UBC
Managerial Economics: Commerce/ FRE 295

October 25, 2012

NAME: _____, _____ (please print)
(Surname) **(Given Names)**

SIGNATURE: _____

STUDENT NUMBER _____

SECTION: _____

PROFESSOR'S NAME: _____

EXAM ROOM _____

Section 101	MW 10:00-11:30 J. Brander
Section 102	MW 11:30 – 1:00 J. Brander
Section 103	MW 1:00-2:30 M. Tappata
Section 104	MW 2:30-4:00 M. Tappata
Section 105	MW 4:00-5:30 S. Meyer
Section 106	TTh 11:00-12:30 J. Vercammen
Section 107	TTh 2:00-3:30 R. Shrestha

Maximum Score: 100
Time Available: 1 hour and 50 minutes (110 minutes).

Instructions:

There are two parts to this exam. The first part consists of 20 multiple-choice questions. and the second contains 5 longer questions. Please answer all multiple choice questions and **choose 4 out of 5 longer questions**. If you do all 5 questions the last question will not be marked. The longer questions are worth 60% of the exam so you should make sure you leave enough time to do these questions.

This is a closed-book exam. You may not use books, notes, or electronic devices such as smartphones except that you may use a non-graphing, non-programmable calculator.

You may use pen or pencil. Answers must go in the indicated places. For the multiple choice questions you must transfer your answers to the answer sheet, which is the next page in this exam.

For each longer question your answer must fit in the indicated space. However, if you wish to re-do a question, you may cross out your answer and provide the answer somewhere else on the exam, such as on the back of a page, but the total space used should be no more than allowed in the original question.

Please do not leave the exam room during the final 15 minutes of the exam, as that is disruptive to other students. If you have a question or want scrap paper just raise your hand.

PART I. MULTIPLE CHOICE ANSWERS (Use letters A, B, C, or D.) Put your answers here. Multiple choice answers placed elsewhere will not be marked.

1. _____
2. _____
3. _____
4. _____
5. _____
6. _____
7. _____
8. _____
9. _____
10. _____
11. _____
12. _____
13. _____
14. _____
15. _____
16. _____
17. _____
18. _____
19. _____
20. _____

Total Multiple Choice Marks: _____ / 40

PART II: Marks for Longer Questions: Put your answers in the indicated place on each page. Choose 4 questions out of 5.

Question 1. _____
Question 2. _____
Question 3. _____
Question 4. _____
Question 5. _____

Total Longer Question Marks: _____ / 60

Overall Mark: _____/ 100

PART I

MULTIPLE CHOICE QUESTIONS

Each question has one correct response. There are 20 questions. Each question is worth 2 pts. If you choose the correct answer you get 2 pts. Otherwise you get no points for that question. **Transfer your answers to the answer page (p. 2).**

1. Which of the following would most likely result in a shift to the right in the demand curve for bicycles?

A. A decrease in the price of gasoline.
B. An increase in the cost of a key input used for bicycle manufacturing.
C. A price increase for public transit.
D. A reduction in the number of bicycle lanes available.

2. Demand for blueberries is given by $Q^d = 800 - 500p$. The supply curve is $Q^s = 200 + 100p$. Which of the following statements is true?

A. The equilibrium price exceeds 1.
B. A price ceiling of 1.10 would cause excess demand.
C. The equilibrium quantity is 300.
D. All of the above.

3. Assume that we have a downward sloping linear demand curve.

A. The price elasticity of demand will be a constant equal to the slope of demand.
B. The price elasticity will vary along the line with the inelastic portion at higher prices.
C. Revenue will be maximized only if the demand curve is perfectly elastic.
D. None of the above.

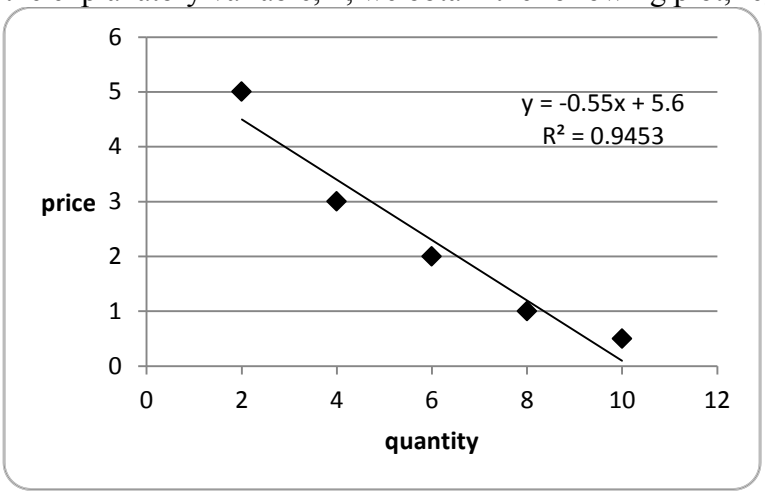
4. Suppose the demand for avocados in Vancouver is $Q = a + bp + e$, where e is a random error that is sometimes positive, sometimes negative, and sometimes zero. We estimate a linear regression equation and obtain estimates of a and b. It follows that

A. The R^2 could be equal to 1.
B. a and b must be positive integers
C. The R^2 must be less than 1 and cannot be negative.
D. Avocados must be a normal good.

5. We have the following price and quantity information from a local lemonade stand entered in a spreadsheet.

Quantity, x	Price, y
2	5
4	3
6	2
8	1
10	0.5

Using the trendline option in Excel and treating price as the dependent variable, y, and quantity as the explanatory variable, x, we obtain the following plot, regression line, and R^2.



From this regression which statement is true?

A. The estimated demand curve is $Q = 5.6 - 0.55p$ (rounded to 2 decimals)
B. If we write demand as $Q = a + bp$, our results indicate that $b < -1$.
C. The regression line suggests a perfect fit with the data.
D. None of the above.

6. Erin lives in Quebec City and loves to eat dessert. She spends her entire allowance on yoghurt and pudding. The price of a cup of yoghurt is $4 whereas the price of a cup of pudding is $ 8. At the current level of consumption, her marginal utility from yoghurt is 20 and that from pudding is 32. She has standard indifference curves (bowed in towards the origin) and wants to maximize utility.

A. She can increase her utility by consuming more yoghurt.
B. She can increase her utility by consuming more pudding.
C. The last dollar spent on yoghurt provides her with more utility than the last dollar spent on pudding.
D. Both A and C.

7. You have already spent $500 registering your car with ICBC. If you spend an additional $2,000 on repairs, you can drive it to school for the year. Alternatively, your friend offers to rent it from you for $3,000 and also offers to reimburse 1/2 of your registration fee (that is $250) for the year without requiring you to do any repairs. What is your annual opportunity cost of using the car to drive to school?

A. $ 5,250.
B. $ 3,500.
C. $ 5,500.
D. $ 5,000.

8. Suppose a firm has a production function given by $q = 5LK$, where L and K represent labor and capital units respectively. The wage rate is w and rental rate of capital is r. These factor prices are constant. For this production function:

A. The marginal product of labour is diminishing.
B. Average cost declines as the firm produces more.
C. The marginal product of K and L are both equal to 5.
D. L and K are perfect substitutes.

9. Assume that it costs a firm $8,000 to produce 50 units of output, Q. The variable cost of production is given by $2Q^2$.

A. The firm's fixed cost of production is $5,000.
B. The firm enjoys economies of scale in production for all levels of Q.
C. The cost of producing 60 units is $10,200.
D. Both A and C.

10. Which of the following statements is true?

A. Limited liability companies cannot borrow more than a legally specified cap or upper limit.
B. Government-owned enterprises are required to maximize profits.
C. Corporations must be publicly traded companies.
D. None of the above

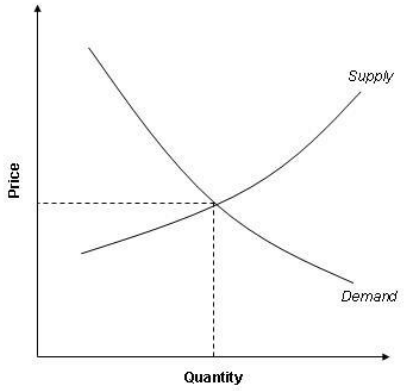
11. The owner of Code Monkey Inc., a software company, asks the management team to select the profit-maximizing price for its unique product. The (inverse) demand curve for this product is given by $p = 100 - Q$. The cost function is $C(Q)=1500$. The financial compensation for each member of the team is a constant fraction of sales revenue.

A. Incentives are aligned: managers have an incentive to choose a price that maximizes profits.
B. Incentives are misaligned: managers have an incentive to choose a price that is too low.
C. Incentives are misaligned: managers have an incentive to choose a price that is too high.
D. Managers will choose a price that maximizes revenues but will not maximize profits.

12. Assume that the market for hard drives is perfectly competitive, that all firms are identical and that each has long run cost function $C(q) = 48 + 3q^2$ where q is measured in thousands of units per year. The long run equilibrium price is:

A. Below $22
B. $24
C. Above $30
D. Impossible to determine without more information.

13. The market for avocados is perfectly competitive and is shown in the following diagram. The government sets a subsidy of *s* per lb., lowering MC (and hence the supply curve) by amount *s*.



A. Consumer and producer surplus increase.
B. Consumer surplus increases; producer surplus decreases.
C. Consumer surplus decreases; producer surplus increases.
D. None of the above.

14. An important rule of profit-maximizing uniform monopoly pricing is to never choose an output level where demand for the product is inelastic. This rule makes sense because when demand is inelastic:

A. Profits for the monopolist are always negative.
B. Marginal revenue is always negative.
C. Revenue and cost would both be higher if sales were reduced to where demand is elastic.
D. Sales must be increased to ensure that marginal revenue is equal to marginal cost.

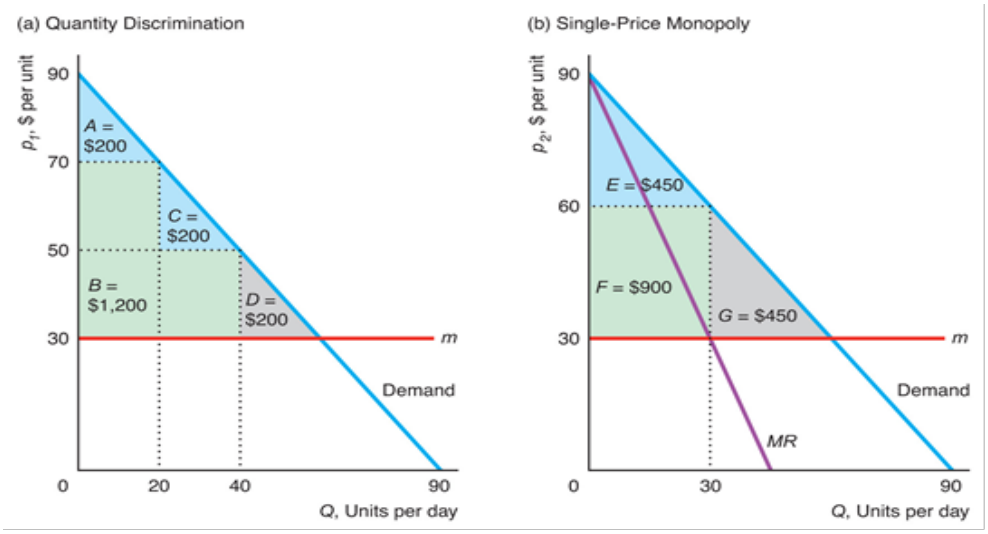
15. Suppose all firms in market A are perfectly competitive, which implies that all firms produce where price is equal to their marginal cost. Suppose market B has a single monopolist that produces where marginal revenue is equal to marginal cost.

A. Price is equal to marginal revenue in both markets.
B. Market B has greater deadweight loss than market A.
C. Deadweight loss will decrease in market A if the demand curve shifts up.
D. None of the above.

16. Consider a profit-maximizing monopoly fitness centre in a small town. The firm uses two part pricing. Customers pay a monthly membership fee and also pay $\$p$ per hour when they use the club. Assume all customers are identical. Which of the following statements is true?

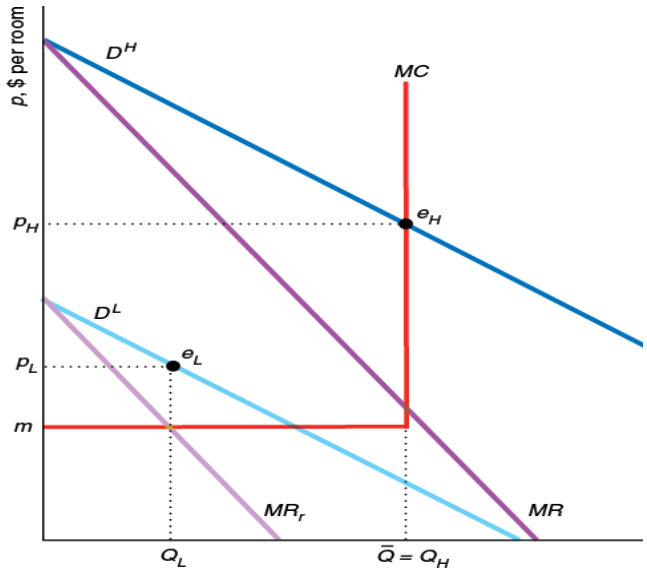
A. Because the fitness centre has market power it will charge a per hour fee, p, that exceeds marginal cost.
B. The fitness centre should charge different membership fees to different customers.
C. Both A and B.
D. None of the above.

17. A consumer has a demand curve given by $p = 90 - Q$. In the following diagram, panel (a) shows the consequences of quantity-based price discrimination if the firm charges \$70 each for the first 20 units and \$50 each for any additional units. Panel (b) illustrates profit-maximizing uniform monopoly pricing. The red line shows marginal cost. Identify the correct statement from the alternatives below.



A. The average price paid under quantity-based price discrimination is the same as under uniform monopoly pricing.
B. Revenue under quantity-based price discrimination exceeds revenue under uniform monopoly pricing by more 600.
C. Profits are higher with uniform monopoly pricing than with quantity-based price discrimination.
D. None of the above.

18. Consider a hotel that has high demand in the summer and low demand in the winter. The hotel's profit maximizing peak load pricing strategy is illustrated as follows.



Which statement is true?

A. Price is higher in winter than in summer.
B. Marginal revenue is higher in summer than in winter.
C. Capacity is reached in both periods.
D. None of the above.

19. Suppose two Cournot duopoly firms produce a homogenous product (such as steel) with constant marginal costs: m_1 for firm 1 and m_2 for firm 2, where $m_1 < m_2$. The two firms then switch from the Nash-Cournot equilibrium to form a cartel that maximizes joint profits. (The firms divide up the resulting profits equally.)

A. The cartel's production will come from firm 1 only.
B. The total quantity sold in the market will increase.
C. Deadweight loss in the market will decrease.
D. None of the above.

20. Consider a Cournot duopoly model with linear demand and constant marginal cost. A firm's best response curve:

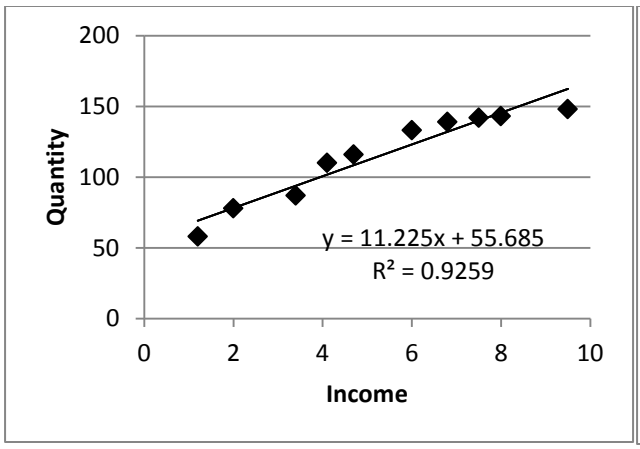
A. Shows the cost minimizing level of production for that firm.
B. Is flat if the two firms in the duopoly have the same level of marginal cost.
C. Shifts toward the origin if that firm's marginal cost decreases.
D. Indicates that the firm will produce less if its competitor chooses to produce more.

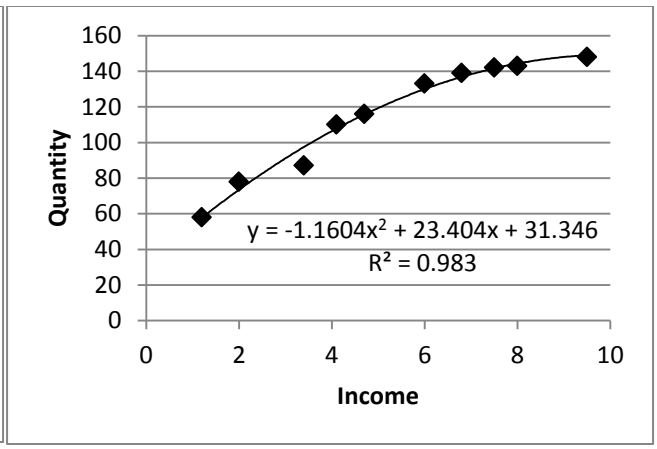
Part II

LONGER QUESTIONS

Choose 4 questions out of 5. If you do all 5 questions the last question will not be marked. Show your working and provide (brief) explanations where appropriate. Confine your answers to the space provided in the question. You may cross out an answer and do the entire answer somewhere else if necessary but the total space used cannot exceed the original space provided.

1. **Regression and Elasticity**. A supermarket chain used data from focus groups to estimate the effect of income on demand for gourmet ice cream in Vancouver. The following two diagrams show two regressions that were used by the market research team to assess the relationship between income and demand.





a. What are the main points illustrated by these two regression diagrams? List three points and explain them briefly. (Hint: What do these diagrams tells us about the relationship between income and quantity and what do you learn by comparing the two diagrams?) (7 pts)

b. You are asked to provide your **best** estimate of the point income elasticity of demand at an income level of 10. What is your answer? (Hint: Recall that any point elasticity can be calculated using the form (dy/dx) (x/y). In this case y is quantity and x is income.) Also explain briefly in words how you would calculate the arc income elasticity of demand for an increase in income from x_1 to x_2. Provide a formula if you can. (8 pts).

2. Cost Minimization

A bicycle parts company has production function $Q = L\,K^2$ where K = machine units and L = labor hours. The wage rate, w, is \$15 per hour, and the rental rate on machines, r, is \$60 per unit.
a) At the current level of output, the marginal product of machines is 300 and the marginal product of labor is 200. Draw an appropriate diagram and explain how the firm should change the ratio of the two inputs to lower its cost of producing the current level of output. (7 pts)

b) Determine how much L and K the firm would need to use to minimize the cost of producing 2000 units. What is this cost? (8 pts)

3. Perfect Competition.

a) The long run equilibrium price in a perfectly competitive market is \$100 and the total quantity traded is Q=5000. Each firm in the market has a cost of production given by $C(q) = 500 + 5q^2$. Derive a firm's average cost curve and marginal cost curve and illustrate these curves in an appropriate diagram. Assuming the industry is in long run equilibrium, calculate and show the quantity produced by each firm. How many firms are in the market? (8 pts).

b) In a perfectly competitive market, the market demand curve is $Q = 6000 - 10p$ and the supply curve is perfectly elastic at a price of 100. Illustrate the solution in a supply-demand diagram. Determine total consumer surplus and producer surplus in this market and explain why total surplus falls if output is restricted to Q=3000. (7 pts)

4. **Pricing**

a. A local theatre has found that students have a different demand curve from everybody else. Student inverse demand has been estimated to be $p_s = 20 - 0.1Q_s$. The inverse demand curve for all other consumers is $p_e = 50 - 0.25Q_e$. The movie theatre's cost function is $C(Q)=200 + 5Q$ where $Q = Q_s + Q_e$. Find the profit-maximizing price to charge each group. (No diagram is needed.) Briefly explain what the resale problem is and how it can be avoided in this case. (8 pts).

b. Joey's snack shack is trying to come up with a strategy to price its customer's favorite snacks (crackers and cheese). The table below shows the willingness to pay of the four different types of consumers that buy snacks at Joey's. Assume costs are zero.

Consumer type	Crackers	Cheese
A	3	1
B	3	2.50
C	2.50	3
D	1	3

Determine Joey's maximum profit if he prices crackers and cheese individually, if he uses pure bundling, and if he uses mixed bundling. Which approach yields the highest profit. Show your working. (7 pts)

5. Cournot Oligopoly. Consider a market with linear demand and two identical Cournot duopoly firms (A and B). The firms produce a homogenous commodity with a constant marginal cost of 10. Market demand is given by inverse demand function $P = 110 – Q$ where P is the market price and Q is total production by the two firms (i.e., $Q = q_A + q_B$).

a. Derive the Cournot best response curves for the two firms. Calculate the Nash-Cournot equilibrium price and quantity. (No diagram is needed.) (8 pts)

b. Find the profit-maximizing price and quantity if the two firms operate as a cartel. How would formation of a cartel affect consumer surplus? Illustrate this effect using a diagram containing a demand curve and the relevant prices and quantities under the two situations: Cournot duopoly and a profit-maximizing cartel. Show the difference in consumer surplus on the diagram. (7 pts).

Continue with answer to 5b here if necessary:

Extra space for rough work: Material from here on will not be marked.

Managerial Economics Midterm Answers 2012

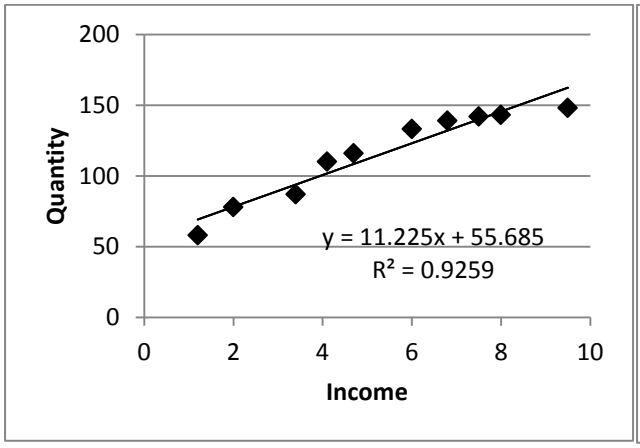
PART I. MULTIPLE CHOICE ANSWERS (Use letters A, B, C, or D.) Put your answers here. Multiple choice answers placed elsewhere will not be marked.

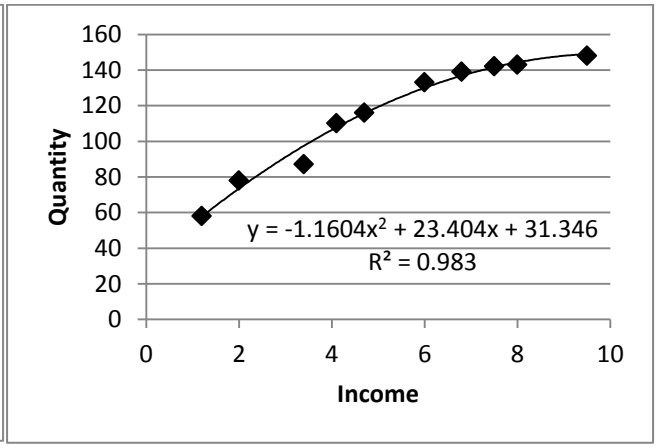
1. C	**11. A**
2. C	**12. B**
3. D	**13. A**
4. C	**14. B**
5. B	**15. B**
6. D	**16. D**
7. A	**17. A**
8. B	**18. B**
9. C	**19. A**
10. D	**20. D**

Total Multiple Choice Marks: _____ / 40

Part II: LONGER QUESTIONS (Choose 4 out of 5, 15 marks each).

1. **Regression and Elasticity**. A supermarket chain used data from focus groups to estimate the effect of income on demand for gourmet ice cream in Vancouver. The following two diagrams show two regressions that were used by the market research team to assess the relationship between income and demand.





a. What are the main points illustrated by these two regression diagrams? List three points and explain them briefly. (Hint: What do these diagrams tell us about the relationship between income and quantity and what do you learn by comparing the two diagrams?) (7 pts)

*Point 1: (relationship between income and quantity). **Both** graphs show that quantity demanded is **increasing** in income. Gourmet ice cream is therefore a **normal good** (3 pts).*

*Point 2: (comparison). The **quadratic regression** (shown on the right) fits the data better. We can see this from the larger R^2 for this regression (2 pts).*

Other: 2 pts. There are many things that could be said. For example, you might point out that the effect of income in increasing income diminishing as income rises if we accept the quadratic regression as accurate.

b. You are asked to provide your **best** estimate of the point income elasticity of demand at an income level of 10. What is your answer? (Hint: Recall that any point elasticity can be calculated using the form (dy/dx) (x/y). In this case y is quantity and x is income.) Also explain briefly in words how you would calculate the arc income elasticity of demand for an increase in income from x_1 to x_2. Provide a formula if you can. (8 pts).

We should use the quadratic version because it appears to be the better regression.

The elasticity is dy/dx (x/y), so we must find dy/dx and y.

dy/dx = 2(-1.1604)x + 23.404

At x = 10, we find that dy/dx = .196

We need to find y: y = -116.04 + 234.04 + 31.346 = 149.346

Putting all this together: elasticity = (.196)10/149.346 = 0.013 (1 pt)

To calculate an arc elasticity for a change from x1 to x2 we need to find the corresponding values of y1 and y2 and determine the percentage change in quantity (y) and the percentage change in income (x). We divide the percentage change in quantity by the percentage change in income.

arc elasticity = ((y2 – y1)/y)/(x2 – x1)/x*) where y* = (y1 + y2)/2 and x* = (x1 +x2)/2.*

2. Cost Minimization

A bicycle parts company has production function $Q = L\,K^2$ where K = machine units and L = labor hours. The wage rate, w, is \$15 per hour, and the rental rate on machines, r, is \$60 per unit.
a) At the current level of output, the marginal product of machines is 300 and the marginal product of labor is 200. Draw an appropriate diagram and explain how the firm should change the ratio of the two inputs to lower its cost of producing the current level of output. (7 pts)

$MP_L = K^2 = 200$
$MP_K = 2KL = 300$

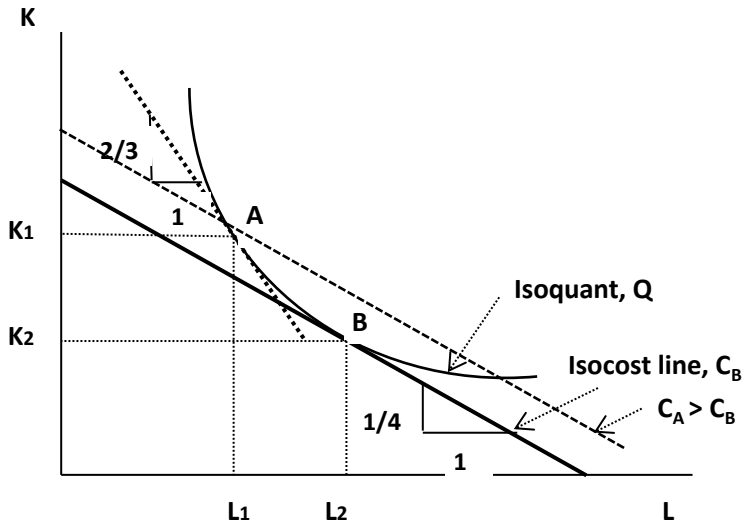
Method 1:
Assume K is on the vertical axis. The slope of budget line w/r = 15/60 =1/4
At the current production level (point A in the graph below), slope of isoquant, MP_L/MP_K = 200/300 = 2/3

Since at A, $MP_L/MP_K > w/r$ (i.e., one dollar spent on L produces more than a dollar spent on K), the company should hire more L and less K (i.e., move towards B) to lower the cost of producing the given output Q.

(This could be done with L on the vertical axis.)

or Method 2: *At present $MP_L/w = 200/15 = 13.33$; $MP_K = 300/60 = 5$*

As the marginal product per dollar is higher for labour than for capital the firm can lower costs by using more labour and less capital – reducing the capital to labour ratio.



b) Determine how much *L* and *K* the firm would need to use to minimize the cost of producing 2000 units. What is this cost? (8 pts)

For cost minimization: $MP_L/w = MP_K/r$
$K^2/15 = 2LK/60$
$L = 2K$
Substitute this value into production function, $Q = L K^2 = 2000$
$2K^3 = 2000$
$K = 10$ and $L = 20$

*Min Cost of producing 2000 units = $wL + r K = 15*20 + 60*10 = \$900$*

3. Perfect Competition.

a) The long run equilibrium price in a perfectly competitive market is \$100 and the total quantity traded is Q=5000. Each firm in the market has a cost of production given by $C(q) = 500 + 5q^2$. Derive a firm's average cost curve and marginal cost curve and illustrate these curves in an appropriate diagram. Assuming the industry is in long run equilibrium, calculate and show the quantity produced by each firm. How many firms are in the market? (8 pts).

$AC = C/q = 500/q + 5q$ (1 pt)
$MC = dC/dq = 10q$ (1 pt)

To get quantity there are 3 methods that could be used: Any method is worth 3 pts if properly shown and explained.

Set p = MC so 100 = 10q so q = 10
Or, could minimize AC to get dAC/dq = - 500/q^2 + 5 so q = 10
Or, could set MC = AC to get 10q = 500/q + 5q so q = 10

In diagram: AC must be U-shaped (1 pt), MC must be straight, start at the origin and cut AC at its min (1 pt)

The market has 5000/10 = 500 firms. (1 pt)

b) In a perfectly competitive market, the market demand curve is $Q = 6000 - 10p$ and the supply curve is perfectly elastic at a price of 100. Illustrate the solution in a supply-demand diagram. Determine total consumer surplus and producer surplus in this market and explain why total surplus falls if output is restricted to Q=3000. (7 pts)

Solution: Q = 6000 – 10(100) = 5000. (1 pt)
Draw demand curve: p = 600 – 0.1Q
CS = ½(600 – 100)5000 = 1,250,000. (1 pt); PS = 0 (1 pt)
If output is restricted CS falls as shown in diagram because at Q = 3000 marginal willingness to pay as shown by the demand curve exceed marginal cost as shown by the supply curve and there is deadweight loss. (2 pts)

A correctly drawn diagram is worth 2 points. It should show the demand curve, the horizontal supply curve and the consumer surplus.

4. **Pricing**
a. A local theatre has found that students have a different demand curve from everybody else. Student inverse demand has been estimated to be $p_s = 20 - 0.1Q_s$. The inverse demand curve for all other consumers is $p_e = 50 - 0.25Q_e$. The movie theatre's cost function is $C(Q)=200 + 5Q$ where $Q = Q_s + Q_e$. Find the profit-maximizing price to charge each group. (No diagram is needed.) Briefly explain what the resale problem is and how it can be avoided in this case. (8 pts).

MC=5
$MR_S=20-0.2Q_S$
$MR_E=50-0.5Q_E$
$MR_S=MR_E=MC$
$20-0.2Q_S=5$
$Q_S=75$
$P_S=\$12.50$
$50-0.5Q_E=5$
$Q_E=90$
$P_E=\$27.50$
Resale problem(1 pt) : If students can buy tickets for \$12.50 they would be able to resell them to everyone else for some amount greater than \$12.50 but not more than \$27.50. 1 mark for students buying and reselling higher to everyone else
This can be avoided by asking for ID when entering the theatre to ensure the ticket holder is a student. (1 pt).

b. Joey's snack shack is trying to come up with a strategy to price its customer's favorite snacks (crackers and cheese). The table below shows the willingness to pay of the four different types of consumers that buy snacks at Joey's. Assume costs are zero.

Consumer type	Crackers	Cheese
A	3	1
B	3	2.50
C	2.50	3
D	1	3

Determine Joey's maximum profit if he prices crackers and cheese individually, if he uses pure bundling, and if he uses mixed bundling. Which approach yields the highest profit. Show your working. (7 pts)

Individual pricing: profit max at $P_{crackers}$=\$2.50 and P_{cheese}=2.50
*Π =3*2.50+3*2.50=\$15*

Pure bundling: profit max at P_{bundle}=\$4
*Π=4*4=\$16*

Mixed bundling: profit max at P_{bundle}=\$5.50 and $P_{crackers}$=\$3 and P_{cheese}=\$3
*Π=2*5.50+1*3.00+1*3.00=\$17*

Therefore mixed bundling would yield the highest profit

5. Cournot Oligopoly. Consider a market with linear demand and two identical Cournot duopoly firms (A and B). The firms produce a homogenous commodity with a constant marginal cost of 10. Market demand is given by inverse demand function P = 110 – Q where P is the market price and Q is total production by the two firms (i.e., $Q = q_A + q_B$).

a. Derive the Cournot best response curves for the two firms. Calculate the Nash-Cournot equilibrium price and quantity. (No diagram is needed.) (8 pts)

Recognize that industry price can be expressed as $P = 110 – q_A - q_B$. The profit function for firm A is given by $\pi_A = q_A(110 – q_A – q_B) – 10q_A$. Firm A chooses q_A to maximizing π_A while treating q_B as fixed (this is a requirement of a Nash equilibrium). Take the derivative and set the resulting expression equal to zero to maximize π_A. This gives

$$d\pi_A/dq_A = 110 – 2q_A – q_B – 10 = 0$$

Now solve this equation for q_A to get $q_A = 50 – 0.5q_B$. This is the best response curve for firm A.

Alternatively, students can determine revenue $R_A = q_A(110 – q_A – q_B)$ and get $MR_A = dR_A/dq_A$ and set this marginal revenue equal to marginal cost to obtain $110 – 2q_A – q_B – 10 = 0$. The best response curve is therefore $q_A = 50 – 0.5q_B$.

The best-response curve for firm B will be analogous because the two firms have the same cost. Thus, we have $q_B = 50 – 0.5q_A$.

To solve for the Nash-Cournot equilibrium quantities, substitute $q_B = 50 – 0.5q_A$ into $q_A = 50 – 0.5q_B$ to obtain:

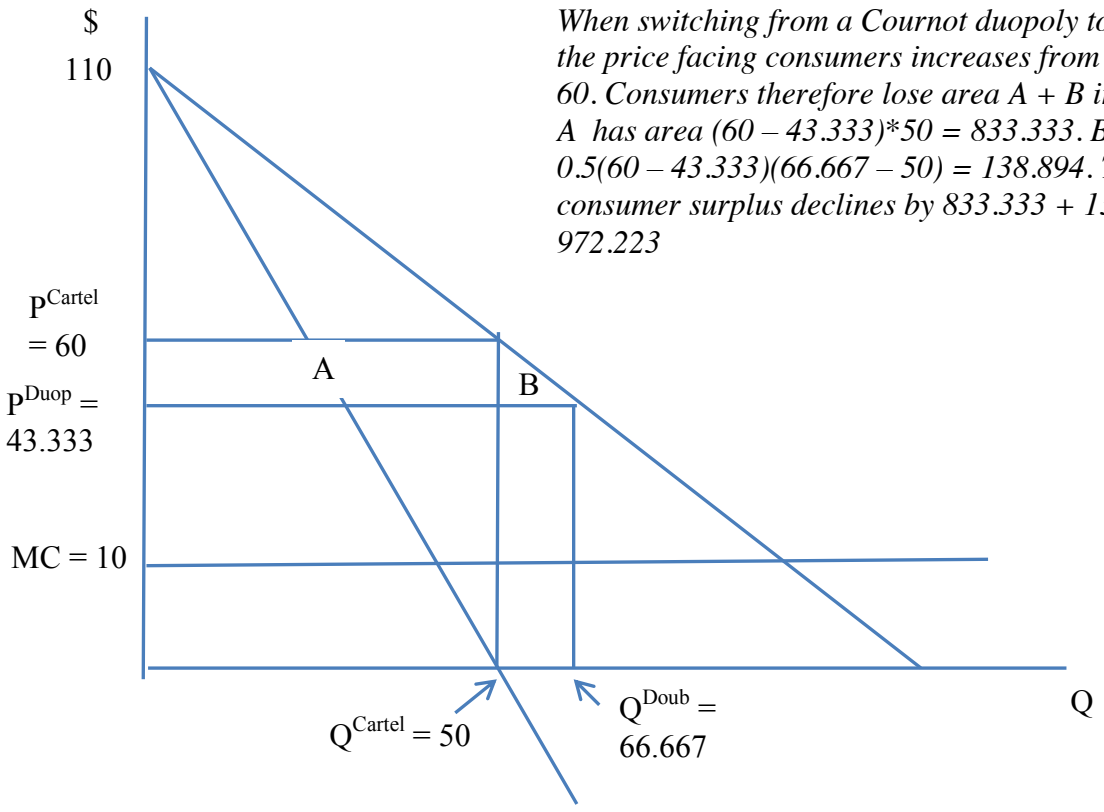
$q_A = 50 - 0.5(50 - 0.5q_A)$

Solve this equation to obtain $q_A^* = 100/3$. Substitute this expression into $q_B = 50 - 0.5q_A$ to obtain $q_B^* = 100/3$. Expressed in decimal format we have $q_A^* = q_B^* = 33.333$. The total production for both firms is 33.333 + 33.333 = 66.666

To solve for the Nash-Cournot equilibrium price, substitute $q_A^* = 100/3$ and $q_B^* = 100/3$ into $P = 100 - q_A - q_B$ to obtain $P^* = 110 - 100/3 - 100/3$. This reduces to $P^* = 130/3$. In decimal format this is $P^* = 43.333$.

b. Find the profit-maximizing price and quantity if the two firms operate as a cartel. How would formation of a cartel affect consumer surplus? Illustrate this effect using a diagram containing a demand curve and the relevant prices and quantities under the two situations: Cournot duopoly and a profit-maximizing cartel. Show the difference in consumer surplus on the diagram. (7 pts).

If the two firms operated as a cartel the marginal cost of production is equal to 10 (production can take place in either firm A or firm B). The cartel maximizes profits by choosing Q where marginal revenue (MR) is equal to marginal cost (MC). Industry demand is $P = 110 - Q$, so $MR = 110 - 2Q$. Profit maximization requires $110 - 2Q = 10$. The solution to this equation is $Q^* = 50$. Using inverse industry demand, the optimal price is $P^* = 110 - 50 = 60$.



*When switching from a Cournot duopoly to a cartel the price facing consumers increases from 43.333 to 60. Consumers therefore lose area A + B in surplus. A has area (60 – 43.333)*50 = 833.333. B has area 0.5(60 – 43.333)(66.667 – 50) = 138.894. Thus, consumer surplus declines by 833.333 + 138.894 = 972.223*