

# MS&E 260 Homework 4

Summer 2019, Stanford University

Due: July 31st, 2019, at 10:30AM (PDT)

**Problem 1.** Imagine a two-firm supply chain that consists of a supplier and a retailer. The supplier has a marginal cost  $c = \$40$  and a wholesale price  $w = \$60$ . The retailer is looking to sell its product at  $p = \$100$ ; at this price point, demand over the lifespan of the product is distributed normally with mean 200 and standard deviation of 10. The salvage value of the product is  $s = \$5$  for the retailer.

- (a) What is the expected profit for the supplier and the retailer?
- (b) Suppose the supply chain was integrated (or alternatively, the supply chain is perfectly coordinated.) What is the optimal order quantity of the retailer? What is the expected total profit for the supply chain?
- (c) Now assume the firms seek to form a revenue sharing contract. Let  $f$  be the upfront fee and  $\theta$  be the revenue share percentage. Suppose they decide on an upfront fee of \$30 per unit. What is the share  $\theta$  so that the chain is perfectly coordinated? What is the expected profit for the retailer under this contract?
- (d) Assume now that the firms are looking to form a buyback contract. What would be the buy-back price that perfectly coordinates the supply chain assuming the wholesale price remains \$60 per unit? What is the expected profit for the supplier and the retailer?

**Problem 2.** Company  $A$  produces two types of items, product 1 and product 2. The marginal cost of producing product 1 is \$8, and the annual total expected demand is normally distributed with  $\mu = 300$  and standard deviation 80. The marginal cost of producing product 2 is \$10, and its annual total expected demand is normally distributed with  $\mu = 200$  and standard deviation 50. The production lead time is six months.

Company  $B$  is the retailer of these two products, and the retail prices for product 1 and 2 are \$20 and \$24, respectively. The products not sold at the end of the sales period will be sold to another company at a price of \$3 for product 1 and \$4 for product 2.

- (a) Company  $A$  charges a wholesale price \$13 for product 1 and a wholesale price \$15 for product 2. What are the optimal quantities  $q_1^*$  and  $q_2^*$  for products 1 and 2 respectively such that Company  $B$  maximizes its profits?
- (b) Assume now that the management team of Company  $A$  is not satisfied with this agreement for product 1 and wants to develop a new supply chain contract. The following two types of contracts are available. Which of them should Company  $B$  accept?
  - i. Contract 1: Buy-back contract:  $w = 13$  and  $b = 5$
  - ii. Contract 2: Revenue-sharing contract:  $f = 8$  and share = 85%

**Problem 3.** Watch the following video: <https://youtu.be/wPkhyKGJLvs>

In the video, Joe references a problem regarding excessive demand for Disney restaurants. What are some ways in which Joe can use operations management in order to solve this problem? In your response, discuss three ways to solve this problem, using concepts such as revenue management, capacity optimization, and supply chain management, among others. Make sure to provide a qualitative discussion on how these proposed solutions will influence the underlying mathematical models associated with the concepts (such as revenue management, capacity optimization, and supply chain management).

**Problem 4.** Discuss the differences between the revenue sharing contract model and the buyback contract model. In particular, what types of situations would one be advantageous over the other?

**Problem 5.** Read the following articles:

- <https://www.forbes.com/sites/paulmartyn/2018/04/27/the-nfl-draft-a-data-driven-supply-chain-if-ever-there-was/#53ee3aa043cf>
- <https://www.sunherald.com/news/local/military/article161039534.html>

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.