

This does not require any internet access and is well suited for those with access issues.

NZQA Approved

Remote Internal Assessment Resource

Mathematics and Statistics Level 3

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| This resource supports remote assessment against:  Achievement Standard 91574  Apply linear programming methods in solving problems |
| Resource title: Rachel’s Roses |
| 3 credits |
| This resource:   * Clarifies the requirements of the standard when delivered remotely * Supports good remote assessment practice * Should be subjected to the school’s usual assessment quality assurance process * Should be modified to make the context relevant to students in their school environment and ensure that submitted evidence is authentic |

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| Date version published by Ministry of Education | Originally published December 2012 and edited 2020  To support remote internal assessment due to COVID-19 |
| Quality assurance status | These materials have been quality assured by NZQA.  NZQA Approved number A-A-5-2020-91574-01-6466 |
| Authenticity of evidence | Teachers must manage authenticity for any assessment from a public source, because students may have access to the assessment schedule or student exemplar material.  Using this assessment resource without modification may mean that students’ work is not authentic. The teacher 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. |

**Internal Assessment Resource**

Achievement Standard Mathematics and Statistics 91574: Apply linear programming methods in solving problems

Resource reference: Mathematics and Statistics 3.2AR

Resource title: Rachel’s Roses

Credits: 3

Teacher guidelines

The following guidelines are supplied to enable teachers to carry out valid and consistent assessment remotely using this internal assessment resource.

Teachers need to be very familiar with the outcome being assessed by Achievement Standard Mathematics and Statistics 91574. The achievement criteria and the explanatory notes contain information, definitions, and requirements that are crucial when interpreting the standard and assessing students against it.

Context/setting

This activity requires students to use linear programming to maximise a grower’s income in terms of blocks planted in roses and daisies.

Teacher note: You could modify this task by choosing another context in which to set a similar activity.

Conditions

This assessment activity may be conducted in one or more sessions. Confirm the timeframe with your students.

Students are to complete the task independently.

Students are expected to use appropriate technology, but pen and paper methods are appropriate for this task for students who do not have digital access.

Resource requirements

None.

Additional information

None.

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| Achievement | Achievement with Merit | Achievement with Excellence |
| Apply linear programming methods in solving problems. | Apply linear programming methods, using relational thinking, in solving problems. | Apply linear programming methods, using extended abstract thinking, in solving problems. |

Student instructions

Introduction

Rachel grows roses and daisies for a local flower market. She is looking at planting options to maximise her income.

This activity requires you to use linear programming to model the constraints Rachel has for her planting and to make recommendations so that she can maximise her income in the current year and in future years. You will present your findings as a written report, supported by graphs, equations and relevant calculations.

The quality of your reasoning and how well you link this to the context will determine the overall grade.

You have <<teacher to insert time here>> in which to independently complete this task.

Task

Rachel produces roses and daisies for a local flower market. Roses are very labour-intensive and Rachel is looking at her planting options in order to maximise her income.

Using the constraints outlined in the Resource Sheet, write a report making recommendations as to how many blocks of roses and daisies Rachel should plant to maximise her income in the current year and in future years.

As you write your report take care to clearly communicate your findings using appropriate mathematical statements. Include graphs, equations, and relevant calculations.

Resource Sheet

*Constraints*

Flowers are planted in blocks of a standard size.

Roses require 5 hours of labour per block, and daisies require 2.5 hours per block. Rachel has 90 total hours of labour available for the two crops.

Rachel has 20 blocks available for planting. This can be written as *r* + *d* ≤ 20, where *r* is the number of blocks planted in roses and *d* is the number of blocks planted in daisies.

To keep her contract with the flower market, Rachel must plant at least 7 blocks of roses. She feels that planting anything less than 3 blocks of daisies would make travel to the flower market uneconomical.

*Income predictions*

For the current year, Rachel expects to receive $5,000 per block for her daisies and $8,000 per block for her roses. Her income, $*I*,can be expressed as  
*I* = 5 000*d* + 8 000*r*.

The future value of daisies and roses is unknown. However, payments per block of daisies and block of roses are forecast to be in a ratio of 1:2.

Assessment schedule: Mathematics and Statistics 91574 Rachel’s Roses

Teacher note: You will need to adapt this assessment schedule to include examples of the types of responses that can be expected.

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| Evidence/Judgements for Achievement | Evidence/Judgements for Achievement with Merit | Evidence/Judgements for Achievement with Excellence |
| The student has applied linear programming methods in solving problems.  This involves selecting and using linear programming methods, demonstrating knowledge of concepts and terms, and communicating using appropriate representations.  Examples of possible student responses:   * *Finding the equation of a linear inequality, for example, the equation for hours of labour.* * *Representing the feasible region graphically, correctly showing at least two of the constraints.* * *Identifying the point that maximises income for the feasible region.*   *The examples above are indicative of the evidence that is required.* | The student has applied linear programming methods, using relational thinking, in solving problems.  The student has connected different concepts or representations. The student has related findings to the context or has communicated thinking using appropriate mathematical statements.  Example of possible student responses:  The student correctly graphs the linear system and identifies the feasible region. They have recommended the correct number of blocks of roses and daisies that Rachel needs to plant to maximise her income in the current year. They have started to investigate the income in future years.  *The examples above are indicative of the evidence that is required.* | The student has applied linear programming methods, using extended abstract thinking, in solving problems.  The student has identified relevant concepts in context. The student has used correct mathematical statements or communicated mathematical insight.  Example of possible student responses:  The student has formed and used a system of linear constraints to find optimal solutions and has shown contextual understanding of the multiple solutions associated with the ratio in future years.  *The examples above are indicative of the evidence that is required.* |

Final grades will be decided using professional judgement based on a holistic examination of the evidence provided against the criteria in the Achievement Standard.