



Venue \_\_\_\_\_

Seat Number \_\_\_\_\_

Student Number 

--	--	--	--	--	--	--	--	--

Family Name \_\_\_\_\_

First Name \_\_\_\_\_

*This paper is for St Lucia Campus students.*

Question	Mark
----------	------

[illegible]

Total

## Question 1 – Integer Programming

*12 marks total*

A recent storm in Pacific Paradise requires the shipment of emergency relief supplies by ferry to one of their islands. The relief supplies will easily fit into two ferry loads, but they want to maximise the value of supplies going on the first load.

The supplies are carried by different truck types, with a specified number of trucks of each type. Each truck type has a length, mass, and value (for the relief goods it can carry). The ferry has five lanes for trucks; the first four have a length of 40 metres while the last is only 35 metres. The ferry can carry up to 120 tonnes. This data is provided in the Python file.

- a) Formulate an integer programming model to maximise the total value of relief goods that can be loaded onto a single load of the ferry. Implement your model in Python, using comments to briefly explain each variable and constraint. *[8 marks]*
- b) The ferry must not be too unbalanced, left to right. (Front to back balance can be ignored as this is easily corrected with ballast.) If the five lanes are numbered 0 to 4, this can be considered as follows:
  - For each truck in lane 0 or 1, multiply the mass of the truck by the distance from the centre lane (lane 0 is 2 lanes away from the centre lane, lane 1 is 1 lane away). This is the left balance total.
  - For each truck in lane 3 or 4, do a similar calculation (lane 3 is 1 lane away from the centre lane, lane 4 is 2 lanes away). This is the right balance total.
  - The larger of the left and right balance totals must be no more than 5% higher than the smaller of the left and right balance totals.

Extend your integer programming model to include this requirement. Implement your model in Python, using comments to briefly explain each variable and constraint. *[4 marks]*

When run, your Python code should produce the optimal objective value for each one of these two models, along with the truck types to load into each lane.

## Question 2 – Dynamic Programming

*8 marks*

Pacific Paradise Gas is introducing a cylinder delivery service for its regional customers. The data file gives the travel time (minutes) between each pair of customers and from the service depot, and the number of cylinders requested by each customer for a particular day.

A delivery driver starts at the depot and must return to the depot within 6 hours. What is the maximum number of cylinders she can deliver in this time?

Implement a dynamic programming formulation in Python, including comments in your code that describe the state variables, actions and value function. When run, your code should show the optimal value and the customers to visit.

**END OF EXAMINATION**