

Whitman School of Management, Syracuse University, Fall 2017
Supply Chain Management 600 (Business Analytics)
Group Assignment 3
Due: Midnight, Tuesday, November 14, 2017, Total Points = 30

Please answer the following questions using Excel Solver. Submit the Excel worksheets in a single Excel file and a short Word document describing the answers.

1.(5+5+5+5 = 20 pt) A company has two products A and B, with unit prices P_A and P_B . The demands (in number of units) for A and B, denoted by Q_A and Q_B , are given by:

$$Q_A = 200,000 * P_A^{-2} * P_B^{-0.5}$$

$$Q_B = 1000,000 * P_A^{-0.5} * P_B^{-3}$$

Fixed costs are zero, and the unit variable costs of A and B are $VC_A = 10$, and $VC_B = 10$.

The profit from A is $\Pi_A = (P_A - VC_A) * Q_A = (P_A - 10) * 200,000 * P_A^{-2} * P_B^{-0.5}$

The profit from B is $\Pi_B = (P_B - VC_B) * Q_B = (P_B - 10) * 1000,000 * P_A^{-0.5} * P_B^{-3}$

The total profit is $\Pi = \Pi_A + \Pi_B$.

At present $P_A = P_B = 25$.

1.(a) Suppose the company wants to keep P_B fixed at 25, and change P_A to maximize Π_A . Using Excel Solver, what P_A should the company choose? What are the corresponding Π_A , Π_B and Π ?

1.(b) Suppose the company wants to keep P_A fixed at 25, and change P_B to maximize Π_B . Using Excel Solver, what P_B should the company choose? What are the corresponding Π_A , Π_B and Π ?

1.(c) Suppose the company sets P_A equal to profit maximizing price from 1(a) and P_B equal to the profit maximizing price from 1(b). Then, what are Π_A , Π_B and Π ?

1.(d) Suppose the company wants to vary both P_A and P_B simultaneously to maximize $\Pi = \Pi_A + \Pi_B$. Using Excel Solver, what P_A and P_B should the company choose? What are the corresponding Π_A , Π_B and Π ?

Note:

- The demand functions used in question 1 are estimated by running regressions of log of demand as dependent variable, and logs of the two prices as independent variables. Clearly, the model is only valid for the ranges of price used in estimation.
- When you try to find prices to maximize the total profit from the two products combined, you may get unreasonable solutions where the price of one product is close to zero in cases like we have here with negative cross elasticities of demand. (For positive cross elasticities, you may get the opposite situation where the price of one product is extremely high.) To avoid these possibilities, it is useful to impose bounds on prices when using Solver to maximize total profit.

- In the present case, you may like to add constraints that $P_A \geq VC_A = 10$, and $P_B \geq VC_B = 10$. That will give you reasonable results. (In real life, prices are sometimes set below variable cost. Then, you have a negative profit from that product, but the increased demand from other products compensates for that loss. This is called **loss leader pricing**.)
- As starting prices in 1(d), you may use $P_A = 25$, $P_B = 25$, or the prices from 1(c). Both will give you the correct answer.

2.(10 pt) Acme Bakery makes five products, cupcake, pound cake, raisin bread, cookie and muffin and is trying to decide how many units of each product to make. It has three limited resources that are used to make these products:

- Egg (180 units)
- Sugar (120 units)
- Butter (150 units)

The number of units of each resource needed to make one unit of each product and the profit from a unit of each product are given below.

Product	(1) Cupcake	(2) Pound Cake	(3) Raisin Bread	(4) Cookie	(5) Muffin
Egg	10	10	0	5	5
Sugar	5	10	4	5	6.25
Butter	5	7	4	5	2.5
Profit	12	20	6	12	12

Acme wants to maximize profit subject to the constraints imposed by the limits of the three resources. Using Excel Solver, find the number of units of each product to make and the corresponding profit.