THE UNIVERSITY OF QUEENSLAND
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Family Name _____

First Name _____

School of Mathematics & Physics

EXAMINATION

Semester One Final Examinations, 2019

MATH7232-1 Operations Research and Mathematical Planning (Practical)

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

For Examiner Use Only

Question	Mark
1 (a)	
1 (b)	
2 (a)	
2 (b)	

Total _____

Instructions To Students:

There are **20** 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.

Question 1 – Integer Programming

12 marks total

The management of BigCorp want to know where to locate their factories in a new market, so as to serve 20 big customers. They have 10 possible factory locations. For each possible location, they know the cost of building a factory there, given by the vector `Build` in the code stub. For each customer/location pair, they know the cost of assigning the customer to a factory at the location, given by the matrix `Assign` in the code stub. Each customer must be assigned to a built factory and each factory can serve at most 6 customers.

a) Formulate an integer programming problem to choose the factories to build and the customer/factory assignments to make so as to minimise the total cost of building factories and assigning customers to factories. Write the formulation in the space below. Implement your formulation in Python. Your code should use Gurobi to calculate the solution and then print out the optimal objective value, the factories to build, and a list of customers for each factory to be built. *[8 marks]*

b) BigCorp have the option of building bigger factories. A bigger factory at a location costs 50% more than the standard factory at that location but has a capacity of 8 customers. Write a modified formulation in the space below. Modify your Python implementation suitably.

You may submit separate Python files for parts 1(a) and 1(b), or one Python file with a clearly commented way to switch between the two questions. *[4 marks]*

Question 2 – Dynamic Programming

8 marks

A bookstore wishes to plan their stock of a classic book for the next six weeks. Based on previous data, they estimate the following weekly sales:

Week	1	2	3	4	5	6
Sales	14	8	17	22	12	6

They purchase the books in boxes of 10 at a cost of $50 per box. Any books not sold at the end of a week are kept on the shelf for the next week with a storage cost of $0.50 per book. At the end of the six weeks they can sell any remaining stock to the distributor for $1 per book. They receive $12 for each book they sell.

a) How many boxes of the books should the store order for each week to maximise their total profit? Implement a dynamic programming formulation in Python, including comments in your code that describe the stages, state variable and value function. Write the optimal solution in the spaces below. *[4 marks]*

Week	1	2	3	4	5	6
Boxes						

Total profit = $_____

b) There is a rumour that this classic book will soon be turned into a movie, increasing demand for people to read it. Assume that in each week there is a 30% chance that the movie will be announced and, in that week and all subsequent weeks, the sales will be double the values given above (but the bookstore will not know about the announcement in advance). How many boxes should the bookstore order for Week 1 and what is their maximum expected profit for the six weeks?

Update your dynamic programming formulation in Python, including comments in your code that describe changes to the stages, state variable and value function. Write the optimal solution in the space below. *[4 marks]*

Week 1 boxes = _____

Expected profit = $_____

END OF EXAMINATION