MICROECONOMICS 3
PROBLEMS #6

EXTERNALITIES

Problem #1

The private and social marginal costs functions are given by the following formulas: $MPC(q) = MSC(q) = 10 + 3q$, where q stands for output quantity. The private and social marginal benefits functions are: $MPB(q) = 70 - 2q$, $MSB(q) = 70 - q$. Find the Pigouvian subsidy rate eliminating inefficiency in this market.

Problem #2

A milk dairy is located in the neighborhood of the airport. The total revenue of the airport is $TR_A(A) = 48A$, while the total cost is $TC_A(A) = A^2$, where A is the daily amount of landing airplanes. The total revenue of the dairy is $TR_D(C) = 60C$, while the total cost is $TC_D(C) = C^2 + C*A$, where C is the amount of cows (in hundreds). Notice that the nearby localization of the airport causes negative externalities for the dairy.

a) How many cows would the dairy have and how many airplanes would be landing daily, if both enterprises maximized profits in absence of any legal restrictions concerning negative effects of the airport's activity on its surroundings? Find the total profits of both enterprises in this case. Assume there is no possibility of an agreement between the airport and the dairy concerning the number of landing airplanes.
b) Find the Pigouvian tax rate aiming at a correction of the erroneous market allocation described in point a). How many cows would then be kept by the dairy and how many airplanes would be landing? Find the total profits of both enterprises for this case (calculate the tax as $T(A) = (MSC(A_{corr}) - MPC(A_{corr}))(A - A_{corr})$, where A_{corr} is the daily number of landing airplanes following the correction of the erroneous allocation).
c) Assume that there exists a law that demands that the airport fully compensates the dairy's loss of profits caused by the negative externalities of the airport's activity. How many cows would then be kept by the dairy and how many airplanes would be landing? (the remaining conditions are as in point a)). Find the total profits of both enterprises.
d) Assume that both enterprises are able to agree on the number of landing airplanes. Find the compensation amount that the dairy should offer the airport in order to maximize its profits (provide the relevant calculations). How many cows would then be kept by the dairy and how many airplanes would be landing? Find the total profits of both enterprises.

Problem #3

Every morning 6000 persons must commute from the southern residential district in city A to the northern one, where they work. All of them go by car. They may choose to drive through the city center (road 1) or use the beltway (road 2). Road 2 is longer than road 1, however it is never crowded. By beltway it takes 45 minutes to drive from the southern to the northern district. The driving time on road 1 depends on the congestion in the following way: $t = 20 + n/100$, where t – time to reach the destination in minutes, n – number of users of the road.

a) In equilibrium how many persons will use road 1?
b) How much time will altogether inhabitants of the southern district spend driving from the south to the north?

Experts have been hired to determine the maximum number of persons who should use road 1 in order to minimize the total time spent driving in the morning by all inhabitants of the southern district.

c) Assuming it is not possible to reach them by phone call determine this number yourself.
d) How long will it now take a person using road 1 to drive to the north?
e) How much time will altogether inhabitants of the southern district now spend driving from the south to the north?

Based on economists' calculations the value of time spent driving has been estimated to be 30 cents per minute.

f) How much should the fee for using road 1 be so that the total driving time of all inhabitants of the southern district is minimized?
g) Who will incur costs as a result of introducing such fee? Is the answer to this question dependent on the way the revenue from fees is distributed between the inhabitants?

Problem #4

Two farmers are living in a village. One of them raises pigs, while the other runs an agritourism farm. The pig farm generates externalities in the form of unpleasant odor and noise. The total cost function for the pig farmer is $TC_1 = 0.03P^2 + 30P$, where P stands for the number of pigs raised per year, while the total cost function for the agritourism farm is $TC_2 = 0.02T^2 + 0.02TS + 5T$, where T denotes the number of nights spent on the farm by tourists per year. Both the market for pigs and the market for agritourism are purely competitive. The price of an adult pig is 120 zloty, while the price of a single night at the agrotourism farm is 40 zloty.

a) Find the output and annual profits of the pig farmer and agritourism farm, assuming that there is no government intervention and that farmers cannot communicate with each other.
b) Find the socially efficient output of each farmer, assuming internalization of the externality described above.
c) Find the Pigouvian tax rate aimed at correction of the erroneous market allocation described in point a).

Multiple choice questions:

Problem #1

The production of good X generates negative externalities. Assuming that the market for good X is purely competitive, in equilibrium:

a) output level will be higher and the price level will be higher than socially optimal
b) output level will be lower, while the price level will be higher than socially optimal
c) output level will be higher, while the price level will be lower than socially optimal
d) output level will be lower and the price level will be lower than socially optimal

Problem #2

Private and social marginal cost functions are given, respectively, by the following formulae: $MPC(q) = 4q$, $MSC(q) = 4 + 5q$, while the private and social marginal benefit function is

$MPB(q) = MSB(q) = 28 - q$ (conventional notation). The Pigouvian tax rate $PT(q)$ eliminating the market inefficiency is:

a) 8
b) 6
c) 4
d) 1
e) none of the above

Problem #3

Intervention in the market aiming at correcting an erroneous market allocation resulting from a negative externality (external cost) may consist in introducing a tax so that:

a) the marginal external cost is equal to zero
b) the injured receive a compensation equal to the total external costs
c) marginal social benefits are equal to marginal social costs
d) marginal external benefits are equal to marginal external costs
e) none of the above

Problem #4

The Coase Theorem suggests a way to correct erroneous market allocations resulting from externalities. The practical application of this approach is often hindered by:

a) the difficulty that the government encounters when estimating the size of the externality
b) the unfair burdening of the entity generating the externality with the obligation to pay a fee to the injured party
c) the lack of insurance covering the risk involved in the transaction between the injurer and the injured party
d) the existence of high transaction costs
e) none of the above

Problem #5

The marginal costs of a firm producing good X are given by the formula $MCF = 0.6X$. The government estimated that the social costs of producing X are $MCS = 0.8X$. The firm is a price taker and the market price is P_X=48. How much should the tax per unit amount to?

a) 12
b) 14
c) 16
d) 10
e) 8