for pastures according to what kind of animal will be eating them, or whether it is a wet or dry area.

## Pastures in New Zealand

Most pastures in New Zealand are a mixture of grasses and clovers. Pasture requires sunlight, moisture, soil, and soil nutrients to grow. Factors influencing pasture growth include sunlight hours, seasons, soil quality, soil moisture and the location.

### Grasses

Grasses are the most common kind of plant in pastures. Most grass species were introduced from overseas, including:

* perennial ryegrass
* cocksfoot
* tall fescue
* prairie grass
* timothy
* Yorkshire fog
* browntop
* kikuyu.

New Zealand also has some native grasses, like tussock, most often seen in the South Island high country.

### Clover and other legumes

Legumes are plants that can help other plants grow better, because they can change nitrogen from the air in the soil into a form that other plants can use.

Clovers are the most common legumes in pastures. The main kinds are:

* white clover
* red clover
* subterranean clover, which pushes its own seed underground.

Two other legumes that farm animals like to eat are lucerne and lotus.

### Herbs, shrubs and trees

Sometimes farm animals eat herbs like chicory and plantain, or leaves of willows or poplar trees. Animals like the taste and the plants contain nutrients that are good for their health.

Source: Charlton, D., 'Pastures', Te Ara – The Encyclopaedia of New Zealand, <http://www.TeAra.govt.nz/en/pastures>.

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Assessor/Educator guidelines

# Introduction

The following guidelines are supplied to enable assessors/educators to carry out valid and consistent assessment using this internal assessment resource.

As with all assessment resources, education providers will need to follow their own quality control processes. Assessors/educators must manage authenticity for any assessment from a public source, because learners may have access to the assessment schedule or exemplar material. Using this assessment resource without modification may mean that learners' work is not authentic. The assessor/educator may need to change figures, measurements or data sources or set a different context or topic. Assessors/educators need to consider the local context in which learning is taking place and its relevance for learners.

Assessors/educators need to be very familiar with the outcome being assessed by the achievement standard. The achievement criteria and the explanatory notes contain information, definitions, and requirements that are crucial when interpreting the standard and assessing learners against it.

# Context/setting

This activity requires learners to conduct an experiment investigating various effects of different factors on the growth of pasture grass (or another plant), using statistical methods, with statistical insight.

# Conditions

This assessment activity should be conducted in several sessions, over an extended period such as several weeks.

Learners will present their work and findings independently (for Part 3), but they can work in small groups of two or three for Parts 1 and 2. (The instructions may need to be adjusted if learners work independently for all parts of the activity.)

Confirm the time-frame with learners, including the time between the first and successive parts of the activity to allow them to adjust their plans based on your feedback.

Collect and securely store learners’ work between each part of the activity.

Learners cannot achieve this standard without actively contributing to the planning and data collection. The assessor/educator may determine this by direct observation or by questioning learners about the process.

Learners may use appropriate technology (e.g. statistical software or spreadsheets). Specify the format of the report and presentation (e.g. a computer slide show, written report or oral presentation).

Relevant contextual knowledge is essential. Give learners time to research the context before beginning the investigation.

Learners may use Resource A or access their own relevant contextual information using the internet or other sources.

# Resource requirements

Provide learners with:

* a copy of Resource A
* access to background information (e.g. the library or internet)
* resources appropriate to their confirmed experimental plan (e.g. rulers or other measuring devices)
* access to a suitable area for growing the plants selected (e.g. 1 m squares in a nearby field or garden, or seed trays in a greenhouse or laboratory)
* suitable plants or seeds for growing.

# Additional information

The plan for the experiment should be simple. A simple experimental design involves one explanatory variable and one response variable, such as:

* measuring the change in the response variable between two dependent values for the explanatory variable (paired comparison)
* comparing the response variable across two (or more) independent values of the explanatory variable (categorical)
* exploring the relationship between the response variable and independent values of the explanatory variable (numerical).

Assessors/Educators need to ensure learners are familiar with any context specific vocabulary used in this resource.

# Assessment schedule: Mathematics and Statistics 91265 – Investigating pasture growth

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| Evidence/Judgements for Achievement | Evidence/Judgements for Achievement with Merit | Evidence/Judgements for Achievement with Excellence |
| The learner conducts an experiment to investigate a situation using statistical methods, showing evidence of using each component of the investigation process by:   * posing an investigative question about the experimental situation * planning the experiment by determining appropriate variables and measures, and determining the data collection and recording methods * conducting the experiment and collecting the data * selecting appropriate displays and measures * discussing the displays and measures   For example:  The learner clearly compares the growth rate of the control and treatment grass, showing the differences between the two sets of data, and comments on the distribution.   * communicating findings in a conclusion   For example:  The learner clearly states their conclusion to the question in context.  *The examples above are indicative of the evidence that is required.* | The learner conducts an experiment to investigate a situation using statistical methods, with justification, linking components of the investigation process to the context, explaining relevant considerations in the process, and supporting findings with statements that refer to evidence from the experiment by:   * posing an investigative question about the experimental situation   For example:  The purpose or question links to the situation being investigated.   * planning the experiment by determining appropriate variables and measures, and determining the data collection and recording methods   For example:  The learner considers related variables and the possible effects of these.   * conducting the experiment and collecting the data * selecting appropriate displays and measures * discussing the displays and measures, using supporting evidence linked to the context   For example:  The learner clearly analyses the plants’ average growth and comments on the middle 50% and clusters. Comments are justified by supporting evidence.   * communicating findings in a conclusion and linking findings to the experimental situation   For example:  The learner clearly states their conclusion to their question in context and produces statistical evidence to support their claim*.*  *The examples above are indicative of the evidence that is required.* | The learner conducts an experiment to investigate a situation using statistical methods, with statistical insight, integrating statistical and contextual knowledge throughout the investigation process which may involve reflecting on the process or considering other variables by:   * specifying the purpose of the investigation and the investigative question, and showing how these are relevant to the situation being investigated * planning the experiment by determining appropriate variables and measures, and determining the data collection and recording methods   For example:  The learner considers related variables and possible effects of these, and develops the plan to mitigate against these if possible.   * conducting the experiment and collecting the data * selecting appropriate displays and measures * discussing the displays and measures, integrating statistical and contextual knowledge   For example:  The learner clearly comments on and analyses any increase in growth after applying fertiliser and states the numerical value in context. The learner comments on the middle 50% and clusters and on the appropriate statistics for plants whose growth increased over a specific threshold.   * communicating findings in a conclusion and linking findings to the experimental situation   For example:  The learner reflects on key aspects of the experimental process (e.g. by considering possible sources of variability in the data, effects of related variables, and other areas to investigate).  The learner clearly states their conclusion in context and gives statistically produced evidence to support their findings; comments on any unusual values and other factors that could have affected growth rates for the experiment; gives a possible extension to the experiment based on their findings.  *The examples above are indicative of the evidence that is required.* |

Final grades will be decided using professional judgement based on an examination of the evidence provided against the criteria in the Achievement Standard. Judgements should be holistic, rather than based on a checklist approach.