SUID:

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Exam 2
Spring 2019

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 75 points possible on the exam and you'll have 80 minutes to work on it. Budget your time accordingly.

4. Do all your work on this exam. If you need extra space, write on the backs of the pages. However, if you do write an answer on the back of a page, be sure you've **NOTED THAT NEAR THE QUESTION**.

5. Some formulas for areas:

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

6. Some algebraic relationships for exponents:

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

7. The general form of the Cobb-Douglas utility function, its demand equations, and its expenditure function:

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

Question 1 (15 points)

Some states have recently started using minimum-price laws to combat smoking. The laws were generally passed many years ago for other purposes but they allow the states to impose minimum prices on a range of products, including cigarettes.

Suppose a state is considering using a minimum price rule to reduce smoking among teenagers. The market is initially in equilibrium with a price of $4 per pack and 100,000 packs purchased. The demand elasticity by teens is known to be -1.2 and the supply elasticity by tobacco companies is known to be 0.4. The proposal under discussion is to require cigarettes to be sold for no less than $5 per pack.

(a) Please determine: ☐ the new quantity of quantity sold under the policy; ☐ the changes in CS and PS; and ☐ the change in SS the policy would create. ☐ Briefly discuss whether the policy is effective at reducing teen smoking and whether it has any undesirable side effects. *Extra credit*: *What tax rate on cigarettes, in dollars per pack, would be needed to produce the same change in smoking? Why is the rate the size it is? Why might that cause a state to use a minimum price rule rather than a tax?*

Question 2 (5 points)

A household has the Stone-Geary 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 $P_x = 16$ and $P_y = 25$.

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

Question 3 (10 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.

Year	HH	Income	Px	Py	X	Y
2018	A	3720	6	9	485	90
	B	3600	6	9	270	220
	C	1980	6	9	198	88
	D	1800	6	9	150	100
2019	A	3480	8	10	380	44
	B	4000	8	10	225	220
	C	2880	8	10	200	128
	D	2068	8	10	141	94

(a) Please: ☐ determine which one is the CD household and calculate its value of *b*; ☐ draw a diagram illustrating the CD household's 2019 equilibrium. Please note that information about the key functions associated with CD preferences is given on the cover of the exam.

Year	HH	Income	Px	Py	X	Y
2019	A	3480	8	10	380	44
	B	4000	8	10	225	220
	C	2880	8	10	200	128
	D	2068	8	10	141	94

Question 3, continued

Now suppose that in 2019 the government wants to revise the tax system. It wants to raise at least $700 of revenue and also shift the CD household's consumption away from X and toward Y. It plans to impose a $4 tax on X and a $1 subsidy on Y. In addition, it also plans to impose a $400 lump sum income tax on the household. You may assume the supplies of X and Y are perfectly elastic so P_x would rise to $12 and P_y would fall to $9. For convenience, the data for 2019 are repeated above.

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

Question 4 (15 points)

One of the households in the table to the right regards X and Y as perfect complements and always buys h units of good X for each unit of good Y. In the remainder of the exam, this will be referred to as the PC household.

Year	HH	Income	Px	Py	X	Y
2018	A	3720	6	9	485	90
	B	3600	6	9	270	220
	C	1980	6	9	198	88
	D	1800	6	9	150	100
2019	A	3480	8	10	380	44
	B	4000	8	10	225	220
	C	2880	8	10	200	128
	D	2068	8	10	141	94

(a) Please: ☐ *derive* the PC household's demand equations for X and Y in terms of h, P_x, P_y and income M (be sure to show the steps involved, don't just write down the demand equations); and ☐ determine which one of the households in the table has perfect complements preferences and calculate the value of h.

Year	HH	Income	Px	Py	X	Y
2019	A	3480	8	10	380	44
	B	4000	8	10	225	220
	C	2880	8	10	200	128
	D	2068	8	10	141	94

Question 4, continued

Now suppose that in 2019 government imposes a slight variation on the policy from Question 3: a $4 tax on X and $1 subsidy on Y (both the same as before), but imposes a $394 lump sum income tax on the PC household (slightly less than before).

(b) Please compute: ☐ the PC household's new equilibrium; ☐ the overall effect on the government's budget, and indicate whether the policy raises at least $700; ☐ the CV; and ☐ indicate whether the household is better or worse off. Finally, show the new equilibrium in a well-labeled diagram.

Question 5 (15 points)

A household buys two goods, X and Y, and its preferences can be represented by the utility function shown below. Preferences like this are said to be "quasilinear" because utility is linear in Y. Also shown are the household's demand equations and its expenditure function.

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

Initially, $P_x = \$4$, $P_y = \$4$, and M = \$60,000. The government is considering a policy that would impose a \$2 tax on X. The supply of X is perfectly elastic and its price would rise to $P_x = \$6$.

(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. ☐ What's unusual about the results? (It's a feature of the quasilinear preferences.)

Question 6 (15 points)

An individual's preferences about consumption in two periods, C_0 and C_1, are given by a Cobb-Douglas utility function with the form: $U = C_0^{0.6} C_1^{0.4}$. In period 0 his income is \$40,000, and in period 1 it will rise to \$120,000. However, he also has an opportunity to enroll in either of the two training programs in the table below (one program at most). He can borrow or save at an interest rate of 25%.

Program	Tuition in 0	Raise in 1
A	\$21,000	\$30,000
B	\$38,000	\$60,000

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

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