

ECON 200 - PS 4 - Fall 16

ANSWER KEY

November 23, 2016

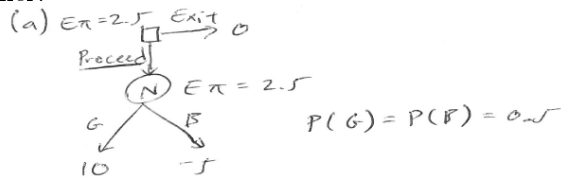
Part I

Short Case Study Problems

1 Consulting Fees and Cost of Information

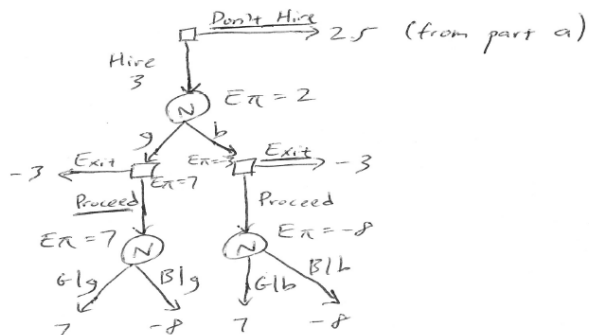
If the market for your new product turns out well (G) you will gain incremental profit of 10 (millions of \$), but otherwise (B) you will lose 5 if you bring out the product. You can assure an incremental profit of 0 if you cancel now. You believe the probability of G is 0.5.

- Draw the decision tree and solve it; state whether or not you should bring out the product.
- Suppose a consultant can tell you now whether to expect G or B. Her fee is 3. Is it worthwhile to hire her?



Bring out the product since the expected payoff of doing so (2.5) is greater than exiting (0).

- (b) If the consultant is always correct, $P(g|G) = P(b|B) = 1$:



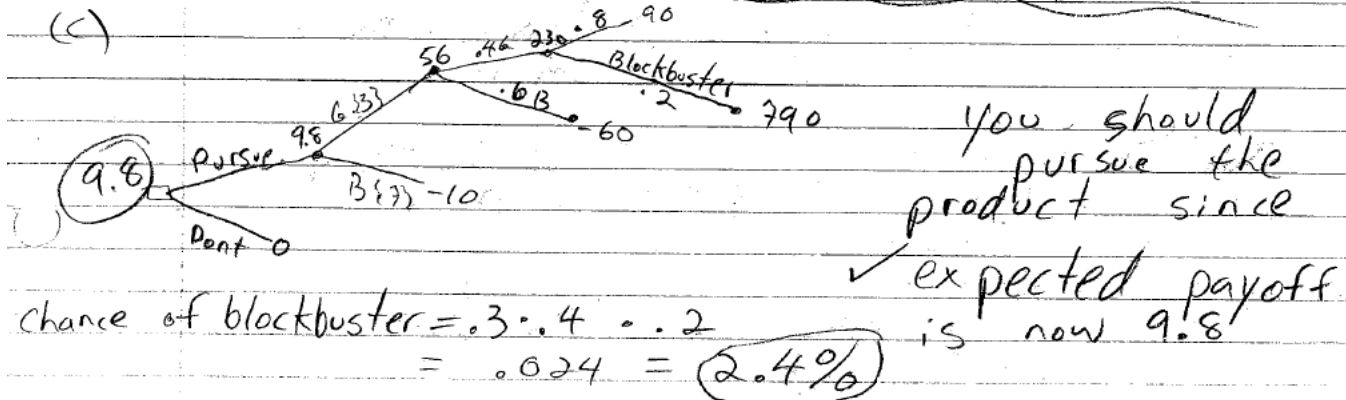
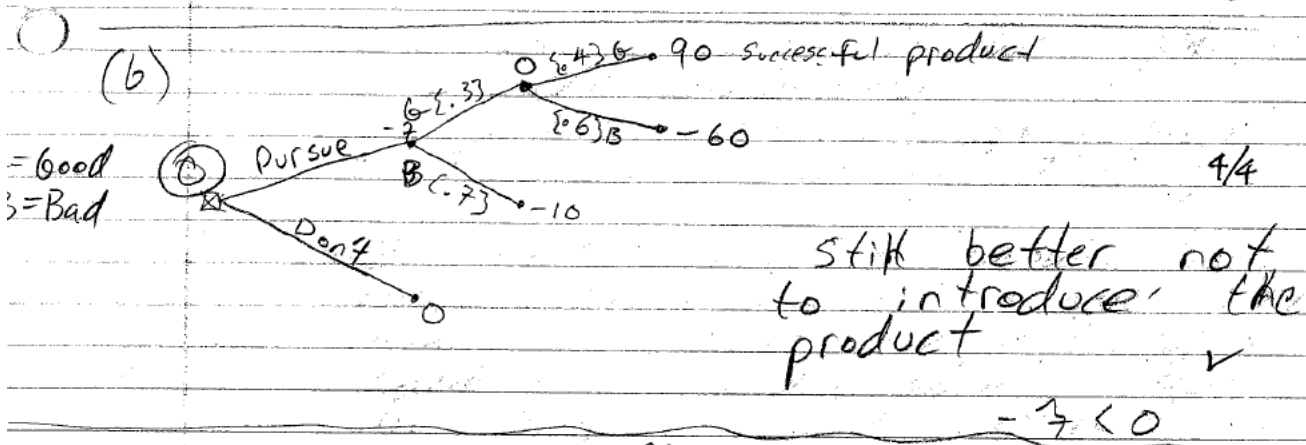
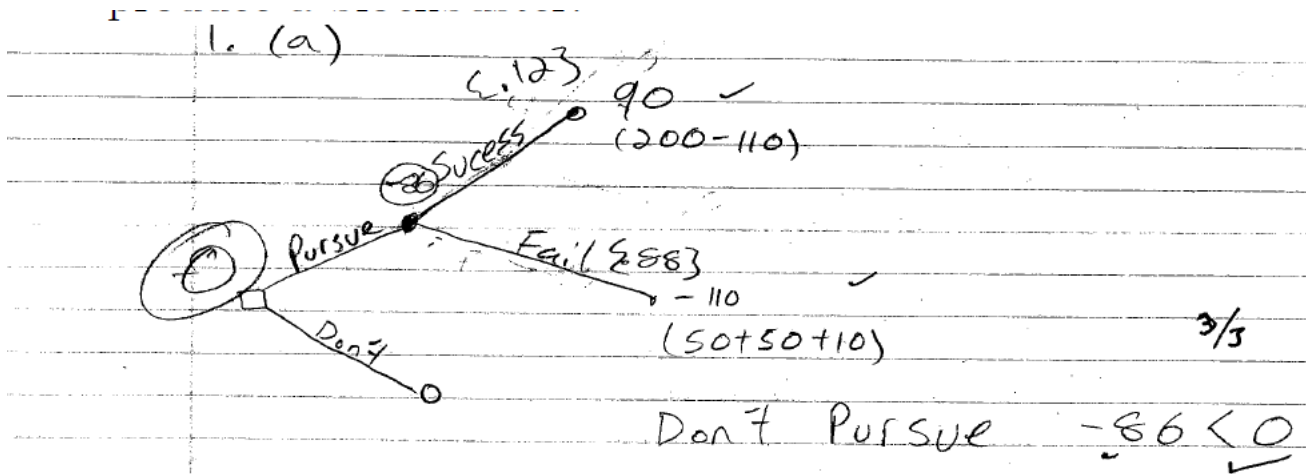
It is not worthwhile to hire the consultant.

Note that, even if the consultant is completely accurate, the informed tree (worth 2) is worth less than the uninformed tree (worth 2.5)

2 Startup and Timing of Costs

As a financial analyst for a biotech startup company, you are to advise on whether to pursue a line of research that will cost \$10 (“R&D”) now and with probability 0.3 will lead to a potential product. It costs \$50 to test such a potential product, and the test leads to FDA approval (“validation”) with probability 0.4. At that point the product is marketable, and at a further cost of \$50 (“production”) it can be sold, bringing on average \$200 in revenue (net of other costs not mentioned). Assume that all dollar figures are present values in \$millions. Revenues come only from marketable products.

- a. Draw and solve the decision tree, assuming that you must sink all mentioned costs (R&D, validation and production) immediately.
- b. Redraw and solve the decision tree assuming that you can wait to see the R&D outcome before sinking the validation cost, and can wait for FDA approval before sinking the production cost.
- c. Now assume that the situation is as in b. above except that with probability 0.2 a marketable product is a “blockbuster.” At an additional cost of \$100 (expansion) a blockbuster generates net revenue of 1000 instead of 200. Once more, draw and solve the decision tree. Also note the probability that the line of research will ultimately produce a blockbuster.



Note: it is possible to interpret that you know a product will be a blockbuster or not. The above assumes that you can choose to expand only if the product is a blockbuster. Always state your assumptions.

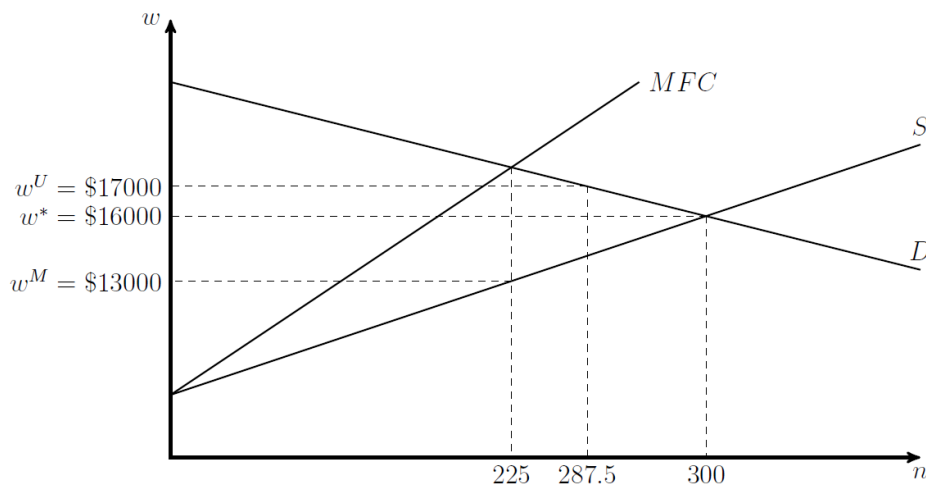
3 Monopsony

The demand for TAs at the University of Chico is approximated by the inverse demand function $w = 40000 - 80n$, where w is the annualized wage and n is the number of TAs hired. The supply is approximated by $w = 4000 + 40n$. If U Chico uses its market power fully, what wage will it pay and how many TAs will it hire? If TAs unionize and enforce $w = \$17,000$, how many TAs will be hired? Comment briefly on the efficiency ($TS = CS + PS$) implications of the union wage.

3.1 Instructor Solution

The university chooses the number of TAs to maximize its objective function, which is the benefit from TAs minus cost to hire. First-order condition is marginal benefit equals marginal factor cost. Total cost is given by $(4000 + 40n)n$, so marginal factor cost is $w = 4000 + 80n$. Setting marginal factor cost equal to inverse demand function, the university hires $n^M = 225$ TAs and sets wages equal to $w^M = \$13,000$ when it acts as a monopsonist. When students unionize and demand wages of $w^U = \$17,000$, the university will hire $n^U = 287.5$ TAs.

When the TAs unionize, the effect is that there is a price floor on wages. When we looked at price floors earlier in the quarter, we saw that they resulted in deadweight loss. But in this problem, the price floor actually reduces deadweight loss since it brings us closer to competitive equilibrium. This is because the monopsonist is already inefficient, so introducing a second distortion such as a price floor can actually reduce inefficiency. If the union compromises and sets the wage $\$16,000$, this achieves the most efficient allocation.



4 Lost Lake and Regulated Monopolies

Lost Lake CA is an isolated community with 20 households, each of whose demand for electricity is well approximated by $p = 60 - q$. The total cost of electricity generation and distribution there is $c(Q) = 900 + Q$. The local city council regulates electricity suppliers.

- a. If the city council wants to avoid deadweight loss, what price ceiling will they choose for electricity? What is the corresponding CS and PS? What profit does the electrical power supplier earn?

To avoid deadweight loss, the council will have to set the price to what it would be in competitive equilibrium, p^* . In this problem, since marginal cost is constant and equal to 1, the supply curve is just a flat line given by $p = 1$. Therefore, in competitive equilibrium the price is $p^* = 1$.

Producer surplus is equal to zero because the supply curve is flat. To find consumer surplus, we first aggregate household demand q into demand for the entire town: $Q = 20q = 1200 - 20p$. At a price of $p^* = 1$, $Q^* = 1180$. Consumer surplus is then $\frac{1}{2}(1180)(60 - 1) = 34810$. The power company's profit is $p^*Q^* - c(Q) = \$900$, so it actually is losing \$900.

- b. The supplier threatens to shut down. What price can the city council set to ensure nonnegative economic profit?

In general, the supplier's profit $p(Q)Q - c(Q)$ is a function of Q . Therefore, we can set this equation equal to zero and find its roots in order to find which values of Q generate zero profits. The equation is

$$\frac{1}{20}Q^2 - 59Q + 900 = 0$$

Applying the Quadratic Formula, we find that the roots are $Q = \{15.5; 1164.5\}$. The profit is nonnegative when $1.77 \leq p \leq 59.2$.

- c. An imaginative city council member suggests charging each household a fixed annual fee plus a per-unit price for electricity consumption. Is there a fee+price combination that would maximize efficiency, and also induce participation by the supplier and all households? If so, compute it; if not, explain why none exists.

The only way to maximize efficiency (and avoid deadweight loss) is to set the per-unit price $p = p^* = 1$. However, we know that the supplier is making a loss at that price so we will need to charge households a fixed fee sufficient to make up for the supplier's loss in order to guarantee its participation. Since the supplier's loss is \$900, we would need to charge a fixed fee of at least $\$900/20 = \45 per household. However, if we charge too high of a fee then households may not wish to participate. In general, households will choose to participate if their surplus is nonnegative. In part (a), we calculated the surplus of all households when $p = 1$ and there is no fixed fee. Therefore, a household's surplus will be nonnegative as long as the fixed fee does not exceed $\$34810/20 = \1740.5 .

To summarize, the per-unit price must be equal to $p^* = 1$ in order to achieve maximum efficiency. When $p = p^*$, the fixed fee for each household must be between \$45 and \$1740.5. If the fee is lower than \$45, then the supplier would rather shut down than continue to make a loss. If the fee is higher than \$1740.5, then households would rather avoid using electricity altogether. This way of pricing is called a two-part tariff.

5 Two-Market Monopolist

Baytech sells gizmos in the home market where it faces the demand function $q_H = 100 - 3p_H$. It also sells the same product in a foreign market where it faces the demand function $q_F = 200 - 7p_F$. Its cost function is $c(q_T) = 30 + 12q_T + q_T^2$, where $q_T = q_H + q_F$.

- a. What output and price choices maximize Baytech's profit?

Write profit as

$$\text{TR}_H(q_H) + \text{TR}_F(q_F) - c(q_H + q_F)$$

where TR_H and TR_F are total revenues in the home and foreign markets, respectively. By taking derivatives, we see that Baytech's profit-maximizing conditions are

$$\max_{q_H, q_F} \text{TR}_H(q_H) + \text{TR}_F(q_F) - c(q_H + q_F)$$

$$\frac{\partial \pi}{\partial q_H} = 0 \implies \text{MR}_H(q_H) - c'(q_H + q_F) = 0$$

$$\frac{\partial \pi}{\partial q_F} = 0 \implies \text{MR}_F(q_F) - c'(q_H + q_F) = 0$$

Therefore,

$$\text{MR}_H(q_H) = c'(q_H + q_F) = \text{MR}_F(q_F)$$

This says that marginal revenue at home equals marginal revenue abroad equals the marginal cost of producing for the combined market. (By the way, $\frac{dc(q_T)}{dq_H} = \frac{dc(q_T)}{dq_T} \cdot \frac{dq_T}{dq_H} = c'(q_H + q_F)$, since $\frac{dq_T}{dq_H} = 1$.)

Likewise, $\frac{dc(q_T)}{dq_F} = c'(q_H + q_F)$.

Substituting in the marginal revenues (obtained by taking the derivative of $\text{TR}_H(q_H) = p_H(q_H) \cdot q_H$ and $\text{TR}_F(q_F) = p_F(q_F) \cdot q_F$) and marginal cost,

$$\text{MR}_H = \frac{100}{3} - \frac{2}{3}q_H = 12 + 2(q_H + q_F) = c'$$

$$\text{MR}_F = \frac{200}{7} - \frac{2}{7}q_F = 12 + 2(q_H + q_F) = c'$$

Solve the system of two equations in two unknowns to find

$$q_H^{opt} = 7.45$$

$$q_F^{opt} = 0.73$$

Which imply

$$\begin{aligned}p_H &= 30.85 \\p_F &= 28.47\end{aligned}$$

- b. Antidumping regulations force Baytech to unify its prices. What choice of $p = p_H = p_F$ now maximizes profit? What is the maximum Baytech would rationally spend to eliminate the antidumping regulation? With $p = p_H = p_F$, we now have

$$q_T(p) = q_H(p) + q_F(p) = 200 + 100 - 3p - 7p = 300 - 10p$$

Inverse demand is therefore $p(q_T) = 30 - \frac{1}{10}q_T$. Baytech's optimization problem is now

$$\begin{aligned}\max_{q_T \geq 0} & \left(30 - \frac{1}{10}q_T\right) q_T - (30 + 12q_T + q_T^2) \\s.t. & q_H \geq 0, q_F \geq 0, q_H + q_F = q_T\end{aligned}$$

The first-order condition gives $q_T = 8.18$ and $p = 29.18$. Remember, though, that an interior solution must also satisfy $q_H \geq 0$ and $q_F \geq 0$. It turns out that $q_F(29.18)$ is negative. Therefore, the first-order condition does not give us an interior solution so we have to check corner solutions.

First, find the solution when $q_F = 0$. The problem is

$$\max_{q_H \geq 0} \left(\frac{100}{3} - \frac{1}{3}q_H \right) q_H - (30 + 12q_H + q_H^2)$$

which gives $q_H = 8$, $p = 30.67$, and profits of 55.33. The other possible corner solution is when $q_H = 0$. In this case, the problem is

$$\max_{q_F \geq 0} \left(\frac{200}{7} - \frac{1}{7}q_F \right) q_F - (30 + 12q_F + q_F^2)$$

which gives $q_F = 7.25$, $p = 27.535$, and profits of 30.07.

Therefore, Baytech will choose to produce its gizmos only in the home market and make a profit of 55.33. Baytech's unregulated profit in part (a) is 55.54, implying that Baytech should be willing to spend up to $55.54 - 55.33 = 0.21$, \$0.21 per period to overturn the regulation.

$$7.45 \cdot 30.85 + 0.73 \cdot 28.47 - \left(30 + 12 \cdot (7.45 + 0.73) + (7.45 + 0.73)^2\right) = 55.54$$

6 Price Discrimination in Airfare

Econometric analysis of air travel demand yields the following elasticity estimates for (first class, unrestricted coach, discount) demand: income = (1.8, 1.2, 1.1), and own-price = (-0.9, -1.2, -3.7). Predict the fares that a profit-oriented airline would pick for a route with no serious competition and marginal cost \$150 per passenger.

6.1 Instructor Solution

This is an example of third-degree price discrimination. Applying the markup formula

$$p_i = \frac{|\epsilon_i|}{|\epsilon_i - 1|} c$$

from the notes, we get

$$\begin{aligned}p_F &= \frac{0.9}{0.9 - 1} (100) = -\$1350 \\p_U &= \frac{1.2}{1.2 - 1} (100) = \$900 \\p_D &= \frac{2.7}{2.7 - 1} (100) = \$205.56\end{aligned}$$

Plainly, the formula does not give a valid price for first-class tickets, p_F . This is because demand for these tickets is inelastic ($-0.9 < 1$). Faced with inelastic demand for first-class tickets, the profit-maximizing firm will raise p_F to an arbitrarily high level until demand is no longer inelastic. (As long as demand is inelastic, when a firm raises its price, total revenue will increase and total costs will fall.)

7 Comparing Market Structures

Direct demand is $Y = 86 - p$, where Y is the sum of output across all firms, and each firm has a cost function $c(y) = 14y$. a. Firms operate in the market by setting quantities. What are outputs, prices, profits and deadweight losses for monopoly, duopoly, triopoly and perfect competition markets? Show all work, but then collect your answers into a table, with columns for market structure and rows for performance measures. Which market structure is most efficient and WHY?

With perfect competition, the profit maximization condition $p = MC$ implies that $86 - Y = 14$, or $Y = 72$, $p = 14$, and $\pi = 0$. Of course, with perfect competition there is no deadweight loss.

Rather than solving the cases with 1 firm, 2 firms, and 3 firms separately, it's easier to just solve for N firms. Then, firm i maximizes

$$\max_{y_i} [86 - (y_1 + \dots + y_N)] y_i - 14y_i$$

which has the first-order condition

$$72 - (y_1 + \dots + y_{i-1} + 2y_i + y_{i+1} + \dots + y_N) = 0$$

which can be re-arranged as

$$y_i = 72 - Y$$

Note that this condition holds for each of the N identical firms. If we add all these conditions together, we get

$$\sum_{i=1}^N y_i = N(72 - Y)$$

Of course, the sum on the left-hand side is just equal to Y , so we can solve the above for Y to get $Y = 72 \frac{N}{N+1}$. Note that when we let N go to infinity, we get $\lim_{N \rightarrow \infty} Y = Y^* = 72$.

For the monopolist case where $N = 1$, we get $Y^M = 36$, $p^M = 50$, $\pi^M = 1296$, and deadweight loss of $\frac{1}{2}(72 - 36)(50 - 14) = 648$. Note that to find the deadweight loss, we first had to find industry supply. Since the firm has inelastic supply at $p = 14$, inverse industry supply is also the horizontal line $p = 14$.

With a duopoly ($N = 2$), we get $Y^D = 48$, $p^D = 38$, $\sum_{i=1}^2 \pi_i^D = 1152$, and deadweight loss of $\frac{1}{2}(72 - 48)(38 - 14) = 288$. With a triopoly ($N = 3$), we get $Y^T = 54$, $p^T = 32$, $\sum_{i=1}^3 \pi_i^T = 972$, and deadweight loss of $\frac{1}{2}(72 - 54)(32 - 14) = 162$.

To summarize:

	Y	p	$\sum \pi_i$	DWL
Monopoly	36	50	1296	648
Duopoly	48	38	1152	288
Triopoly	54	32	972	162
Perfect Comp.	72	14	0	0

Not surprisingly, perfect competition comes out as the most efficient market structure. With the other market structures, the firm(s) restrict(s) output in order to raise prices and earn profits. This behavior, however, generates deadweight loss.

b. Suppose firms set price instead of quantity. Again prepare a table of the same size and shape, and compare it to that in part a. How does your answer on efficiency change?

When firms compete by choosing prices, then in (short-run) Bertrand equilibrium, the firm with lowest cost can capture the whole market by choosing a price just below the marginal cost of the firm with the next-lowest cost. If all firms are identical, then they lower prices until they reach marginal cost; they divide up the market and all earn zero profits.

To summarize:

	Y	p	$\sum \pi_i$	DWL
Monopoly	36	50	1296	648
Duopoly	72	14	0	0
Triopoly	72	14	0	0
Perfect Comp.	72	14	0	0

Compared to part (a), the monopolist's behavior is still the same but now, as soon as we introduce any competition, we go immediately to the efficient (zero-profit) outcome.

Part II

Short Essay

8 Natural and Unnatural Monopolies and Public Policy

Which of these firms are natural or unnatural monopolists? What are reasonable public policies towards them? Google, Facebook, AirBnB, Amazon, Uber, Golden State Warriors.

8.1 Instructor Guidance

Natural monopolies are ones which arise from insufficient demand or high (natural) barriers to entry, among other things. Facebook might be considered a natural monopoly, because it would be extremely difficult to lure new customers away from Facebook to competitors until you have a large group using the competitor (network effects). A reasonable public policy toward a natural monopoly is to enforce anti-trust law to ensure that these companies do not unfairly overcharge customers, undersupply services, or otherwise take advantage of their market power.

Unnatural monopolies arise from policies or interventions that restrict market entry. An example might be the NBA allowing only one team to serve the San Francisco Bay Area, though it could be natural if there is only enough demand for one team. The best policies here are those which remove barriers to entry or otherwise encourage competition.

Suggestion: Google, Facebook, AirBnB, and Uber are natural monopolists due to network externalities. Amazon is a conglomerate, trying to use monopoly power in one area to undercut incumbents in related services. The Warriors are an unnatural monopoly generated by an anti-trust exemption for the NBA. The NBA regulates entry, hiring, draft picks, etc.

9 Imperfect Competition Market Structures in Practice

Pick an industry you know something about; if none, pick bookstores. Use one or two models of imperfect competition to organize a discussion of output and pricing decisions and profitability in the chosen industry. For example, for bookstores, you might consider Bertrand oligopoly (covered in class), or monopolistic competition, or dominant firm/competitive fringe (look them up if you are interested). Max 250 words; please print it on a separate page.

9.1 Instructor Guidance

Any relevant, well-argued response is appropriate. Friedman's position: retail bookstores, before Borders and Amazon, were monopolistic competitors, or faced a kinked demand curve. Now Amazon is a monopolist in most local markets (not Santa Cruz), but is keeping prices low to prevent entry.