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 Two Final Examinations, 2018

MATH4202-1 Advanced Topics in Operations Research (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

Materials Permitted In The Exam Venue:

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

Calculators - Any calculator permitted - unrestricted

Materials To Be Supplied To Students:

None

Instructions To Students:

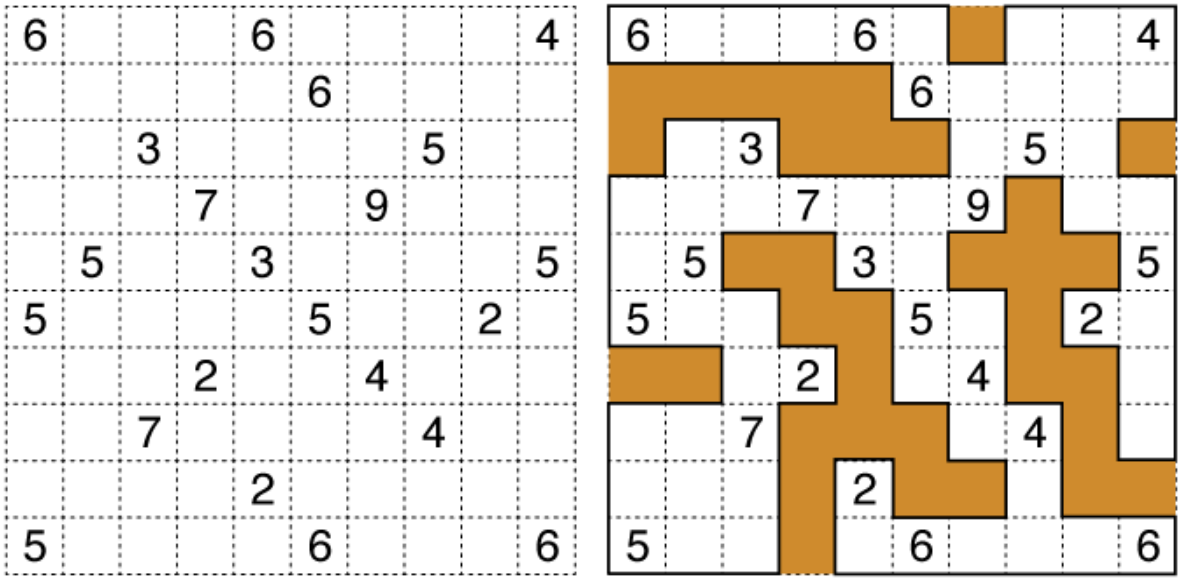
Additional exam materials (eg. answer booklets, rough paper) will be provided upon request.

For Examiner Use Only

Question	Mark

Total _____

A Shading Puzzle



Consider the shading puzzle pictured above – input on the left, solution on the right.

The rules of this puzzle are:

a) The squares with starting numbers (seed squares) are unshaded.

b) For each seed square, the number in the square indicates the total count of unshaded cells connected vertically and horizontally to the seed square including the square itself. For example, in the solution the 9 has six unshaded squares connected in a row to the left, two above, zero to the right and zero below. 9=6+2+0+0+1 (the last 1 is for the seed square itself).

c) Every “island” of shaded squares must connect to the edge of the board.

d) The unshaded squares must form one connected piece.

Your task is to formulate and implement an MIP to solve this problem.

1. Write down an MIP formulation of the problem, excluding rules c and d. (6 marks)

2. Describe in words how you would check a solution of the MIP for compliance with rules c and d, and what extra constraints you would add to a solution that broke these rules. (2 marks)

3. Implement your MIP from question 1 in Python using the stub code for your data. Your code should print out the answer in an appropriate form. Name variables and constraints and comment your code so the connection between the code and your answer to question 1 is clear. (9 marks)

4. Modify your MIP code to repeatedly solve the problem, check for violations of rule c and add additional constraints as needed. (3 marks)

Hint: You will need variables to indicate if each square is shaded or not. You will also need variables to keep track of unshaded strips of squares connected to the seed squares.

Write answers to 1 and 2 here.

END OF EXAMINATION