THE UNIVERSITY OF QUEENSLAND
AUSTRALIA

This exam paper must not be removed from the venue

Venue _____

Seat Number _____

Student Number |__|__|__|__|__|__|__|__|

Family Name _____

First Name _____

School of Mathematics & Physics

EXAMINATION

Semester One Final Examinations, 2017

MATH3202 Operations Research and Mathematical Planning (Practical Exam)

This paper is for St Lucia Campus students.

Examination Duration: 120 minutes

Reading Time: 10 minutes

Exam Conditions:

This is a School Examination

This is an Open Book Examination

During reading time - write only on the rough paper provided

This examination paper will be released to the Library

Materials Permitted In The Exam Venue:

(No electronic aids are permitted e.g. laptops, phones)

None

Materials To Be Supplied To Students:

None

Instructions To Students:

There are **15** marks available on this exam from **2** questions.

You may access any material during the exam including material on paper, in your electronic files or online. However, you may not communicate with other people during the exam.

Submit your Python files for each question through Blackboard before the end of the exam.

For Examiner Use Only

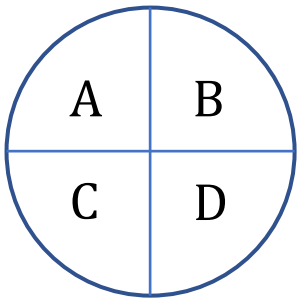
Question	Mark

Total _____

Question 1 – Integer Programming

8 marks

Space stations require occasional resupply of provisions that are delivered by rockets and, since rockets require their payloads to be balanced, deciding where to place cargo is critical to successful missions. The following figure shows a cross-section of the four compartments, A, B, C and D, in a typical delivery payload:



In order for the payload to be balanced, the total mass of cargo in section A must be equal to that of section D, and likewise for sections B and C. Note that section A does not need to equal section B and nor does section C need to be equal to section D.

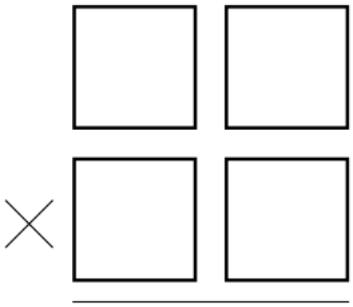
There are 15 packages each of varying masses that must be included in the delivery. The masses of the packages in kilograms are as follows: 70, 90, 100, 110, 120, 130, 150, 180, 210, 220, 250, 280, 340, 350, 400. Each section must contain at least three packages and no compartment can hold more than 1,000 kg.

Formulate the problem of loading this delivery into the four compartments as an integer programming problem. Write the formulation in the space below. Implement your formulation in Python.

Question 2 – Stochastic Dynamic Programming

7 marks total

Suppose you have a shuffled stack of ten cards, each showing a number from 0 to 9. You draw a card at random and place it in one of the four boxes in the following two-digit multiplication template:



Once a card is placed it cannot be moved. You draw a second card and place it in one of the three remaining boxes. You repeat this two more times to complete the boxes, and then multiply the two numbers you have formed together to get the answer. The goal is to make the answer as low as possible. What strategy should you use in placing the digits to minimise the expected value of the answer?

Implement a dynamic programming formulation of this problem in Python. Include comments in your code that describe the stages, state, actions and value function. Write the optimal strategy in the space below.

END OF EXAMINATION