

- The duration of the exam is 1 hour 20 minutes.
- The exam consists of 7 problems and it is worth 100 points. The extra credit problem will only be counted if you lose points on other problems.
- Please write in the space provided. If necessary, write on the back of the page.
- Please ask me if you have any questions.
- To receive full credit you have to carefully explain all your answers and show all your work.

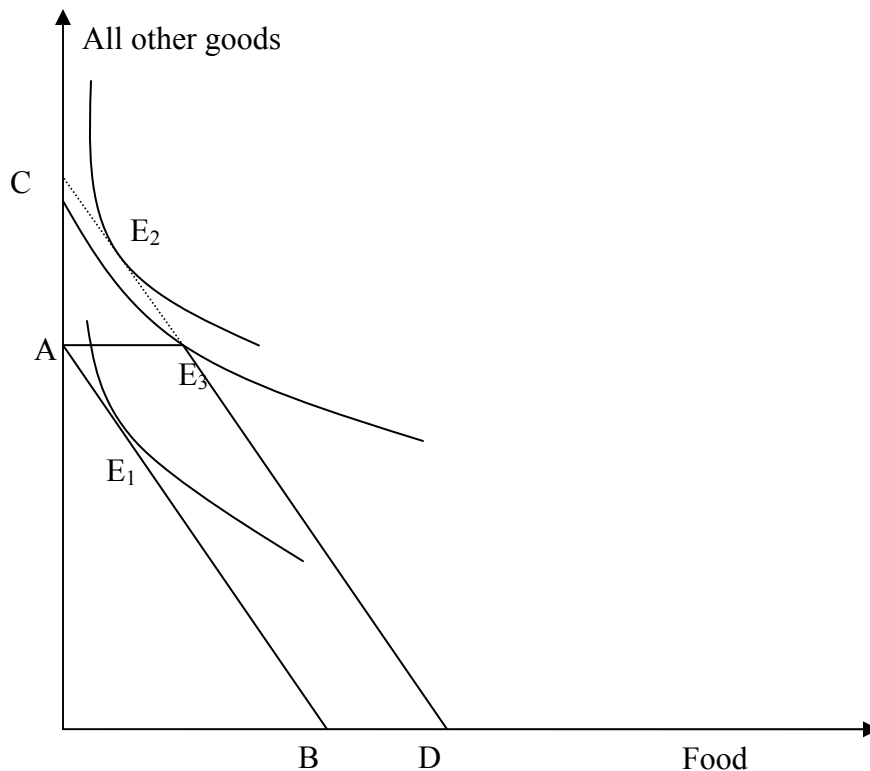
General advice: *If you get stuck in the early parts of a problem, do not stop there. You can receive substantial partial credit by explaining how you would solve the rest of problem if you had the necessary answers from its previous parts.*

1. (10 points) What are the requirements of the First Welfare Theorem?
 - **Competitive markets (no monopolistic power)**
 - **Existence of markets for all commodities.**
2. (10 points) Briefly discuss at least two problems associated with income distribution data collected by US Census Bureau.

The data collected by US Census Bureau:

- **Counts only cash income and doesn't include in-kind benefits;**
 - **Ignores taxes – taxes obviously change income distribution, wealthy people generally pay more in taxes relative to their pre-tax incomes;**
 - **Measures income over a year, which may or may not be the perfect time frame to measure income over;**
 - **Units of measurement – people are counted as members of the same household only if they are legally part of the same family.**
3. (10 points) Which welfare programs are generally more efficient – cash benefit programs or in-kind benefit programs. Explain.

The cash benefit programs are generally more efficient. Consider the figure below. The choice is between food stamps and equivalent sum of cash. Initially the budget is AB and the optimal consumption bundle is E_1 . Now, if this person is given cash his budget becomes CD he chooses bundle E_2 . If instead he gets equivalently valued food stamps, his budget is AE_3D and he chooses E_3 , which is clearly inferior to E_2 .



4. (20 points) Suppose that researchers want to study the effect of the consumption of Ecstasy (illegal drug) on brain damage. The following econometric equation is being estimated: $BD_i = a_1 + a_2 E_i + e_i$, where BD_i is some objective measure of brain damage of person i , and E_i is the monthly consumption of Ecstasy by person i , e_i is the error term, a_1 and a_2 are parameters to be estimated. Suppose that regression procedure yields positive estimates of both parameters: $a_1 = 0.5$ and $a_2 = 1.35$ (which means that there is positive correlation in the data between brain damage and Ecstasy consumption).
- a. Give at least two examples of factors which the error term is intended to capture here.

Generally, the error term captures the influence of all other relevant variables not already included in the regression equation. The possible examples include:

- **Consumption of *other* illegal drugs ;**
- **Level of toxic pollutants in the county of residence ;**
- **Whether this person leads active lifestyle (falls often when playing ball) ;**
- **Presence of related medical problems in parents;**

- b. Name at least three problems with regression analysis and provide specific interpretation of these problems for the case discussed in this problem.
- **It is possible that the consumption of Ecstasy is not exogenous. Both of the variables in question may be determined jointly by some factor, which we can call “propensity to engage in dangerous activities”.**
 - **It is necessary to control for other factor affecting brain damage (see part (a)). The omission results in bias.**
 - **Measurement error may be an issue. It is presumably difficult to collect accurate information from drug addicts. Plus, brain damage is probably difficult to quantify.**
 - **There may be different subpopulations with different tolerance for drugs. Some people may get brain damage just after a few pills, some others may have their brain technically intact after long continuous use.**
- c. Do you think other empirical methods would allow us to get “better” (more reliable) results? Carefully argue why or why not?

Interviews are not likely to get much better results because the question is inherently quantitative and probably requires quantitative technique to address it. Experiments on the other hand could perform much better. Mostly because experiments allow random assignment of subjects to ‘drug’ and ‘no drug’ groups. The problem is obvious – nobody would want to hook healthy people on drugs just to study their effects. The classical experiments are therefore not possible to conduct here.

5. (30 points) Imagine that there are two people in one room – Mary and Jane. Mary is smoking cigarettes. The table below shows Mary’s Marginal Private Benefits (MPB_M) and Marginal Private Costs (MPC_M) of smoking each additional cigarette, as well as Marginal Damages (MD_J) to Jane from each additional cigarette:

Number of cigarettes smoked	MPB_M	MPC_M	MD_J
1	14	5	5.5
2	12	6	6
3	10	7	6.5
4	8	8	7
5	6	9	7.5
6	4	10	8
7	2	11	8.5

- a. How many cigarettes is Mary going to smoke? Explain.

Mary is going to smoke 3 or 4 cigarettes (both answers are acceptable). The first three cigs give Mary positive net benefit ($MPB_M > MPC_M$). She is indifferent between smoking the fourth cig and not smoking it because $MPB_M = MPC_M$.

- b. What is the socially optimal number of cigarettes? Explain.

Socially optimal number of cigarettes is either 1 or 2 (both answers are acceptable). The marginal benefits of the first cigarette are higher than marginal social costs ($14 = MPB_M > MSC = MPC_M + MD_J = 5 + 5.5 = 10.5$). The society is indifferent between Mary having second cig and not having it ($MPB_M = MSC = 12$).

- c. What is the net welfare benefit to society from moving from output in part (a) to socially optimal output in part (b)?

Depending on how you answered parts (a) and (b) you can have minor differences which are perfectly acceptable as long as you explain how you got the numbers. For example, assume that Mary smoked 4 cigs and it is socially optimal to smoke 2. The reduction will hurt Mary by $3 = (8 - 8) + (10 - 7)$ – lost net benefit from fourth and third cigarettes respectively. Jane will gain (not suffer) $13.5 = 7 + 6.5$ – damages from fourth and third cigarettes respectively. The net gain is therefore $13.5 - 3 = 10.5$. If you assumed that Mary smokes 3 cigs the net benefit to society is 3.5 (irrespective of your answer in part (b)). Both of these numbers are acceptable (both of them are positive, which is the only important thing here).

- d. Suggest a Pigouvian tax that would induce Mary to smoke socially optimal number of cigarettes?

The optimal Pigouvian tax should be equal to the Marginal Damages at the socially optimal output. There are two acceptable answers to this question $t = 5.5$ and $t = 6$.

- e. Suppose that property rights to the air in the room were assigned to Jane. Do you think that Coase Theorem could be applied here? Explain.

The Coase Theorem requires that:

- **Costs of bargaining are low (which is the case here because there are just two people involved);**
- **Property right are well-defined and it is easy to identify the source of damages (which is also the case here).**

So Coase Theorem could certainly be applied here.

- f. Do you think it makes sense to ban smoking in this room altogether? Explain.

No, it is not socially optimal to have zero smoking. Even though Jane is hurt by any number of cigarettes smoked in the room, society has to take into account

the benefits to Mary from smoking. Generally, it almost never makes sense to get rid of all pollution.

6. (20 points) Consider two neighbors Terry and Rob. They both plan to produce fireworks on the New Year's Day. The (inverse) demand functions are given by:
 $P_T = 50 - Q_T$; $P_R = 50 - Q_R$ (quantities are expressed in number of rockets used); the marginal cost is given by $MC = 40 = \text{const}$.
- a. First suppose that Terry and Rob can prevent each other from watching the fireworks that each of them produces. In other words, fireworks display is excludable and is therefore a private good. What is the efficient number of rockets used by both Terry and Rob in this case? Show all your work.

First we have to find the total demand in this economy. In case of private goods, we perform *horizontal summation* of individual demand curves. We first invert both of the individual demand curves

$$Q_T = 50 - P_T, 0 \leq P_T \leq 50; \quad Q_R = 50 - P_R; \quad 0 \leq P_R \leq 50$$

Then we sum the two demands (we sum quantities for each level of price) to get

$$Q = 100 - 2P, 0 \leq P \leq 50$$

Now, to find the equilibrium in this market, we need to invert it back (to be able to equate it with supply, which is expressed in dollar terms)

$$P = 50 - 1/2Q, 0 \leq Q \leq 100$$

So Supply = 40 = 50 - 1/2Q = demand produces the following quantity

$$Q_{pr}^* = 20, P_{pr}^* = \$40.$$

We know that in private good case competitive markets produce efficient result.

- b. Now assume that it's impossible to exclude neighbors from watching and enjoying fireworks. Now fireworks display is a public good. What is the efficient number of rockets in this case? Show all your work.

Again, we have to find the total valuation in this economy. In case of public goods, we perform *vertical summation* of individual demand curves. This amounts to summing the inverse demands given in the setup of the problem.

$$P = 100 - 2Q$$

Now, to find the efficient level of public good, we just set our total valuation schedule given above equal to supply (=40)

$$\text{So, } 40 = 100 - 2Q$$

By solving the equation above we get quantity $Q_{pb}^* = 30$, $P_{pb}^* = \$40$.

- c. Define the free-rider problem. Based on your results in parts (a) and (b), comment if free-rider problem is present in this case? (If you weren't able to answer either part (a) or part (b) or both, assume that quantity in part (a) is 25 and quantity in part (b) is 35)

Free rider problem is an incentive for an individual to claim that his valuation of a good is lower than it actually is. Both Terry and Rob have an incentive to say that 'I don't really care about fireworks'; at the same time hoping that his neighbor will produce fireworks for everyone to see and enjoy. As a result, the amount of fireworks that markets produce is suboptimal.

7. (extra credit – 5 points) State of Virginia recently came very close to passing a bill that would introduce \$50 fine for wearing pants in such a way that underwear is visible in “a lewd or indecent manner” (bill passed through state House but was rejected by the Senate). The bill would effectively prohibit wearing pants very low. Provide a justification for such a policy based on theory of externalities. Do you think this policy would lead to efficient outcome? Explain why or why not?

It is more or less obvious that the reason for such a policy would be a negative externality. People may extract negative utility from having to look at the underwear of other people on the street. What is more difficult to determine is whether this policy would have been efficient. I would argue that it wouldn't on at least two grounds. First of all, it is not clear that all people displaying their underwear in public impose exactly the same costs on other people. It is fairly easy to think of good-looking individuals that actually have positive effects on other people (positive externality). At the very least it is reasonable to assume that there is sizeable heterogeneity as far as negative externalities are concerned. We know that in the presence of heterogeneity command-and-control methods produce inefficient results (this is a command-and-control method despite its similarity to a tax; this regulation would effectively ban wearing pants low). Other point that I wanted you to make is that generally it is not efficient to ban externality-producing activity. The benefits to the wearer should be taken into account too.