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Economics for Public Decisions

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Exam 2
Fall 2020

Instructions:

1. The exam is **closed-notes, closed-book** and **no collaboration** is allowed.
2. It will **end at 9:15** to allow everyone 5 minutes for scanning and submitting answers.
3. There are **65 points** possible on the exam and you'll have about 75 minutes to complete it.
4. **Show all your work**. Answers without supporting work will receive little or no credit.
5. Write your answer on paper and then **scan it and submit it** at the end of the exam.
6. Please **number the pages** as you go so you can scan them in the right order.
7. If you have a **tablet**, you can use that instead of paper as long as you can produce a PDF.

Some useful formulas:

Areas:

$$A = \frac{1}{2}bh \qquad A = \left(\frac{b_1 + b_2}{2}\right)h$$

Exponents:

$$(AB)^c = A^c B^c \qquad A^c A^d = A^{c+d} \qquad \frac{1}{\left(\frac{A}{B}\right)^c} = \left(\frac{B}{A}\right)^c \qquad (A^c)^d = A^{cd}$$

Cobb-Douglas:

$$U = X^a Y^{1-a} \qquad X = \frac{aM}{P_x} \qquad Y = \frac{(1-a)M}{P_y} \qquad M = U * \left(\frac{P_x}{a}\right)^a \left(\frac{P_y}{1-a}\right)^{1-a}$$

Question 1 (15 points)

Rural areas in the United States have long lagged behind urban areas in access to high speed internet service because it's more much more expensive to serve customers who are far apart. This lack of access has become especially serious during the pandemic as many school districts have had to shift part or all of their teaching online.

Suppose a county government with a mix of urban and rural areas decides to address the problem by requiring the local internet service provider (ISP) to adopt a cross subsidy policy. Initially, in the absence of the new policy, urban (U) and rural (R) customers are each charged the ISP's WTA for serving them. As shown in the table of initial information below, those WTAs differ a lot:

Variable	**U**	**R**
Number of customers	100,000	1,500
Cost per customer (WTA)	$40	$250
Demand elasticity	-0.4	-2.5

The county would like to move to a single price for both groups. It would like the price to be low enough to increase the number of R customers substantially but high enough for the ISP to break even overall. An analyst is arguing that a price of $50 would work.

(a) Please determine: ☐ the new number of customers in each market if the policy is adopted; ☐ the amount of extra revenue the ISP would earn in the U market; ☐ the amount it would spend on the subsidy in the R market; ☐ the net overall impact of the policy on the ISP's budget; and ☐ briefly comment on whether the policy would achieve the government's goals. Finally, the policy divides the population into a number of subgroups. Please: ☐ list the groups and ☐ report the welfare impact on each.

Question 2 (15 points)

A government is considering imposing a minimum wage. There is no minimum wage in place now and the market is in equilibrium with a wage of $10 and 100,000 workers employed. The elasticity of demand for labor is known to be -0.2 and the elasticity of labor supply is known to be 0.25. The government would like to set the minimum wage as high as possible without causing more than 10% of existing workers to lose their jobs.

(a) Please determine: ☐ the appropriate minimum wage; ☐ the new number of workers who will be employed under the policy; ☐ the change in CS and PS resulting from the policy; and ☐ the DWL it would create. Briefly discuss who gains and who loses from the policy.

Question 3 (5 points)

A household has the utility function and demand equations shown below. Please derive its expenditure function. Be sure to show the steps, not just the final result. Then calculate the amount of income the household would need to get a utility of 100 when $P_x = 100$ and $P_y = 25$.

$U = (X - 50)^{0.5}(Y)^{0.5}$	$X = 50 + \frac{0.5(M - 50P_x)}{P_x}$	$Y = \frac{0.5(M - 50P_x)}{P_y}$

Year	Px	Py	HH	Income	X	Y
2019	25	10	A	4350	52	305
			B	4000	80	200
			C	4200	84	210
			D	4900	56	350
2020	30	20	A	4300	30	170
			B	4480	56	140
			C	4800	80	120
			D	4800	64	144

Question 4 (15 points)

One of the households in the table to the right has Cobb-Douglas preferences. In the remainder of the exam, this will be referred to as the CD household.

(a) Please: ☐ determine which one is the CD household and calculate its value of *a*; then ☐ draw a diagram illustrating the household's 2020 equilibrium. Please note that information about the key functions associated with CD preferences is given on the cover of the exam.

Year	Px	Py	HH	Income	X	Y
2020	30	20	A	4300	30	170
			B	4480	56	140
			C	4800	80	120
			D	4800	64	144

Question 4, continued

Now suppose that good X causes a negative externality of $6 per unit. To reduce the externality, in 2020 the government decides to impose a $6 tax on X. However, to lessen the overall impact on the household it also plans to provide a $2 subsidy on each unit of Y and to also give the household a $96 lump sum subsidy. You may assume the supplies of X and Y are perfectly elastic so P_x would rise to $36 and P_y would fall to $18. For convenience, the data for 2020 are repeated above.

(b) Please calculate: ☐ the new values of X and Y under the policy; ☐ the overall effect of the policy on the government's budget; ☐ the CV, and indicate whether the household is better or worse off; ☐ the reduction in damage from the externality; and ☐ the net impact of the policy on social surplus.

Question 5 (15 points)

A household buys two goods, X and Y, and its preferences can be represented by the Stone-Geary utility function shown below (it's an extension of Cobb-Douglas). Also shown are the household's demand equations and its expenditure function.

$U = (X - 100)^{0.5}(Y + 100)^{0.5}$	$X = 100 + \frac{0.5\left(M - 100(P_x - P_y)\right)}{P_x}$
$M = 2UP_x^{0.5}P_y^{0.5} + 100(P_x - P_y)$	$Y = -100 + \frac{0.5\left(M - 100(P_x - P_y)\right)}{P_y}$

Initially, $P_x = \$50$, $P_y = \$50$, and M = \$40,000. The government is considering a policy that would impose a \$10 tax on X. The supply of X is perfectly elastic and its price would rise to $P_x = \$60$.

(a) Please calculate: ☐ the initial equilibrium before the policy is enacted (both X and Y); ☐ the new value of X with the policy in place (it's OK to skip the new value of Y); ☐ the total government revenue raised by the tax; ☐ the CV for the policy; and ☐ the policy's income and substitution effects for the X good.