Instructions: You need paper (lined if possible), a ruler and a pen or a pencil to write this test. You may answer the questions in any order you like. You should start each question on a new page. You must write your answers; typed answers will not be accepted. When you are finished answering the questions, please order the pages so your answers to question 1 are first, and then your answers to question 2, etc. Then, in a single email message, send an image of each page to me at jburbidg@uwaterloo.ca. Please put Econ 393, your name and your id number in the subject line of your email. The deadline for submitting your answers is 6:00 pm Tuesday August 4th, Toronto time. The marks allocated to each question are shown in brackets.

1. (2 marks for each part) Use your ruler to draw a demand and supply competitive equilibrium in a price-quantity diagram. Assume straight lines for demand and supply, and draw the supply curve so that it passes through the origin.
   (i) At the competitive equilibrium, why is there an incentive for the firms (the suppliers) to form a monopoly?
   (ii) At the competitive equilibrium, why is there an incentive for the consumers (the buyers) to form a monopsony?
(i) This question tried to get you to think intuitively about the incentives at point E, either for the sellers or for the buyers, to act as a single agent. Start with sellers who have no ability to price discriminate. With no price discrimination the market demand is the sellers’s average revenue. Since average revenue is downward-sloping marginal revenue must lie below it (average falling implies marginal less than average). Marginal cost to the monopoly is the competitive industry’s supply curve. So, at E, MC > MR for the monopoly. That means that it could increase profits by cutting output and raising price. This incentive could only be stronger if it can practice price discrimination — having the power to practice price discrimination cannot reduce profits.

(ii) Now think about the buyers forming a monopsony. And, again, start with the assumption that the monopsony does not have the ability to price discriminate across suppliers. On this assumption the average cost to the monopsony of getting output is the competitive industry’s supply curve. Since average cost rises with output marginal cost to the monopsony lies above average cost (average rising means marginal greater than average). Thus, for the monopsony, at E, marginal cost of output exceeds the marginal benefit (which is read off the demand line). The monopsony can increase consumers’ surplus by reducing output and the price it pays for output. And, since having the power to price discriminate across suppliers cannot reduce its maximized consumers’ surplus, the incentive to form a monopsony could only be increased if price discrimination is possible.

2. (2 marks for each part) True, false and explain. Marks awarded will depend on the quality of your explanation.
(i) Let ABC Corp. be a monopolist. That ABC charges customer X the same price as customer Y should be interpreted by Industry Canada as proof that ABC is not discriminating between customer X and customer Y.
(ii) Economic theory suggests that the Department of Finance should consider replacing the federal excise tax on gasoline, which is a specific tax, with an ad valorem tax.
(iii) With regard to the acquisition of human capital, earnings uncertainty compounds the inefficiencies caused by capital market imperfections.

**ANSWER**

(i) False. See Quiz 3, question 2 (c). Price discrimination occurs when price divided by marginal cost differs across customers. The bowling alleys example had price the same but MC different for many people.

(ii) True. The firms selling gasoline clearly have monopoly power. Assignment 4 shows that while specific and ad valorem taxes are equivalent in perfect competition, ad valorem taxes are more efficient with monopoly.

(iii) False. See the notes on human capital.

3. (4 marks) Suppose the inverse demand for Molson Canadian beer in Canada is given by

\[ p_c = a - bY_c, \]

where \( Y_c \) is cases sold per month and \( p_c \) is the price per case. Assume Molson’s marginal cost is \( m \) dollars for every case of beer, it has one plant with a capacity of \( \overline{Y} \) cases per month, and its fixed costs are \( F \) dollars per month. In addition, suppose Molson, if it wanted to, could sell all the beer produced by this plant in the US for \( p_a \) Canadian dollars per case, and trade restrictions prevent beer sold in the US from being re-sold in Canada. Assume \( a > p_a > m \). To maximize its profits what price should Molson charge for beer sold in Canada and what would be its total profits from the two markets?

**ANSWER**

If Molson finds it profitable to sell some beer in the US we have

\[
\begin{align*}
\text{Profits}(Y_c) &= (a - bY_c)Y_c + p_a(\overline{Y} - Y_c) - m\overline{Y} - F \\
&= (a - p_a)Y_c - bY_c^2 + (p_a - m)\overline{Y} - F \\
\text{Profits}'(Y_c) &= (a - p_a) - 2bY_c = 0 \\
Y_c &= \frac{a - p_a}{2b} \\
p_c &= a - bY_c = a - \frac{a - p_a}{2} = \frac{a + p_a}{2} \\
\text{Profits} &= Y_c(a - p_a - bY_c) + (p_a - m)\overline{Y} - F \\
&= \left(\frac{a - p_a}{2b}\right)\left(a - p_a - \frac{a - p_a}{2}\right) + (p_a - m)\overline{Y} - F \\
&= \frac{1}{b}\left(\frac{a - p_a}{2}\right)^2 + (p_a - m)\overline{Y} - F
\end{align*}
\]
If \((a - p_a)/(2b) > Y\) then Molson would sell only in Canada and

\[
\begin{align*}
Y_c &= Y \\
p_c &= a - bY \\
\text{Profits} &= (a - bY)Y - mY - F
\end{align*}
\]

4. (2 marks for each part) An airport is located next to a large tract of land owned by a housing developer. Noise from the airport reduces the value of the developer’s land. Let \(X\) be the number of planes using the airport and \(Y\) be the number of houses the developer builds. Assume

\[
\begin{align*}
\text{Airport profits} &= 2aX - X^2 \\
\text{Developer profits} &= bY - Y^2 - XY, \text{ where } 4a > b > a > 0.
\end{align*}
\]

Put your answers for parts (i) and (ii) into a table like the one below. In row (i) each firm acts to maximize its own profits and there is no communication between the firms. In row (ii) the airport and the developer merge their firms and maximize their joint profits. Label the optimal level of \(X\) in row (ii) \(X^*\).

(iii) Now suppose there is no merger, but the developer offers to pay the airport \(A\) dollars to get the airport to set \(X = X^*\). What are the bounds on \(A\) such that both the airport and the developer have at least as much profit as each has in (i)?

<table>
<thead>
<tr>
<th>Setting</th>
<th>(X)</th>
<th>(Y)</th>
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<th>Profits: dev.</th>
<th>Total profits</th>
</tr>
</thead>
<tbody>
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<td>(a^2)</td>
<td>((b - a)^2/4)</td>
<td>(a^2 + (b - a)^2/4)</td>
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<td>(ii) ‘Merger’</td>
<td>((4a - b)/3)</td>
<td>((2b - a)/3)</td>
<td>((8a^2 + 2ab - b^2)/9)</td>
<td>(4(b - a)^2/9)</td>
<td>((12a^2 - 6ab + 3b^2)/9)</td>
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**ANSWER**

For (i) and (ii) we have

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(iii) The bounds on \(A\) satisfy

\[
\begin{align*}
\text{Air. profits in (i) - Air. profits in (ii)} & \leq A \\
\text{Dev. profits in (ii) - Dev. profits in (i)} & \leq \frac{4(b - a)^2}{9} - \frac{(b - a)^2}{4}
\end{align*}
\]

\[
\begin{align*}
\frac{a^2 - 8a^2 + 2ab - b^2}{9} & \leq A \\
\frac{a^2 - 2ab + b^2}{9} & \leq A \\
\frac{(b - a)^2}{9} & \leq A
\end{align*}
\]

4
5. (4 marks) Ann and Bruce share an apartment. The landlord pays for heat and air conditioning. Ann and Bruce both play chess, and they own a chess set. Let $T$ be the temperature in the apartment in degrees Celsius and $G$ be the number of games of chess they play against each other each week. Assume $T$ and $G$ are continuously variable, and Ann’s utility function is

$$U_A(T, G) = -(T - 20)^2 - (G - 4)^2,$$

and Bruce’s utility function is

$$U_B(T, G) = -(T - 24)^2 - (G - 2)^2.$$

As precisely as you can, describe the Pareto efficient values for $T$ and $G$.

**ANSWER.**

The question didn’t ask you to draw a picture but it helps if you do. Ann and Bruce’s indifference curves are circles. Ann’s are centred at $(T, G) = (20, 4)$. Bruce’s are centred at $(24, 2)$.

The Pareto efficient allocations lie along the straight line $AB$. Observe that $C$ and $D$ are not Pareto efficient. More formally,

$$\frac{\text{MRS}_A}{2(T - 20)} = \frac{\text{MRS}_B}{2(4 - G)} \quad 20 \leq T \leq 24$$

$$\frac{\text{MRS}_A}{2(T - 20)} = \frac{\text{MRS}_B}{2(24 - T)} \quad 20 \leq T \leq 24$$

$$T + 2G = 28 \quad 20 \leq T \leq 24.$$
6. (4 marks) Suppose the used car market in Vancouver this week has many people looking to buy a used car and 500 people willing to sell their used cars. Used cars are one of two types — good cars or lemons. Buyers cannot tell car quality before they buy; each seller knows whether their car is a lemon or a good car. Buyers are willing to pay \( w \) dollars for a good car and \( x \) dollars for a bad car. Each seller of a good car wants at least \( y \) dollars; each seller of a lemon wants at least \( z > 0 \) dollars. All buyers are risk neutral. Everybody knows that a fraction \( g, 0 < g < 1 \), of the 500 cars are good. Assume \( w > y > z \) and \( w > x > z \). Describe each possible equilibrium in this market and the parameter values for which it exists.

**ANSWER** See Quiz 8, question 2.

7. (2 marks for each part) Assume that everybody in New Liskeard, with population \( n + 1, n \geq 1000 \), is just like everyone else. Everybody likes to drive around town but nobody likes the resulting noise, pollution and traffic congestion. Each resident’s utility function is

\[
U(m, d, h) = m + bd - d^2 - eh/n, \quad b > e > 0
\]

where \( m \) is the number of Big Macs consumed per day, \( d \) is the number of hours per day that each person drives, \( h \) is the total number of hours driven by all other citizens, and \( b \) and \( e \) are parameters of the utility function. In addition, suppose the price of a Big Mac is 1 dollar, everyone has an income of \( y > be \) dollars per day and it costs nothing to drive.

(i) Find \( U \) in the private equilibrium as a function of \( b, e, y \).

(ii) Find the tax rate, \( t \), measured in dollars per hour of driving that the government would have to levy to maximize the utility of each resident. Note that \( t \) will depend on at least one of \( b, e \) and \( y \).

**ANSWER**

(i) Since it costs nothing to drive each person sets \( U_2(m, d, h) = 0 \). This implies \( d = b/2 \), \( h = nb/2 \) and \( U = y + b(b - 2e)/4 \).

(ii) With everyone identical the government can see that \( h = nd \) and so in a social optimum

Individual utility\((m, d) = m + bd - d^2 - ed = m + (b - e)d - d^2.\)

Thus the socially efficient level of \( d = (b - e)/2 \). To engineer this outcome the government can make use of the fact that utility-maximizing agents will set

\[
\text{MRS}_{dm} = \frac{\text{price of } d}{\text{price of } m} = \frac{b - 2d}{1} = \frac{\text{price of } d}{1} = \frac{t}{1}.
\]

Setting \( t = e \) dollars per hour of driving will induce each person to choose \( d = (b - e)/2 \).
8. (3 marks for each part) (i) What are the main differences between the standard model of competitive equilibrium studied in Econ 391 and what Wright et al. label as ‘traditional’ search models?

(ii) What are the main differences between ‘traditional’ search models and ‘directed’ search models surveyed by Wright et al.?

**ANSWER**

This question asked you to talk about the differences between (a) the Econ 391 model of competitive equilibrium; (b) the traditional (older) search model; and (c) the directed (newer) search model. The Wright survey has a detailed answer for the differences between (b) and (c), as well as a good discussion of the inability of (a) to explain important features of the world around us. But the main difference between (a) and (b) is that there really is no theory of the price determination in the Econ 391 model. In the Econ 391 model *if* price happens to be at the intersection of the demand and supply curves *then* quantity demanded equals quantity supplied. But there is no real explanation as to how price is determined. Where are the thousands of people — traders etc. — who make markets, like the stock market or foreign markets, work (and sometimes *not* work). They are not in the Econ 391 model. On the other hand, (b) does have a (simple) story of how prices are determined.