ECON 173 - Intermediate Microeconomic Analysis
Drake University, Fall 2024
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Signature: _____

Printed name: _____

FINAL EXAMINATION VERSION A

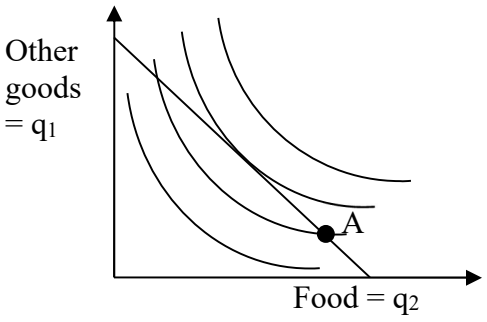
INSTRUCTIONS: This exam is closed-book, closed-notes. Calculators, mobile phones, and wireless devices are NOT permitted. Point values for each question are noted in brackets. Maximum total points = 200.

I. MULTIPLE CHOICE: Circle the one best answer to each question. Feel free to use margins for scratch work [2 pts each—40 pts total].

(1) Which utility function below violates the assumption of "monotonicity" or "more is better"?

a. $U(q_1,q_2) = 7\, q_1\, q_2$.
b. $U(q_1,q_2) = (4q_1) / (3q_2)$.
c. $U(q_1,q_2) = 7\, q_1^4\, q_2^3$.
d. $U(q_1,q_2) = 4\, q_1^{1/2} + 3\, q_2^{1/2}$.

The next two questions refer to the following graph of a consumer's budget line and indifference curves. Suppose the consumer is currently at bundle A for some reason.



(2) This consumer could enjoy higher utility, without increasing total spending, by

a. purchasing less food and more other goods.
b. purchasing more food and fewer other goods.
c. purchasing less food and fewer other goods.
d. any of the above.
e. none of the above.

(3) Let MU_1 denote the marginal utility of other goods and MU_2 the marginal utility of food for this consumer. Let p_1 denote the price of other goods and p_2 denote the price of food. At bundle A,

a. $MU_2 = MU_1$ and $p_2 = p_1$.
b. $MU_2/MU_1 = p_2/p_1$.
c. $MU_2/MU_1 < p_2/p_1$.
d. $MU_2/MU_1 > p_2/p_1$.
e. cannot be determined from information given.

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(4) Which function is homogeneous of degree zero in income and prices?

a. $q_1^* = 0.02\, I + 0.7\, (p_2/p_1)$.
b. $q_1^* = I/(8p_1) + 7$.
c. $q_1^* = 0.05\, I - 2p_1 + 0.1\, p_2$.
d. $q_1^* = 0.07\, I + 0.3/p_1$.
e. All are homogeneous of degree zero.

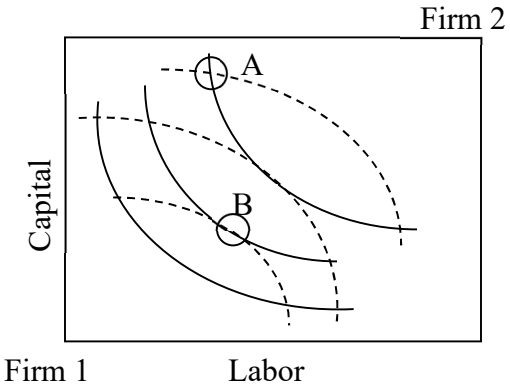
(5) Suppose a firm produces an output using capital and labor. The increase in output from a one-unit increase in labor input, while holding capital input constant, is called
a. the marginal rate of substitution in production of labor for capital.
b. the average product of labor.
c. the price of labor.
d. the marginal product of labor.

(6) In the short run, a firm should shut down immediately if its
a. revenue is less than fixed cost.
b. profit is negative.
c. revenue is less than producer surplus.
d. revenue is less than variable cost.

(7) *Price equals average cost* in a competitive industry in long-run equilibrium because
a. business owners have a sense of fairness.
b. individual firms adjust their output levels using the rule "price equals average cost" to maximize profit.
c. consumers refuse to pay more than what is reasonable.
d. positive profits encourage entry of new firms while negative profits encourage existing firms to leave the industry.
e. the threat of government regulation causes firms to hold prices down.

(8) Suppose there is a change in government policy affecting the automobile industry. Which of the following outcomes would be a *Pareto improvement*?
a. Producers gain $5 billion while consumers are unaffected.
b. Producers gain $5 billion while consumers lose $10 billion.
c. Producers gain $10 billion while consumers lose $5 billion.
d. Both (a) and (c).
e. All of the above.

The next two questions refer to the following Edgeworth box diagram for production. The solid curves are Firm 1's isoquants. The dashed curves are Firm 2's isoquants.



(9) From allocation A, *both* firms can produce more output if
a. Firm 1 gives Firm 2 some capital, and Firm 2 gives Firm 1 some labor.
b. Firm 1 gives Firm 2 some labor, and Firm 2 gives Firm 1 some capital.
c. Firm 1 gives Firm 2 some capital and some labor.
d. Firm 2 gives Firm 1 some capital and some labor.
e. No trade will allow both firms to produce more output.

(10) From allocation B, *both* firms can produce more output if
a. Firm 1 gives Firm 2 some capital, and Firm 2 gives Firm 1 some labor.
b. Firm 1 gives Firm 2 some labor, and Firm 2 gives Firm 1 some capital.
c. Firm 1 gives Firm 2 some capital and some labor.
d. Firm 2 gives Firm 1 some capital and some labor.
e. No trade will allow both firms to produce more output.

(11) Suppose all firms in an industry have the same marginal cost. According to the Cournot model of oligopoly, the equilibrium price will be higher,
a. the more firms in the industry.
b. the fewer firms in the industry.
c. The price does not depend on the number of firms in the industry.

(12) Which market model predicts the smallest quantity of total output?
a. Price competition.
b. Collusion to maximize joint profits.
c. Cournot oligopoly.
d. All models predict the same quantity of output, if all use the same assumptions about market demand and marginal cost.

(13) According to the so-called "Coase theorem," external costs like pollution can be efficiently resolved if bargaining is efficient and
a. property rights are given to the polluter.
b. property rights are given to the victim of pollution.
c. either of the above.
d. none of the above.

(14) An efficient way to distribute pollution permits is
a. to sell them at auction.
b. to allow them to be bought and sold by polluters.
c. either of the above.
d. to assign them by a lottery.

(15) Water aquifers (underground water sources) in the western United States are rapidly being depleted. No one can be prevented from taking water from a well on their own property—yet the more water is taken, the less is left for other people. Water aquifers in the western United States are therefore
a. a nonrival good.
b. a nonexcludable good.
c. both of the above.
d. none of the above.

(16) If a highway is not crowded and there are no toll gates, the highway is
a. a nonrival good.
b. a nonexcludable good.
c. both of the above.
d. none of the above.

(17) A risk-averse person's utility function shows
a. increasing marginal utility of wealth (or income).
b. constant marginal utility of wealth (or income).
c. decreasing marginal utility of wealth (or income).
d. none of the above.

(18) Which utility function shows risk aversion?
a. $U(W) = 2 + 5\ W^2$.
b. $U(W) = 2\ \ln(5W)$.
c. $U(W) = 2 + 5^W$.
d. $U(W) = 2 + 5W$.

(19) Healthy individuals are less likely to apply for health insurance. This is an example of
a. adverse selection.
b. moral hazard.
c. exchange efficiency.
d. market power.
e. risk aversion.

(20) Irving Berlin wrote a song called "Doin' What Comes Naturally" for the musical *Annie Get Your Gun* in 1946. One verse goes

> *Cousin Jack insured his shack,*
> *And now he plays with matches.*
> *He'll collect just wait and see,*
> *Doin' what comes naturally.*

Cousin Jack's behavior is an example of
a. market power.
b. moral hazard.
c. substitution effects.
d. adverse selection.

II. SHORT ANSWER: Please write your answers in the boxes on this question sheet. Use margins for scratch work.

(1) [Income elasticity of demand: 10 pts] Suppose that a consumer's income rises by 5%, and the income elasticity of demand for restaurant meals is 1.4 .

a. Does the income elasticity indicate that restaurant meals are an *inferior* good, a *necessary* good, or a *luxury or superior* good?	
b. Will the quantity demanded of restaurant meals *increase* or *decrease*?	
c. By about how much?	%
d. Will the share of the consumer's budget devoted to restaurant meals *increase* or *decrease*?	
e. By about how much?	%

(2) [Slutsky equation: 10 pts] The Slutsky equation in elasticity form is given by

$$\varepsilon = -S\,\eta + \varepsilon^{comp}$$

where, as usual, ε denotes the own-price elasticity of demand, S denotes the share of total consumer spending devoted to the good (a fraction), η denotes the income elasticity of demand, and ε^{comp} denotes the compensated demand elasticity. Suppose that for electricity, $\varepsilon = -0.8$, $S = 0.1$, and $\eta = 0.4$.

a. Compute the compensated elasticity of demand for electricity (ε^{comp}).	

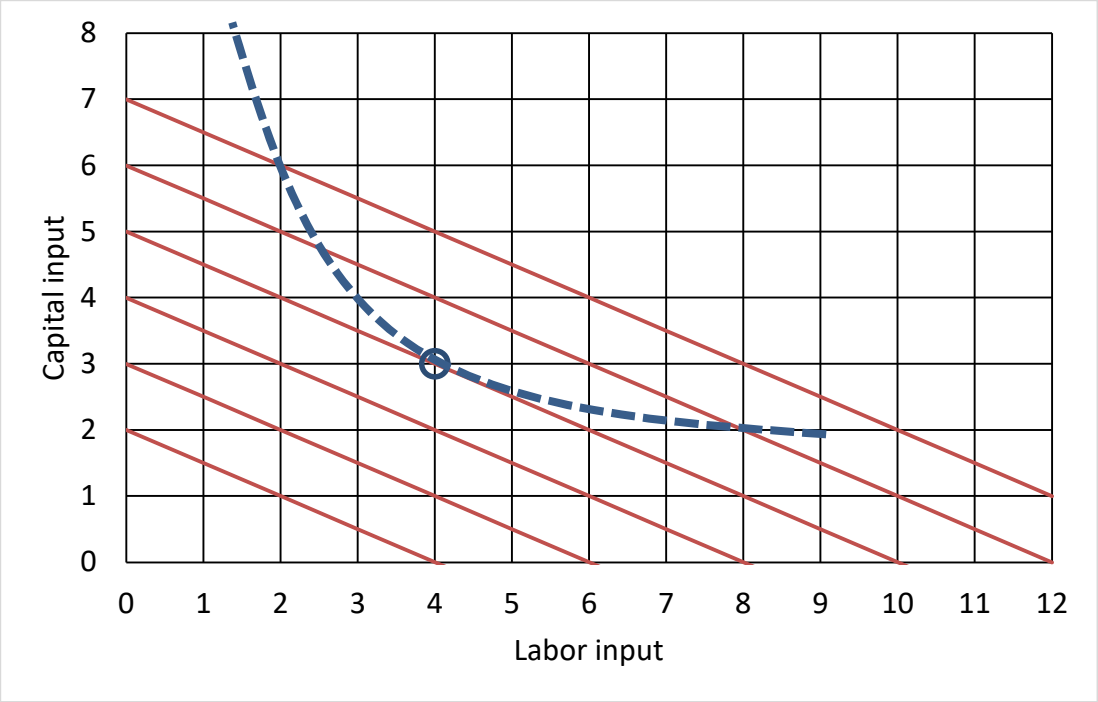
First, suppose the price of electricity rises by 10%, but the consumer's income does *not* change.

b. Does the quantity demanded of electricity *increase* or *decrease*?	
c. By about how much?	%

Alternatively, assume that the price of electricity rises by 10%, but now suppose the government helps the consumer by giving them a cash transfer equal to 10% of last year's spending on electricity.

d. Does the quantity demanded of electricity *increase* or *decrease*?	
e. By about how much?	%

(3) [Cost minimization; Cost in the short run: 10 pts] A firm wants to produce 500 units of output at lowest cost. This firm must pay \$10 per hour for labor and \$20 per hour for capital. The graph below shows the firm's isoquant for 500 units of output per hour as a dashed curve and several isocost lines as solid lines. The small circle marks a tangency.



First, suppose the firm can hire whatever amounts of labor and capital it wants.

a. How many units of capital will it hire? _____ units

b. How many units of labor will it hire? _____ units

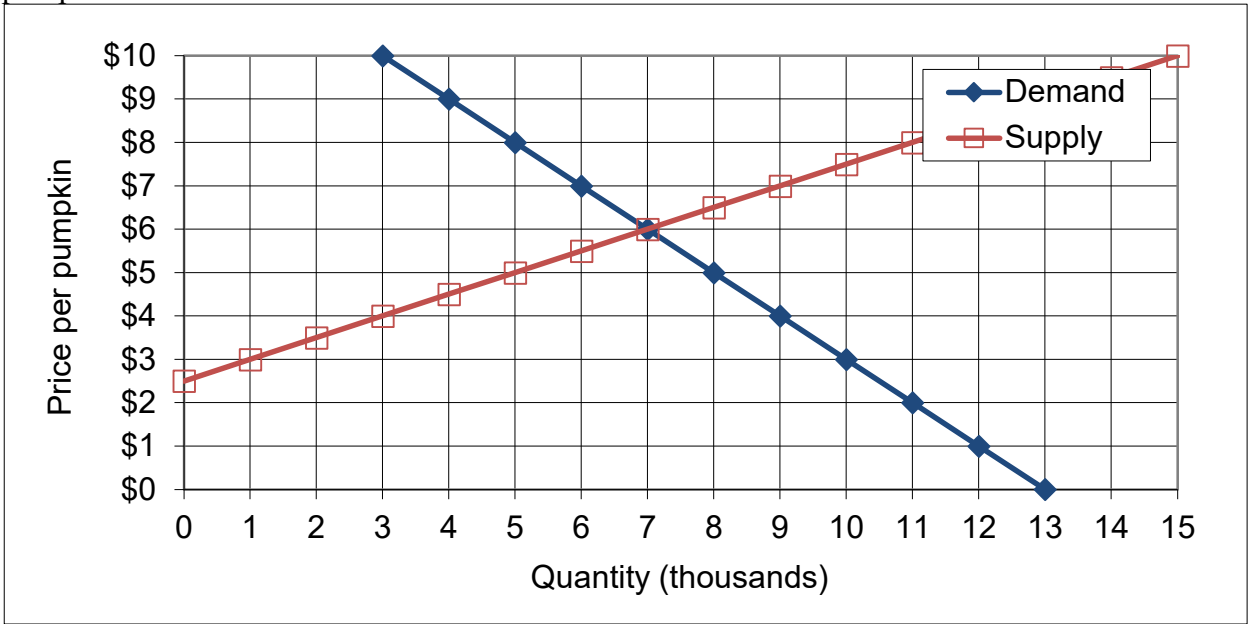
c. Compute the firm's total cost. \$ _____

Alternatively, suppose the firm's capital input is fixed in the short run at **2** units, but the firm's labor input is variable. The firm still wants to produce 500 units of output.

d. How many units of labor will it hire? _____ units

e. Compute the firm's total cost in the short run. \$ _____

(4) [Welfare analysis of taxes and subsidies: 20 pts] The following graph shows the market for pumpkins.

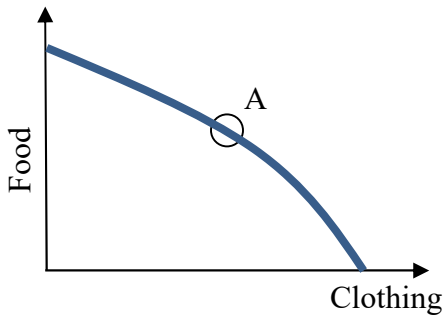


a. Find the equilibrium price without government intervention.	$

Suppose the government offers a **subsidy of $ 3** per pumpkin.

b. Compute the equilibrium quantity sold.	thousand
c. Compute the equilibrium net price paid by buyers (excluding the subsidy).	$ per pumpkin
d. Compute the equilibrium total price received by sellers (including the subsidy).	$ per pumpkin
e. Does producer surplus *increase, decrease,* or *remain constant* because of the subsidy?	
f. By how much?	$ thousand
g. Does consumer surplus *increase, decrease,* or *remain constant* because of the subsidy?	
h. By how much?	$ thousand
i. Compute the total direct cost of the subsidy program to the government. That is, compute the amount that the government must pay to buyers and/or sellers.	$ thousand
j. Compute the deadweight social loss caused by the subsidy.	$ thousand

(5) [General equilibrium: 8 pts] Consider the graph at right of an economy's production-possibility curve. Assume this economy is in general competitive equilibrium at point A, where the slope of the production-possibility curve is **–4**.



a. What is the opportunity cost of a unit of clothing? In other words, how many units of food must be given up in order to produce one more unit of clothing?

b. What is the opportunity cost of a unit of food? In other words, how many units of clothing must be given up in order to produce one more unit of food?

c. Consider the typical consumer's budget line with food on the vertical axis and clothing on the horizontal axis. What must be the slope of every consumer's budget line in this economy?

d. If the price of a unit of food is **$ 4**, then what must be the price of a unit of clothing?

units of food
units of clothing
$

(6) [Lerner index of market power: 4 pts] The Lerner index of market power is defined as the fraction of price that represents a markup over marginal cost: L = (P-MC)/P. Suppose a particular airline route has a price elasticity of demand of **-2**.

a. Compute the Lerner index if this market is a monopoly.

b. Compute the Lerner index if this market is a symmetric Cournot duopoly of two airlines.

(7) [Nonrival goods: 6 pts] A city government will offer a free outdoor concert series during the summer in a neighborhood park. About **1000** people are likely to enjoy the concerts. Each concert costs $**4000** to produce. Let Q denote the number of concerts. A typical individual person's marginal benefit from the concert series is given by the following expression: **MB = 10 – 2 Q** .

a. How many concerts would a typical *individual* pay for, for their private enjoyment?

b. Give an expression for the marginal social benefit from the concert series.

c. Compute Q* the socially-optimal number of concerts.

concerts
MSB =
concerts

(8) [Game theory: 12 pts] Grocery chains A and B are choosing locations for a new store. The downtown location is more profitable than the uptown location, but if the chains choose the same location, they split the business. Their situation is expressed by the following game in normal form.

		Chain B	
		Locate uptown	Locate downtown
Chain A	Locate uptown	A gets \$2 million. B gets \$2 million.	A gets \$4 million. B gets \$6 million.
	Locate downtown	A gets \$6 million. B gets \$4 million.	A gets \$3 million. B gets \$3 million.

a. Which outcomes of this game (if any) are Pareto-efficient[1]? Answer "YES" or "NO."

Chain A plays "Uptown" and Chain B plays "Uptown."	
Chain A plays "Downtown" and Chain B plays "Downtown."	
Chain A plays "Uptown" and Chain B plays "Downtown."	
Chain A plays "Downtown" and Chain B plays "Uptown."	

b. Which outcomes of this game (if any) are dominant-strategy equilibria[2]? Answer "YES" or "NO."

Chain A plays "Uptown" and Chain B plays "Uptown."	
Chain A plays "Downtown" and Chain B plays "Downtown."	
Chain A plays "Uptown" and Chain B plays "Downtown."	
Chain A plays "Downtown" and Chain B plays "Uptown."	

c. Which outcomes of this game (if any) are Nash equilibria in pure strategies? Answer "YES" or "NO."

Chain A plays "Uptown" and Chain B plays "Uptown."	
Chain A plays "Downtown" and Chain B plays "Downtown."	
Chain A plays "Uptown" and Chain B plays "Downtown."	
Chain A plays "Downtown" and Chain B plays "Uptown."	

[1] Ignore the welfare of consumers.
[2] "Equilibria" is the plural form of "equilibrium."

III. PROBLEMS: Please write your answers in the boxes on this question sheet. Show your work and circle your final answers.

(1) [Finding individual demand functions: 12 pts] A consumer has the following utility function: $U(q_1, q_2) = q_1^2 \, q_2^4$, where q_1 denotes the quantity of entertainment and q_2 denotes the quantity of other goods.

a. Find a formula for the consumer's marginal rate of substitution in consumption of other goods for entertainment—that is, the |slope| of the consumer's indifference curve with entertainment on the vertical axis and other goods on the horizontal axis. The variables q_1 and q_2 should be the only unknowns. Circle your final answer.

Let p_1 denote the price of entertainment and let p_2 denote the price of other goods. Let I denote the consumer's income.

b. Solve for the consumer's demand function for entertainment—that is, the formula showing q_1^* as a function of p_1, p_2, and I (but not q_2). Show your work and circle your final answer. [Hint: check that your answer is homogeneous of degree zero.]

c. Solve for the consumer's demand function for other goods—that is, the formula showing q_2^* as a function of p_1, p_2, and I (but not q_1). Show your work and circle your final answer. [Hint: check that your answer is homogeneous of degree zero.]

(2) [Input substitution; Returns to scale: 9 pts] Suppose a production function is given by

$$q = 8\, x_1^{1/4}\, x_2^{3/4}\,.$$

a. Find an expression for the marginal product of input 1. Are there diminishing returns to input 1? Justify your answer.

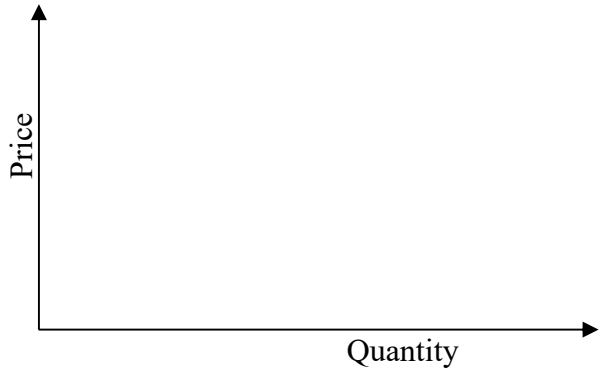
b. Find an expression in terms of x_1 and x_2 for the marginal rate of substitution in production of input 2 for input 1—that is, the absolute value of the slope of an isoquant, with x_1 on the vertical axis and x_2 on the horizontal axis. Does production show a diminishing marginal rate of substitution? Justify your answer.

c. Does this production function have *constant* returns to scale, *increasing* returns to scale, or *decreasing* returns to scale? Justify your answer.

(3) [Welfare analysis of international trade: 10 pts] Suppose domestic demand and supply for a good are given by the following equations. (Use the graph at right for scratch work.)

Demand: $Q_D = 50 - 5\,P$

Supply: $Q_S = 10\,P - 10$



First consider the domestic market without international trade.

a. Compute the equilibrium price and quantity without international trade.

Now suppose the market is opened to international trade, and the world price turns out to be **$2** .

b. Does the country *import* or *export* this good? How much?

c. Does consumer surplus *increase* or *decrease* as a result of international trade? By how much?

d. Does producer surplus *increase* or *decrease* as a result of international trade? By how much?

e. Does the country as a whole (consumers plus producers) *gain* or *lose* as a result of international trade? By how much?

(4) [Monopoly, profit maximization: 14 pts] Suppose a monopolist has total cost function given by **$TC(Q) = 3Q + (Q^2/20)$.** This monopolist faces a demand curve given by **$P = 15 - (Q/20)$.** Show your work and circle your final answers. Note: question continues on next page. Use graph at bottom of next page for scratch work.

a. Find the monopolist's marginal cost function.

b. Find the monopolist's average cost function.

c. Find the monopolist's marginal revenue function.

d. Compute the monopolist's profit-maximizing level of output Q_M.

e. Compute the monopolist's profit-maximizing price P_M.

f. Compute the monopolist's profit.

g. Compute the social deadweight loss caused by the monopolist. (You may use the graph for scratch work.)

(5) [External benefit and Pigou subsidy: 10 pts] Suppose supply and demand for a particular vaccine are given by the following equations. Use the graph at right for scratch work.

Demand: $P_D = 16 - (Q/10)$.

Supply: $P_S = 6 + (Q/10)$.

a. Compute the unregulated equilibrium price and quantity.

Persons who are vaccinated lower the risk of disease to everyone around them, creating an external benefit. Marginal external benefit per vaccine is estimated to be **MEB = 8 – (Q/10).**

b. Find a formula for the marginal social benefit of the vaccine.

c. Compute the socially-optimal quantity of vaccinations.

d. Compute the deadweight loss from unregulated competition.

e. Compute the Pigou subsidy rate on this vaccine, in dollars per unit, that would result in the socially-optimal quantity of vaccinations.

(6) [Uncertainty, risk aversion, demand for insurance: 10 pts] Aaron has \$80 in income but faces a 50% chance of losing \$60 and thus being reduced to only \$20 in income. Aaron's utility function is given by $U(I) = 15 - (160/I)$, where I denotes income.

a. Compute Aaron's expected income (in dollars).

b. Compute Aaron's expected utility (in utils).

c. Compute the level of risk-free income that would be just as desirable as Aaron's current risky situation (in dollars).

d. Compute the maximum insurance premium Aaron would be willing to pay for full insurance against potential loss.

e. Compute the so-called "fair insurance" premium for full insurance against Aaron's potential loss.

(7) [Hidden characteristics and adverse selection: 10 pts] Suppose the market for homeowners insurance consists of 1000 people. Order these people from high-risk to low-risk, and index them by Q = 0 to 1000. The expected loss of the Qth person is given by EL = 300 – 0.2 Q. (Thus the last person's expected loss is about $100.) Everyone is risk-averse, and willing to pay $50 more than their expected loss (EL) for insurance.

a. Give an equation for the demand for insurance P_D or willingness-to-pay, as a function of Q.

b. Give an equation for the marginal cost of insurance MC as a function of Q. (Assume there are no administrative costs.)

c. If the market were efficient, how many people would get insurance? Why?

d. Give an equation for the average cost of insurance AC as a function of Q. [Hint: AC has the same intercept but half the slope of MC.]

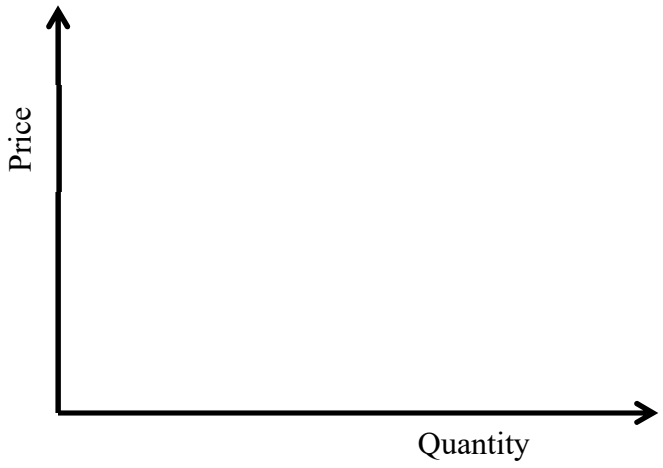
e. Assume the market is competitive, but that insurance companies cannot observe individual persons' expected loss. Find the equilibrium price P and quantity Q of insurance.

IV. CRITICAL THINKING: Answer just *one* question below (your choice). [5 pts]

(1) Suppose a consumer normally buys 20 gallons of gasoline per month at a price of $3. Which would this consumer prefer: a reduction in price from $3 to $1, or an increase in income of $40 ? Justify your answer with a graph of a demand curve. Use the concept of consumer surplus.

(2) Exchange efficiency (also called "efficiency in distribution") requires that each consumer's marginal rate of substitution in consumption (MRSC) of food for clothing be equal to every other consumer's MRSC of food for clothing. Is this condition satisfied in an unregulated economy with competitive markets? Why or why not? (Ignore the graph.)

Circle the question you are answering and write your answer below. Full credit requires good grammar, legible writing, accurate spelling, and correct reasoning.



[end of exam]