SUID:

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Exam 2
Fall 2021

DO NOT OPEN THIS EXAM UNTIL YOU ARE TOLD TO DO SO.

Instructions

1. Write your SUID in the upper right corner of this exam. **DO NOT** write your name.

2. **SHOW ALL YOUR WORK**. Answers without supporting work will receive little or no credit.

3. There are 80 points possible on this exam and you will have 80 minutes to complete it. Be sure to budget your time accordingly.

4. You may write on the backs of pages, on the extra page at the end, or on extra sheets of paper but **BE SURE TO NOTE THAT NEAR THE QUESTION**.

5. If you use extra sheets of paper, please number them so you can do step 4 above.

6. Some formulas for areas:

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

7. Some algebraic relationships for exponents:

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

8. Some functions relevant for Cobb-Douglas preferences:

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

Question 1 (15 points)

An important cross subsidy arises in electricity markets where customers are often charged a flat rate per unit of electricity no matter what time of day they consume it. The cross subsidy arises because utilities have very high costs during peak demand periods (typically late afternoons) but much lower costs at other times.

Suppose a particular utility charges $0.14 per unit and supplies two markets: off peak (O) and peak (P). Data about the markets is given below. The utility is currently running a deficit of $1.4 million and is considering removing the cross subsidy by charging buyers in each period its WTA for that period.

Variable	**Off peak**	**Peak**
Units sold	100 Million	20 Million
WTA in dollars per unit	$0.07	TBD
Demand elasticity	-0.4	-0.1

(a) Please determine: ☐ the amount of extra revenue the utility is initially earning in the off peak market; ☐ the utility's WTA in the peak period; ☐ the new number of units sold in each market if the cross subsidy is removed; ☐ the change in CS in each of the markets; and ☐ the impact of removing the cross subsidy on overall social surplus (both markets together).

Question 2 (15 points)

Suppose hackers carry out a ransomware attack that shuts down a major gasoline pipeline (similar to what happened to the Colonial Pipeline last spring). The attack causes the price of gas to rise to $8 per gallon and the quantity of gas to drop from its normal level to 1 million gallons. The government is concerned about the high price and is considering imposing a price ceiling of $4 per gallon. The elasticity of demand for gasoline is known to be -0.2 and the elasticity of supply is known to be 0.4.

(a) Please determine: ☐ the new quantity of gasoline under the price control; ☐ 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.

$U = (X-10)^{0.5}(Y+10)^{0.5}$	$X = 10 + \frac{0.5M - 5P_x + 5P_y}{P_x}$	$Y = -10 + \frac{0.5M - 5P_x + 5P_y}{P_y}$

Question 4 (15 points)

One of the households in the table to the right has perfect complements preferences and likes *b* units of the Y good for each unit of X. In the remainder of the exam, this will be referred to as the PC household.

Year	Px	Py	HH	Income	X	Y
2020	10	10	A	3000	135	165
			B	3000	200	100
			C	2600	208	52
			D	1800	90	90
2021	12	8	A	3064	116	209
			B	3040	190	95
			C	3000	200	75
			D	2400	80	180

(a) Please: ☐ determine which one is the PC household and calculate its value of *b*; ☐ derive the household's demand curves for X and Y (be sure to show the steps); and ☐ draw a diagram illustrating the household's 2021 equilibrium.

Year	Px	Py	HH	Income	X	Y
2021	12	8	A	3064	116	209
			B	3040	190	95
			C	3000	200	75
			D	2400	80	180

Question 4, continued

Now suppose that in 2021 the government decides to shift the PC household's consumption away from X and toward Y. To do so, it imposes a \$4 tax on X and a \$4 subsidy on Y. In addition, it provides the household with a lump sum subsidy of \$272 dollars to offset part of the impact of the policy. You may assume the supplies of X and Y are perfectly elastic so P_x would rise to \$16 and P_y would fall to \$4. For convenience, the data for 2021 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; 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 utility function shown below. Be sure to note that it's NOT Cobb-Douglas: the X and Y terms are *added*, not multiplied, in the utility function. Also shown are the household's demand equations and its expenditure function.

$U = X^{0.5} + \mathrm{Y}^{0.5}$	$X = \frac{M * P_y}{P_x(P_x + P_y)}$	$Y = \frac{M * P_x}{P_y(P_x + P_y)}$	$M = \frac{U^2 * P_x * P_Y}{P_x + P_y}$

Initially, $P_x = \$30$, $P_y = \$30$, and M = \$60,000. The government is considering a policy that would provide a \$10 subsidy on X. The supply of X is perfectly elastic and its price would fall to $P_x = \$20$.

(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 CV for the policy; and ☐ the policy's income and substitution effects for the X good.

Question 6 (15 points)

An individual is concerned about consumption in two periods: 0 and 1. In period 0 her income is $120,000, and in period 1 it will fall to $60,000. However, she also has an opportunity to enroll in training program A or B in the table below (one program at most). She can borrow or save at an interest rate of 25% and her preferences about consumption in two periods, C_0 and C_1, are given by a Cobb-Douglas utility function with the form: $U = C_0^{0.5} C_1^{0.5}$.

Program	Tuition in 0	Raise in 1
A	$24,000	$50,000
B	$10,000	$20,000

(a) Please determine: ☐ which training program, if any, she should take; ☐ how much she consumes in each period; and ☐ the amount she borrows or saves in period 0. Finally: ☐ illustrate your results with an appropriate diagram showing her intertemporal budget constraint after she decides whether or not to take a training program, an indifference curve, and her equilibrium.

Additional page for calculations
If you use this, please remember to indicate near the question that part of the answer is here.