**NZQA**

**Approved**

Achievement standard: 91257 Version 2

Standard title: Apply graphical methods in solving problems

Level: 2

Credits: 4

Resource title: Fertiliser findings

Resource reference: Mathematics and Statistics VP-2.2 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-02-2015-91257-02-8189 |
| 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

Achievement standard: 91257

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Learner instructions

# Introduction

This assessment activity requires you to apply graphical methods in solving problems.

You are going to be assessed on how you apply graphical methods, using extended abstract thinking, to solve the problem of how much fertiliser to apply to get the best crop yields.

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

A fertiliser company is investigating crop yields for different applications of its product. The same area was planted under the same conditions in eight different plots. The only difference was the amount of fertiliser (nitrogen in the form of urea) that was applied. The yield is measured in terms of kilograms of dry matter per hectare.

These were the results:

|  |  |
| --- | --- |
| **Nitrogen (kg/ha)** | **Yield (kg/ha)** |
| 15 | 1946 |
| 30 | 1986 |
| 45 | 2099 |
| 60 | 2250 |
| 75 | 2345 |
| 90 | 2615 |
| 105 | 2698 |
| 120 | 2669 |

The company wants to use a graphical model to estimate the yield for other amounts of fertiliser.

You need to do the following:

* Investigate possible graphical models for application rates, using data values from 15 kg/ha to 120 kg/ha. Find the equation for each model. You should investigate the following models: power, log exponential, parabolic and cubic models.
* Decide which of the investigated models best fits the data. Justify your choice by discussing how well the model fits the data and also identifying features of the models (for example their basic shape, intercepts, symmetry, turning points, large value behaviour).
* Use your model to estimate the yield for a fertiliser application of 65 kg/ha.

The company would like to have a decision on a final model that can be used to estimate yields from application rates of 0–150 kg/ha. It is known that an application rate over 150 kg/ha will result in the crop being destroyed.

Investigate each of your previous models and discuss how good they are for a range of application rates from 0–150 kg/ha.

Either modify your model, or create a new one, that enables accurate yield estimates for this set of application rates. You may need to consider the use of a piecewise function.

Draw an accurate graph of your new model and write down its equation.

Discuss how well your new model fits the data, and also enables estimates outside the given range of data values.

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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 use extended abstract thinking when applying graphical methods in solving problems. They are required to investigate different non-linear models for a set of data. The data comes from the results of an experiment that involves measuring crop yields when different amounts of a fertiliser are applied, in a controlled situation, to the crop.

# Conditions

Learners need to work independently to complete this activity.

# Resource requirements

Assessors/educators are expected to replace the provided data with information specific to their own situation. The data set must allow a meaningful investigation of different graphical models.

Learners should have access to appropriate technology.

# Additional information

Ensure learners are familiar with any context specific vocabulary used in this resource.

# Assessment schedule: Mathematics and Statistics 91257 – Fertiliser findings

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| --- | --- | --- |
| Evidence/Judgements for Achievement | Evidence/Judgements for Achievement with Merit | Evidence/Judgements for Achievement with Excellence |
| The learner applies graphical methods in solving problems by:   * selecting and using graphical methods * demonstrating knowledge of the properties of functions and graphs * communicating using appropriate representations   For example, the learner has:   * connected the data with the graph of a model and its equation for more than one model * discussed the appropriateness of the models with respect to identified features of the functions * used a model to estimate a crop yield for a given amount of fertiliser.   *The examples above are indicative of the evidence that is required.* | The learner applies graphical methods, using relational thinking, in solving problems by involving one or more of:   * selecting and carrying out a logical sequence of steps * connecting different concepts or representations * demonstrating understanding of concepts * forming and using a model   and also relating findings to a context, or communicating thinking using appropriate mathematical statements  For example, the learner has:   * connected the data with the graph of a model and its equation for more than one model * discussed appropriateness of the models with respect to identified features of the function, and these have been related to the context * decided, with reasons, on a best model and used it to estimate a crop yield for a given amount of fertiliser * investigated different models for application rates up to 150 kg/ha and discussed, in context and with reference to features of the functions, their appropriateness * worked towards establishing a preferred model for the extended range of application amounts.   *The examples above are indicative of the evidence that is required.* | The learner applies graphical methods, using extended abstract thinking, in solving problems by involving one or more of:   * devising a strategy to investigate a situation * identifying relevant concepts in context * developing a chain of logical reasoning, or proof * forming a generalisation   and also using correct mathematical statements, or communicating mathematical insight  For example, the learner has:   * decided, with reasons, on a best model and used it to estimate a crop yield for a given amount of fertiliser * investigated different models for application rates up to 150 kg/ha and discussed, in context and with reference to features of the functions, their appropriateness * established an appropriate model for the extended set of application volumes, and has accurately written its equation * justified, in context, the final model for the entire range of application rates.   *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.