Problem 1

15 points

Table 3.2 of Shapiro and Varian is reproduced below as Table 1 (reference [7], page 62). Give an example of each discrimination category from your experience. We will award a 5-point bonus if you can make a realistic case along ten or more price discrimination dimensions for a single information product.

<table>
<thead>
<tr>
<th>Product Dimension</th>
<th>Likely Uses or Users</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 delay</td>
<td>patient / impatient users</td>
</tr>
<tr>
<td>2 user interface</td>
<td>casual / inexperienced users</td>
</tr>
<tr>
<td>3 convenience</td>
<td>business / home users</td>
</tr>
<tr>
<td>4 image resolution</td>
<td>newsletter / glossy uses</td>
</tr>
<tr>
<td>5 speed of operation</td>
<td>student / professional uses</td>
</tr>
<tr>
<td>6 format</td>
<td>on-screen / printed uses</td>
</tr>
<tr>
<td>7 capability</td>
<td>general / specific uses</td>
</tr>
<tr>
<td>8 features</td>
<td>occasional / frequent users</td>
</tr>
<tr>
<td>9 comprehensiveness</td>
<td>lay / professional users</td>
</tr>
<tr>
<td>10 annoyance</td>
<td>high-time-value / low-time-value users</td>
</tr>
<tr>
<td>11 support</td>
<td>casual / intensive users</td>
</tr>
</tbody>
</table>

Table 1: Price discrimination dimensions for information products.

An example for Category 1 would be paperback / hardcover versions of the same book, with the paperback version coming out months or years later.

Problem 2

15 points

Table 2 shows the result of research on the structure of a particular market for an information product. There is only one version of the product, but there are five customer classes, from A to E, and the highest viable price is estimated for each category. We would like to explore how useful price discrimination is for raising the firm’s revenue. Perfect price discrimination gives the result for the last row, ‘Five prices’.

(a) If the supplier can only charge one price, what price gives the highest total revenue over all the categories? Fill in the empty spaces in the 'One price' row.
(b) As (a), but if the supplier can charge two prices, what are the best two prices to use? Fill in the empty spaces in the ‘Two price’ row.

Hint: some of the customers will not be served. You may want to use a spreadsheet for this.

<table>
<thead>
<tr>
<th>Viable prices</th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>E</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sales vol. potential (000)</td>
<td>$19</td>
<td>$14</td>
<td>$9</td>
<td>$7</td>
<td>$5</td>
<td>1,100</td>
</tr>
<tr>
<td>% of market vol.</td>
<td>150</td>
<td>150</td>
<td>350</td>
<td>250</td>
<td>200</td>
<td>1,100</td>
</tr>
<tr>
<td>Contribution (000)</td>
<td>13.6</td>
<td>13.6</td>
<td>31.8</td>
<td>22.7</td>
<td>18.2</td>
<td>100</td>
</tr>
<tr>
<td>One price</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>Two prices</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>Five prices</td>
<td>$2850</td>
<td>$2,100</td>
<td>$3,150</td>
<td>$1,750</td>
<td>$1,000</td>
<td>$10850</td>
</tr>
</tbody>
</table>

Table 2: The benefits of price discrimination.

**Problem 3**

20 points

See the paper copy that we handed out in class of pages 73–81 from *Nonlinear Pricing*, by Robert Wilson. This describes the benefits of pricing each increment of the quantity sold at a different rate. We examine the common case of a *quantity discount*: the consumer surplus (buyer’s utility minus the price, at a specific quantity level) normally drops as a buyer buys more of an item, and to optimize profits it may help to lower prices for customers who buy more.

a Consider Table 4.1, on page 76 of the handout. Read the descriptions on page 76 and 77 carefully, and then make a model of the table. (A spreadsheet like Excel is ideal for this.) Develop active formulas to compute \( R(p(q), q) \). Check to see that you can obtain the author’s results for each of the table entries.

b Recompute the optimal Total Profit if the marginal cost \( c = 0 \); what is your answer for this case? (Note that the marginal cost was \( c = \$1 \) and the Total Profit was \$480 in the original model.)

c What is the aggregate demand \( \bar{D}(p) \) in the case where \( c = 0 \), and the uniform price \( p \) is \$3.00 ?

d Plot the optimal price for each demand increment (the optimal tariff) versus demand (1, 2,...,5 units) from part b; also plot the uniform tariff from part c versus the same demand.

Note that pages 73–80 are included in the handout, and are good background reading for this problem. However, nearly all the information you need to complete the problem is on pages 76 and 77.

**Problem 4**

20 points

In Varian and Shapiro, Chapter 3, page 58, a successful versioning strategy is discussed in which Wolfram Research released a student copy of Mathematica for a much lower price. In order to prevent cannibalization of its high-end product, the speed of the student version was reduced by forcing floating point calculations to be done in software rather than hardware.

Figure 1 shows an example of how Wolfram might price its two products. As in the diagram on page 38 on differential pricing shows, they want to capture both high-end and low-end users. By our theory of
consumer surplus discussed in class, users will buy the version which gives them the highest individual surplus. In this fictitious example Wolfram has set prices $P_{fast}=$350 and $P_{slow}=$150.

Think of the abscissa, quantity, ordered from the zealots on the left to casual users on the right. The first few users would have been willing to pay $500 for the fast version. Those users see a consumer surplus of $500 - 350 = 150$ for the fast version, but only $200 - 150 = 50$ for the slow version. $150 > 50$, so the zealots will buy the fast version.

This continues out to around 15K users, where the consumer surplus for the slow version becomes greater. Finally, before the 30K user mark $P_{slow}$ hits the lower demand curve and no more sales occur.

(a) Compute the optimal price points $P_{fast}$ and $P_{slow}$ for these demand curves (which give the highest possible revenues), using only the information included in the plot. In other words, move the $P_{fast}$ and $P_{slow}$ lines around to maximize the revenue rectangles.

(b) Suppose the additional cost of the software floating point library needed for the slow version was subtracted from the total revenue gained when calculating $P_{fast}$ and $P_{slow}$. Wolfram should offer the slow version as long as it actually boosts revenue. How much should Wolfram be willing to pay for the floating point library?

Hint: It’s OK to make copies of the plot and draw sketches to find the approximate solutions. Just explain how you found your answer. Of course, being Mathematica developers, the people at Wolfram found precise approximation formulas for these demand curves. We will give five points extra credit if you find precise solutions using these formulas: the top curve is given by $500 - 0.4Q^2$, and the bottom curve by $200 - \frac{1}{20}e^{0.24Q}$. 
Problem 5

15 points Please choose either Question 5.1 or Question 5.2 below (not both), and answer parts (a) and (b).

Question 5.1 In Chapter 2, Varian and Shafer describe competition in the market for encyclopedias between Encyclopedia Britannica and Microsoft. Referencing Porter’s ”Strategy and the Internet” diagram of the five forces that determine industry structure:

(a) For each of the five forces, briefly describe one or two ways that it changed when Microsoft bought Funk and Wagnalls and entered the encyclopedia business. Among contemporary shifts in technology, keep in mind that sales of PCs running Windows were taking off at that time.

(b) How might the rise of Wikipedia change the structure of this industry again?

Question 5.2 Use Porter’s five forces model to analyze a market for an information good or service that you would like to know more about. Here are some examples, and you are welcome to come up with a different one.

- The office productivity suite market. Some current suppliers are Microsoft Office, Open Office, and Google Docs.
- The scientific software market. Examples include Matlab, Mathematica, SAS, SPSS, and Maple. They now have to compete with open-source alternatives such as R, Weka, and Octave.
- The high-end mobile phone market. Examples of phones include the Blackberry, the iPhone, the Android, the Samsung SGH-i780, and many others. Then phone manufacturers must team up with carriers who provide service, unless they have WiFi capability like the Android.
- The higher education market.

(a) For each of the five forces, identify at least two (more is better) of the most important actors. Most of these will be the names of companies, but for the “buyers” box, the actors may be individual consumers. In that case, give an approximate number for the total available market (the TAM) for this product, and identify two or more of the largest market segments. For example, market segments might be “government, education, and commercial” for scientific software. Porter provides two different diagrams for analyzing pricing power in his two articles: the ”Strategy and the Internet” diagram, and ”The Five Competitive Forces...” diagram. They are roughly equivalent; you may choose either one, shown below in Figure 2.

(b) In one or two paragraphs, describe the current industry dynamics. How is the balance of pricing power changing? Based on these dynamics, how do you expect the market to have changed if you repeat the analysis on Jan. 1, 2010?

Problem 6

15 points  
(a) Discriminatory pricing can under some circumstances be illegal. The general focus of US law is to maintain the viability of multiple sellers as a means to preserve competition. The principal legislation is the Robinson-Patman Act – see

http://en.wikipedia.org/wiki/Robinson-Patman_Act
However several standards must be met simultaneously for a prosecution under the act to be successful. By an inspection of Table 3.1 on page 60 of VS, which of the act’s requirements definitely does not apply to the software, thus rendering Kurzweil exempt from lawsuits?

(b) In general, do you think discriminatory pricing is ethical? Can you think of any circumstances under which it would not be right to adopt discriminatory pricing policies?

**Further Reading**

Please see the references below for further background information.

**References**


