Math 115 Excel Group Project 3 Worksheet
Price Elasticity of Demand: U.S. Demand for Gasoline

The price elasticity of demand measures the responsiveness of the demand for a particular commodity to a change in its price.

1. The formula for the price elasticity of demand is

   \[ E(p) = \] 

   When you calculate \( E(p) \) for a particular commodity at a given price \( p \), you get a number. What does that number tell you about the commodity? What are the units on the answer? (See Lecture Notes 5.6.)

   When a commodity is elastic, buyers change / do not change their buying habits when the price changes.
   Conversely, when a commodity is inelastic, buyers change / do not change their buying habits when the prices change.

2. Milk If the price of milk were increased, do you think consumers would change their buying habits? Give a reason to support your guess. Answer in sentences.

   When the price of milk is $4.00 per gallon, the U.S. consumes approximately 430 thousand gallons of milk per day. Suppose that at this price, the price elasticity of demand for milk is approximately 0.75.
   a. This means if price is raised by _______ percent, the demand for milk will increase / decrease by approximately _______ percent.
   b. If the price were currently $4.00 per gallon, and sellers raised the price by 1%, the new price would be ______ (include units). In this case, the demand would be reduced to ______________________ (include units).
   c. Milk is an elastic / inelastic commodity.

3. Private Helicopters If the price of a private helicopter were increased, do you think consumers would change their buying habits? Give a reason to support your guess. Answer in sentences.

   When the price of a particular two-seat helicopter is $450,000, the manufacturer sells approximately 400 helicopters per year. Suppose that at this price, the price elasticity of demand for this type of helicopter is approximately 3.
   a. This means if price is raised by _______ percent, the demand for these helicopters will increase / decrease by approximately _______ percent.
   b. If the price were currently $450,000, and sellers raised the price by 1%, the new price would be ____________ (include units). In this case, the demand would be reduced to _______________________ (include units).
   c. These helicopters are an elastic / inelastic commodity.
Consider the two price-demand graphs below. The labels give the x-value.

Which graph represents a commodity that is elastic at a price of $100 per unit, and which represents a commodity that is inelastic at $100 per unit? Label the graphs and explain how can you tell. Answer in sentences, and include numerical values to substantiate your claims.

Each quote below describes consumer demand as it is related to the price of a commodity. Decide if the quote indicates that the commodity elastic or inelastic. Explain your conviction in sentences.

5. **Coffee** In the article "Coffee Cravers Ignoring Bean-Price Surge for Caffeine Fix" on Bloomberg.com [1], Doreen Cappelli is quoted to say, “I don’t drink wine and alcohol,” Cappelli, 52, said after buying the $3.25 drink at Blue Bottle Coffee at San Francisco’s Ferry Building, in the shadow of the Bay Bridge. “Coffee is one of my pleasures in life. I would pay double.”

*Does Doreen's behavior indicate that coffee is an inelastic commodity, or an elastic commodity at that price?*
6. **Jewelry** This quote is from the article "Americans Snap Up Gold Jewelry as Metal's Price Sinks," in MoneyNews.com [2]: "I always look for the price of gold in the news and pay attention to discounts and deals," John Mora Gonzalez, a 31-year-old mechanic in New York, said after purchasing a necklace for his wife for Christmas. Mora had spotted J.C. Penney Co.'s 20-percent discount on fine jewelry, and paid $40 for a 10-karat gold necklace. 

*Does John's behavior indicate that gold jewelry is an inelastic commodity, or an elastic commodity at the current prices?*

7. **Music** This quote by Phil Leigh, senior analyst for Inside Digital Media is from the article, "Music download prices rising?" from CNN Money [3]: "If the labels really want to fight piracy, it defies logic to increase prices and create more of a disincentive for the consumer to use legitimate providers. If they want to encourage the public to use legitimate online pricing, raising prices is about the last thing they should think of doing."

*Does Phil consider music an inelastic or an elastic commodity at current prices?*

**References**


(In that article, Phil Leigh was also quoted saying, "I think whoever came up with this idea understands the online music industry about as well as a cow understands algebra.")
Excel Group Project 3

Data and Sample Calculations
The file Excel Project 3 Data.xlsx includes three tabs.
- The first and second tabs contain data on demand and price for gasoline by region.
- The third tab contains sample calculations for the Group Component.
- The fourth tab contains sample calculations for the Individual Component.

Rubric
This assignment includes a Group Component (50%) and an Individual Component (50%). The requirements summarized here are described in detail in the pages that follow.

<table>
<thead>
<tr>
<th>Group Component (submit 1 report per group)</th>
<th>Individual Component (submit 1 report and 1 worksheet per group member)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Typed report with correct grammar and spelling, and all required content (see Step 6)</td>
<td>Typed report with correct grammar and spelling, and all required content (see Step 10)</td>
</tr>
<tr>
<td>40%</td>
<td>45%</td>
</tr>
<tr>
<td>In-Class Worksheet (must attend to obtain credit)</td>
<td>An acknowledgement of participation (see Step 11)</td>
</tr>
<tr>
<td>10%</td>
<td>5%</td>
</tr>
</tbody>
</table>

You can do this before getting together with your group:

Step 1: Read about Gasoline Prices
The following is from the introduction to an article called, "(Un?)Happiness and Gasoline Prices in the United States," published in September 2010 by the Brookings Institute. The report includes a discussion of the spike you will see in your price data in 2008.

Gasoline purchases are an essential part of the American way of life. There were about 250 million motor vehicles in the United States in 2008 – just under a vehicle per person. Americans drive an average of more than 11,000 miles per year, and gasoline purchases are an essential part of most households' budgets. Between 1995 and 2003, gasoline prices in the U.S. averaged about $1.49 a gallon, with average prices rising above $2.00 in 2004. By the summer of 2008, gasoline prices had reached a national average of $4.11 per gallon. At that time, Americans earning less than $15,000 a year were spending as much as 15 percent of their household income on gasoline – double the proportion from seven years earlier. In addition, unpredictable fuel costs make planning monthly household expenditures difficult, which can be detrimental to individual welfare and even to the overall economy.

Gasoline prices fell in the aftermath of the 2009 economic crisis. Prior and during the financial crisis, rising gasoline prices were seen as a symptom of an uncertain economic situation, as well as evidence of the questionable sustainability of our future oil supply. Gasoline prices abated along with the decrease of economic activity that accompanied the onset of the recession, reaching their minimum in late December 2008. A few months later, as the economy entered a gradual recovery phase, gasoline prices also trended upward. In contrast to the previous period of great uncertainty about future oil supplies, however, these price trends were considered more positively as signs of the U.S. economic recovery.

Consider reading the full report. Here is the source; to download the full report, follow the link on the right of that page.
More About Gasoline Prices
The U.S. Energy Information Administration, whose data we use for this assignment, presents insights about gasoline prices. (These brief articles are a good way to get an understanding of the big picture.)

- Why gasoline prices fluctuate
  http://www.eia.gov/energyexplained/index.cfm?page=gasoline_fluctuations
- Factors affecting gasoline prices
  http://www.eia.gov/energyexplained/index.cfm?page=gasoline_factors_affecting_prices
- How gasoline prices vary across the U.S.
  http://www.eia.gov/energyexplained/index.cfm?page=gasoline_regional

Group component
Work as a group to complete the following analysis and report.

Step 2: Prepare your data
- Open the spreadsheet ExcelProject3Data.xlsx.
  Create a new spreadsheet that has only the data for your region, as follows:
  - Copy and paste the columns entitled Line Number, Month and Year into your new spreadsheet, columns A, B and C.
  - Copy the column for your region from the Demand tab and paste it in column D.
  - Copy the column for your region from the Price tab and paste it in column E.
  The dates on the price and demand tabs coincide, but do make sure that the data you paste in lines up with the correct dates.

Step 3: Display and describe the price-demand data
Economists always plot the price on the vertical axis and the quantity demanded on the horizontal axis, when graphing the relationship between price and demand.

- Create a scatter plot that displays the demand from column D on the horizontal axis and the price from column E on the vertical axis. Format the chart as follows.
  o Delete the legend, since you will display only one data series on this chart.
  o Title the chart.
  o Format the vertical scale to include dollar signs and two decimal places.
  o Format the horizontal axis labels to include 1000's place commas.
  o Label the horizontal and vertical axis appropriately, including units.
  o Change the colors as you see fit.

This data appears to have a large variation in prices, but a relatively small variation in demand, but looks can be misleading. For example, if you changed the horizontal scale to range from 7000 to 10,000 the data would appear more spread out horizontally. To understand the relative spread of the data ranges, do the following calculations:

- Calculate the median volume of gasoline sold per day. In cell D171 (at the bottom of the demand column), use Excel's MEDIAN function to find the median of the demand data. Label the calculation for easy reference by typing, "Median," in cell C171.

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
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</thead>
<tbody>
<tr>
<td>C</td>
<td></td>
</tr>
<tr>
<td>D</td>
<td></td>
</tr>
<tr>
<td>171</td>
<td>Median=MEDIAN(D2:D170)</td>
</tr>
</tbody>
</table>
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- Similarly, find the minimum and maximum volumes of gasoline sold per day, using Excel's MIN and MAX functions, in cells D172 and D173. Again label the results "Minimum" and "Maximum" respectively, in column C.

<table>
<thead>
<tr>
<th></th>
<th>C</th>
<th>D</th>
</tr>
</thead>
<tbody>
<tr>
<td>172</td>
<td>Minimum</td>
<td>=MIN(D2:D170)</td>
</tr>
<tr>
<td>173</td>
<td>Maximum</td>
<td>=MAX(D2:D170)</td>
</tr>
</tbody>
</table>

- Find the range of the data in cell D174, by subtracting the minimum from the maximum.

<table>
<thead>
<tr>
<th></th>
<th>C</th>
<th>D</th>
</tr>
</thead>
<tbody>
<tr>
<td>174</td>
<td>Range</td>
<td>=D173-D172</td>
</tr>
</tbody>
</table>

- What percent of the median does the range comprise? Calculate the percentage in cell D175. Change the format of that cell to display the result as a percentage. Tip: If you can't figure out how to do something in Excel try a Google search. For example, search for "Format cell percentage Excel 2008 Mac."

<table>
<thead>
<tr>
<th></th>
<th>C</th>
<th>D</th>
</tr>
</thead>
<tbody>
<tr>
<td>175</td>
<td>Percentage of the median</td>
<td>=D174/C171</td>
</tr>
</tbody>
</table>

- Select Cells D171:D175 and fill to the right by one cell to calculate these values for the price column. Select cells E171:E174 and format them to match the formatting of the prices in column E. Make sure E175 displays a percent.

  From what you see here, do consumers tend to change their purchasing habits due to changes in the price of gasoline? You will address this question in your report.

**Step 4: Display the price-demand data as a time-series**

We have the month and year in separate columns so that we can sort the data in the next step. For this chart, you will create a column that has both the month and the year, so that you can use these as labels in your chart.

- In Column F, use Excel's CONCATENATE function to combine the text in column B with the year in column C. CONCATENATE combines multiple text strings into one string. For example to combine "Green" and "frog," with a space between them, we would use the command =CONCATENATE("Green","\","frog"). The cell would contain the text "Green frog". Similarly, in cell F2, combine the contents of cell B2 with cell C2, with a space in between.

<table>
<thead>
<tr>
<th></th>
<th>F</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>=CONCATENATE(B2,&quot;&quot;,C2)</td>
</tr>
</tbody>
</table>

  You should see January 2000 in cell F2. Fill down to get the month and year for each row of the data. Adjust the column width so that the words fit in the cells in column F.

- Select the data in columns D and E, and create a Line Chart (not an X Y Scatter plot).
- Change the Category (X) axis labels to the labels you created in column F. Tip: Right click on the chart and choose Select Data from the drop down menu, to reveal the Select Data Source dialog box. Your first data series is selected. Click in the Category (X) labels box, and then select F2:F170 on your spreadsheet. Then click on your second data series, and do it again. While you are there, you can add or change the Name of the series, to how you wish it to appear in the legend.
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• Of course the data in these two columns are not measured using the same units, so you'll need to use two vertical axes, as you did in Excel Project 2. Initially, only one vertical axis will appear. Double click on the data series showing demand, to reveal the formatting menu. Select "Secondary Axis" from the Axes options.
• Look at the graph and say, "Whoa! What happened in 2008?" Reread the paragraph in Step 1, and consider reading the entire article.
• To make the graph easier to read, adjust the horizontal (category) axis scale. Double click on the axis, and select Scale in the dialog box. Set the interval between labels and the interval between tick marks to 12 (since there are 12 months in the year, this will mean that only January will be labeled).
• On the chart, display the vertical gridlines.
• Format the chart as follows.
  o Title the chart.
  o Format the vertical price scale to include dollar signs and two decimal places.
  o Format the vertical demand scale to include 1000's place commas.
  o Label the two vertical axis appropriately, including units.
  o Change the colors as you see fit.
  o Include a legend. Consider moving it to the top or bottom to make a more economical use of space.

From what you see here, does price fluctuate with the seasons? Does demand? You will address this in your report.

Step 5: Compile a group project report (1 per group)
Work together to create a 1-2 page well organized and well written report showing your group's work. Include the following.
• An introduction saying what data you are studying. Include a brief statement about the location of your region (Here's the map: http://www.eia.gov/petroleum/gasdiesel/diesel_map.cfm)
• The chart you created in Step 3, with the following.
  o No legend.
  o A title.
  o Dollar signs and two decimal places on the price-axis, 1000's place commas on the demand axis.
  o Labels on the axes, including units.
In Excel, you can click on a chart to select it, and then copy and paste it directly into a word file. Within the word file, you can still change the formatting (colors, fonts labels, line thickness and so on) of your charts to your liking.
• A table that shows the Median, Maximum, Minimum, Range, and Percentage for both price and demand, which you calculated in Step 3. You can paste this in directly from Excel: select cells C171:E175, copy and then paste into Word. Reformat it as you see fit.
• A paragraph answering this question: Do consumers tend to change their purchasing habits due to changes in the price of gasoline? When you answer this, verbally describe the information in the table above. Give the median price and demand for your region, and explain how much the price and demand each varied between January 2000 and January 2014. Use the percentages you calculated to compare the variation in price to the variation in demand. Your paragraph should include numerical values with correct units.
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- The chart you created in Step 4, with the following.
  - A title.
  - A legend.
  - Dollar signs and two decimal places on the price-axis, 1000's place commas on the demand axis.
  - Labels on the two vertical axes, including units.
  - Horizontal axis scale showing labels for each January in the data set only (see Step 4).
  - Vertical and horizontal gridlines.
- A paragraph discussing seasonal variation in demand. Address the following:
  - How you can tell from the graph that the demand varies with the seasons?
  - In which seasons do consumers appear to have the highest and lowest demand for gasoline? Describe the maximum and two relative minima that appear each year. (Tip: In Excel, click on the graph to select it. Then mouse-over the data; Excel will show you the values.)
  - What are consumers doing at these times that could affect their demand for gasoline?

Step 6: Choice for individual portion
In your individual component, you will estimate the elasticity of demand for gasoline in the period after 2010, removing seasonal differences in demand by considering data from a single month in 2010, 2011, 2012 and 2013. Because many things, including the price, contribute to the demand for gasoline, the regional data is quite scattered, and regression lines do not fit it well. The data for the whole U.S. is "cleaner" in that linear regression models fit the data with higher $r^2$ values. So for the individual component, you will use the U.S. Data.

- Assign each group member one of the following months: May, September or December.
- Copy the demand and price data for the whole US into a new spreadsheet. Here's how:
  - Copy and paste the columns entitled Line Number, Month and Year into a new sheet in your spreadsheet, columns A, B and C.
  - Copy the column for the U.S. from the Demand tab and paste it in column D.
  - Copy the column for the U.S. from the Price tab and past it in column E.
- Select the data, and use Excel's sort feature to sort the data, first by month and then by year. (For help sorting, start with the Help menu in Excel. If that does not help you, try Google.) After you sort, you should see first the data from April, in years 2000 through 2013 (in order), then the data from August, in years 2000 through 2013, and so on, with the months listed in alphabetical order.
- If, for some reason, you wish put the data back in chronological order, sort it by line number.
- Each group member should copy the header in row 1 and the rows containing data from his or her month into a new sheet. Members will use these data to complete the individual portion of the assignment.
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Individual Component

Each group member completes a report presenting an approximation of the elasticity of demand for the U.S. as a whole, in 2013. Use only data from the month selected in Step 6. Your grade does not depend on the Individual Components of your group members.

Step 7: Calculate the elasticity in 2013

You will calculate the price elasticity of demand in 2013 using the formula

\[ E(p) = -1 \cdot \frac{p}{q} \cdot \frac{dq}{dp} \]

To do that, you need to approximate \( dq/dp \) in 2013.

- Create a scatter plot showing, for years 2010 through 2013, with the price on the horizontal axis and the demand on the vertical axis. This is opposite of how economists represent this data, but we would like to represent \( q \) as a function of \( p \), so we need \( q \) on the y-axis and \( p \) on the x-axis. Your scatter plot should have four data points.
- Fit a quadratic regression line to the data, and display the equation on the chart. In the resulting equation, \( y \) represents the demand (\( q \)) and \( x \) represents the price (\( p \)).
- Calculate the formula for the derivative of demand with respect to price, \( dq/dp \).
- Find the value of the price elasticity of demand in 2013, using the formula above.
  - For \( p \) and \( q \), use the data from your month in 2013.
  - For \( dq/dp \), use the formula you found above, evaluated at the price in your month in 2013.

From this calculation, if the price were increased by 1% from its value in your month in 2013, how much would demand decrease? Is demand elastic or inelastic in 2013? You will discuss this question in your report.

Step 8: Compile an individual report (1 report per group member)

- Title your report with a title that includes what month's data you study.
- An introduction that says what data you are discussing. Indicate what consumers may be doing during your month and how that might influence the demand for gasoline. (Don't forget that in some parts of the country, it is cold from November to March.)
- Display the charts you created in Step 7. The chart should include the following.
  - No legend.
  - A title.
  - Dollar signs and two decimal places on the price-axis, 1000's place commas on the demand axis.
  - Labels on the axes, including units.
  - A quadratic regression line, with its equation and \( r^2 \) value displayed on the chart.
- Write a paragraph explaining how you approximate the price elasticity of demand in 2013. Give your answers when you describe the steps. For example, when you say you fit a quadratic regression curve to the data, say what the formula is. Use \( p \) for price and \( q \) for quantity. Be sure to included:
  - The formula for the demand \( q \) as a quadratic function of price \( p \).
  - The formula for the derivative of the demand with respect to price \( dp/dq \).
  - The price elasticity of demand in 2013 (you do not need to present the formula for \( E(p) \), just the value).
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- Conclude with an interpretation of the numerical value you obtained for the price elasticity of demand in 2013. Answer the following in your paragraph.
  - Is the demand is elastic or inelastic in 2013?
  - What would happen to demand if the price were raised 1% from its value in 2013? Say what the price is in 2013, what it would be if it were 1% higher, what the demand is in 2013, and approximately what the demand would be if the price were raised by 1%. Refer to the Worksheet for Excel Group Project 3, numbers 2 and 3 for guidance.
- Include correct units on all numerical values.

Step 9: Acknowledgement of participation
At the end of your individual report, write a sentence or two saying what contribution you made to the group's part of the project.