THE UNIVERSITY OF MELBOURNE

Student Number

Written assignment,

School of Mathematics and Statistics

MAST20018 Discrete Maths and Operations Research

This weekly assignment consists of 2 pages (including this page)

On the weekly assignments:

- All course assignments are individual activities. You can ask 'high-level' questions (i.e., no specific mention to answers) in #perusall.
- Assignment 1 (due - end of week 4) is scored on a 0 - 20 scale. Each subsequent assignment will be scored using a 0 -10 scale. The maximum total number of points in the 9 assignments is, therefore, $A = 20 + 8 \times 10 = 100$.
- Best answers for each question will be selected for the course memory (CM) and will receive extra points. This is optional. To be considered for extra points and to be included as an author in the CM, you must follow the additional instructions below:

  submit your assignment as a text file.

  use the double brackets notation to link any other related concept.

  write your mathematics using LaTeX. Use $ your-equation-here $ to indicate LaTeXcode.

  For example, to write a_i type a_i.
- If you don't want to engage with the 'extra point' activities, feel free to submit your answers as a pdf (use a phone app, e.g., to scan your work). **Use a single page per question**.
- Extra points from Perusall (P) and Course Memory (CM) activities will be added to A and capped at 100: your final mark in the assignments component (worth 20% of the final mark) will be given by $\min(A + P + CM, 100)$

- **Specific comments for this assignment:**

  Goal: The goal of this assignment is to help develop your ability to do research on your own and summarise your understanding using written text (question 1) and increase and test your understanding of the graphical solution method and basic modelling techniques in linear programming.

  Full marks will be given for answers that are correct and *concise but still comprehensive*. You will also be assessed based on the clarity and organisation of your submission, which includes correct use of notation (see pinned question on notation in the course memory).

  Submission due on **August 28th, 2020 11:00 pm AEST** via Canvas/Gradescope (click on "Assignment 1" on the sidebar).

Question 1 (6 marks)

Chose **one** of the following keywords and do some research on it. Write one or two paragraphs summarising its meaning. One approach for your research is to start at the Wikipedia pages for the topics and start exploring the web from there. **Your submission must be a text file**. All text you write should be your own (no copy/paste). The assignments will be scanned for plagiarism.

Keywords: operations research, applied mathematics, decision theory, management science, operations management, basic feasible solution, polyhedron, polytope, linear algebra, slack variable, George Dantzig, Leonid Kantorovich, convexity, convex sets, Julia programming language, JuMP (Julia for Mathematical Programming Package), nonlinear programming, mixed-integer programming, CPLEX, Gurobi, the diet problem, the knapsack problem, the bin packing problem, the assignment problem, the simple assembly line balancing problem.

Examples (from course memory):

Linear programming is an [[optimisation]] framework. It is used to find the best solution for a decision-making problem that can be represented by a [[mathematical modelling]]. In linear programming, this mathematical model has an [[objective function]] and [[constraints]], all written in terms of linear expressions on the decision variables.

To model in mathematics is to abstract the key characteristics we are interested in a given situation from reality. Choosing what to model and what to ignore in a real-problem is an art of sorts. Too much detail will often lead to models that are hard (impossible ?) to solve in the appropriate time-frame. Too little detail will lead to a model that does not capture key aspects of your situation and, therefore, leads to solutions that can not be applied in practice.

- The core idea behind **mathematical optimisation** is to translate a real-life problem into a [[mathematical modelling]] and then obtain the [[optimal solution]] for the model. In other words, [[mathematical optimisation]] is about solving decision-making problems with a formal approach: model the problem under a given framework ([[linear programming]], e.g.) and use a [[solution technique]] for that framework to obtain the optimal solution for the obtained [[model]].

Question 2 (6 marks) Solve Exercise I.8.7 (Chapter I - "Linear and Integer Optimization: Theory and Practice" - available under the Reading section in Perusall).

Question 3 (8 marks) Read section I.6.3 (Chapter I - "Linear and Integer Optimization: Theory and Practice" - available under the Reading section in Perusall) and solve exercise I.8.13.

End of Exam—Total Available Marks = 20