University of Athens **Academic year 2023-2024**

Department of Economics

Master's program in Applied Economics

Course: Economic Policy

Assignment no. 1:

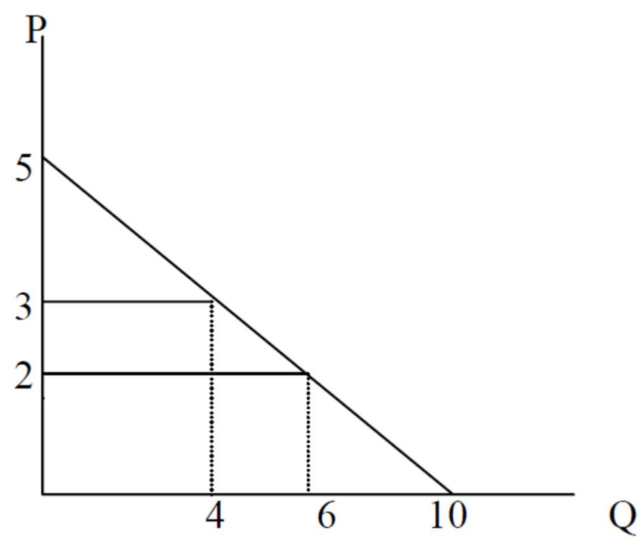
Answer all questions. Deadline 7 May 2024

Question 1.

Annas' demand curve for apples is: $Q = 10 - 2P$, where Q is the pounds of apples per week, and P is the price per kilo of apples.

(1) If the price of apples is €3 per kilo, what is Anna's consumer surplus?

(2) If the price goes down to €2 per kilo, what is the change in consumer surplus?



Question 1. Answer

The inverse demand for apples is $P = 5 - (1/2)\,Q$, which is shown in the above diagram.

The quantities corresponding to P=3 and P=2 are calculated according to the demand function.

(1) When the price is €3, the consumer surplus CS = (1/2) x 4 x (5 − 3) = 4

(2) When the price is €2, the consumer surplus CS = (1/2) x 6 x (5 − 2) = 9

So the change in consumer surplus is $\Delta CS = 9 - 4 = 5$

(We can also calculate the change in consumer surplus by using the formula for trapezoid $\Delta CS = (1/2)\text{x}(4 + 6) \text{ x } (3 - 2) = 5$, or by adding the rectangle and triangle together: $\Delta CS = (3 - 2) \times 4 + (1/2) \times (3 - 2) \times (6 - 4) = 4 + 1 = 5$

Question 2.

Which of the following is true
Consumer surplus is:

a) A measure of consumer welfare.
b) The area under the ordinary demand curve.
c) The area under the supply and demand curves.
d) The best measure of consumer welfare.

Question 2 Answer: a
Response: Consumer surplus is the difference between the willingness to pay for additional units of a good and the price that is actually required in order to obtain the good. As such, it is the area under the ordinary demand curve *and* above price. Hence, (b) and (c) are incorrect. Consumer surplus is measured under the ordinary demand curve. Whether consumer surplus is the "best" measure of consumer welfare is a matter of some dispute. When there is no income effect, compensating variations, equivalent variations and consumer surplus all yield the same measure of consumer welfare and can be considered equivalent. If there are income effects, however, consumer surplus falls between the equivalent variation and compensating variation because it does not keep purchasing power constant when prices are changed. As a result, it approximates what we might *like* to measure when a change in prices occurs, but does not measure it precisely.

Question 3.
Which of the following statements is true?

a) The compensating variation measures the income transfer necessary to maintain the consumer at the initial level of utility when facing the new prices.
b) The compensating variation measures the income transfer necessary to maintain the consumer at the final level of utility when facing the old prices.
c) The equivalent variation measures the income transfer necessary to maintain the consumer at the initial level of utility when facing the new prices.
d) The equivalent variation measures the income transfer necessary to maintain the consumer at the final level of utility when facing the old prices.

Question 3 Answer: a, d
The definition of the compensating variation is the measure of income transfer necessary to maintain the consumer at the initial level of utility when facing the new prices. The definition of the equivalent variation is the income transfer necessary to maintain the consumer at the final level of utility when facing the old prices. This is a purely definitional question. (b) is incorrect because it is the definition of the equivalent variation, and (c) is incorrect because it is the definition of the compensating variation.

Question 4.

Since the free market (competitive) equilibrium maximizes social efficiency, why would the government ever intervene in an economy?

Question 4, Answer

Efficiency is not the only goal of government policy. Equity concerns induce government to intervene to help people living in poverty, even when there are efficiency losses. In economic terms, a society that willingly redistributes resources has determined that it is willing to pay for or give up some efficiency in exchange for the benefit of living in a society that cares for those who have fewer resources. Social welfare functions that reflect this willingness to pay for equity or preference for equity may be maximized when the government intervenes to redistribute resources.

Question 5

Consider a firm with no fixed costs, but continuously increasing marginal costs (*MC*). The demand curve is D=6-Q, and the supply S=Q. The variable *Q* denotes quantity, while *P* denotes price.

a) Assume initially that the firm uses marginal cost pricing (as in competitive market equilibrium). Find *Q* and *P* in this case. How big is the firm's profit? How big is the producer surplus? How big is the consumer surplus? (Assume that the compensated demand curve is identical to the ordinary demand Find social welfare as the sum of the consumer surplus and the producer surplus.)
b) Now assume that the firm behaves like a monopolist. What is the monopoly output and price? What is the firm's profit? How big is the producer surplus? How big is the consumer surplus? Find social welfare in monopoly.
c) Compare your findings in a) and b) and comment briefly.
d) Calculate the deadweight loss resulting from monopoly in this case. Compare the deadweight loss under monopoly and perfect competition.

Answer to Question 5.

a) Marginal cost pricing implies that $Q = 3$, $P = 3$. Producer surplus = $\frac{1}{2}\cdot 3\cdot 3$ = 4.5.
b) Profit = Producer surplus (as no fixed costs). Consumer surplus = $\frac{1}{2}\cdot 3\cdot 3$ = 4.5. SW = 4.5 + 4.5 = 9.
c) Monopoly pricing implies $Q = 2$, $P = 4$. Producer surplus = profit = $\frac{1}{2}\cdot 2\cdot 2 + 2\cdot 2$ = 6. (Producer surplus = area between MC and the price line.) Consumer surplus = $\frac{1}{2}\cdot 2\cdot 2$ = 2. SW = 6 + 2 = 8.
d) Social welfare lower under monopoly pricing than under marginal cost pricing.

Question 6

a) Consider a mini-society consisting of five individuals. They earn respectively 5, 20, 25, 10, and 40. Draw the Lorenz curve for this mini-society.
b) Assume that the government implements a programme yielding the following distribution: 20, 5, 15, 40, and 20. How did the programme impact the distribution as measured by the Lorenz curve?

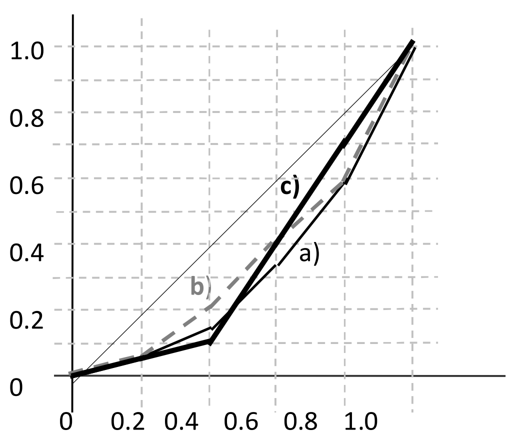
c) Assume that instead of the programme in c), the government implements a redistribution programme resulting in the following incomes: 5, 30, 30, 5, and 30. How did this programme change the distribution in b) as measured by the Lorenz curve?

Answer to Question 6

a)

	Share of population	≤ 0.2	≤ 0.4	≤ 0.6	≤ 0.8	≤ 1.0
a)	Share of income	0.05	0.15	0.35	0.60	1.00
b)	Share of income	0.05	0.20	0.40	0.60	1.00
c)	Share of income	0.05	0.10	0.40	0.70	1.00

b) Share of income



Results: Distribution b) more even than a). Distribution c) cannot be ranked vs. distribution a) using a Lorenz curve as the curves cross.

Question 7

Consider a Lorenz curve given by the equation $s_M = (s_h)^2$ where $s_M \in [0,1]$ denotes the share of income and $s_h \in [0,1]$ denotes the share of households.

a) Explain how the Gini coefficient is calculated and how it should be interpreted.

b) Calculate the Gini coefficient for the Lorenz curve in b).

Answer Question 7

a) The Gini coefficient is two times the area between the Lorenz curve and the 45°-line. Lower Gini implies lower inequality. Gini coefficient measures inequality but not impact on social welfare.

b) Area *below* Lorenz curve = $\int_0^1 s_h^2 ds_h = \frac{1}{3}$. Area between Lorenz curve and 45°-line = $\frac{1}{2} - \frac{1}{3} = \frac{1}{6}$. Gini coefficient = $\frac{1}{6} / \frac{1}{2} = \frac{1}{3}$.

Question 8

Consider two households, A and B, with potentially different demographic compositions. Both have (monetary) income and spend it on two goods, x_1 and x_2. Good 1 is food, while good 2 is housing. The price of good 1 is p_1 and the price of good 2 is p_2. Household A has income M^A and the utility function $U^A = (x_1^A)(x_2^A)^{M^A}$, while household B has income M^B and the utility function $U^B = (x_1^B)(x_2^B)^{(M^B)^2}$. (Notice the income variables in the exponents.)

a) Find household A's and household B's demand for food. (The households take incomes and prices as given.)

b) At which income level does household A spend 50% of its income on food? At which income level does household B spend 20% of its income on food?

c) Find the Engel equivalence scale.

Answer Question 8

a) Solve max. problem or insert into formula:

$$x_1^A = \frac{1}{1+M^A}\frac{M^A}{p_1}$$

$$x_1^B = \frac{1}{1+(M^B)^2}\frac{M^B}{p_1}$$

b) Share^A = $\frac{x_1^A p_1}{M^A} = \frac{1}{1+M^A} = 0.5 \;\Rightarrow\; M^A = 1$.

Share^B = $\frac{x_1^B p_1}{M^B} = \frac{1}{1+(M^B)^2} = 0.2 \;\Rightarrow\; M^B = 2$.

c) Engel equivalence scale ~ spend same share on food $\Rightarrow \frac{1}{1+M^A} = \frac{1}{1+(M^B)^2}$ $\Rightarrow$ Engel equivalence scale = $\frac{M^A}{M^B} = M^B$. If ratio $\frac{M^A}{M^B} = M^B$ then the two households spend the same on food.

Question 9.

Sketch the indifference curves of the Bergson-Samuelson social welfare function $W = U^1 + U^2$. What do these indifference curves imply about the degree of concern for equity of the social planner? Repeat for the welfare function $W = \min\{U^1, U^2\}$.

Answer Question 9.

Take a given level of social welfare $\overline{W}$. The indifference curve for the social welfare function $W=U^1+U^2$ at this level of social welfare is defined by the values U^1 and U^2 that satisfy: $U^2= \overline{W} - U^1$
The indifference curves are downward-sloping straight lines with gradient -1. These curves are shown in Figure 1. The indifference curves imply that the social planner does not care about equity. For instance, the inequitable allocation $U^1= \overline{W}$, $U^2= 0$ is judged as no worse than the equitable allocation $U^1= \frac{\overline{W}}{2}$, $U^2= \frac{\overline{W}}{2}$
The indifference curves for the social welfare function $W=\min\{ U^1, U^2 \}$ are sketched in Figure 2
This welfare function represents an extreme concern for equity. Social Welfare is determined by the utility level of the worst-off consumer. Raising the utility of the better-off has no effect on social welfare.

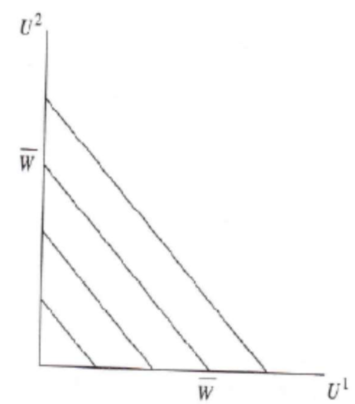


Figure 1: Indifference curves of $W= U^1+U^2$

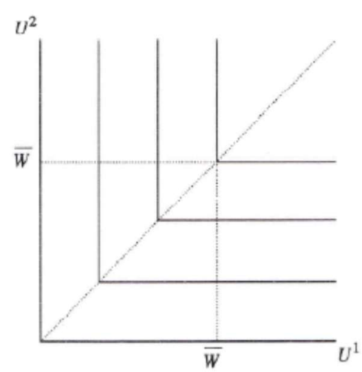


Figure 2: : Indifference curves of $W= \min(U^1, U^2)$

Question 10.

There are H consumers who each have utility function $U^h = \log (M^h)$. If the social welfare function is given $W = \sum U^h$, show that a fixed stock of income will be allocated equitably. Explain why this is so.

Answer Question 10.

Substituting in the individual utility functions allows the social welfare function to be written as

$$W = \sum_{h=1}^{H} U^h = \sum_{h=1}^{H} \log(M^h)$$

If the total stock of income is M, the optimisation problem for allocating income is

$$\max \sum_{h=1}^{H} \log(M^h) \quad \text{subject to } M = \sum_{h=1}^{H} M^h$$

Denote the Langrange multiplier on the constraint by λ. The necessary condition for the optimisation are

$$\frac{1}{M^h} - \lambda = 0, \quad h = 1, \ldots, H.$$

Therefore, $M^h = \frac{1}{\lambda}$ for all h.

This implies that all consumers must be allocated the same income level.
The calculations have shown that the unique optimum is to allocate income equitable and yet the social welfare function is not one that values equity. The explanation for this apparent paradox is that the welfare function does not care about equity of allocation of utility but only that the sum of utilities is maximized. It does not care about the allocation of income since the individual utility functions are strictly concave in income. This makes social welfare a strictly concave function of incomes and hence results in the unique and equitable optimal allocation.

Question 11.

Consider a community with ten persons.
a. Plot the Lorenz curve for the income distribution (2, 4, 6, 8, 10, 12, 14, 16, 18, 20).
b. Consider an income redistribution that takes two units of income from each of the four richest consumers and gives two units to each of the four poorest. Plot the Lorenz curve again to demonstrate that inequality has decreased.
c. Show that the Lorenz curve for the income distribution (2, 3, 5, 9, 11, 12, 15, 17, 19, 20), crosses the Lorenz curve for the distribution in part a.
d. Show that the two social welfare functions $W = \sum M^h$ and $W = \sum \log(M^h)$ rank the income distributions in parts a and c differently.

Answer Question 11.

a. The total value of income in the population is 2 + 4 + 6 + 8 + 10 + 12 + 14 + 16 + 18 + 20 =110. This is used to compute the first three columns of Table1. Plotting the third column (*Y* axis) against the fourth column (*X* axis) produced the (outer) Lorenz curve in Figure 1.

Table 1.

Data for Lorenz Curve

Income	Sum	Proportion of total	Proportion of population
2	2	1,8	10
4	6	5,5	20
6	12	10,9	30
8	20	18,2	40
10	30	27,3	50

12	42	38,2	60
14	56	50,9	70
16	72	65,5	80
18	90	81,8	90
20	110	100,0	100

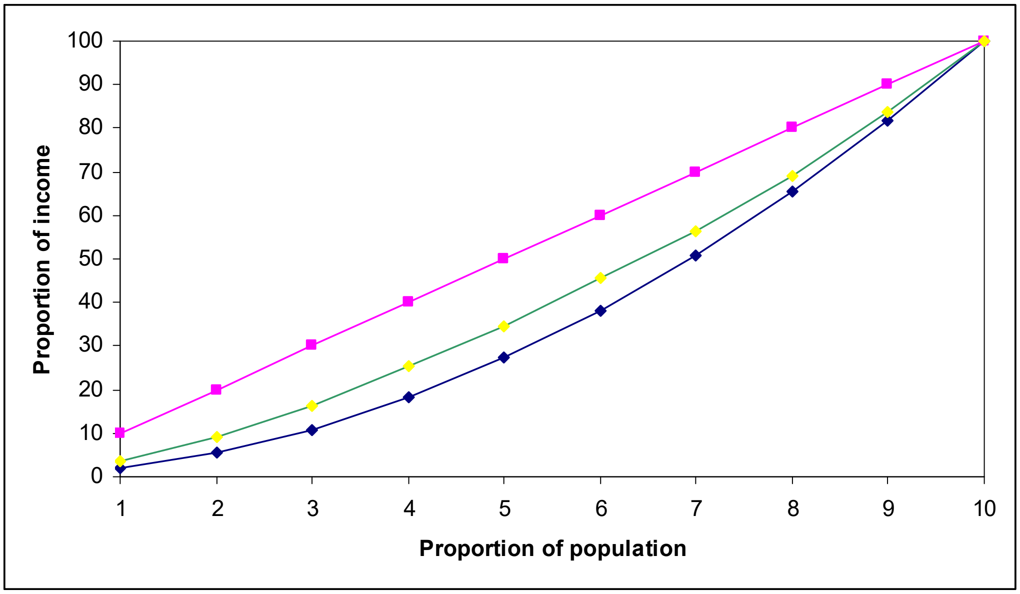


Figure 1. Lorenz curves

b. The new income distribution is (4, 6, 8, 10, 10, 12, 12, 14, 16, 18). The data for this are given in Table 2. Plotting the Lorenz curve for this income distribution gives the inner Lorenz curve in Figure 1. The inner curve represents a lower degree of inequality.

Table 2.

Income	Sum	Proportion of total	Proportion of population
4	4	3,6	10
6	10	9,1	20
8	18	16,4	30
10	28	25,5	40
10	38	34,5	50
12	50	45,5	60
12	62	56,4	70
14	76	69,1	80
16	92	83,6	90
18	110	100,0	100

c. The data are shown in Table 3. A comparison with the data in Table 1 shows that the two Lorenz curves cross. The curve from part a is initially above that from part c but falls below for population proportions in excess of 80 percent.

Table 3.

Income	Sum	Proportion of total	Proportion of population
2	2	1,8	10
3	5	4,4	20
5	10	8,8	30
9	19	16,8	40
11	30	26,5	50
12	42	37,2	60
15	57	50,4	70
17	74	65,5	80
19	93	82,3	90
20	113	100,0	100

d. For the income distribution in part a,

$$W = \sum M^h = 110$$

$$W = \sum \log(M^h) = 22.036$$

For the income distribution in part c,

$$W = \sum M^h = 113$$

$$W = \sum \log(M^h) = 21.963$$

The two welfare functions do rank the income distributions differently.

Question 12.
For a utilitarian social welfare function construct M_{EDE} for the distributions used in the previous exercise if the utility of income is logarithmic. Find the Atkinson inequality measure. Repeat the exercise for the Rawlsian social welfare function. Compare and discuss.

Answer Question 12.
The value of M_{EDE} when social welfare is utilitarian solves

$$HU(M_{EDE}) = \sum_{h=1}^{h} U(M^h).$$

For the logarithmic utility function and the first income distribution,

$10 \log(M^1_{EDE}) = \log(2) + \log(4) + \log(6) + \log(8) + \log(10) + \log(12) + \log(14) + \log(16) + \log(18) + \log(20)$,

so $10 \log(M^1_{EDE}) = 22.036$, giving $M^1_{EDE} = e^{2.2036} = 9.0576$.

For the second income distribution,

$10 \log(M^2_{EDE}) = \log(4) + \log(6) + \log(8) + \log(10) + \log(10) + \log(12) + \log(12) + \log(14) + \log(16) + \log(18)$,

giving $M^2_{EDE} = e^{2.3134} = 10.109$.

For the third income distribution,

$10 \log(M^3_{EDE}) = \log(2) + \log(3) + \log(5) + \log(9) + \log(11) + \log(12) + \log(15) + \log(17) + \log(19) + \log(20)$,

giving $M^3_{EDE} = e^{2.1963} = 8.9917$.

The Atkinson inequality measure is defined by

$A = 1 - M_{EDE}/\mu$.

Calculating this for the three distributions gives

$$A^1 = 1 - \frac{9.0576}{11} = 0.17658$$

$$A^2 = 1 - \frac{10.109}{11} = 0.081$$

$$A^3 = 1 - \frac{8.9917}{11.3} = 0.20427$$

The value of M_{EDE} when social welfare is Rawlsian is equal to the minimum income level. This gives

$M^1_{EDE} = 2$, $M^2_{EDE} = 4$, $M^3_{EDE} = 2$

And

$$A^1 = 1 - \frac{2}{11} = 0.81818$$

$$A^2 = 1 - \frac{4}{11} = 0.63636$$

$$A^3 = 1 - \frac{2}{11.3} = 0.82301$$

The value of the inequality index is much closer to 1 (the maximum value) for the Rawlsian social welfare function than for the utilitarian. Both provide the same ranking of income distributions.

Question 13

Assume that fireworks are a public good. Aris and Betty have the following individual demand curves for fireworks. P_A= 200 – Q_A and P_B =100 - Q_B, where QA and QB represent the amount of fireworks consumed by Aris and Betty, respectively. The marginal cost of producing another unit of fireworks is given by: . MC = 25+(1/2) Q

a. Calculate the socially optimal quantity of fireworks.

b. If Betty did not contribute at all for the fireworks, and Aris provided her privately optimal quantity, what would be the welfare loss to society?

Answer Question 13

a. The aggregate demand curve is: P=300 – 2Q if Q≤100, P=200-Q if Q≥100. Thus, the MC intersects the demand curve along the second segment, and, 200-Q=25 + (1/2)Q or Q=116,67.

b. Aris would provide Q=116, 67, and there would be no welfare loss.

Question 14.

Is the following statement true?
"If there are negative externalities in production or consumption, competitive equilibrium is unlikely to be Pareto efficient but positive externalities enhance the efficiency of the market."

Answer Question 14.

False, When there are externalities, (negative or positive, the market Is not efficient.

Question 15.

Suppose that demand for a product is Q = 1,200 – 4P and supply is Q = –200 + 2P. Furthermore, suppose that the marginal external damage of this product is €8 perunit. How many more units of this product will the free market produce than is socially optimal? Calculate the deadweight loss associated with the externality.

Answer Question 15.

To answer this question, first calculate what the free market would do by setting demand equal to supply:

1,200 – 4P = –200 + 2P, or 1,400 = 6P. P ≈ 233.33,

so $Q_{\text{Free Market}}$ = 1,200 – 4(233.33) ≈ 266.67.

The socially optimal level occurs when the marginal external cost is included in the calculation. Suppose the €8 externality were added to the price each consumer had to pay. Then demand would be Q = 1,200 – 4(P + 8).

Solving for P, 1,200 – 4(P + 8) = –200 + 2P, or P = 228.

Solving for Q, 1,200 – 4(228 + 8) = 1,200 – 944. $Q_{\text{Social Opt}}$ = 256, 10(2/3) units less than provided by the free market.

Deadweight loss is the area of a triangle of height 8 and width 10(2/3): ½ (8 × 10(2/3) ≈ 42.67.

Question 16.

We add the demands of private goods horizontally but add the demands of public goods vertically when determining the associated marginal benefit to society. Why do we do this and why are the procedures different for public and private goods?

Answer Question 16.

The horizontal summation of private goods adds up the individual quantities demanded by each consumer, which we do because each consumer uses up the quantity he or she purchases. The vertical summation for public goods adds up each consumer's willingness to pay for each additional unit. Because the good is public, each consumer gets to consume each unit. This sum therefore gives the total social valuation of each additional unit—society's demand curve.

Question 17.

It is known that some fraction d of all new cars are defective. Defective cars cannot be identified as such except by those who own them. Each consumer is risk neutral and values a non-defective car at €16,000. New cars sell for €14,000 each, and used ones for €2,000. If cars do not depreciate physically with use, what is the proportion d of defective new cars?

Answer Question 17.

In the market equilibrium the price of new cars equals the expected value of the new cars, which is the average of the value of non-defective with probability (1-d) and the value of defective cars with probability d. (with Δ the loss of value of a defective car). Since cars do not depreciate physically, the consumers are indifferent between used cars and defective new cars (i.e. they value defective cars for €20,000). So equating the market price of new cars with the their expected value obtains

$[1-d] \times 16{,}000 + d \times 2{,}000 = 14{,}000$

Solving for the proportion of defective new cars, we get

$16.000 - d[16{,}000 - 2{,}000] = 14{,}000$ or $d = 1/7$.

Question 18

There are two types of drivers on the road today. Speed Racers have a 5% chance of causing an accident per year, while Low Riders have a 1% chance of causing an accident per year. There are the same number of Speed Racers as there are Low Riders. The cost of an accident is €12,000.

a. Suppose an insurance company knows with certainty each driver's type. What premium would the insurance company charge each type of driver?

b. Now suppose that there is asymmetric information so that the insurance company does not know with certainty each driver's type. Would insurance be sold if:

i. Drivers self-reported their types to the insurance company?

ii. No information at all is known about individual driver's types?

If you are uncertain whether insurance would be sold, explain why.

Answer Question 18.

a. The insurance company expects to pay out €12,000 in claims to 5% of the Speed Racers it covers, so it must collect at least 0.05(€12,000) = €600 from each one. Similarly, it must collect at least 0.01(€12,000) = €120 from each Low Rider.

b.

i. Every individual would claim to be a Low Rider, but if the insurance company sold insurance to everyone for €120, it would lose money because of the presence of Speed Racers in the population. The insurance company would quickly increase premiums, but if it increased them by too much the Low Riders would leave the market. It cannot be determined here exactly how much more than €120 the Low Riders would tolerate, as their risk aversion is not specified. As more Low Riders chose not to purchase insurance, the pool of covered drivers would include a higher and higher proportion of Speed Racers, requiring the insurance company to increase premiums again to cover the claims.

ii. The insurance company could offer a premium that averages the expected claims. In a population of half Low Riders and half Speed Racers, the pooling premium would be (€600 + €120)/2 = €360. The Low Riders would have to be extremely risk averse to be willing to pay €360 to cover an expected loss of €120. If they (the Low Riders) opted out of the market, the insurance company would be back to the adverse selection problem discussed above: an insured pool containing a high proportion of Speed Racers.