MS&E 260 Homework 1

Summer 2019, Stanford University

Due: July 3rd, 2019, at 10:30AM (PDT)

Problem 1. Formulate each of the following problems as a linear programming problem:

(a) A manufacturer wishes to produce an alloy, that is, by weight 60% of metal X and 40% of metal Y. There are four alloys available for the manufacturer to extract metal X and Y:

Table 1: Alloys Composition and Price

Alloys	1	2	3	4
% X	20	40	10	35
% Y	80	60	90	65
Price/ton	1	3	2	4

The manufacturer wishes to find the amounts of the various alloys needed to produce one ton of desired alloy and to determine the least expensive combination.

(b) Quantities $a_1, a_2, ..., a_m$, respectively, of a certain product are to be shipped from each of m locations and received in amounts $b_1, b_2, ..., b_n$, respectively, at each of n destinations. We assume that the total amount shipped is equal to the total amount received. Associated with the shipping of a unit of product from origin i to destination j is a shipping cost c_{ij} . It is desired to determine the amounts x_{ij} to be shipped between each origin-destination pair $i \in 1, 2, ..., m$ and $j \in 1, 2, ..., n$ so as to satisfy the shipping requirements and minimize the total cost of transportation.

(c) Suppose that there are 2 sources that generate waste and 3 disposal sites. The amount of waste generated at source A is 200 and at source B is 400. The capacity of disposal sites 1, 2 and 3 are 250, 150 and 100, respectively. The unit shipping costs from waste source A to disposal sites 1, 2 and 3 are 35, 15, and 20, respectively. The unit shipping costs from waste source B to disposal sites 1, 2 and 3 are 20, 5, and 15, respectively. Write the formulation for determining the optimal assignment that minimizes transportation costs.

Problem 2. Stanford Dining is thinking of catering Magical 24-hour Energy Donuts that tastes like regular donuts but when consumed, keeps students fully awake the whole day. Based on surveys, these donuts have an anticipated steady demand of about 24,000 donuts per year. The fixed cost per unit is $3. It costs $250 to place an order. Inventory holding costs are based on an annual interest rate of 15%.

(a) What is the optimal order quantity?

(b) Suppose that Lala Land, the producer of Magical Donuts, provides an all-unit discount with the following schedule:

   i. $3Q$ for $Q \leq 5{,}000$

   ii. $2Q$ for $5{,}000 < Q < 6{,}250$

   iii. $1Q$ for $Q \geq 6{,}250$

What is the optimal order quantity in this case? Using your optimal order quantity, what is the total cost?

(c) Now suppose that Lala Land provides an incremental discount as follows:

   i. $3Q$ for $Q \leq 6{,}000$

   ii. $\$18{,}000 + \$2.90(Q - 6{,}000)$ for $6{,}000 < Q < 10{,}000$

   iii. $\$30{,}000 + \$2.80(Q - 10{,}000)$ for $Q \geq 10{,}000$

What is the optimal order quantity in this case? Using your optimal order quantity, what is the total cost?

Problem 3. The Batu Co. manufactures car engine spare parts. One particular spare part has a known and constant demand rate of 1,600 units per year. The fixed cost of the setup for each production run is $200 and the inventory holding cost is $4 per unit per year. There is a lead time of 1 week. Assuming that there is infinite production capacity, compute:

  (a) The economic order quantity

  (b) The optimal reorder point (Be careful about the time unit when multiplying, they should be the same)

  (c) The resulting annual setup cost

Now assume that there was a finite production rate of 8,000 units per year. Compute:

  (d) The EOQ

  (e) The maximum inventory level

  (f) The total annual holding cost

Problem 4. Read the following articles:

- `https :// www . defensenews . com / air / 2017 / 04 / 24 / gao - urges - caution - on - economic-order-quantity-buy-for-f-35-jet/`

- `http://scdigest.com/experts/DrWatson_19-02-19.php?cid=15200`

Select one of these two articles, and do the following:

1) Briefly summarize the article.

2) Provide a few interpretive thoughts on the article, using what you have learned from class.

3) Provide one recommendation on how the dilemma posed in the article could be resolved.

Some notes:

- Please limit your responses to one page, double spaced, 12 point font.

- There is no right answer to this question. We are evaluating your ability to apply what you learn in class to practical applications.

- This question is not intended to be free points. If you do not demonstrate a sufficient level of critical thinking, full credit will not be awarded.