Instructions: You need paper (lined if possible), a ruler and a pen or a pencil to write this quiz. 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. 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 June 16th, Toronto time. The marks allocated to each question are shown in brackets.

1. (4 marks) Look at assignment 6 on the web site. You will see the answers for Workouts Question 34.1 organized into a table with rows. Create a table like this for question 34.2. I would recommend columns for $P_H$, $H$, honey producer profits, $P_A$, $A$, apple producer profits, and the subsidy to the honey producers.

ANSWER

We know nothing about consumer preferences in this question so “social surplus” can’t include consumers’ surplus — it will be simply total profits. Thus, to the columns suggested above, it’s useful to add a column for total profits.

<table>
<thead>
<tr>
<th>Regime</th>
<th>$P_H$</th>
<th>$H$</th>
<th>$H$ Profits</th>
<th>$P_A$</th>
<th>$A$</th>
<th>$A$ Profits</th>
<th>Total profits</th>
<th>Subsidy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Private eq.</td>
<td>2</td>
<td>100</td>
<td>100</td>
<td>3</td>
<td>150</td>
<td>325</td>
<td>425</td>
<td>0</td>
</tr>
<tr>
<td>Central planner</td>
<td>2</td>
<td>150</td>
<td>75</td>
<td>3</td>
<td>150</td>
<td>375</td>
<td>450</td>
<td>0</td>
</tr>
<tr>
<td>Mechanism</td>
<td>3</td>
<td>150</td>
<td>225</td>
<td>3</td>
<td>150</td>
<td>375</td>
<td>600</td>
<td>$1 per unit of $H$</td>
</tr>
</tbody>
</table>

The “social surplus”, that is, total profits is higher with the central planner than it is in the private equilibrium. To get to an efficient allocation we need to increase $H$ production to 150. Using the price equals marginal cost rule for a competitive firm we can see that increasing $P_H$ to 3 will work. So the efficient subsidy is $3 - 2 = 1$ dollar per unit of $H$. In the “Mechanism” row we see total profits have increased to 600. Does this mean the mechanism has done better than the central planner could? No, because the cost of the subsidy is 150 dollars and 600 $-$ 150 = 450, that is, we have designed a mechanism that does as well as the central planner. It is impossible to do better than the central planner.
2. Question 34.4 is particularly important because it shows the importance of property rights in resolving externality problems. Whatever the endowment of property rights, there are gains from trade for each of Tom and Jerry, but where they end up is very heavily influenced by the endowment of property rights — does Tom have the right to play music at any time and at any volume, or does Jerry have the right to a quiet room? The history of smoking is a good example of changing property rights. When I started teaching at McMaster you could smoke in the classroom, then only in your office, then only outside the building, then only at a distance of several feet from one exit of each building. And, now, the entire campus is smoke free. In the following question some of the Pareto efficient allocations are tangencies of indifference curves and some are intersections of indifference curves on the boundary of the Edgeworth rectangle.

(3 marks for each part) Ed and Fiona live together. Ed likes to smoke cigarettes in the house; Fiona dislikes cigarette smoke. Their utility functions are:

\[
\begin{align*}
    u_E(m^E, c) &= m^E - (10 - c)^2 \\
    u_F(m^F, c) &= m^F - c^2,
\end{align*}
\]

where \(m\) is dollars spent on private goods per day and \(c\) is the number of cigarettes smoked in the house by Ed per day. Assume Ed and Fiona each have 40 dollars to spend per day and cigarettes are free. As precisely as you can, describe the Pareto-efficient allocations in two settings: (a) Ed has the right to smoke as much as he likes in the house; (b) Fiona has the right to prevent Ed from smoking in the house.

**ANSWER**

Use the framework for the Tom and Jerry question discussed in class and drawn on the web site (problem 34.4). Set up an Edgeworth rectangle with cigarettes on the vertical axis and a horizontal axis of length equal to total income for Ed and Fiona, that is, 80. Let the origin for Ed be in the lower left corner; the origin for Fiona be in the lower right corner. Some Pareto efficient allocations will be tangencies between Ed and Fiona indifference curves. Writing MRSs as positive numbers we have

\[
\text{MRS}^E_{mc} = \frac{1}{2(10 - c)} = \frac{1}{2c} = \text{MRS}^F_{mc}\text{ which occurs when } c = 5.
\]

Refer to the picture at the end of this pdf. If we start at \(A\), where Ed has the right to smoke as much as he likes, the weakly Pareto superior tangencies lie along \(CD\) where \(c = 5\). \(DE\) comprises the weakly Pareto superior allocations where Ed’s indifference curves are steeper than Fiona’s. If we start at \(B\), where Ed has to ask for Fiona’s permission to smoke, the weakly Pareto superior tangencies lie along \(FG\) where \(c = 5\). \(GH\) comprises the weakly Pareto superior allocations where Fiona’s indifference curves are steeper than Ed’s. As with the Tom and Jerry question, we can see here that the initial endowment of property rights has a large impact on the likely bargaining outcomes.
3. (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

\[ U(m, d, h) = m + ad - d^2 - bh/n, \ a > b > 0 \]

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 \(a\) and \(b\) are parameters of the utility function. In addition, suppose the price of a Big Mac is 1 dollar, everyone has an income of \(y > ab\) dollars per day and it costs nothing to drive.

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

(b) 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 \(a, b\) and \(y\).

**ANSWER**

(a) Since it costs nothing to drive each person sets \(\frac{\partial U}{\partial d} = 0\). This implies \(d = a/2\), \(h = na/2\) and \(U = y + a(a - 2b)/4\).

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

\[ \text{Individual utility}(m, d) = m + ad - d^2 - bd = m + (a - b)d - d^2. \]

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

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

Setting \(t = b\) dollars per hour of driving will induce each person to choose \(d = (a - b)/2\).
Edgeworth rectangle for Ed and Fiona

- Ed's ind. curves are red
- Fiona's ind. curves are blue
- At A, Ed can smoke as much as he wants
- At B, Fiona can prevent Ed from smoking

CDE: Pareto efficient allocations for A
FGH: Pareto efficient allocations for B