

DSA/ISE 5113 Advanced Analytics and Metaheuristics

Homework #1

Instructor: Charles Nicholson

Due: See course website for due date

Requirement details

1. Homeworks should be submitted in a clean, clear, concise electronic format. You must show your logic, work, and/or code where appropriate.
2. Any code (e.g., AMPL model or data file) is part of your solution – make sure to provide comments on what your code is doing. Keep it clean and clear!
3. For any mathematical programming problem, please ensure you clearly define the following elements in the your answer: (i) **any necessary assumptions**, (ii) **decision variables**, (iii) **objective and objective function**, and (iv) **constraints**.

For example, don't simply use the variable x_1 and assume I can figure out what it means! Also, please label your constraints in meaningful ways, both in the problem formulation text and in any relevant code. Points may be deducted if proper definitions/documentation is missing.

Question 1: SMULLYAN'S ISLAND REVISITED (10 points)

Inhabitants on Smullyan's Island are either always telling the truth or always lying. You meet three people, Gregor, Tywin, and Catelyn on the Island. You turn to Gregor and ask "how many of you are truth-tellers?" Gregor mumbles something unintelligible, but Tywin and Catelyn speak up:

Tywin: "He said only one of us is truth-teller."

Catelyn: "No he didn't!"

From this, using truth-tables, what can you tell about Gregor, Tywin, and Catelyn?

Question 2: BABY YODA (10 points)

Din Djarin is a lone Mandalorian gunfighter and bounty hunter sometimes referred to as "Mando" who has recently rescued what appears to be baby Yoda (see Figure 1) from resurgent evil Empire forces.

Unfortunately, while baby Yoda understands the Mandalorian's language, he does not speak it. Baby Yoda in fact only says two words, "gurmp" and "pvlork" which Mando knows must mean 'yes' or 'no', but he does not know which word means which!

Furthermore, it is unknown whether or not this child is a truthful being or a sinister lying creature from the dark side...

Mando's conversation with the child goes as follows:



Figure 1: Baby Yoda

Mando: “Does gurmp mean *yes*?”

Child: “Pvlorck!”

Can you determine what ‘gurmp’ means? Can you determine if baby Yoda is a liar or truth-teller or an evil dark side liar? Use truth-tables (or a close variation of a truth-table) to demonstrate your case.

Question 3: PORTFOLIO SELECTION (15 points)

Refer to the *Portfolio Selection* example in the *Applied Mathematical Programming* textbook in Chapter 1, Section 1.3. The problem is discussed in detail and modeled correctly in mathematical form. Please code this problem in AMPL and solve for an optimal solution. You may “hard code” all parameters for this problem as opposed to using a data file.

Note: The optimal solution and objectives given on pages 9 and 10 of the text are incorrect!

Question 4: ADVERTISING (20 points)

Complete all parts of Exercise 1-1 from the *AMPL* textbook (Chapter 1). You may “hard code” all parameters for this problem as opposed to using a data file. However, a data file to specify parameter values and sets will probably benefit you.

Question 5: STEEL MILL (25 points)

Complete all parts of Exercise 1-2 from the *AMPL* textbook (Chapter 1).

This exercise is derived from the steel mill example discussed in detail in Sections 1.1 – 1.6 of the textbook. Reading this discussion through prior to attempting the problem should help you further understand the modeling aspects of AMPL. Please code this with a separate model and data file.

Question 6: PORTFOLIO SELECTION REVISITED (20 points)

Complete all parts of Exercise 3 on page 25 from Chapter 1 of *Applied Mathematical Programming*.