Economics 428   Gallant
Sample final exam   Fall 2021

There are about nine more questions on this sample final exam than there would be on an actual final exam.

Directions: For the multiple choice questions, circle the letter to indicate your choices. Each question has been constructed so that there is one and only one correct or best answer. For the problems, show how you are solving each part of the problem and be as clear as you can with your answers. Partial credit will be awarded if significant progress is made towards the answer. Clearly indicate your final answer. This exam will be closed-book and closed-note, with the exception that each student may have one 8.5×11 sheet of paper with material on it. Calculators may be used. Each student must work the exam individually and independently of other students or individuals.

1. (2 *points*) A public good is

    (a) Rival and excludable
    (b) Rival and non-excludable
    (c) Non-rival and excludable
    (d) Non-rival and non-excludable

2. (2 *points*) To aggregate individual demands to the the market demand curve for a rival good one

    (a) Sums horizontally, i.e., for each marginal willingness to pay one adds up the quantities each individual is willing to buy.
    (b) Sums vertically, i.e., for each quantity one adds up the marginal willingness to pay of each individual.

3. (2 *points*) To aggregate individual demands to the the market demand curve for a non-rival good one

    (a) Sums horizontally, i.e., for each marginal willingness to pay one adds up the quantities each individual is willing to buy.

(b) Sums vertically, i.e., for each quantity one adds up the marginal willingness to pay of each individual.

4. (2 *points*) If the marginal social benefit curve is steeper than the marginal abatement cost curve, and if the abatement marginal cost curve is not known with certainty by the regulator, then to regulate emissions

   (a) A cap and trade policy is preferable.
   (b) An emissions tax policy is preferable
   (c) It doesn't matter, one works as well as the other.

5. Consider an airport that produces noise that decays as the distance d, in miles, from the airport increases: $N(d) = 1/d^2$. Fritz works at the airport. Fritz's damage from noise is \$1 per unit of noise and is associated with where Fritz lives. That is, if Fritz lives d miles from the airport his damage is $D(d) = (\$1)(1/d^2)$ and his marginal damage is $MD(d) = (\$1)(-2/d^3)$. His round-trip cost of commuting is \$2 per mile. The closest he can live to the airport is 0.1 mile.

   (a) (5 *points*) Write an expression for Fritz's total costs (noise and transportation).

   (b) (5 *points*) What is the distance that Fritz will live from the airport in the absence compensation for the noise? What are his total costs?

   (c) (5 *points*) Suppose Fritz is compensated for his damage, wherever he may live. How close to the airport will he choose to live? How much will he be compensated?

6. A hedonic regression is run on the selling prices P of houses near an airport that sold within the last five years that results in the equation

$$P = 100000 - 200 \times N + 0.25 \times \text{income}$$

where P is the most recent selling price in current year dollars, $N = 1/d^2$, and d is the distance from the airport in miles. By current year dollars one means that the selling prices have been adjusted for inflation and the base year is the year of today's date.

   (a) (5 *points*) What is the marginal willingness to pay on a per house basis for noise abatement when the benchmark is the noise level at 0.1 mile from the airport.

(b) (2 *points*) What is the annualized marginal willingness to pay assuming an interest rate of 10%.

7. Consider two adjacent states, S_1 and S_2, that wish to control particulate emissions from power plants and cement plants; New Jersey and Pennsylvania, for example. Each state wants to remove all particulates larger than 100 nanometres from the airspace below 1000 feet. Suppose this requires 50 kilotons of abatement in each state. The aggregate cost of abatement when the marginal abatement costs of all industries within the state are equalized is $3A_1^2$ for state S_1 and it is A_2^2 for state S_2, where A_i is measured in kilotons.

(a) (5 *points*) If the states do not cooperate, what is the cost of abatement in state S_1.

(b) (2 *points*) Would a permit market with 50 kilotons of emissions permits distributed to the firms by means of an ascending clock auction equate the marginal abatement costs of all power and cement firms within state S_1? You may assume that no firms are bankrupted.

(c) (5 *points*) If the states do not cooperate, what is the cost of abatement in state S_2.

(d) (5 *points*) If the states do cooperate by means of a 100 kiloton cap and a permit market that covers both states with permits allocated by an ascending clock auction, what is the total cost of abatement. You may assume that no firms are bankrupted. You may also assume that a joint auction will not change the aggregate cost functions $3A_1^2$ for state S_1 and A_2^2 for state S_2.

(e) (2 *points*) Why does the sum of the costs of abatement from question 7a and 7c not equal the cost of abatement in question 7d.

8. A beekeeper, Jane, and a farmer with an apple orchard, Joe, are neighbors. This is convenient for Joe because the bees pollinate the apple trees: one beehive pollinates one acre of orchard. Unfortunately, there are not enough bees next door to pollinate the whole orchard and pollination costs are $10 per acre. Jane, the beekeeper, has

total costs of $TC = H^2 + 10H + 10$ and marginal cost $MC = 10 + 2H$, where H is the number of hives. Each hive yields $20 worth of honey.

(a) (5 *points*) How many hives would Jane maintain if operating independently of Joe?

(b) (5 *points*) How many hives would Jane maintain if Joe offers Jane $10 per hive?

(c) (5 *points*) What is the extra profit (surplus) that Jane receives from this transaction?

(d) (5 *points*) Suppose that Joe wants to try to capture this surplus for himself by making Jane a take it or leave it offer. How many hives over and above the answer to question 8a should Joe offer to buy and how much should Joe offer Jane in total for this incremental number of hives.

9. In a market, demand is given by $P = 50 - Q$ and the (private) marginal cost of production for the aggregation of all firms (the industry supply curve) is given by $MC = Q$. Pollution by the industry creates external damages given by the (constant) marginal external cost curve $MEC = 30$.

(a) (4 *points*) Calculate the output and price of if the industry operates under competitive conditions without regulation.

(b) (4 *points*) Calculate the socially efficient price and output of the industry.

(c) (5 *points*) Calculate the deadweight loss due to operating at the competitive level of output rather than the socially efficient level of output.

10. Suppose that a steel mill and a laundry are close to each other and the existing abatement technology permits these production possibilities:

steel mill abatement	steel mill profit	laundry profit
none	800	75
25%	700	150
50%	600	300
75%	500	350
100%	400	400

Profits are in millions of $.

(a) (3 *points*) If the laundry has a right not to be damaged by the steel mill's pollution, which of the production possibilities will be chosen and how much will the steel mill pay the laundry?

(b) (3 *points*) If the steel mill has the right to pollute, which of the production possibilities will be chosen and how much will the laundry pay the steel mill?

11. (2 *points*) The marginal private cost of paint production is $MC = 2 + 0.05Q$, where Q is measured in gallons per month. Because paint production releases volatiles that contribute to air pollution the marginal social cost (sum of marginal private cost and marginal external cost) is $MSC = 2 + 0.06Q$. The competitive market price for paint is spray is $14 per gallon. What is the socially efficient level of output.

(a) 0
(b) 100
(c) 200
(d) 300
(e) 400

12. There are two groups in a community. Their demand curves for public television in hours of programming, T, are given respectively by

$$W_1 = \$300 - T$$
$$W_2 = \$420 - 2T.$$

Suppose public television is a pure public good that can be produced at a constant marginal cost of $300 per hour.

(a) (2 *points*) Graph the two groups' marginal willingness to pay as well as the total willingness to pay. Label the axes and the curves in the graph.

(b) (4 *points*) What is the efficient number of hours of public television?

(c) (4 *points*) How much public television would a competitive private market provide?

13. Suppose the state is trying to decide how many miles of a senic river it should preserve. There are 100 people in the community, each of whom has an identical demand function given by $P = 10 - Q$, where Q is the number of miles preserved and P is the price in dollars each person is willing to pay for Q miles of preserved river.

(a) If the cost of preserving Q miles is $C(Q) = 500 \times Q$ dollars, how many miles would be preserved in a socially efficient allocation?

(b) How large is the consumer surplus?

14. (a) Suppose you want to remove ten fish of an exotic species that have been illegally introduced to a lake (e.g., piranha). You have three possible removal methods. Assume that q_1, q_2, and q_3 are, respectively, the amount of fish removed by each method that you choose to use so that the goal will be accomplshed by any combination of methods such that $q_1 + q_2 + q_3 = 10$. If the marginal costs of each removal method are, respectively, $10q_1$, $5q_2$, and $2.5q_3$, how much of each method should you use to achieve the removal cost-effectively?

(b) Why isn't an exclusive use of method 3 cost effective?

(c) Suppose that the three marginal costs were constant (not increasing as in case 14a) such that $MC_1 = 10$, $MC_2 = 5$, and $MC_3 = 3.5$. What is the most effective outcome in that case?

15. The most abundant greenhouse gas is

(a) carbon dioxide

(b) methane

(c) water vapor

(d) ozone

16. For observational data such as global temperature, stock market prices, unemployment, the most persuasive scientific evidence that one variable causes a change in another is

   (a) A model derived from accepted theory that demonstrates that a change in one variable causes a change in another.

   (b) A regression that finds a significant relationship between the two variable.

   (c) Plots of the two variables showing that they move together in the same proportion over time.

17. Listed below are considerations within an economic model, such as Ken Judd's DSICE model, that cause the model to value an uncertain future payment that is expected to be $100 at a lower price than a certain future payoff of $100. Which is missing in Ken Judd's model?

   (a) The amount of expected variability in the payoff (standard deviation).

   (b) Elasticity of intertemporal substitution, how much consumption one is willing to defer when the interest rate increases.

   (c) Risk aversion, what bets one is willing to accept.

   (d) Uncertainty in ones understanding, uncertainty that the model and the values plugged into it are correct.

18. If $P_1 = 9$ and $P_2 = 10$ for the example considered in class to illustrate Coase's Theorem, the following table results.

$P_1 = 9$, $P_2 = 10$	Q_1	Q_2	Profit 1	Profit 2	Total
Optimal (merge firms)	0	5			21
No Property Rights	4.5	2.75	12.25	3.57	15.82
Firm 1 Shut Down	0	5	0	21	21
Property Rights					
Polluter Pays	?	?	?	?	?
Victim Pays	?	?	?	?	?

(a) Fill in the cells marked with question marks.

(b) What is the dead weight loss due to the externality?

19. If $P_1 = 13$ and $P_2 = 10$ for the example considered in class to illustrate Coase's Theorem, the following table results.

$P_1 = 13$, $P_2 = 10$	Q_1	Q_2	Profit 1	Profit 2	Total
Optimal (merge firms)	5.33	2.33			34.33
No Property Rights	6.5	0	34.25	0	34.25
Firm 1 Shut Down	0	5	0	21	21
Property Rights					
Polluter Pays	?	?	?	?	?
Victim Pays	?	?	?	?	?

(a) Fill in the cells marked with question marks.

(b) What is the dead weight loss due to the externality?

20. Suppose that there are two consumers with willingness to pay as follows:

Group 1: Green good $100; Conventional good $50.

Group 2: Green good $75; Conventional good $40.

How much revenue will the following two pricing schemes generate?

Scheme 1: Green good $90; Conventional good $40.

Scheme 2: Green good $80; Conventional good $40.

21. Firm 1's marginal abatement cost is $MAC_1(A_1) = \$A_1$, Firm 2's marginal abatement cost is $MAC_2(A_2) = \$2A_2$, and Firm 3's marginal abatement cost is $MAC_3(A_3) = \$6A_3$. These three firms have a total abatement requirement of A. The firms will divide the abatement among themselves such that $A = A_1 + A_2 + A_3$ and $MAC_1(A_1) = MAC_2(A_2) = MAC_3(A_3)$. That is, they will equalize marginal abatement costs. Each firm has more emissions that A so that it would be possible for one firm to perform all the abatement necessary but this is unlikely to equalize abatement costs.

(a) Compute A_1, A_2, and A_3.

(b) Compute $MAC_1(A_1)$ for the value of A_1 computed in Part 21a

(c) Compute $MAC_2(A_2)$ for the value of A_2 computed in Part 21a

(d) Suppose that there are 300 firms, 100 that have MAC_1, 100 that have MAC_2, and 100 that have MAC_3. Suppose that each firm has chosen an output that produces emissions $E = 15$, has enough permits to cover $E = 10$, and can afford to abate $A = 5$ if it cannot buy permits cheaper than it can abate. If these 300 firms participate in a permit market; what will be the price of a permit.