Problem Set #3
ECO 3101, Fall 2013

1. Use the definitions of the various measures of cost to fill out the following table.

q	TC	TVC	TFC	AC	MC	AVC
1	18					
2					16	10
3						
4	66					
5				10	18	
6		108				

2. Consider a firm that produces output from capital and labor according to the production function q = 10LK. The price of capital (r) is $120 per unit. The price of labor (w) is $30 per unit.

a. If capital is fixed at 10 in the short run, how much labor must be employed to produce 1000 units of output in the short run?
b. What is the total cost of producing 1000 units of output in the short run? The average total cost?
c. If the price of labor increases from $30 per unit to $40 per unit, what happens to the total cost of producing 1000 units of output in the short run (up or down, and by how much)? What happens to the average total cost?
d. At the initial prices, which bundle of inputs (L, K) would enable the firm to produce 1000 units of output at the lowest cost in the long run?
e. What is the total cost of producing 1000 units of output in the long run at the initial prices? The average total cost?
f. If the price of labor increases from $30 per unit to $40 per unit, what happens to the total cost of producing 1000 units of output in the long run (up or down, and by how much)? What happens to the average total cost?

3. Consider a firm that manufactures widgets from labor, capital, and raw materials. The firm's production function is q = 5KL. Each unit of capital costs $10,000 per month and each unit of labor costs $5000 per month. In addition to the capital and labor costs involved, $2000 of raw materials are required for each widget that gets produced. In the short run, the firm's capital is fixed at 5 units.

a. What is the short run total cost *function* for this firm (total cost as a function of q)?
b. What is the short run marginal cost function for this firm (marginal cost as a function of q)? The short run average total cost function (ATC as a function of q)?
c. In the long run, what capital/labor ratio should the firm pick if it wants to minimize total production costs at any level of output?
d. What is the firm's long run total cost function? The long run marginal cost function? The long run average total cost function?

4. In the context of a firm's output decision, what is the difference between the "short run" and the "long run"? What determines the shape of a firm's average total cost curve in the short run? What determines the shape of a firm's average total cost curve in the long run? Explain.

5. Consider a firm that produces output from labor and capital according to the per-day production function: $q = K^2L$. Suppose that the firm's manager has been given a production target of 8000 units per day, and the firm can purchase capital and labor at per-day prices of $40/unit of capital and $20/unit of labor respectively.

a. Suppose the firm employs 80 units of labor each day. What quantity of capital would it need to employ to meet the daily production target? What would be its total cost each day in that case?
b. Calculate the marginal product per dollar spent on labor at the input bundle used in (a), and repeat the calculation for capital. Based on your calculations, should the firm move toward a more labor-intensive production process or a less labor-intensive production process if it wants to cut costs? Explain.
c. What input bundle should the firm employ if it wants to meet its production target at the lowest possible cost? What would be the total cost per day in that case?

6. Under what conditions is a firm considered to be "perfectly competitive"? What will its total revenue curve look like in that case? What will its marginal revenue curve look like? Explain.

7. Consider a perfectly competitive firm with the following cost curves:

- $TC = 200 + 2q^2$
- $MC = 4q$
- $AVC = 2q$

a. If output can be sold at P = $100 per unit, what is the profit-maximizing output level?
b. How much profit will the firm earn when P = $100?
c. What is the firm's shutdown price?
d. What is the firm's break-even price? *Assume that TC is the same in the short run and long run.*

8. Describe the difference between a firm's "accounting profit" and their "economic profit". Would a firm be satisfied earning an economic profit of 0? Explain.

9. Consider a perfectly competitive industry with 200 identical firms. Each firm has short run production function: $q = 10L^{1/2}$. Each firm pays $4000 per unit for labor and has short run fixed costs of $1000.

a. What is the short run total cost function (TC, expressed as a function of q) for each firm in the industry?
b. What is the short run supply function for each firm in the industry (q as a function of P)?
c. What is the short run market supply function for the industry (Q^S as a function of P)

d. If the market demand curve is given by $Q^d = 5400 - 2P$, what will be the short run equilibrium price and quantity?
e. How much profit will each firm earn in the short run?

10. Under what conditions will a perfectly competitive market with identical firms be in long run equilibrium? What does this imply about the shape of the long run market supply curve for "constant cost industries"? Explain.

11. Consider a perfectly competitive, constant cost industry in which firms face the following cost curves in both the short run and long run:

- TVC = $q + q^2$
- TFC = 6

a. What is the marginal cost function for each firm in the industry (MC as a function of q)?
b. What is the supply function for each firm in the industry (q as a function of P)?
c. What is the "break-even price" for each firm in the industry?
d. Suppose that there are initially 80 firms in the industry and aggregate demand is given by $Q^d = 520 - 20P$. What are the short run equilibrium values of price (P) and aggregate quantity (Q)?
e. How much profit will each firm earn in the short run?
f. What are the long run equilibrium values of price (P) and quantity (Q)?
g. How many firms will be producing in the long run equilibrium?

12. Consider a perfectly competitive, constant-cost industry in which firms face the following long run cost functions:

- TFC = 50
- TVC = $2q^2$

a. What is the long run equilibrium price?
b. If the market demand curve is given by $Q^d = 1600 - 25P$, what will the aggregate quantity supplied (Q^S) be in the long run? How many firms will produce in this industry? *Assume all firms have the same cost curves.*
c. At that price, how much economic profit will each firm earn? How much producer surplus will each firm earn? How does the firm's producer surplus compare to its fixed costs?
d. What is aggregate consumer surplus in the long run equilibrium?
e. Suppose the government decides to help firms in this industry by paying a subsidy of $10 for each unit of output produced. All else equal, what will the new long run equilibrium seller's price be? What will the new long run, equilibrium buyer's price be? What will the aggregate quantity supplied (Q^S) be in the new long run equilibrium?
f. How does the subsidy affect sellers' welfare in the long run? Explain.
g. How does the subsidy affect buyers' welfare in the long run? Explain.
h. Are the benefits of the subsidy program justified by its cost? Explain.

13. Describe how each of the following shocks would affect price (P), aggregate sales volume (Q), and the output level of individual sellers (q) in a perfectly competitive, constant cost industry in *both* the short run and long run. Be sure to clearly indicate the predicted direction of change for each variable in both the short run and long run, and to illustrate your predictions with the appropriate diagrams.

a. A technological advance increases the marginal product of labor at each level of labor employment.
b. A recession decreases average buyer income. *Assume the good is a normal good*.
c. The government imposes a lump sum annual fee on all producers.

14. Consider a monopolist that faces market demand curve $P = 120 - 0.02Q^d$. The firm's total costs of production vary with output according to $TC = 60Q + 25,000$.

a. What is the firm's marginal revenue function (MR as a function of Q)?
b. What output level and price maximize profit for this firm? How much profit will the firm earn at that price and quantity?
c. Suppose the government levies an excise tax of $10 per unit on the firm's product. What will be the new profit-maximizing output level and price?
d. What is the firm's post-tax profit?

15. Consider a monopolist serving 2 geographically separated markets. Demand curves for the two markets are as follows:

- $P_1 = 15 - Q_1^d$
- $P_2 = 25 - 2Q_2^d$

and the firms total costs are given by $TC = 5 + 3(Q_1 + Q_2)$.

a. What is the marginal revenue function for each market?
b. If the firm is able to charge a different price in each market, what combination of prices will maximize its profit? How much profit will the firm make in that case?
c. What will aggregate consumer surplus be under the price discrimination scheme?
d. If the firm is forced to charge the same price in both markets, what price should it charge? How much profit would it earn in that case?
e. What would aggregate consumer surplus be under the common pricing scheme?
f. Which pricing scheme is more efficient? Explain.