
Instructions: This problem set is due in class on Wednesday, November 3. If you get stuck, you are encouraged to ask questions of the instructor or the tutors. Jeff has office hours Friday 1:00–2:00pm, Monday 3:00–4:00pm, and Tuesday 10:0–11:00am in Vollum 229. Tutors will be available at work sessions Monday and Tuesday 7–10pm in the Dorothy Johansen House.

1. Cournot Duopoly. Bartels and Jaymes are two individuals who one day discover a stream that flows wine cooler instead of water. Bartels and Jaymes decide to bottle the wine cooler and sell it but, depending on the circumstances, they may either cooperate (collude as a monopolist) or compete as Cournot duopolists. The marginal cost of bottling wine cooler and the fixed cost to bottled wine cooler are both zero. The market demand for bottled wine cooler is given as:

$$P = 90 - 0.25Q,$$

where Q is the total quantity of bottled wine cooler produced and P is the market price of bottled wine cooler. Use graphs to illustrate your answers when appropriate.¹

- a. What is the economically efficient price of bottled wine cooler? What is the economically efficient quantity of bottled wine cooler produced?
- b. If Bartels and Jaymes were to collude with one another and produce the profit-maximizing monopoly quantity of bottled wine cooler, how much bottled wine cooler will they collectively produce? At that output level, what price will Bartels and Jaymes charge for bottled wine cooler? At that output level, what is the welfare loss relative to the economically efficient point?
- c. Now suppose that Bartels and Jaymes act as Cournot duopolists, what are the reaction functions for Bartels and for Jaymes? (Hint: They are symmetric.) In the long run, what level of output will each produce if the two producers act as Cournot duopolists? In the long run, what will be the price of wine coolers be if they act as Cournot duopolists? What will be the welfare loss compared with economic efficiency and with monopoly?

2. Production, marginal product, and input demand. The table below shows a firm's output per day for zero through six workers.

¹ Remember that you can calculate the marginal-revenue curve corresponding to a linear demand curve easily: it has the same vertical intercept and twice the slope as the demand curve. In other words, if the demand curve is $P = \alpha - \beta Q$, then the marginal-revenue curve is $MR = \alpha - 2\beta Q$. You will need to apply this formula more than once in this problem.

Q	L
0	0
46	1
84	2
114	3
136	4
150	5
156	6

The firm's demand and marginal revenue curves are:

$$P = 50 - 0.125Q \quad MR = 50 - 0.25Q,$$

where Q = daily sales, and P = output price.

- Determine the marginal product of labor for one through six workers.
- Determine the firm's marginal revenue product.
- How many workers should the firm hire if total wage costs including fringe benefits are \$30 per hour? (Remember that output is measured daily; each worker is assumed to be employed for eight hours per day.)

3. A competitive labor market. The market for production workers in Dudeville, California is highly competitive. The market supply and demand curves for production workers are given as:

$$L_S = -2500 + 1000W \quad L_D = 10500 - 625W,$$

where L_D = labor demand is full time workers per hour, L_S = labor supply is full time workers per hour, and W = hourly wage. RollerBall Manufacturing Co. employs production workers in the manufacture of bearings for skateboards and roller skates. The firm's production function is given by the expression:

$$Q = 88.8L - 0.5L^2,$$

where Q = output, measured as boxes of bearings per hour, and L = number of workers employed per hour. From this production function, the marginal product and average product of labor are:

$$MP = 88.8 - L \quad AP = 88.8 - 0.5L$$

RollerBall currently sells bearings for \$10 per box and is a price-taker in both output and input markets.

- a. Determine the equilibrium wage and level of employment in the market. Calculate the total rent that is being earned by workers.
- b. Determine the number of workers that RollerBall Manufacturing would employ at the wage determined in part (a). What total output will White produce?

4. Making an investment decision. The Edgeworth Box Company produces packaging materials. Edgeworth is considering undertaking one or both of two investment projects. The first investment involves a new automated warehouse for the firm's cardboard, foam, and plastic inventory. The warehouse can be expected to have a useful life of ten years, after which it will be obsolete with no scrap value. The warehouse involves \$3,000,000 in capital cost that must be paid immediately. The warehouse will lower the firm's cost \$400,000 for each of the first five years, and \$500,000 per year thereafter. The second project involves the acquisition of a computerized order system that would allow the firm's salespeople to link directly with the computer to place orders. The computerized network will require an initial capital cost of \$1,000,000, but will save the firm \$300,000 per year in support staff costs. Edgeworth's managers believe that the order system will be obsolete after five years. Cash flows for each project will be at year end. Edgeworth uses a 10% discount (interest) rate in evaluating the investment projects. Interest rates and future cash flows are in real terms, net of all tax effects.

- a. Calculate the net present value of each investment project. Which project(s) should the firm accept?
- b. Comment on the impact of a change in the discount rate on the NPV. (Analyze both an increase and a decrease in the discount rate.)