HOMEWORK ASSIGNMENT FOR CHAPTER 1

1) The figure below gives the graph of the curve $Y=\frac{6}{X}$ and the graph of a linear function.

![Graph of $Y=\frac{6}{X}$ and a linear function]

a) Find the equation of the linear line.
b) Compute the slope of the curve $Y=\frac{6}{X}$ at point A, and compare it (in magnitude) with the slope of the linear line that passes through A.
c) Compute the slope of the curve $Y=\frac{6}{X}$ at point B, and compare it (in magnitude) with the slope of the linear line that passes through B.

2) Write down the equations of the lines drawn in the below figure.

![Graph with lines I, II, and III]
3) (a) Draw the contour lines for \( Y = 10 \) and \( Y = 20 \) for the following function:

\[ Y = (\sqrt{X_1})X_2 \]

(b) Calculate the slope of both curves at \( X_1 = 4 \)

4) The values that \( U \) takes depends on the values that are taken by \( C \) and \( P \).

Specifically, \( U(C, P) = C \times P^2 \).

(a) Draw the contour curve for \( U = 128 \).

(b) Calculate the slope of the function you drew at point \( A=(2C, 8P) \).

5) The values the variable \( Y \) takes depends on the values that are taken by \( X_1 \), \( X_2 \) and \( X_3 \).

\[ Y = 5000 + 250X_1 - 2X_2 + 10X_3 \]

(a) Are \( Y \) and \( X_1 \) positively or negatively related? Explain.

Are \( Y \) and \( X_2 \) positively or negatively related? Explain.

Are \( Y \) and \( X_3 \) positively or negatively related? Explain.

(b) Fill in the blanks:

Everything else being constant, one unit increase in the value of \( X_1 \) would cause \( Y \) to ___________ by ____________ units.

Everything else being constant, one unit decrease in the value of \( X_2 \) would cause \( Y \) to ___________ by ____________ units.

Everything else being constant, one unit increase in the value of \( X_3 \) would cause \( Y \) to ___________ by ____________ units.
HOMEWORK ASSIGNMENT FOR CHAPTER 2

1) Suppose you will estimate the demand (\(Q_M^d\)) for Muffins in Delaware. For this task you decided to include as your independent variables: the price of muffins (\(P_M\)), the average income of consumers (\(I\)), price of donuts (\(P_D\)) a substitute good, and price of coffee (\(P_C\)), a complement good. Thus, you will regress \(Q_M^d\) on the following four variables: \(P_M\), \(I\), \(P_D\) and \(P_C\). You are expecting muffin to be a normal good.

a) Write down an example of a demand function for muffins which includes the variables listed above. (The values of the coefficients are not important but the signs are! So if you like you can use letters such as \((a_1, a_2, a_3, a_4)\) instead of numbers for the coefficients of the independent variables, you must decide just on the correct signs for the coefficients.

b) In reality if consumers in Delaware regard muffins as inferior goods, then how would you change your answer to part (a)?

2) The demand for good X is given by \(Q_X^d = 1,245 - 0.5P_X + 0.25P_Y - 8P_Z + 0.1I\)
Research shows that the prices of the related goods are given by \(P_Y = $5,900\) and \(P_Z = $90\), while the average income of individuals consuming this product is \(I = $55,000\).

a) Indicate whether goods Y and Z are substitutes or complements for good X. Explain.
b) Is X an inferior or a normal good. Explain.
c) Determine the demand equation. How many units of good X will be purchased when \(P_X = $6,000\)?
d) Find the inverse demand equation for good X and graph the demand curve for good X.

3) The market demand and supply functions for dry cleaning services are given by the following equations.
\(Q_D = 500 - 100P\)
\(Q_S = 25P\)
where P is the price of a shirt dry cleaned in Delaware and Q is the number of shirts demanded and supplied.

a) Find the equilibrium price and quantity in the dry cleaning market
b) Due to a newly invented detergent spray which cleans as good as dry cleaning, demand for dry cleaning services declined by 25%. Find the new equilibrium price and quantity in the dry cleaning market.
4) The market demand and supply functions for beer by the pack are given by the following equations.

\[ Q_D = 750 - 50P + 0.25I \]
\[ Q_S = 900 + 50P - 400P^W \]

where \( P \) is the price of a pack of beer, \( I \) is the average income of a consumer in Delaware and \( P^W \) is the price of wheat (major input in beer production).

(a) Suppose the average income of a consumer is $1,000 and the price of wheat is $1 per pound.

Graph the Supply and Demand curves.
Calculate the equilibrium price and equilibrium quantity of beer.

(b) Suppose due to a drought the price of wheat increases from $1 to $1.25.

Write down the new supply equation for beer.
Calculate the effect of change in wheat prices on the equilibrium price and quantity of beer.
Sketch the new supply curve on the graph you produced for part (a).

5) For each of the 5 markets given in the below table:

Draw the initial market equilibrium and clearly mark the price and quantity.

Determine the effect of the events on the corresponding market by identifying the shift in the relevant curves.

Find the new equilibrium price and quantity and report the change in them.
(i.e. Final Price: higher or lower? Final Quantity: higher or lower?)

<table>
<thead>
<tr>
<th>MARKET</th>
<th>EVENT</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Internet capable cell phones</td>
<td>Technological advances reduce the cost of producing 3G chipsets used in cell phones</td>
</tr>
<tr>
<td>2. iPods</td>
<td>The price of downloadable songs on iTunes decreases</td>
</tr>
<tr>
<td>3. Skateboards</td>
<td>Public lost their interest in skateboards due to the recent popularity of WayBoards</td>
</tr>
<tr>
<td>4. McDonalds Food</td>
<td>New taxes reduced the net income of the households. (Assume that McDonalds food is an inferior good)</td>
</tr>
<tr>
<td>5. Linkin Park Concert Tickets</td>
<td>Tax cuts increase the net income of the households. (Assume that Linkin Park concert ticket is a normal good)</td>
</tr>
</tbody>
</table>
6) For the following pairs of goods, would you expect the cross price elasticity of demand to be positive, negative or zero? Briefly explain your answers.

a) Red umbrellas and black umbrellas  
b) Coca cola and Pepsi  
c) Grape jelly and peanut butter  
d) Chocolate chip cookies and milk  
e) Computers and software  
f) Socks and alarm clocks

7) Assume that the price elasticity of demand for cigarettes at the current market price is \( -0.5 \). The current equilibrium price for a pack of cigarettes is \( P^* = $4.00 \) and equilibrium quantity \( Q^* = 2 \) million packs.

(a) Fit a linear demand curve to the given data.  
(b) Find the inverse demand equation and graph the demand curve.  
(c) Calculate price elasticity of demand at \( P = $8 \) per pack.

8) Assume that the price elasticity of copper demand is \( -0.4 \) at the equilibrium price \( P^* = $0.75 \) and equilibrium quantity \( Q^* = 7.5 \) million tons. The world supply of copper is estimated as: 
\[
Q_s = -4.5 + 16P 
\]

(a) Fit a linear demand curve to the given data and verify the equilibrium price and equilibrium quantity.  
(b) Using the demand curve you derived in part (a), calculate the effect of a 20\% decline in copper demand on the price of copper.

9) The demand for good X is given by 
\[
Q_d^X = 1.245 - 0.5P_X + 0.25P_Y - 8P_Z + 0.1I 
\]
Good X sells for $6,000 (\( P_X = $6,000 \)). Research shows that the prices of the related goods are given by \( P_Y = $5,900 \) and \( P_Z = $90 \), while the average income of individuals consuming this product is \( I = $55,000 \).  

a) Calculate the price elasticity of demand for good X at the current price of X.  
b) Calculate the cross price elasticity of demand for good X, with respect to price of good Y.  
c) Calculate the income elasticity of demand for good X.

10) Suppose you are the marketing manager of an amusement park and you are told to come up with strategies that would increase the profits of the park. You decided to modify the entrance fees charged in an effort to raise profits. For this you have estimated the price elasticity of demand for the amusement park and found that to be \( -0.8 \).  

a) Would you lower or raise your entrance fees? How would your revenue change as a result? Explain.  
b) What is the impact of your chosen strategy in part (a) on your profit? Explain.
11) Suppose the Theater and Dance Department at OWU is considering changing the way they price tickets for their productions. Having taken research methods and intermediate microeconomics you were hired as an economic consultant and were asked to estimate the demand for tickets. As the consultant you have classified people who go to the productions of theatre and dance department into two groups and have come up with two demand functions. The demand equation for the general public ($Q_g$) and students ($Q_s$) are given below:

\[ Q_g = 500 - 5P \]
\[ Q_s = 200 - 4P \]

a) Graph the two demand equations on one graph. If the current price of tickets is $35, identify the quantity demanded by each group.
b) Find the price elasticity of demand for each group at the current price and quantity.
c) Is the theater department maximizing the revenue it collects from ticket sales by charging $35 for each ticket? Explain.
d) (Bonus) What price should he charge each group if he wants to maximize the revenue it collects from ticket sales?
HOMEWORK ASSIGNMENT FOR CHAPTER 3

1) Assume that the demand for cotton in U.S. is given by \( Q^d = 70 - 0.5P \) and the supply of cotton is given by \( Q^s = -20 + P \). Initially the market is in equilibrium, thus the price of cotton is determined through demand and supply.

a) Draw the demand and supply curves for cotton and find the consumer surplus and producer surplus.

b) Suppose the government introduces a price support program to increase the price received by cotton producers to $80. The program details are as follows:

- The cotton producers can produce any amount they wish given the fact that they are going to receive $80 per unit. (No quota)
- Consumers will buy as much cotton as they want at a price of $80.
- Government will buy out the excess supply of cotton from producers and burn it.

i) Calculate the change in Consumer Surplus after the price support
ii) Calculate the change in Producer Surplus after the price support
iii) Calculate the change in Total Welfare (Don’t forget about the Government expenses)
In the above figure the market demand and supply for milk is given. The market is initially in free market equilibrium.

Suppose the government introduces a price support program to increase the price received by milk producers to $40. The program details are as follows:

- The milk producers can produce any amount they wish given the fact that they are going to receive $40 per unit. (No production quota)
- Milk producers will sell all their output to consumers at a price $P_C$ dictated by market demand.
- Government will pay the milk producers $(40 - P_C)$ for each unit they sell.

i) Calculate the change in Consumer Surplus

ii) Calculate the change in Producer Surplus

iii) Calculate the change in Total Welfare (Don’t forget about the Government expenses)
3) The demand and supply for doughnuts in Delaware is given in the figure below.
(a) Calculate the consumer surplus, producer surplus and total surplus generated in this market.
(b) Suppose City of Delaware imposed a maximum price ceiling of $2 on the price of doughnuts. Calculate the consumer surplus, producer surplus and total surplus after the maximum price law.
(c) Compare your answers for (a) and (b). Who is better off? Who is worse off?

4) Laptoplane is a company which offers internet access at airports to customers who are travelling. The company estimated the average consumer’s demand for internet access and it is given in the figure below.
a) Calculate the total value an average consumer places on 10 minutes of total internet access?
b) Suppose Laptoplane charges $0.60 per minute for internet access. Calculate the consumer surplus.
HOMEWORK ASSIGNMENT FOR CHAPTER 4:

1. Consider the indifference curve $U_1$ in the graph given below. Prove that the bundle $A$ (a bundle on the indifference curve) is preferred to the bundle $B$ (a bundle below the indifference curve) using the 3 assumptions about consumer preferences (Completeness, Non-satiation = "More is Better" and Transitivity).

2. The following table gives points on two different indifference curves ($U_1$ and $U_2$) for George's preferences over apples and oranges:

<table>
<thead>
<tr>
<th>Indifference Curve $U_1$</th>
<th>Indifference Curve $U_2$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Quantity of Apples ($Q_{apples}$)</td>
<td>Quantity of Oranges ($Q_{oranges}$)</td>
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<tr>
<td>2</td>
<td>13</td>
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<tr>
<td>7</td>
<td>2.7</td>
</tr>
</tbody>
</table>

(a) Draw both Indifference Curves on the same graph with $Q_{apples}$ on the X-axis and $Q_{oranges}$ on the Y-axis. 
Using your graph, answer the questions in part-(b).

(b) Which of the following does George prefer in each case?
- Bundle $A = (3$ Apples, 6 Oranges) or Bundle $B = (6$ Apples, 3 Oranges)?
- Bundle $C = (2$ Apples, 13 Oranges) or Bundle $D = (8$ Apples, 6 Oranges)?
- Bundle $E = (1$ Apples, 10 Oranges) or Bundle $D = (8$ Apples, 6 Oranges)?
3. Patrick’s preferences for albums by Coldplay (C) and Led Zeppelin (L) are given below. Patrick’s indifference curve that passes through bundles A=(1L, 6C) and B=(3L,2C) is given below.

Calculate the marginal rate of substitution (MRS) at bundles A and B. Give a verbal interpretation of your answer.

4. Draw an indifference map for a typical person’s preferences over five-dollar bills and ten-dollar bills using the vertical axis for five-dollar bills and the horizontal axis for ten-dollar bills. What is the marginal rate of substitution (MRS)?

5. Victoria eats vanilla ice cream and Oreo cookies only together, and then only if they are mixed in a fixed ratio of 1 pint of ice cream to 3 crushed Oreos.

a) Draw an indifference map, which represents Victoria’s preferences over vanilla ice cream and Oreo cookies using the vertical axis for Oreo cookies and the horizontal axis for pints of vanilla ice cream.

b) Which assumption does Victoria’s preferences over these two goods violate?

6. Mark spends all of his monthly income on interstate phone calls and food. His monthly income is $400 and the unit price of food is \( P_F = $1 \). Consider two calling plans offered by his phone company:

Calling Plan 1: Each minute is $0.10

Calling Plan 2: The first 200 minutes is free, after that each minute is $0.25

Draw Mark’s budget set under each calling plan. In your graph, use Y-axis for food and X-axis for phone calls.
7. During the World War II, US government rationed gasoline, setting a quota on how much a consumer could purchase. A student with a weekly income of $6 has to allocate his income between meals and gasoline. Price of meals is $1.00 and price of gasoline is $0.50. If the gasoline quota is at 10 gallons, draw the student’s budget line before and after the quota.

8. Elaine’s indifference curves representing her preferences between movies and CDs are given below. Her entertainment budget is $60. The price of CD is $12 and the price of movies is $6. (I = $60, P_C = $12 and P_M = $6)

a) How would Elaine allocate her budget between movies and CDs?

b) If the price of movies increases to $12, how would her consumption choices change?

In your answer to (a) and (b) please use Elaine’s indifference curves given in the graph paper.
9. Mr. Bond likes martinis, however he only enjoys them when they are made in the exact proportion of two ounces of gin (G) to one-ounce vermouth (V).

   Mr. Bond has a nightly drink allowance of $5. Suppose an ounce of gin is $1 and an ounce of vermouth is $0.5.

   a) Draw Mr. Bond’s indifference map.

   b) On the same graph plot Mr. Bond’s budget line and find his consumption bundle. How many martinis would he consume?

10. Art spends his free time on visiting amusement parks (P) and art museums (M). The art museum in town charges $5 per visit. On the other hand, Art must pay $10 per visit to the amusement park for the first five visits but only $5 per visit in excess of five visits. Art has $60 for entertainment purposes. His indifference curves for amusement park and art museum are given on the attached page.

   Draw Art’s budget set and find Art’s optimal consumption choice.

11. Suppose Ms. Color, has $200 to spend on pink sweaters (P) and lime-green sweaters (L) at the department store “Saks 1st Avenue”. Ms. Color does not care what color sweater she wears but deems it very important to buy as many sweaters as possible with the $200. Pink sweaters cost $40 each and lime-green ones cost $20 each.

   a) Draw Ms. Color’s budget line and indifference map. What is her optimal consumption choice?

   b) Suppose the department store imposes a new rule: Each customer can buy at most 6 lime-green sweaters. Under the new rule, draw Ms. Color’s new budget set and indifference map, then find the optimal consumption bundle.

12. Greg’s utility for shiny shoes (S) and hairspray (H) is represented by the utility function

   \[ U(S, H) = S^2 \times H \]

   Greg has a weekly budget of $360 to be spent on shiny shoes and hairspray. Price of hairspray is \( P_H = $20 \), price of shiny shoes is \( P_S = $40 \).

   a) Draw Greg’s Budget Line and sketch the indifference curve that passes through the bundle \( A = (3S, 12H) \). (You should calculate at least 3 points on IC other than bundle A)

   b) Calculate the marginal rate of substitution (MRS) at bundle A. Give a verbal interpretation of your answer

13. Matt’s preferences for food and clothing are given by the indifference curves drawn on the graph attached. Matt has an income of $120 to spend on food (F) and clothing (C). Initially the price of clothing is \( P_C = $10 \) and the price of food is \( P_F = $1 \). Then the price of food rises to \( P_F = $3 \). You will use the graph provided to examine the effect of this price increase on the quantity of food purchased.

   a) Find Matt’s consumption choice before (label it A) and after the price change (label it B).
b) Calculate the following:
Total Effect, Substitution Effect and Income Effect.

Verify that the Total Effect = Substitution Effect + Income Effect

c) Is Food a Normal or an Inferior Good for Matt? Explain in one sentence.

d) How much money should be given to Matt so he could afford bundle A at new prices?
How much money should be given to Matt so that he would be as happy as before the price change?

14. Josh has $32 of weekly entertainment budget, which he wishes to spend on concerts and movies. Price of a concert ticket is $8 and price of a movie ticket is $4.
The utility that Josh receives by consuming C units of concerts and M units of movies is given by the utility function: 

(a) Calculate and draw the indifference curve that passes through bundle A = (2M, 3C). Also draw Josh’s budget line on the same graph.

(b) Calculate the marginal rate of substitution (MRS) at bundle A. Give a verbal interpretation of your answer.

(c) Does bundle A maximize Josh’s utility given his budget constraint? If not, explicitly show all the bundles in his budget set which give him a higher utility than bundle A.

15. The utility that Dorothy receives by consuming food F and clothing C is given by

U(F, C) = F × C

(a) Using Y axis for clothing and X axis for food, draw the indifference curve associated with a utility level of 12, and the indifference curve associated with a utility level of 24. Are the indifference curves convex?

(b) Suppose that food costs $1 a unit, clothing costs $3 a unit, and Dorothy has $12 to spend on food and clothing. Using Y axis for clothing and X axis for food, graph the budget line that she faces on the same graph where you draw Dorothy’s indifference curves.

(c) What is the utility maximizing choice of food and clothing?

(d) What is the marginal rate of substitution of food for clothing when utility is maximized?

e) Suppose that Dorothy buys 3 units of food and 3 units of clothing with her $12 budget. Would her marginal rate of substitution of food for clothing be greater or less than 1/3? Explain.
HOMEWORK ASSIGNMENT FOR CHAPTER 5:

1) In class we have learned that if people make all the trades they want, the resulting equilibrium will be Pareto efficient. By moving from this efficient equilibrium, we can not make one person better off without harming another person. At a Pareto efficient equilibrium, the marginal rates of substitution between individuals are equal since their indifference curves are tangent to one another. In this question you will investigate some of these concepts.

Suppose Hassan and Karan are on a deserted island where they can not produce anything. They have recovered some food from their ship. Hassan has 10 giant cookies and 8 milk boxes. Karan has 10 giant cookies and 2 milk boxes. The Edgeworth box for this economy is drawn for you. (Check graph paper)

a) Consider the initial endowment point given above. Calculate the marginal rate of substitution (MRS) at this point for Hassan and Karan. Are the two individual’s MRS equal at this point? What does this mean for the trade opportunity between Hassan and Karan?

b) Is this initial endowment efficient? If your answer is “no”, then show ALL of the allocations that make both Hassan and Karan better off by perhaps shading them.

c) Of those allocations you found in (b) that made both individuals better off, mark the ones that are efficient.

d) Of the efficient allocations you marked for part (c), pick ONE allocation and explain how Hassan and Karan can achieve that allocation by trading?
2) Initially suppose Pooja has 10 candy bars and 5 bags of chips and Claire has 5 candy bars and 10 bags of chips. After trading with one another, Pooja has 12 candy bars and 3 bags of chips.

a) Draw an Edgeworth box representing the economy given above (you can choose the origins of the individuals anyway you like)

b) Mark the initial allocation in your box and label it A. Mark the new allocation and label it B. Draw some indifference curves that are consistent with this above mentioned trade being optimal both for Pooja and Claire. (i.e. they have exhausted all mutually beneficial trade opportunities)

c) Is the allocation you labeled as B efficient?
HOMEWORK ASSIGNMENT FOR CHAPTER 6:

1. Suppose Austin's initial wealth (his assets + his money) is $20,000. His driving skills are such that with 10% probability he would make an accident which would cause him to lose his $5,000 car and with 90% probability no accident would occur.

   His utility function is given by: $U = \sqrt{M}$ where M is his total wealth.

   a) Calculate his expected utility if he does not have any car insurance.

   b) [Full Coverage Insurance: No deductible]

      An insurance agent offers him an insurance with a cost of $500, which would cover all his losses (= $5000) in the case of an accident. Would he accept the insurance offer?

   c) [Partial Coverage Insurance: $1000 deductible]

      An insurance agent offers him an insurance with a cost of $400, which would cover $4000 of his losses in the case of an accident. (i.e. with this insurance policy, he will suffer a loss of $1000 in the case of an accident). Would he accept the insurance offer?

2. Suppose Kramer has $100,000 to invest. (Kramer does not have any other assets, so his total initial wealth is $100,000). He has two investment options: Microsoft stock and T-bond. The Microsoft stock is a financial asset that has a return rate of 2% with a probability of 0.4 and a return rate of 10% with probability 0.6. The T-bond returns 6.75% with certainty. Kramer is risk averse and his utility is given by $u(M) = \sqrt{M}$, where M is Kramer’s wealth.

   a) Calculate Kramer’s expected utility if he invests in the Microsoft stock.

   b) Calculate Kramer’s expected utility if he invests in the T-bond.

   A financial advisor suggests Kramer to put 60% of his money to Microsoft stock and 40% of his money to T-bond. Which of the following investment options would Kramer prefer?

   i) Invest only in stock

   ii) Invest only in bond

   iii) Use the portfolio suggested by the financial advisor.
HOMEWORK ASSIGNMENT FOR CHAPTER 7:

1. The local shoe repair shop’s production function is displayed in the following table.

<table>
<thead>
<tr>
<th>Capital Input</th>
<th>1</th>
<th>2</th>
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<th>4</th>
<th>5</th>
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</table>

(a) Suppose the firm wants to produce Q = 24 units. Which combinations of (L, K) will enable the firm produce this output level? Draw the isoquant associated with Q = 24.
(b) What are the different combinations of L and K that can produce 35? Draw the isoquant associated with Q = 35.
(c) Suppose in the short run (SR) capital is fixed at a level K = 2 whereas the quantity of labor can be varied. Find the amount of labor input that is necessary to produce Q = 24 units of output. Repeat the same for Q = 35.

2. The production function for White Cloud dry cleaning business is given in the table below. White Cloud employs workers (L) and uses dry cleaning machines (K) to service its customers. Its output is the number of garments dry cleaned per day.

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<thead>
<tr>
<th>Labor Input (L)</th>
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<td>587</td>
<td>679</td>
<td>753</td>
</tr>
<tr>
<td>9</td>
<td>0</td>
<td>141</td>
<td>318</td>
<td>488</td>
<td>609</td>
<td>708</td>
<td>789</td>
</tr>
<tr>
<td>10</td>
<td>0</td>
<td>137</td>
<td>314</td>
<td>492</td>
<td>617</td>
<td>722</td>
<td>809</td>
</tr>
</tbody>
</table>
(a) Assume currently White Cloud owns two dry cleaning machines that it uses in production. Fill in the table given in the graph paper.

(b) Graph the Total Output, MP and AP curves.

(c) Please examine the graphs you have drawn in (b). What is the relation between TP and MP curves? What is the relation between AP and MP curves?

3. For each of the following production functions, determine whether the production function exhibits increasing returns to scale, decreasing returns to scale or constant returns to scale.
   (i) \( Q = 10 \sqrt{L} \sqrt{K} \)
   (ii) \( Q = 3K + 4L \)
   (iii) \( Q = 300K^{0.2} L^{0.5} \)
   (iv) \( Q = 0.5K^{0.9} L^{0.5} \)
   (v) \( Q = \sqrt{L} + \sqrt{K} \)

4. Consider a firm using two inputs; capital (K) and labor (L) in production. The firm's production technology is characterized by the following production function:
   \( Q = F(K, L) = 40K\sqrt{L} \)

   In the short run (SR), the quantity of the capital (K) that the firm uses is fixed at \( K = 10 \) whereas the quantity of the labor input can be varied. Price of labor is $4,000 per worker and the price of capital is $2,000 per unit. (\( P_L = $4,000 \) and \( P_K = $2,000 \))

   Derive the equation of the TC as a function of Q in the short run and identify the variable and fixed cost component of the TC equation.

5. Given the cost function for your firm: \( TC = 40 + 4Q + 2Q^2 \)
   (i) Find the equation for fixed cost (FC) and variable cost (VC).
   (ii) Find the equations for AFC, AVC and ATC.

6. Consider a firm using two inputs; capital (K) and labor (L) in production of tuna cans. The firm's production technology is characterized by the following production function:
   \( Q = 6K + 4L \)

   where \( K \) = capital input per hour and \( L \) = Labor input per hour and \( Q \) = Output of tuna cans per hour.

   (a) In the short run (SR), assume that the quantity of the capital (K) that the firm uses is fixed at 6. i.e. \( K = 6 \) whereas the quantity of the labor input can be varied.

   How much labor input is required to produce \( Q = 60 \) tuna cans per hour in the short run? Repeat the same for \( Q = 100 \).

   (b) Assuming capital is fixed at \( K = 8 \), how much labor input is required to produce \( Q = 60 \) tuna cans per hour in the short run? Repeat the same for \( Q = 100 \).

   (c) Graph the isoquants that correspond to the following output levels: \( Q = 60 \) and \( Q = 100 \).
7. Consider a firm using two inputs; capital (K) and labor (L) in production. The firm's production technology is characterized by the following production function:

\[ Q = F(K, L) = 100KL \]

Price of labor is $100 per worker and the price of capital is $400 per capital. i.e. \( P_L = $100 \) and \( P_K = $400 \).

a) Draw the isoquant curve, for an output level of \( Q = 10,000 \) (Graph paper is attached)
b) Find graphically the optimal input mix that will minimize costs of production in the long run
c) Calculate the total cost of producing 10,000 units in the long run.

8. Given the following scenarios, draw a few isoquants for each of the following firms’ production function:

a) Aunt Annie’s Bakery produces cakes using eggs (E) and premixed ingredients (I). For each cake the bakery uses one egg and one package of premixed ingredients. (When you add two eggs to one package of ingredients, you produce only one cake. Similarly, when you have only one egg, you can’t produce two cakes even if you have two packages of ingredients)
b) Ride-On-Us produces bicycles from bicycle frames (F) and tires (T). Every bicycle needs exactly two tires and one frame.
9. The isoquant curves for the production function \( Q = F(K, L) = \sqrt{K \sqrt{L}} \) is given in the graph below and also on the attached sheet. Price of labor is $100 per worker and the price of capital is $400 per capital. i.e. \( P_L = $100 \) and \( P_K = $400 \).

a) In the long run both inputs are variable. For output levels (Q=50, Q=100, Q=150) find graphically the optimal input mix that will minimize costs of production. Then fill the table.

<table>
<thead>
<tr>
<th>Output (Q)</th>
<th>Optimal Input Mix</th>
</tr>
</thead>
<tbody>
<tr>
<td>50</td>
<td></td>
</tr>
<tr>
<td>100</td>
<td></td>
</tr>
<tr>
<td>150</td>
<td></td>
</tr>
</tbody>
</table>

b) Using the table you filled in part (a), derive the firm’s LR total cost equation and LR average cost equation.
10. Suppose you are producing cell phone leather cases. The isoquant curves representing your daily production process are given in the graph below. Price of labor is $200 per worker and the price of capital is $100 per capital per day. i.e. \( P_L = $200 \) and \( P_K = $100 \).

a) By investigating your firm’s isoquants that are drawn, determine what type of returns to scale your production function exhibit. Explain using numbers.

b) Suppose you are operating in the long run. For output levels (Q=100, Q=200, Q=300) find graphically the optimal input mix that will minimize the costs of production and fill the table given in the graph paper handout by writing the optimal input mixes for each corresponding output.

<table>
<thead>
<tr>
<th>Output (Q)</th>
<th>Optimal Input Mix</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>L</td>
</tr>
<tr>
<td>100</td>
<td></td>
</tr>
<tr>
<td>200</td>
<td></td>
</tr>
<tr>
<td>300</td>
<td></td>
</tr>
</tbody>
</table>
c) Using the table you filled in part (b), derive the firm’s long run average cost equation (LRAC) as a function of output and draw it on the given graph paper.

d) Suppose in the short run you have only 16 machines to work with \((\bar{K} = 16)\), whereas you can hire as many workers as you wish. Your firm’s production function is given by \(Q = 7.3779K^{\frac{1}{3}}L^{\frac{3}{4}}\). Remember \(P_L = $200\) and \(P_K = $100\).

Derive your firm’s short run average total cost equation (SRATC) as a function of output and draw it on the same graph paper as the LRAC function you have drawn in part (c).

(Note: When you are deriving SRATC equation in your calculations please use four decimal points)

Can you explain the relationship between the SRATC curve and LRAC from your graph?
11. Understanding returns to scale in the savings and loan industry is important for regulators who must decide how savings and loans should be restructured in light of the failure of numerous institutions. In this regard, the empirical estimation of a long-run cost function is of importance. The below results are based on J. Holton Wilson’s “A Note on Scale Economies in the Savings and Loan Industry”, Business Economics (January 1981): 45-49.

In this study the savings and loan industry was studied. The data was collected for 86 savings and loan associations for 1975 and 1976 in a region that includes Idaho, Montana, Oregon, Utah, Washington, and Wyoming. Output is difficult to measure in this case because a savings and loan association provides a service to its customers, rather than a physical product. The output $q$ measure used in this study is the total assets of each savings and loan association. In general, the larger the assets of an association, the higher its profitability. The long run average cost (LRAC) is measured by average operating expense. Output and total operating costs are measured in hundreds of millions of dollars. Average operating costs are measured as a percentage of total assets.

A quadratic long run average cost function was estimated for the year 1975 which is given below:

$$LRAC = 2.38 - 0.6153q + 0.0536q^2$$

The associated marginal cost function is given by:

$$MC = 2.38 - 1.2306q + 0.1608q^2$$

a) Calculate the minimum efficient scale for the savings and loans industry. What is the range of output for which a savings and loan institution would enjoy economies of scale and what is the range of output for which diseconomies of scale is observed?

(Hint: You can use the relationship between AC and MC…)

b) Almost all savings and loans institutions in the region studied, had assets less than $574 million. Based on your calculations in part (a), what would you recommend for the firms in this industry and in general for the government when formulating policies to deal with firms in this industry or when formulating policies concerning this industry?
HOMEWORK ASSIGNMENT FOR CHAPTER 8:

1. Suppose that a competitive firm’s marginal cost is given by \( MC(q) = 3 + 2q \) and the average variable cost by \( AVC(q) = 3 + q \). The firm’s total fixed costs are known to be $3 (FC = 3).

Assume that the market price of the firm’s product is determined in the industry as $9.

(a) What level of output will the firm produce?

(b) What will be the profit of the firm in the short run?

2. Assume that the car wash industry in Columbus is a competitive market with 200 identical firms where the price of a basic wash is set in the industry as $10. Industry demand for car wash services is given by \( Q_D = 1100 - 10P \) where \( P \) is the price charged per car wash service and \( Q \) is the entire car wash services demanded in Columbus. Suppose Shiny Car Inc. is a firm providing car wash services in Columbus. It’s cost data is given by \( TC(q) = 100 + q^2 \) and \( MC(q) = 2q \).

(a) What level of output should Shiny Car Inc. produce in the short run? Calculate the profit of the firm in the short run.

(b) Write down the supply equation of Shiny Car Inc. \( (q = f(P)) \)

(c) Write down the industry supply equation \( (Q = f(P)) \)

(d) Solve for the equilibrium price in this market and verify that it is $10.

3. Suppose rocking chair manufacturing is a perfectly competitive industry in which there are 1,000 identical firms. Each firm’s total cost is related to output per day as follows:

<table>
<thead>
<tr>
<th>Output (q)</th>
<th>Total Cost (TC)</th>
<th>Total Variable Cost (VC)</th>
<th>Average Variable Cost (AVC)</th>
<th>Marginal Cost (MC)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>$500</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>$1,000</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>$1,300</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>$1,500</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>$1,800</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>$2,200</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>$2,700</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>$3,300</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>$4,000</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

(a) Copy the table on your answer sheet and complete it by finding VC, AVC and MC at each level of output.

(b) Plot AVC and MC for this single firm. What is the supply curve of this firm? (Indicate it on your graph). How many chairs would the firm produce at prices of $300, $400, $500, $600 and $700? (i.e. write down his supply schedule)
Suppose the market (industry) demand curve in the rocking chair industry is given by the following:

<table>
<thead>
<tr>
<th>Price (per day)</th>
<th>Quantity of chairs demanded</th>
</tr>
</thead>
<tbody>
<tr>
<td>$600</td>
<td>5,000</td>
</tr>
<tr>
<td>$500</td>
<td>6,000</td>
</tr>
<tr>
<td>$400</td>
<td>7,000</td>
</tr>
<tr>
<td>$300</td>
<td>8,000</td>
</tr>
</tbody>
</table>

(c) Use a separate graph for this part. Plot the market demand curve for chairs. Compute and plot the market supply curve using the information you obtained for a single firm in part (b). (Market supply curve is found by summing up the individual firm's supply curves at each price).

(d) What is the equilibrium price and equilibrium quantity in the rocking chair industry?

4. Assume that basic hair cut services in Columbus are supplied by a competitive industry, which consists of identical firms. An individual firm’s long run marginal cost is given by

\[ MC(q) = 3q^2 - 60q + 345 \]

and its long run total cost curve is given by

\[ TC(Q) = q^3 - 30q^2 + 345q. \]

a) Find the firm’s long-run equilibrium output and the long run equilibrium price.

b) If the market price is $25, do firms enter or exit the industry?

c) Suppose the industry demand is given by \( Q_d = 15,000 - 50P \). Find the number of firms in long run equilibrium.

5. Assume that the lawn-treatment service in Central Ohio is a perfectly competitive industry consisting of identical firms. An individual firm in this industry has the following cost structure in the long run:

\[ TC = 400q - 8q^2 + 0.1q^3 \]

\[ MC = 400 - 16q + 0.3q^2 \]

The industry demand function for lawn-treatment services in Central Ohio is given by

\[ Q = 13600 - 40P \]

a) What is the long run equilibrium price in this industry? How many firms will serve Central Ohio in long run equilibrium?

b) Calculate the profit of an individual firm in the long run equilibrium.
HOMEWORK ASSIGNMENT FOR CHAPTER 9:

1. The demand curve facing a monopoly is given by the following equation: \( P = 100 - Q \)
   The firm’s total cost is given by : \( TC(Q) = 10 + 6Q \).
   The firm has constant marginal cost and it is given by \( MC(Q) = 6 \)

   a) Find the profit maximizing output and price and calculate the monopolist’s profit.

   b) Is the output level that you found in part (a) economically efficient? If it is not, then what is the economically efficient output level?

   c) Calculate the deadweight loss caused by the monopolist.
   Hint: First sketch the demand, MR and MC curves of the monopolist and then shade the area that corresponds to DWL.

2. Drugs-R-Us has recently discovered a new drug that is 100% effective in the treatment of AIDS and obtained a patent for the new drug. The market demand for the new drug is given by \( P = 120 - 2Q \). Drugs-R-Us’ cost data is given by \( TC = 50 + 2Q^2 \) and \( MC = 4Q \)

   a) Find the profit maximizing price and quantity for Drugs-R-Us. Calculate the company’s profit.

   b) Calculate the price elasticity of demand at the profit-maximizing price and verify that the rule of thumb for monopoly pricing holds.

   (c) Suppose Drugs-R-Us hires a new manager, Mr. Slate who is going to be responsible from the new drug. To gain prestige, Mr. Slate decides to maximize the revenues of the company. Calculate the price that Mr. Slate would set for the new drug.

   (d) Calculate the company’s profit at the revenue-maximizing price and compare it with your answer in part (a)

3. Assume that Toyota is a monopoly in the market for electric passenger cars. The demand, ATC and MC curves for Toyota are given in the graph below.

   (a) Find the profit-maximizing price for Toyota. Calculate Toyota’s profit.

   (b) Calculate the deadweight loss resulting from Toyota’s monopoly.

   What would be the profit of Toyota if the government forces it to sell the cars at 10 thousand dollars.

   (c) Suppose that the rent that Toyota pays for the factory building increased by 100 thousand dollars. What would be the new price and profit for Toyota?
4. BalletMet, the local ballet company is a monopoly in the production of ballets in the city and sells its performances to two types of consumers: students and adults. The company estimated the demand function for a night’s performance in both markets. In the market for adults the demand is given by: \( P_A = 185 - Q_A \) and in the market for students it is given by \( P_S = 65 - 2Q_S \). The firm’s marginal cost of production is \( MC = 5 \). The firm’s total cost of production is given by the following equation: 
\[ TC = 6,000 + 5Q \]

a) If BalletMet can prevent resale, what price will it charge in each market? How many units will it sell in each market?

b) Calculate Balletmet’s total profit.
HOMEWORK ASSIGNMENT FOR CHAPTER 10:

1. Assume there are only two major airlines, TWA and America West operating in CMH-NYC route. Assume that for a round trip ticket they can charge either a high price of $300 or a low price of $200. Their payoff matrix summarizes each firm's profit from every possible choice of strategies. Each firm must make its choice without knowing what the other has chosen (i.e. firms are choosing their strategies simultaneously).

<table>
<thead>
<tr>
<th></th>
<th>TWA</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>P=$200</td>
</tr>
<tr>
<td>AMERICA WEST</td>
<td>2m</td>
</tr>
<tr>
<td></td>
<td>4m</td>
</tr>
<tr>
<td></td>
<td>1m</td>
</tr>
<tr>
<td></td>
<td>3m</td>
</tr>
</tbody>
</table>

You are brought in as an economic analyst and you will use game theory to predict the pricing strategies that would be used by these two airlines.

a) Does America West have a dominant strategy? Does firm TWA have a dominant strategy?

b) As an economic analyst your job is to estimate possible outcomes for this game between America West and TWA. By using Dominant Strategy Equilibrium concept, can you predict the possible outcome in this market?

2. Ford and GM are two automobile producers who compete in an oligopolistic market. Next year, each has the option of producing either a big car or a small car. The profit matrix below summarizes the payoffs to each firm from every possible choice of strategies. Each firm must make its choice without knowing what the other has chosen (i.e. firms are choosing their strategies simultaneously).

<table>
<thead>
<tr>
<th></th>
<th>GM</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Big car</td>
</tr>
<tr>
<td>FORD</td>
<td>Big car</td>
</tr>
<tr>
<td></td>
<td>Small car</td>
</tr>
</tbody>
</table>

a) Does firm 1 have a dominant strategy? Does firm 2 have a dominant strategy?

b) As an economic analyst your job is to estimate possible outcomes for this game between Ford and GM. You decide to use Nash Equilibrium concept to identify self enforcing strategies. There are two Nash equilibria for this game. Identify them and give a brief explanation as to why they are Nash equilibria.
3. You are the chief economic analyst for Sprint PCS, who plans to offer wireless web service for the new pocket-PC devices in Central Ohio. You can choose one of the three business strategies: offer service only in Delaware (D), offer service only in Columbus (C) or offer service in Both cities (B). Your opponent, Airtouch is also considering to offer a similar service and will also choose one of the three strategies: D, C or B.

Sprint and Airtouch have to make their decisions simultaneously. The game matrix below summarizes the resulting simultaneous move game.

<table>
<thead>
<tr>
<th></th>
<th>C</th>
<th>D</th>
<th>B</th>
</tr>
</thead>
<tbody>
<tr>
<td>C</td>
<td>3, 2</td>
<td>2, 3</td>
<td>1, 4</td>
</tr>
<tr>
<td>D</td>
<td>4, 1</td>
<td>3, 2</td>
<td>3, 3</td>
</tr>
<tr>
<td>B</td>
<td>5, 0</td>
<td>4, 2</td>
<td>2, 1</td>
</tr>
</tbody>
</table>

a) Does Sprint have a dominant strategy? If it does, what is Sprint’s dominant strategy? Does Airtouch have a dominant strategy? If it does, what is Airtouch’s dominant strategy?

b) Find all Nash Equilibria of the game

c) You learned that Airtouch is having difficulty in raising funds for the new project. Due to these problems it is simply not possible for Airtouch to deploy the wireless web service in both cities. Consider the new simultaneous move game where Airtouch’s (B) strategy is eliminated.

i) Does Sprint have a dominant strategy in this new game? If it does, what is Sprint’s dominant strategy in this new game?

ii) Does Airtouch have a dominant strategy in this new game? If it does, what is Airtouch’s dominant strategy in this new game?

iii) Find all Nash Equilibria for this new game.

4. Suppose two firms compete in an oligopolistic market. The market demand curve is given as $P = 36 - 3Q$, where $Q = q_1 + q_2$. Each firm has constant marginal cost. $MC_1 = 18$ and $MC_2 = 18$.

As in the model of oligopoly discussed in class, both firms make their output decisions at the same time, each taking the others output as fixed. (Cournot Competition)

a) Find the best response function of firm 1.

Find the best response function of firm 2.
b) Suppose firm 1 is producing 1 unit and firm 2 is producing 2 units \((q_1 = 1, q_2 = 2)\).
Is this pair of output levels a Nash equilibrium for this quantity competition game? (i.e. does either firm have an incentive to change its output level given the output level of its rival?)

c) Calculate the Nash equilibrium output levels for firm 1 and firm 2. (In Nash equilibrium each firm is maximizing its profit given the output of its competitor so no firm has an incentive to change its output.)

d) Calculate the profit of each firm.

5. Suppose two firms compete in an oligopolistic market. The market demand curve is given as \(P = 36 - 3Q\), where \(Q = q_1 + q_2\). Each firm has constant marginal cost. \(MC_1 = 18\) and \(MC_2 = 18\).

Both firms make their output decisions at the same time, each taking the others output as fixed.

a) For this market, you have solved the result of the quantity competition game in question 4. In other words, you have found the Nash Equilibrium output levels for the two firms previously. Now suppose instead of competing against one another the two firms decide to come together and collude (i.e. act like a Cartel) so as to maximize their joint profit. They hired you as a consultant and your job is to recommend them the output level that they should choose to produce. What would be your recommendation?

b) Given your recommendation for the cartel in (a), would the two firms stick to your advice and produce the quantity you recommended or do they have an incentive to cheat on the cartel agreement unilaterally?

6. Suppose there are two firms with identical cost functions. The incumbent firm is a monopoly and can invest in research and development (R&D) that will lower its costs. Then the second firm, the entrant may enter. The game tree which represents the above scenario is given below.

(a) Find the outcome of this game.

(b) If there was no threat of entry by the Entrant, would the incumbent find it profitable to invest in R&D?
7. Find all Nash Equilibria for the following game.

<table>
<thead>
<tr>
<th></th>
<th>a</th>
<th>b</th>
<th>c</th>
<th>d</th>
<th>e</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>A</strong></td>
<td>63, -1</td>
<td>28, -1</td>
<td>-2, 0</td>
<td>-2, 45</td>
<td>-3, 19</td>
</tr>
<tr>
<td><strong>B</strong></td>
<td>32, 1</td>
<td>2, 2</td>
<td>2, 5</td>
<td>33, 0</td>
<td>2, 3</td>
</tr>
<tr>
<td><strong>C</strong></td>
<td>54, 1</td>
<td>95, -1</td>
<td>0, 2</td>
<td>4, -1</td>
<td>0, 4</td>
</tr>
<tr>
<td><strong>D</strong></td>
<td>1, -33</td>
<td>-3, 43</td>
<td>-1, 39</td>
<td>1, -12</td>
<td>-1, 17</td>
</tr>
<tr>
<td><strong>E</strong></td>
<td>-22, 0</td>
<td>1, -13</td>
<td>-1, 88</td>
<td>-2, -57</td>
<td>-3, 72</td>
</tr>
</tbody>
</table>

8. Assume that in a high sea, there are 24 minke whales. There are two nations bordering the high sea who will try to hunt the whales. There are two hunting seasons: Spring and Fall. Both nations will make their spring season output decision simultaneously and then the remaining whales are equally shared in the fall season among the two nations.

The payoff of a nation is given by: Spring season output $\times$ Fall season output

a) Fill in the game matrix below.

<table>
<thead>
<tr>
<th></th>
<th>2</th>
<th>4</th>
<th>6</th>
<th>8</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>2</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>4</strong></td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td><strong>6</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>8</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

b) Find all the Nash equilibria of the game above.

c) What is the symmetric Nash Equilibrium for this game?

d) What is the symmetric socially desirable outcome?
HOMEWORK ASSIGNMENT FOR CHAPTER 12:

1. Consider two types of consumers: Will (High Risk) and Grace (Low Risk)

<table>
<thead>
<tr>
<th>Total Wealth (Car + Other Assets)</th>
<th>Car</th>
<th>Probability of Accident</th>
</tr>
</thead>
<tbody>
<tr>
<td>Will $10,000</td>
<td>$7,500</td>
<td>75%</td>
</tr>
<tr>
<td>Grace $10,000</td>
<td>$7,500</td>
<td>55%</td>
</tr>
</tbody>
</table>

Pleasantville has 1,000 drivers identical to Will and 1,000 drivers identical to Grace. Indifference curves for Will and Grace are given in the figure below. In Pleasantville there is no requirement to buy car insurance.

a) The only insurance company in town cannot differentiate between high and low risk drivers and therefore offers a single insurance policy, [POL-1] to all drivers. [POL-1] is a partial insurance with $2,000 deductible and costs $3,000.

Calculate ($w_1$, $w_2$) for this insurance policy and mark it on the diagram given in the last page. Calculate the (expected) profit for the insurance company.

b) The only insurance company in town cannot differentiate between high and low risk drivers and therefore offers a single insurance policy, [POL-2] to all drivers. [POL-2] is a partial insurance with $4,000 deductible and costs $2,000.

Calculate ($w_1$, $w_2$) for this insurance policy and mark it on the diagram given in the last page. Calculate the (expected) profit for the insurance company.
IC for high risk

IC for low risk

(in thousands)

(in thousands)
2. Consider the used car market in Delaware. There are two types of used cars: Low quality (Lemon) and High Quality. Buyers and Sellers in the market have the following valuations for low and high quality cars.

<table>
<thead>
<tr>
<th></th>
<th>Low Quality</th>
<th>High Quality</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sellers</td>
<td>$500</td>
<td>$2,000</td>
</tr>
<tr>
<td>Buyers</td>
<td>$1,000</td>
<td>$2,500</td>
</tr>
</tbody>
</table>

There is asymmetric information in the market for used cars. Sellers know the quality of their cars, however buyers cannot tell whether they are buying a high or a low quality car. There are limited number of sellers and practically unlimited number of buyers. (i.e. we can assume the price is determined by buyer valuations as we discussed in class)

(a) Assume that \( \theta = 0.50 \) (50 percent) of the cars in the market are low quality and \((1-\theta) = 0.50 \) (50 percent) of the cars in the market are high quality. Show that there is no equilibrium price where both types of cars are traded in the market by calculating the following:

- Average Value of the cars in the market (to buyers):
- Profit of High Quality Car Owners:
- Profit of Low Quality Car Owners:

(b) Assume that \( \theta = 0.10 \) (10 percent) of the cars in the market are low quality and \((1-\theta) = 0.90 \) (90 percent) of the cars in the market are high quality. Show that there is an equilibrium price where both types of cars are traded in the market by calculating the following:

- Average Value of the cars in the market (to buyers):
- Profit of High Quality Car Owners:
- Profit of Low Quality Car Owners: