

Problem set #2

Due Session 10

Problem 1

Consider the following demand scenario:

Quantity	Probability
2000	3%
2100	8%
2200	15%
2300	30%
2400	17%
2500	12%
2600	10%
2700	5%

Suppose the manufacturer produces at a cost of \$20/unit. The distributor sells to end customers for \$50/unit during season and unsold units are sold for \$10/unit after season.

- a) What is the system optimal production quantity and expected profit under global optimization?
- b) Suppose the manufacturer is make-to-order (i.e., the distributor must order before it receives demand from end customers).
 - (i) Suppose the manufacturer sells to the distributor at \$40/unit, how much should the distributor order? What is the expected profit for the manufacturer? What is the expected profit for distributor?
 - (ii) Find an option contract such that both the manufacturer and distributor enjoy a higher expected profit than (b)(i). What is the expected profit for the manufacturer and the distributor?
- c) Suppose the manufacturer is make-to-stock. (i.e., the manufacturer must decide how much to produce before the distributor sees the demand and places an order.)
 - (i) Using the same wholesale price contract as part (b)(i), calculate the production level of the manufacturer. What are the expected profits for the manufacturer and for the distributor? Compare your results with part (b)(i).
 - (ii) Find a cost sharing contract such that both the manufacturer and distributor enjoy a higher expected profit than that in (c)(i), and calculate their expected profits.

Problem 2

Using the data from problem 1, assume that the distributor knows the true forecast, given in problem 1; but for this problem we assume that the manufacturer has a distorted forecast, as given below:

Quantity	Probability
2200	5%
2300	6%
2400	10%
2500	17%
2600	30%
2700	17%
2800	12%
2900	3%

- a) Suppose the manufacturer is make-to-order. Using your proposed contract in Problem 1(b)(ii), find the order quantity and expected profit of the distributor, and the expected profit of the manufacturer. Compare your answers with 1(b)(ii).
- b) Suppose the manufacturer is make-to-stock. Using your proposed contract in Problem 1(c)(ii), find the production quantity and expected profit of the manufacturer, and the expected profit of the distributor. Compare your answers with 1(c)(ii).
- c) If you were the distributor and you have the choice of sharing the true demand forecast or the inflated demand forecast with the manufacturer, what will you do in each case (make to order; make to stock)? Explain.

Problem 3

Suppose the manufacturer is make-to-order. Let c be the per unit production cost of the manufacturer, and p be the per unit selling price of the distributor. Suppose the distributor orders X (before knowing the demand) and the demand turns out to be D .

- a) If they have a buyback contract with a wholesale price w and buyback price b , how much does the distributor have to pay the manufacturer?
- b) If they have a revenue sharing contract with a wholesale price w and the manufacturer receives a proportion t of the distributor's sales revenue, how much does the distributor have to pay the manufacturer?
- c) Show that when the selling price of the distributor is ex-ante (i.e., it is decided by the market and the distributor has no control over the selling price), then buyback contract is equivalent to the revenue sharing contract.

- d) Is buyback contract equivalent to the revenue sharing contract in all cases? (Hint: consider the case when the distributor can decide the selling price after signing the contract.)

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