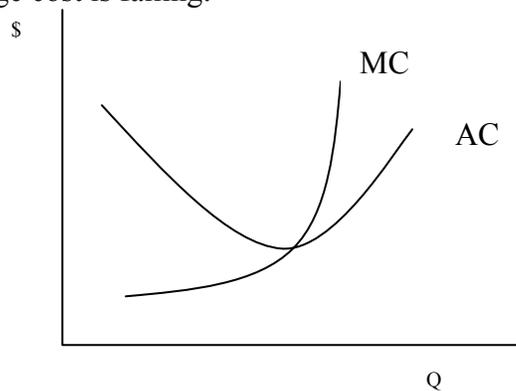
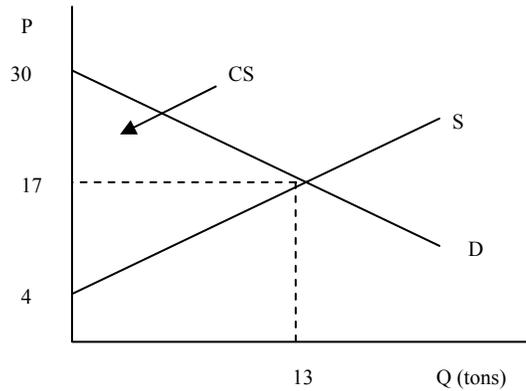


1a) False. If average cost is falling, marginal cost must be less than average cost, but marginal cost may be rising as average cost is falling:



1b) False. Oil companies represent neither demand nor supply substitutes for paint. That is, if paint companies increased the price, consumers could not substitute crude oil for the paint, and oil companies are unlikely to enter the paint market.

2a)



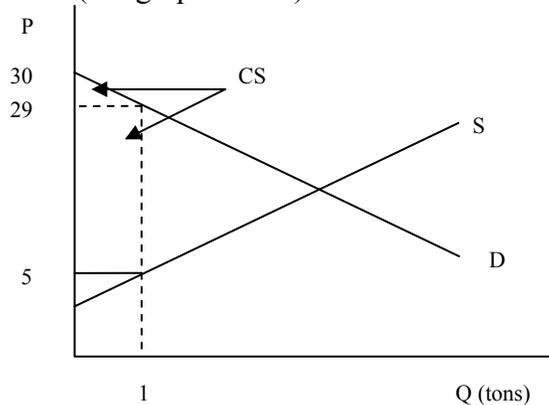
$P^* = 17$: \$17,000 per ton

$Q^* = 13$: 13 tons

$$CS = \frac{1}{2} * (30 - 17) * 13 = \frac{1}{2} * 13 * 13 = \frac{1}{2} * 169 = 84.5:$$

$$CS = \$84,500$$

2b) Quantity supplied = 1: 1 ton. **Consumer surplus falls compared to part (a).** The maximum amount of consumer surplus occurs when those with the highest valued use for plywood are able to purchase it (see graph below).



$$\text{Then } CS = \frac{1}{2} * (30 - 29) * 1 + (29 - 5) * 1 = 24.5:$$

$$CS = \$24,500:$$

$$\begin{aligned} 3a) \text{ Profit} &= \text{Rev} - \text{Cost} = (150 - 2Q) * Q - (250 + 30Q) \\ &= 150Q - 2Q^2 - 250 - 30Q \end{aligned}$$

Choose Q to maximize profit by taking the derivative of profit with respect to Q & setting it equal to zero:

$$150 - 4Q - 30 = 0 \Leftrightarrow 150 - 4Q = 30 \text{ (Marginal Revenue} = \text{Marginal Cost)}$$

Solve for Q: $Q = 30$, or 3,000 donuts

Price is then read off the demand curve:

$$P = 150 - 2 * 30 = \$90 \text{ per 100 donuts}$$

$$\text{Daily Profits} = 90 * 30 - (250 + 30*30) = 2700 - 1150 = \$1550$$

3b) With $FC=350$, the revenues are still greater than the economic cost of production, and KK will not shut down. In other words, profits fall by \$100 to \$1450, but $\text{profits} > 0$ implies that the firm will not shut down. Since marginal cost is unaffected by the increase in fixed costs, daily sales (and price per doughnut) will be the same as in 3a).

Common Mistakes:

Part A:

1. The equation given was in the form of P as a function of Q. You can use the shortcut of “doubling the slope” of the demand curve to get MR only if the equation is written in this form. If the equation is in the form of Q as a function of P, you need to rearrange the equation.
2. MC is calculated by taking the first derivative of the cost function, so for $(250 + 30Q)$, $MC = 30$. You can not use the shortcut of “doubling the slope” for the MC curve.
3. Profit is calculated as Total Revenue minus *Total Costs*. Total costs include fixed cost. If you want to use the following equation, don't forget to subtract fixed costs: $(P - MC) * Q - FC$.

Part B

1. FC do not affect the amount of quantity produced and price. However, FC do affect the company's decision of whether or not to shut down. Thus, we also need to look at the change in profit as a result of the FC increase. If economic profit is negative, daily sales would change because the company should shut down instead of operating.

4) **This problem is the same as a question on 2002's midterm.**

a) The User Cost of Capital for each type of tractor is as follows:

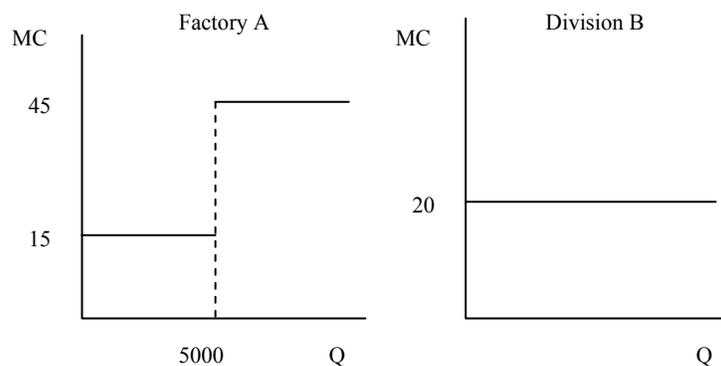
$$\text{UCC for 1-year use of new tractor} = (100,000 - 70,000) + 10\% * 100,000 = \$40,000$$

$$\text{UCC for 1-year use of 1-year-old tractor} = (70,000 - 45,000) + 10\% * 70,000 = \$32,000$$

$$\text{UCC for 1-year use of 2-year-old tractor} = (45,000 - 0) + 10\% * 45,000 = \$49,500$$

b) Since variable cost is the same for all types of tractors, and there is no cost of reselling, each year Old McAdams should use whatever tractor has the lowest UCC. Hence, the best plan is to purchase a 1 year old tractor at the start of each year and sell that tractor (now 2 years old) at the end of each year.

5a)



5b) With no fixed cost, you produce 5000 units in A at \$15 each and outsource 3000 units in B at \$20 each. Note that by producing the first 5000 in Factory A, you save $(20-15)*5000 = \$25,000$ in total costs.

5c) With the fixed cost of $C = \$20,000$, you still save $\$25,000 - \$20,000 = \$5,000$ with the above scheme, so your answer doesn't change.

With the fixed cost of $C = \$45,000$, if you produce 5000 units in factory A, you lose $\$20,000 = \$45,000 - \$25,000$. Therefore you would outsource all units (and shut down factory A, avoiding the fixed cost).

5d) You should pay the \$45,000, because the value of keeping it open is greater than this cost. To see this, we need to compute the value of having the option to use Factory A in the future.

The revenue side is the same regardless of the uncertainty. 3000 will be outsourced whether the marginal cost is \$20 or \$40. So, we can focus on the costs of the first 5,000 units. We need to calculate the expected cost with and without Factory A. First, consider the potential costs of outsourcing versus using Factory A:

Outsource costs of 5000 units at \$20: $OC1 = 20*5000 = 100,000$

Outsource costs of 5000 units at \$40: $OC2 = 40*5000 = 200,000$

Cost of 5000 units in factory A after the investment of \$45,000: $15*5000 = 75,000$

Expected Costs for 5000 units without factory A: $.5 * 100,000 + .5 * 200,000 = 150,000$.

Expected Costs for 5000 units with factory A: 75,000

Therefore the option value of keeping Factory A open is:

$150,000 - 75,000 = 75,000$.

This is greater than the cost of purchasing the option (\$45,000), so you should make the investment.

Note: If you used all 8,000 you get the same answer:

Expected Costs for 8000 units without factory A: $.5 * (8000*20) + .5*(8000*40) = \$240,000$

Expected Costs for 8000 units with factory A:

$$.5 * (5000*15 + 3000*20) + .5*(5000*15 + 3000*40) = \$165,000$$

Therefore the option value of continuing to operate factory A is: $240,000 - 165,000 = 75,000$

Note 2: If you used profits (and assumed $P=60 \rightarrow \text{Revenue of } 60 \cdot 8000 = 480,000$), same answer:
Expected Profit for 8000 without A: $480,000 - 240,000 = \$240,000$
Expected Profit for 8000 with A: $480,000 - 165,000 = \$315,000$

Option Value: $\$315,000 - \$240,000 = \$75,000$.

Note 3: This is similar to the VHS/Beta example from lecture, calculating the expected value with and without Beta, here it is the expected costs with and without Factory A. Some students approached the problem as in problem set 3, question 3, where a more complicated option value question was asked. In that problem, the value of having the uncertainty resolved *before* making the investment was calculated. The investment decision here considers the value of flexibility due to the investment (the option of using Factory A if $M C_b = \$40$).

6) A profit maximizing firm will not produce in the short run if it cannot cover its variable costs of production. Examples of such costs here would be fuel and labor—costs that vary with the running of a boat trip.

In this market, the firms will not produce on any given day if 5 (or fewer) people sign up, but will produce on any given day if 6 people do. If 5 people sign up, the firm would receive \$750. If 6 people sign up, they receive \$900. Therefore, the variable cost of operating a fishing boat trip must be between \$750 and \$900 a day. (Recognizing the cost of the trip as \$750 or \$900 was accepted).

Common Mistakes:

-Recognizing the average cost in the competitive market is $8 \cdot 150 = 1200$, which will cover total cost, but not calculating the variable cost.

-Recognizing that the cost does not vary with the number of people, but not calculating the cost of operating the boat trip (regardless of the number of people).