MIDTERM EXAM

INSTRUCTIONS: Answer any four of the questions below. If you answer more than four, your best four answers will be used to determine your exam grade. Read each question carefully to make sure you understand it. Explain each answer; make sure it responds directly to the question that has been asked. Whenever possible, explain your answer using graphs, diagrams, or other tools of economics. In particular, base your answers on the ideas and concepts presented in this course.

Please PRINT your name in CAPITAL LETTERS on the FRONT of your bluebook. When you are done, hand in your bluebook AND THIS PAPER.

1. An economist performs a regression analysis of the demand for Coca-Cola, and obtains the following results:

\[ Q_C = 0.57 - 0.50 \; P_C + 0.10 \; P_P - 0.15 \; P_K + 0.004 \; I + 0.04 \; F \]

\[
(0.19) \quad (0.10) \quad (0.04) \quad (0.09) \quad (0.001) \quad (0.01)
\]

where \( P_C \) = price of Coke, per 12 oz.; \( Q_C \) = quantity of Coke purchased, in millions of 12 oz. containers per week; \( P_P \) = price of Pepsi, per 12 oz.; \( P_K \) = price of coffee, per 12 oz.; \( I \) = family income, in $/week; and \( F \) = temperature, in degrees Fahrenheit. Standard errors of the coefficient estimates appear in parentheses under the coefficients themselves.

A. Discuss each of the coefficients in these results and explain, briefly, what it tells us about the demand for Coke. (Be sure to mention the economic as well as the purely statistical implications of each coefficient.)

B. Average values of \( I, P_P, P_C, Q_C \) are as follows: \( I = 1890, P_P = 1.50, P_C = 1.50 \), and \( Q_C = 1 \). With this information, compute the elasticity of demand for Coke with respect to the price of Coke using any accepted method of your own choice.

2. According to some estimates, the total revenues from the sale of pornography in Denmark fell by 25 percent in the year immediately following the liberalization of Denmark's censorship laws. (The liberalization made it easier for publishers to produce and sell sexually explicit publications. Assume that it had no effect on the demand for pornography.)

A. Use supply and demand curves to predict the effect of the liberalization of censorship laws on the price of pornography in Denmark. Explain your answer.

B. Based on your answer to (A) above, say whether the liberalization of censorship laws increased or reduced total surplus in the market. Explain your answer.

C. Based on Denmark's experience, some sociologists have argued that getting rid of restrictions on pornography reduces the demand for it. Do you agree or disagree? Explain your answer.

3. Consider the market for rubber bands and the effect of imposing a tax of $1 per pack of 100 rubber bands on producers of rubber bands. In both cases, explain your answers carefully.

A. If this market has very elastic supply and very inelastic demand, how will the total amount of the tax be shared between consumers and producers? Explain your answer.

B. If this market has very inelastic supply and very elastic demand, how will the total amount of the tax be shared between consumers and producers? Explain your answer.

(Hint: You may find it helpful to use supply and demand curves in your answer.)
4. In the small country of Erewhon, housework is measured in standard units called "hums," representing specified amounts of cleaning, dishwashing, meal preparation, etc. (Thus, for example, two hums represent twice as much cleaning, dishwashing, meal preparation, etc., as one hum.) In an hour's work, Jane can either produce 25 hums or earn $50 in the paid labor market, whereas Jim can either produce 75 hums or earn $100 in the paid labor market. At the moment, both of them are working full-time in the paid labor market and have all of their housework done by housekeepers. However, they now decide they want to work less in the paid labor market, and stay at home to do some of their own housework.

A. What is the opportunity cost of producing housework by relying (i) on Jane? (ii) on Jim? Explain your answer.

B. If they decide they want some home-produced output, who should be put to work in the home first -- Jane, or Jim? (Remember that, at the moment, they are doing no housework at all.) Explain your answer.

5. Senator Tweedledum proposes a plan to help reduce the cost of college for needy students by giving $50 billion in government funds to colleges and universities to pay for construction of new dormitories and classrooms. Senator Tweedledee criticizes the Tweedledum plan on the grounds that it is very expensive. Instead of government-funded construction, Tweedledee suggests that colleges and universities be required to cut tuition charges by 50 percent. "This will make it much easier for needy students to attend college -- so enrollment of needy students will go up dramatically -- and it won't cost the government a dime," he argues. Evaluate the two plans thoroughly. Do you believe that the Tweedledee plan is superior to the Tweedledum plan? If so, explain why. If not, explain why not. (Note: You may find it helpful to use supply and demand curves in your answer.)

6. A frost in Florida reduces the size of the orange crop, but has no effect on consumers. Explain what will happen, as a result of this, to each of the following in the new market equilibrium (after the frost has occurred):

A. The price of oranges.
B. The quantity of oranges bought and sold.
C. Producer's surplus.
D. Consumer's surplus.

(Hint: You may find it helpful to use supply and demand curves in your answer.)
1. Note that here $Q_c$ is the dependent variable, so that each coefficient tells us how $Q_c$ will change when there is a change of one unit in the variable pertaining to that coefficient, other things being equal.

(A) Your answer for each coefficient on each independent variable ($P_c$, $P_p$, etc.) should say both (i) what the coefficient for that independent variable means and (ii) whether it is statistically significant. It should also note that the coefficient is a *ceteris paribus* effect, giving the effect on the dependent variable ($Q_c$) of a one-unit change in the independent variable, with all other independent variables in the regression held constant ("other things being equal"). So:

The coefficient on $Q_c = -0.50 = \Delta Q_c/\Delta P_c$, the (inverse) slope of the demand curve. (Note that if we graphed the demand curve in the usual way, with $P_c$ on the vertical axis and $Q_c$ on the horizontal axis, then the slope of that demand curve would be $\Delta P_c/\Delta Q_c = 1/-0.50 = -2.00$) Since it's negative, this coefficient indicates that the demand curve slopes downwards. The $t$-statistic for this coefficient, $-0.50/0.10$, is greater than 2.0, so the coefficient is statistically significant. In effect, the coefficient tells us that in order an increase in price of $1 would result in a decrease of 0.50 in $Q_c$, other things being equal, as we move along a given demand curve.

The coefficient on $P_p$ is positive and statistically significant. (The $t$-statistic for this coefficient is $0.10/0.04$, which is greater than 2.) The coefficient tells us that when the price of Pepsi $P_p$ rises by one unit (other things being equal), the quantity of Coke demanded $Q_c$ rises by 0.10. Thus, Coke and Pepsi are substitutes: when the price of Pepsi rises, we know that the quantity of Pepsi demanded will fall; and the regression tells us that when the price of Pepsi rises, the quantity of Coke demanded will rise. So Coke and Pepsi move in opposite directions; they're substitutes.

The coefficient on $P_k$ is negative but not statistically significant. (For this coefficient, $t = 0.15/0.09 < 2$.) This coefficient tells us that, other things being equal, a one-unit increase in $P_k$ will reduce demand for Coke $Q_c$ by 0.15 units (and we know that a higher coffee price will also reduce demand for coffee). Thus, if we take the regression results at face value, they indicate that Coke and coffee are complements. (That is, looking only at the sign of the coefficient, we see that Coke and coffee will move in the same direction when the price of coffee rises.) However, note again that this effect is not statistically significant; in other words, there is no statistically meaningful relation between the price of coffee and demand for Coke.

The coefficient on $I$ is positive and statistically significant ($t = 0.004/0.001 > 2$). This tells us that when income rises by $1, other things being equal, the demand for Coke $Q_c$ increases by 0.004. Thus, Coke is a normal good.

The coefficient on $F$ is positive and statistically significant. (The confidence interval for this coefficient is $0.04 \pm (2 \times 0.01) = 0.02$ to 0.06, i.e., all positive numbers. Equivalently, $t = 0.04/0.01 > 2$.) It measures the increase in demand for Coke $Q_c$ when temperature rises by one degree Fahrenheit, other things being equal. In other words, demand for Coke rises during warmer weather.

(B) The elasticity of demand for any product with respect to its own price is \( \%\Delta Q_c / \%\Delta P_c = [\Delta Q_c/Q_c]/[\Delta P_c/P_c] = [\Delta Q_c/\Delta P_c] [P_c/Q_c] \). The number you come up with for the elasticity depends on how you calculate the percentage changes in $Q$ and $P$. However, you get equal credit regardless of which method you use to calculate elasticity, so long as you use the method correctly.

First, if you use conventional methods for calculating percentage changes, then the percentage change in any variable is simply the absolute change in the variable divided by its original value. In this case, you will find that the elasticity of demand for Coke is 0.75. As noted in Part A, above, the coefficient on $P_c$ in the regression is equal to $\Delta Q_c/\Delta P_c$. Thus, $\Delta Q_c/\Delta P_c = -0.50$ and $P_c/Q_c = 1.50/1 = 1.50$, so elasticity = -
0.50 \times 1.5 = 0.75 (in absolute value). Note that we used the original levels of P_c and Q_c (1.50 and 1, respectively) in these calculations.

The results are somewhat (but not greatly) different if you use the "midpoint" method. Here, a percentage change in any variable X is defined as the change in X, divided by the average of the old and new levels of X. From the above results, when P_c rises by $1, from 1.50 to 2.50, then Q_c will fall by -0.50, from 1.00 to 0.50, so the average P_c = (1.50 + 2.50)/2 = 2.00. Likewise, Q_c changes by -0.50, from 1 to 0.50, so average Q_c = (1 + 0.50)/2 = 0.75. Thus, percentage change in P_c = 1/2 = 0.50, and percentage change in Q_c = -0.50/0.75 = 0.67. Finally, then, according to the midpoint method, the elasticity of demand = | %ΔQ_c / %ΔP_c | = 0.67 / 0.75 = 0.893. (Remember to take the absolute value!)

2(A). Consider Figure 2A. The liberalization shifted the supply curve for pornography out and to the right, i.e., increasing the quantity of pornography produced at any given price. The result is that the price fell as equilibrium shifted along the demand curve, with a fall in equilibrium price P and an increase in equilibrium quantity Q. Note that although Q rises, P falls. Thus, theory will not tell us what will happen to sales revenue, R = PQ: the rise in Q will tend to raise R, but the decline in P will tend to reduce it. The fact that R actually fell merely means that the elasticity of demand (= %ΔQ/%ΔP) is less than 1, i.e., Q rises but by less than P falls, so that on balance R = PQ falls.

(B) Consider Figure 2B. Initially, with supply curve S and demand curve D, total surplus is area A (= consumers' surplus) plus areas B and D (= producers' surplus): \( A + B + D \). Then the supply curve shifts out, so that the new supply curve is \( S' \). The new surplus is therefore \( A + B + C (= \text{the new consumers' surplus}) + D + E (= \text{the new producers' surplus}) \). Clearly, total surplus has increased (from \( A + B + D \) to \( A + B + C + D + E \)).

(C) The sociologists are confusing revenue and quantity demanded. Liberalizing the anti-pornography laws may have reduced revenue from the sale of pornography, but it also reduced the price and, as a result, the quantity of pornography demanded increased. (Note also that liberalization didn't shift the demand curve at all; it simply caused a movement along the curve.)
3. See Figures 3A and 3B below.

(A) If demand is very inelastic, producers are able to shift most of the tax onto consumers, since in this case consumers will swallow a price increase without cutting down on their purchases. See Figure 3A.

(B) If demand is very elastic and supply is very inelastic, producers will be willing to absorb most of the tax without cutting production very much, and consumers would cut back a lot on purchases if they had to pay very much of the tax. So firms won't be able to shift much of the tax onto consumers; they'll pay most of it themselves. See Figure 3B.

4(A). If we pull Jim out of the market and get him producing in the home, we lose $100 in market output and gain 75 hums of home output, i.e., 100/75 = $1.33 worth of market output lost per unit of home output gained. So the opportunity cost of producing home output using Jim is $1.33 per hum. For Jane, we lose $50 in market output per 25 hums gained, so the opportunity cost of producing home output using Jane is 50/25 = $2 per hum.

(B) From Part A, it is clear that if we want to produce more home output, we should pull Jim out of the market first, since we lose only $1.33 worth of market output per unit of home production gained. That's a lower cost than we would incur (= $2) if we pulled Jane out first.

5. See Figure 5(A) and Figure 5(B). Tweedleddee's plan to force colleges and universities to cut tuition charges is just a "ceiling price" law that will reduce college attendance. Requiring tuition to be no higher than P_e, which is half of the current equilibrium level of P^*, will increase quantity demanded, but that is not going to increase quantity supplied; in fact, quantity supplied will fall. See Figure 5(A). It is possible that more low-income students will end up getting some of this smaller quantity supplied, Q_e, than were able to buy the original (and greater) equilibrium quantity Q^*. However, note that there is no guarantee that this will occur: since the quantity demanded at P_e exceeds the quantity supplied, there will have to be some way to ration the scarce available supply out among the greater number of demanders; but Tweedleddee's proposal does not include a plan for doing this.
(B) In contrast, Tweedledum's plan would put money into the hands of colleges and universities, and will make it less expensive for them to build dormitories, classrooms, etc. As a result, this will shift the supply curve down and to the right. (In order to be able to admit any given number of students, colleges and universities will now be able to do so at a lower price.) Because the supply schedule shifts out (and down), the equilibrium price of attending college will fall, and the new equilibrium quantity of college students will be greater than before. Some of the subsidy is passed on to students in the form of a lower tuition price; some of it is retained by colleges and universities. (Note, in particular, that the drop in price paid by students is less than the total amount of the subsidy, i.e., colleges and universities pass on only a part of the subsidy.) See Figure 5(B).

6. See Figure 6 below. Let the initial equilibrium price be \( P^* \) and the initial equilibrium quantity of oranges bought and sold be \( Q^* \). Now suppose that a frost shifts the supply curve to the left (a "reduction in supply"). The new equilibrium price is \( P^{**} \) and the new equilibrium quantity is \( Q^{**} \).

Finally, remember that producer's surplus is the area under the price actually paid and above the supply curve; and that consumer's surplus is the area under the demand curve and above the price actually paid.

A. So \( P \) rises: \( P^{**} > P^* \).

B. So \( Q \) falls: \( Q^{**} < Q^* \).

C. Producer's surplus changes from \( C + D \) to \( B + C \). To see why, remember that producer's surplus is always given by the area underneath the price received by the producer and above the supply curve. Before the frost, this is \( C + D \) (remember that the original supply curve is \( S \) and the original equilibrium price is \( P^* \)). After the frost, this is \( B + C \) (remember that the new supply curve is \( S' \) and the new equilibrium price is \( P^{**} \)). Note that we can't say for sure whether producer's surplus rises or falls as a result of the frost: the producer "loses" \( D \) amount of surplus, but "gains" \( B \) amount of surplus. So whether the producer gains depends on whether \( B > D \).

D. Consumer's surplus falls from \( A + B + E \) to \( A \). To see why, remember that consumer's surplus is always given by the area underneath the price paid by the consumer and below the demand curve. Before the frost, this is \( A + B + E \) (the original supply curve is \( S \), and the original price is \( P^* \)). After the frost, this is \( A \) (the new supply curve is \( S' \) and the original price is \( P^{**} \)).