

Business Decision Analytics under Uncertainty

Spring 2018, Professor Eckstein

Homework 5

Due Wednesday, March 21

Q1: Ad Purchasing

You have sufficient budget next month to buy a total of 10 ads spread across 6 different regions, with each ad costs \$0.5 million. Your company's marketing analytics team has prepared a study predicting that the net sales S_t (in millions of dollars) in region t should be given by the formula

$$S_t = A_t - B_t e^{-C_t d}$$

Where d is the number of ads purchased in region t , and A_t, B_t, C_t are constants as specified in the following table

Region (t)	1	2	3	4	5	6
A_t	4.1	8.2	6.9	2.3	4.4	5.2
B_t	2.1	4.3	3.2	1.9	2.2	3.1
C_t	0.4	0.3	0.2	0.6	0.4	0.3

You would like to maximize your total predicted profit, with is the sum of the predicted net sales from all regions, minus the amount spent purchasing ads.

Create a Python program that computes pattern of ad purchases that maximizes your total predicted profit. A preamble section containing the above data may be downloaded from the <http://eckstein.rutgers.edu/bdauu> website. If you give the command `import math` at the start of your program, the mathematical function e^x may be accessed through the Python expression `math.exp(x)`. Print out and hand in both the source code for your program and its output. In addition, upload your source code to BlackBoard, under "Assignments" and "Homework Assignment 5, Q1". You are encouraged to use the Python codes distributed in class as a template for your code.

Q2: Planning Maintenance Overhauls

You run the maintenance shop for the local municipal bus service. Over the next 10 weeks, you expect to following number of bus engines to arrive at your shop for overhaul:

Week	1	2	3	4	5	6	7	8	9	10
Arrivals	2	3	6	7	3	2	7	6	2	4

In any given week, you have the capacity to overhaul up to 6 engines. These may be engines that have arrived that same week, or they may be "carried over" from past weeks. However, you only have capacity to "carry over" up to 10 engines from week to week, and carrying over an

engine for a week incurs an opportunity cost a cost of \$1900. Each week, your operating cost for overhauling engines is as follows:

Number of engines overhauled	0	1	2	3	4	5	6
Cost (\$1000's)	0.0	10.0	12.0	13.0	14.0	18.0	21.0

For example, if you decide to overhaul 3 engines in a particular week, your operating cost for that week, will be \$13,000. Because of some planned construction work at your facility, any engines left over at the end of week 10 must be sent to an outside contractor for overhaul at a cost of \$4000 each.

Create a Python program that determines how many engines to overhaul each week so as to minimize your total cost over the 10 weeks, including any outside contractor charges at the end of the period. A preamble section containing the above data may be downloaded from the <http://eckstein.rutgers.edu/bdaau> website. Print out and hand in both the source code for your program and its output. In addition, upload your source code to BlackBoard, under "Assignments" and "Homework Assignment 5, Q2". You are encouraged to use the Python codes distributed in class as a template for your code.