

Sketch of Solutions to Assignment #4 for Managerial Economics, Fall 2015
Due: Monday November 9

A. Elasticity Questions

1. For the first time in two years, Big G (the cereal division of General Mills) raised cereal prices by 2 percent. If, as a result of this price increase, the volume of all cereal sold by Big G dropped by 3 percent, what can you infer about the own price elasticity of demand for Big G cereal? Can you predict whether revenues on sales of its Lucky Charms brand increased or decreased? Explain.

Ans. A 3 percent decrease in demand for a 2 percent change in prices yields an estimate of price elasticity of demand equal to $-1.5 = -3/2$. To answer the question on Lucky Charms, one would need to know if its demand is more or less price sensitive than Big G's average breakfast cereal.

2. If Starbucks marketing department estimates the income elasticity of demand for its coffee to be 1.75, how will looming fears of a recession (expected to decrease consumers incomes by 4 percent over the next year) impact the quantity of coffee Starbucks expects to sell?

Ans. $4 \cdot (-1.75) = -7$ percent.

3. You are a division manager at Toyota. If your marketing department estimates that the semiannual demand for the Highlander is $Q = 100,000 - 1.25P$, what price should you charge in order to maximize revenues from sales of the Highlander?

Ans. $\max_{p \geq 0} p \cdot (100,000 - 1.25p)$, this is a quadratic opening downward so FOCs are necessary and sufficient, the derivative is $100,000 - 2.5p$, setting it equal to 0 and solving yields $p = 100,000/2.5 = 40,000$. This is, not at all coincidentally, the point at which the elasticity of demand is exactly equal to 1.

4. Recently, Pacific Cellular ran a pricing trial in order to estimate the elasticity of demand for its services. The manager selected three states that were representative of its entire service area and increased prices by 5 percent to customers in those areas. One week later, the number of customers enrolled in Pacific's cellular plans declined 4 percent in those states, while enrollments in states where prices were not increased remained flat. The manager used this information to estimate the own-price elasticity of demand and, based on her findings, immediately increased prices in all market areas by 5 percent in an attempt to boost the company's 2007 annual revenues. One year later, the manager was perplexed because Pacific Cellular's 2007 annual revenues were 10 percent lower than those in 2006 — the price increase apparently led to a reduction in the company's revenues. Did the manager make an error? Explain.

Ans. The error was in supposing that one week's data, i.e. information on a very short-term elasticity, would be predictive for the longer term elasticity. The annual result indicates very clearly that it was not predictive.

5. Suppose the own price elasticity of demand for good X is -2 , its income elasticity is 3, its advertising elasticity is 4, and the cross-price elasticity of demand between it and good Y is -6 . Determine how much the consumption of this good will change if:

- a. The price of good X increases by 5 percent.
- b. The price of good Y increases by 10 percent.
- c. Advertising decreases by 2 percent.
- d. Income falls by 3 percent.

Ans.

- a. The demand for good X decreases by 10 percent.
 - b. The demand for good X decreases by 60 percent.
 - c. The demand for good X increases by 8 percent.
 - d. The demand for good X decreases by 9 percent.
6. The owner of a small chain of gasoline stations in a large Midwestern town read an article in a trade publication stating that the own-price elasticity of demand for gasoline in the United States is -0.2 . Because of this highly inelastic demand in the United States, he is thinking about raising prices to increase revenues and profits. Do you recommend this strategy based on the information he has obtained? Explain.

Ans. It is not easy for the economy as a whole to substitute away gasoline, this is why we find an own-price elasticity so close to 0. Within a town, consumers have the ability to easily substitute away from any gas station charging too high a price. Hence, the owner is facing a very different demand curve because there are so many competitors offering a close substitute for gasoline at his/her chain.

B. Price Indexes

1. In year t , prices for the two goods, x_1 and x_2 , are $p_{1,t} = p_{2,t} = 2$, and consumption of the two goods is $(x_1^*, x_2^*) = (5, 5)$. In year $t + 1$, the two prices are $p_{1,t+1} = 2.2$ and $p_{2,t+1} = 2.4$. Show that the CPI indicates a 15% rate of inflation between the two years. How much does this overstate the damage to the consumer if their utility function is $u(x_1, x_2) = x_1 x_2$?

Ans. In lecture, we saw that for this utility function the expenditure function is $e(u^\circ, p_1, p_2) = 2\sqrt{u^\circ} \sqrt{p_1 p_2}$ and that this means that the perfect price index for this consumer is

$$\frac{2\sqrt{u_t} \sqrt{p_{1,t+1} p_{2,t+1}}}{2\sqrt{u_t} \sqrt{p_{1,t} p_{2,t}}} = 1.1489.$$

By comparison the CPI is 1.15, a very small error.

2. In year t , prices for the two goods, x_1 and x_2 , are $p_{1,t} = p_{2,t} = 2$, and consumption of the two goods is $(x_1^*, x_2^*) = (5, 5)$. In year $t + 1$, the two prices are $p_{1,t+1} = 2.2$ and $p_{2,t+1} = 2.4$. Show that the CPI indicates a 15% rate of inflation between the two years. How much does this overstate the damage to the consumer if their utility function is $u(x_1, x_2) = x_1 + x_2$?

Ans. In lecture, we saw that for this utility function the expenditure function is $e(u^\circ, p_1, p_2) = u^\circ \min\{p_1, p_2\}$ and that this means that the perfect price index for this consumer is

$$\frac{u_t \min\{p_{1,t+1}, p_{2,t+1}\}}{u_t \min\{p_{1,t}, p_{2,t}\}} = 1.10.$$

By comparison the CPI is 1.15, which overstates the damage of inflation by 50%.

C. Some Games

1. The following 2×2 games (i.e. they have two players and each player has two actions) have either 1 or 2 pure strategies equilibria. Find all of them.

Prisoners' Dilemma

	Squeal	Silent
Squeal	$(-8, -8)$	$(0, -9)$
Silent	$(-9, 0)$	$(-1, -1)$

Ans. For each player, the strategy "Squeal" strictly dominates the strategy "Silent," hence there is only one equilibrium, both Squealing.

Joint Investment

	Don't invest	Invest
Don't invest	$(2, 2)$	$(12, 0)$
Invest	$(0, 12)$	$(9, 9)$

Ans. For each player, the strategy "Don't Invest" strictly dominates the strategy "Invest," hence there is only one equilibrium, both not investing.

Stag Hunt

	Stag	Rabbit
Stag	(S, S)	$(0, R)$
Rabbit	$(R, 0)$	(R, R)

Ans. Done in lecture.

Battle of the Sexes

	Opera	Rodeo
Opera	$(3, 5)$	$(1, 0)$
Rodeo	$(0, 1)$	$(5, 3)$

Ans. Done in lecture.

2. Product differentiation and political parties. The 1929 Hôtelling model of product differentiation has also been adapted to political competition for votes. Suppose that potential voters can be ranked on a one-dimensional "left-right" scale from a to b , $a < b$, that candidates locate themselves someplace in the interval $[a, b]$, that voters choose the candidate closest to their most preferred point in the interval, and that voters are located everywhere in the interval. Supposing that the candidates want to be elected and that the candidate who attracts more voters is more likely to be elected. Show that the equilibrium must involve "centrism," specifically, show that it cannot be an equilibrium (in this model) for one candidate to choose position p_2 which is to the right of the position p_1 chosen by the other candidate. [Multi-dimensional versions of the model have also been studied, they often arrive at the same sort of conclusion.]

Ans. Done in lecture.

D. Structure of industries.

1. Based on the information given below, indicate whether the following industry is best characterized by the model of perfect competition, monopoly, monopolistic competition, or oligopoly.
 - a. Industry A has a four-firm concentration ratio of 0.005 percent and a Herfindahl-Hirschman index of 75. A representative firm has a Lerner index of 0.45 and a Rothschild index of 0.34.

Ans. The four-firm concentration and the HHI are low, the Lerner and the Rothschild index indicate economic profits and product differentiation. Sounds like monopolistic competition.
 - b. Industry B has a four-firm concentration ratio of 0.0001 percent and Herfindahl-Hirschman index of 55. A representative firm has a Lerner index of 0.0034 and Rothschild index of 0.00023.

Ans. The four-firm concentration and the HHI are very low, the Lerner and the Rothschild index indicate small economic profits and little product differentiation. Sounds very close to perfect competition.
 - c. Industry C has a four-firm concentration ratio of 100 percent and Herfindahl-Hirschman index of 10,000. A representative firm has a Lerner index of 0.4 and Rothschild index of 1.0.

Ans. The four-firm concentration and the HHI are as high as can be, that is, there is one firm. The Lerner index tells us that there is a fair degree of markup, and the Rothschild index also indicates that there is one firm. This is a monopoly.
 - d. Industry D has a four-firm concentration ratio of 100 percent and Herfindahl-Hirschman index of 5,573. A representative firm has a Lerner index equal to 0.43 and Rothschild index of 0.76.

Ans. Oligopoly with moderately large mark-ups, the mark-ups and the Rothschild index indicating product differentiation.
2. A firm has \$1 million in sales, a Lerner index of 0.65, and a marginal cost of \$35, and competes against 1,000 other firms in its relevant market.
 - a. What price does this firm charge its customers?

Ans. The Lerner index, $(p - mc)/p$, is given as 0.65 and $mc = 35$, so $p = 100$ because $(100 - 35)/100 = 0.65$.
 - b. By what factor does this firm mark up its price over marginal cost?

Ans. $100/35 \simeq 2.857$ so approximately 186% mark-up over marginal cost.
 - c. Do you think this firm enjoys much market power? Explain.

Ans. Despite competing against 1,000 other firms, it has a large mark-up, indicating market power. Also, supposing that the price of 100 maximizes profits, we have $L = 0.65 = -1/E_D(100)$ where $E_D(100)$ is the price elasticity of demand for the firm's good at $p = 100$. This means that the price elasticity of demand at the point where $MR = MC$ is -1.54 , another indicator of some market power.
3. Four different industries are dominated by the top 10 firms. Their sales are given below. For each industry, give the Gini coefficient, the four firm concentration ratio, and the Herfindahl-Hirschman index. After you have done this, compare the different methods of ranking the concentration of firms in the different industries.
 - a. The sales in industry A are 39, 96, 83, 45, 52, 7, 62, 82, 201, 41.

Ans. For industry A, the four firm concentration is 0.65, a version of the HHI is $100 \cdot \sum_{i=1}^{10} \left(\frac{s_i}{\sum_j s_j} \right)^2$ where s_i is sales of firm i , and this is equal to 14.97, and the Gini coefficient is 0.35.

b. The sales in industry B are 76, 2, 66, 16, 44, 66, 42, 69, 98, and 41.

Ans. For industry B, the four firm concentration is 0.59, a version of the HHI is $100 \cdot \sum_{i=1}^{10} \left(\frac{s_i}{\sum_j s_j} \right)^2$ where s_i is sales of firm i , and this is equal to 12.76, and the Gini coefficient is 0.29.

c. The sales in industry C are 62, 81, 81, 97, 74, 31, 75, 76, 59, and 71.

Ans. For industry C, the four firm concentration is 0.52, a version of the HHI is $100 \cdot \sum_{i=1}^{10} \left(\frac{s_i}{\sum_j s_j} \right)^2$ where s_i is sales of firm i , and this is equal to 11.68, and the Gini coefficient is 0.21.

d. The sales in industry D are 47, 94, 36, 30, 6, 66, 39, 144, 17, and 49.

Ans. For industry D, the four firm concentration is 0.67, a version of the HHI is $100 \cdot \sum_{i=1}^{10} \left(\frac{s_i}{\sum_j s_j} \right)^2$ where s_i is sales of firm i , and this is equal to 15.27, and the Gini coefficient is 0.38.

In tabular form for the purposes of comparison, we have the following

	A	B	C	D
C_4	0.65	0.59	0.52	0.67
HHI	14.97	12.76	11.68	15.27
Gini	0.35	0.29	0.21	0.38

Notice that all four indexes rank the concentration of the industries in the same way, D is most concentrated, then A, then B, and C is the least concentrated.

E. The feedback/endogeneity critique of causal arguments.

1. Firms like Papa John's, Domino's, Austin Pizza, and Pizza Hut sell pizza and other products that are differentiated in nature. While numerous pizza chains exist in most locations, the differentiated nature of these firms' products permits them to charge prices above marginal cost. Given these observations, is the pizza industry most likely a monopoly, perfectly competitive, monopolistically competitive, or an oligopoly industry? Use the causal view of structure, conduct, and performance to explain the role of differentiation in the market for pizza. Then apply the feedback critique to the role of differentiation in the industry.

Ans. The technology for making and delivering pizzas is quite standard, the barriers to entry fairly low, and the demand (in Austin) is fairly high and steady. The causal view argues that these technological and demand conditions lead to a competitive industry. To avoid the competitive pressures that this induces on profits, the firms try to differentiate themselves from each other. They do this both by offering (slightly) different products and by advertising. All of this is in the hope that, even though there are many options for the consumers, they are willing to pay a premium to get what they most want. (That being said, one market niche for fast food is best described as "maximize calories per dollar" or "feed the poor hungry college students.") The competition from each other and from other cheap(ish) foods puts a tight upper bound on the Lerner index. Generally, one would expect low prices/profits to imply that firms do not want to enter the market.

The feedback critique is essentially the argument that what we see is an equilibrium, a balancing of the forces pulling firms into the industry and keeping them out.

2. From U.S. News and World Report, Feb. 11, 2014, we have the following.

Among millennials ages 25 to 32, median annual earnings for full-time working college-degree holders are \$17,500 greater than for those with high school diplomas only. That gap steadily widened for each successive generation in the latter half of the 20th century. As of 1986, the gap for late baby boomers ages 25 to 32 was just more than \$14,200, and for early boomers in 1979, it was far smaller at \$9,690. The gap for millennials is also more than twice as large as it was for the silent generation in 1965, when the gap for that cohort was just under \$7,500 (all figures are in 2012 dollars).

By 20 years after college, the present gap in the median pay is nearly \$29,000 per year. Without discounting, one finds that the median difference in lifetime earnings between high school diploma holders and college degree holders (after adjusting for the direct expense and opportunity cost of going to college) will be over \$800,000. What is wrong with ascribing the difference in lifetime pay to the value of what universities teach?

Ans. We discussed this in lecture.

3. 400 different acres of land, $i = 1, 2, \dots, 400$, growing corn are treated with 400 different levels of fertilizer, N_1, N_2, \dots, N_{400} (N for nitrogen, though potassium and phosphates also play a large role), and produce per acre yield, Y_1, Y_2, \dots, Y_{400} . The line that best fits the 400 data points in the $N - Y$ plane is given by $Y = \hat{a} + \hat{b}N$ where $\hat{a} > 0$ and $\hat{b} > 0$. What is wrong with using \hat{b} as an estimate of how well fertilizer increases per acre yield? [It is worth bearing in mind that higher quality acres are more responsive to fertilizer, farmers know this, and fertilizer is expensive.]

Ans. We discussed this in lecture.