Problem Set #4

Doing these problems is optional. The solutions to these questions will be posted by Thursday, October 1st and discussed in section on Friday, October 2nd. As always, the educational value of these exercises will be maximized if you attempt to answer these questions before you look at the answers.

Question 1

You have just inherited a piece of property that has two functioning oil wells on it. The inheritance is unusual in that you only are allowed to keep the land for 1 year. After that, you must turn it over to your evil twin brother, who is less deserving than you. Each oil well requires a separate operator, which costs $2,500 per month per operator. Well 1 is the more efficient one. The cost of extracting B barrels of oil in a month is $\text{TC}_1=2500 + 0.05 B^2$ (the 2500 reflects the monthly operator cost). If you shut the well down, it costs you zero. The cost of extracting B barrels of oil in a month from well 2 is $\text{TC}_2=2500 + 0.1 B^2$. If you shut the well down, it costs you zero. The operators are hired on a month-to-month basis, so you can lay them off during the year and stop paying their salaries.

a) If the price at which you could sell the oil were $30/barrel, would you operate well 1? If so, how much would you produce each month? How much profit would you make? Would you operate well 2? If so, how much would you produce each month? How much profit would you make?

b) Instead of the price being $30/barrel all year, it instead turns out to be $35 in the first six months of the year and $25 in the last six months of the year. How much do you produce from each well during each month? Are your profits for the year higher or lower than in part a? Explain this outcome.

c) What is the average cost function for operating well 1? For operating well 2?

d) At what price of oil would you shut down well 1? At what price would you shut down well 2? How do these prices relate to the average cost functions you identified in part c?
Question 2

The market for pencils is easy to enter, but entry takes time. In the short run, the number of firms (and plants) in the industry is fixed. Production occurs in identically-sized plants with each plant having an annual total cost function of \( TC=400+q^2 \) (this includes a normal return on the plant's capital). This, of course, means that each plants' marginal cost of production is \( MC=2q \) and its average cost of production is \( AC=400/q + q \). Currently, no firm owns more than one plant. Pencils are a completely homogeneous good.

a) You own one plant among more than a hundred in the industry. Currently, the price of a pencil is \( P=100 \). How many pencils do you produce each year? What are your annual profits?

b) The demand in the market is \( Q=50,000-200P \). As stated in (a), the price is \( P=100 \). If the market is in short-run equilibrium (meaning each firm is maximizing its profits given that the number of plants is fixed in the short run), how many firms are in the market?

c) Explain why this market is not in long-run equilibrium. Derive the long-run equilibrium in this market. What is the equilibrium price? What is the equilibrium quantity sold by each firm? How many firms are in the market?

d) Now you find a way to produce pencils more cheaply. Your total cost function is now \( TC=200+q^2/2 \), which means your \( AC=200/q+q/2 \) and your \( MC=q \). Your technology is unique and cannot be reproduced by others or replicated by you. In the long run, does this discovery increase your profits? Does it lower the market price? Does it change the number of firms in the market?

e) You have patented your new production technology and have now figured out how to replicate it. That is, you can build as many plants as you like with this technology. How many do you build? What price do you charge? What happens to other producers of pencils?

Question 3

You have been hired to run HaasAir, an airline that serves only one route Oakland-Mexico City, but has a monopoly on that route. You have one plane that can each day carry 300 passengers to and from Mexico City. The plane can make one round-trip flight per day. The daily lease cost of the plane is $20,000, which must be paid even if the plane is not used. The operating cost of making one round-trip flight is $30,000 (e.g. to cover the cost of the jet fuel). In addition, each passenger who flies a round trip costs you $40. No one ever flies on Saturdays. One-third of all flying days (Sundays and Fridays) are heavy demand days, with demand (for round-trip tickets) of \( Q=1000-P \). The other days are light demand, \( Q=400-P \). You can vary price by day of the week. (For simplicity, assume that each round trip either takes place only on peak
days or only on off-peak days.) For the next six months, you are locked into the current lease on the plane. During that time, you cannot lease an additional plane. All costs are incurred and all revenues are collected on the day of the flight.

a) If you operated the flight to Mexico City on Sundays and Fridays, what (round-trip) price would you charge? If you operate on off-peak days, what price would you charge on those days?

b) Will you operate the flight to Mexico City on Sundays and Fridays? Will you operate it on other days?

c) The six month lease has now ended. You anticipate that demand will remain the same for the next six months. Should you renew the lease on this plane? (You cannot lease a plane for just certain days of the week.)

d) A second identical plane is available for the same lease terms. If you leased it, you would increase your daily capacity to 600 roundtrips. Assume that you have leased the second plane for the next 6 months. What prices would you then charge on peak days (Sunday/Friday) and on off-peak days (other days)? How many daily passengers would you carry on peak days? On off-peak days? Would the proportion of capacity used be higher or lower than when you had only one flight? (Note: Assume that flying a second flight on the route does not change the demand function for travel on the route.)

e) Should you lease a second plane?