Answers to Homework 3     Intermediate Microeconomics     due Tuesday, April 27

Each question is worth 5 points.


Two competing firms are each planning to introduce a new product. Each will decide whether to produce product A, product B, or product C. They will make their choices at the same time. The resulting payoffs are shown below.

<table>
<thead>
<tr>
<th></th>
<th>A</th>
<th>B</th>
<th>C</th>
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</thead>
<tbody>
<tr>
<td>A</td>
<td>-10,10</td>
<td>0, 10</td>
<td>10,20</td>
</tr>
<tr>
<td>B</td>
<td>10,0</td>
<td>-20,-20</td>
<td>-5,15</td>
</tr>
<tr>
<td>C</td>
<td>20,10</td>
<td>15, -5</td>
<td>-30,-30</td>
</tr>
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a. Are there any Nash equilibria in pure strategies? If so, what are they?

There are two Nash equilibria in pure strategies. They are \((A, C)\) and \((C, A)\). To show this, notice that if firm 1 chooses \(A\), firm 2 does best to choose \(C\) and if firm 2 chooses \(C\), firm 1 does best to choose \(A\). If firm 1 chooses \(C\), firm 2 does best to choose \(A\), and if firm 2 chooses \(A\), then firm 1 does best to choose \(C\). There are no other Nash equilibria in pure strategies because if firm 1 chooses \(B\), firm 2’s best choice is \(C\), but 1’s best response to this is \(A\). Similarly if firm 2 chooses \(B\), firm 1’s best choice is \(A\), but firm 2’s best response to this is \(C\).

b. If both firms use maximin strategies, what outcome will result?

Firm 1’s maximin strategy is to play \(A\). This gives it the least bad possible outcome assuming that whatever 1 does, 2 plays the strategy that is worst from 1’s point of view. If 1 plays \(A\), the worst possible outcome is \(-10\). If 1 plays \(B\), the worst possible outcome is \(-20\). And if 1 plays \(C\), the worst possible outcome is \(-30\).

By similar reasoning, \(A\) is 2’s maximin strategy. The outcome is thus \((-10, -10)\).

c. If firm 1 uses a maximin strategy and firm 2 knows this, what will firm 2 do (assuming firm 2 believes that firm 1 uses that strategy for sure)?

If 1 plays \(A\) and 2 knows this, 2 will play \(C\) (this makes both of them better off than if 2 had played its maximin strategy).


A beekeeper lives adjacent to an apple orchard. The orchard owner benefits from the bees because each hive pollinates about one acre of apple trees. The orchard owner pays nothing for this service, however, because the bees come to the orchard without his having to do anything. Because there are not enough bees to pollinate the entire orchard, the orchard owner must complete the pollination by artificial means, at a cost of $10 per acre of trees.

Beekeeping has a marginal cost \(MC = 10 + 5Q\), where \(Q\) is the number of
beehives. Each hive yields $40 worth of honey.

a. How many beehives will the beekeeper maintain?

The beekeeper keeps beehives up to the point where the marginal revenue from a the last beehive ($40) equals its marginal cost ($10 + 5Q). This is $Q$ such that $10 + 5Q = 40$. Solving, we get $Q = 6$. So 6 beehives are maintained.

b. Is this the economically efficient number of hives? Explain.

The economically efficient number of hives would be where marginal social benefit of the beehives equals marginal cost. Since pollination by artificial means costs $10 an acre and a beehive pollinates an acre, the additional benefit of a beehive to the orchard owner is $10. This is the marginal external benefit of beehives. Marginal social benefit equals marginal revenue plus marginal external benefit. So MSB equals $10 + 40 = 50$. Setting this equal to $MC$, we get $10 + 5Q = 50$, and $Q = 8$.

Intuitively, the beekeeper doesn’t maintain the economically efficient number of beehives because he doesn’t take into account the benefit the beehives give to the orchard owner.

c. What changes would lead to a more efficient operation?

The orchard owner could offer to pay the beekeeper $10 each for two extra beehives. Then the beekeeper would get a marginal revenue of $50 from each of the last two hives, and would keep 8 hives.

Another possibility is for the two firms to merge.


Suppose that country A and country B both produce wine and cheese. Country A has 800 units of available labor, while country B has 600 units. Prior to trade, country A consumes 40 pounds of cheese and 8 bottles of wine, and country B consumes 30 pounds of cheese and 10 bottles of wine.

Country A can produce a pound of cheese with 10 hours of labor and a bottle of wine with 50 hours of labor. Country B can produce a pound of cheese with 10 hours of labor and a bottle of wine with 30 hours of labor.

a. Which country has a comparative advantage in the production of each good? Explain.

The relative cost of wine in terms of cheese in country A is 5. The relative cost of wine in terms of cheese in country B is 3. So wine is relatively cheaper in country B, and B has a comparative advantage in wine. A has a comparative advantage in cheese.

b. Determine the production possibilities curve for each country, both graphically and algebraically. (Label the pretrade production point PT and the post-trade point P).
The equation of country A’s production possibilities curve (in autarky) is \(10C + 50W = 800\), where \(C\) is the amount of cheese and \(W\) is the amount of wine. The equation of country B’s production possibilities curve is \(10C + 30W = 600\). When trade is allowed, each country completely specializes in the good it has a comparative advantage in. This is because at any output level, it is relatively cheaper to produce cheese in country A and relatively cheaper to produce wine in country B. So country A’s post-trade production point is \((80, 0)\) where cheese in on the x-axis and wine in on the y-axis. Country B’s post-trade production point is \((0, 20)\).

c. Given that 36 pounds of cheese and 9 bottles of wine are traded, label the post-trade consumption point C.

Country A gives country B 36 pounds of cheese in exchange for 9 bottles of wine, so country A ends up consuming \((44, 9)\) and B ends up consuming \((36, 11)\).

d. Prove that both countries have gained from trade.

Initially country A was consuming 40 pounds of cheese and 8 pounds of wine; after trade it consumes 44 pounds of cheese and 9 pounds of wine - by nonsatiation of preferences this is better. Initially country B was consuming 30 pounds of cheese and 10 bottles of wine; after trade it consumes 36 pounds of cheese and 11 bottles of wine.

e. What is the slope of the price line at which trade occurs?

The price line is the line that passes through the post-trade consumption point and the post-trade production point. For country A, this is the line through \((80, 0)\) and \((44, 9)\), which has slope \(\frac{9-0}{44-80} = -\frac{1}{4}\). For country B, this is the line through \((0, 20)\) and \((36, 11)\), which also has slope \(-\frac{1}{4}\) (if you reversed the axes the slope would be -4).


In example 11.1 (page 400), we saw how producers of processed foods and related consumer goods use coupons as a means of price discrimination. Although coupons are widely used in the United States, that is not the case in other countries. In Germany, coupons are illegal.

a. Does prohibiting the use of coupons in Germany make German consumers better off or worse off?

Those consumers that use coupons would be made worse off by their prohibition, because they will either pay a higher price for the same good or not buy the good at all. Those consumers that didn’t use coupons will be made better off from their prohibition. Now the firms will only be able to offer one price to all consumers, and that price will be in the middle between the price offered to coupon-using consumers and the price offered to other consumers.

b. Does prohibiting the use of coupons make German producers better off or worse off?
It makes producers worse off, because they were able to use coupons to capture demand that wasn’t there at a single price. By offering the good at two different prices, they got more profits.

5. (extra credit) Use indifference curves to show that it is possible for two consumers to gain simultaneously from trade with each other even though their preferences are identical (in other words they have the same set of indifference curves). In this problem, you can use a single graph with just one set of indifference curves, but you must be careful to distinguish between the trades of each of the consumers.

You can show both consumers’ preferences by just one indifference curve since they are the same. Trade can be represented by two arrows of the same length going in opposite directions. Then you can see that if the two people start out at different endowment points, there are two arrows of the same length, going in opposite directions, starting from the two endowment points, such that the tips of the arrows lie on a higher indifference curve than the initial endowments. Thus both people have been made better off through trade (see drawing below).
6. (extra credit) There are three contestants in a competition, which has two stages. In the first stage, a race is run. The winner of the race chooses an opponent for the second stage. In the second stage, a committee chooses a winner between the first-stage winner and the person he or she has chosen as an opponent.

Consider person A’s choices of strategy. Person B is known to be the most popular with the committee, so if he is in the final stage, he will win for sure. Also, if person A wins and chooses person C as an opponent, the committee will be angry at A for not choosing person B, and will vote against A. What should person A do? Explain why this is the best strategy.

Person A should not win the race, and hope that C wins the race and chooses A. This is A’s only chance of winning the competition.