

Homework 5

Solutions

Part I

Multiple Choices (2 Points Each)

1. Which of the following statements is correct?
 - (a) The demand for natural gas is more elastic over a short period of time than over a long period of time.
 - (b) The demand for smoke alarms is more elastic than the demand for Persian rugs.
 - (c) **The demand for bourbon whiskey is more elastic than the demand for alcoholic beverages in general.**
 - (d) All of the above are correct.
2. When the price of a bracelet was \$25 each, the jewelry shop sold 20 per month. When it raised the price to \$35 each, it sold 14 per month. Assuming the demand curve didn't change during this time, the arc price elasticity of demand for bracelets is
 - (a) 1.66.
 - (b) **1.06.**
 - (c) 0.94.
 - (d) 0.60.

3. Pierre says that he will spend exactly 10 dollars a day on coffee, regardless of the price of coffee. Pierre's demand for coffee is
- (a) perfectly elastic.
 - (b) **unit elastic.**
 - (c) perfectly inelastic.
 - (d) None of the above answers is correct.
4. Last month, sellers of good Y took in \$100 in total revenue on sales of 50 units of good Y. This month sellers of good Y raised their price and took in \$120 in total revenue on sales of 40 units of good Y. At the same time, the price of good X stayed the same, but sales of good X increased from 20 units to 40 units. Suppose changes in the sales of X are driven by demand shifts as a result of changes in the price of Y, we can conclude that goods X and Y are
- (a) substitutes, and have a cross-price elasticity of 0.60.
 - (b) complements, and have a cross-price elasticity of 0.60.
 - (c) **substitutes, and have a cross-price elasticity of 1.67.**
 - (d) complements, and have a cross-price elasticity of 1.67.

Part II: Problems

Problem 1 (4 Points)

Suppose the market for a good can be represented by the following equations of supply and demand:

$$\text{Supply: } P = 0.05Q_S$$

$$\text{Demand } P = 20 - 0.15Q_D$$

, where Q_S and Q_D denote respectively quantity supplied and quantity demanded.

1. What are the equilibrium price quantity in this market? (2 Points)

$$(W^*, Q^*) = (5, 100)$$

2. What are the price elasticity of demand and the price elasticity of supply at this equilibrium? (2 Points)

$$\epsilon_{d,p} = \frac{dQ_D}{dW} \frac{W^*}{Q^*} = \frac{1}{.15} \frac{5}{100} = .33$$

$$\epsilon_{s,p} = \frac{dQ_S}{dW} \frac{W^*}{Q^*} = \frac{1}{.05} \frac{5}{100} = 1$$

Note: the result that $\epsilon_{s,p} = 1$ should also be readily apparent from the fact that the supply curve is linear and has zero intercept.

Problem 2 (6 Points)

Fred spends his monthly paycheck going out to dinners and going to concerts. His income varies from month to month as does the price of dinners out and the price of concerts. The table below shows the data on number of times he has eaten out each month as well as his income in the month as well as the prices he faced during each month.

Month	Income	Dinner Price	Concert Price	Quantity of Dinners out
Apr	200	10	20	10
May	400	10	20	20
Jun	200	20	20	5
Jul	150	15	30	5

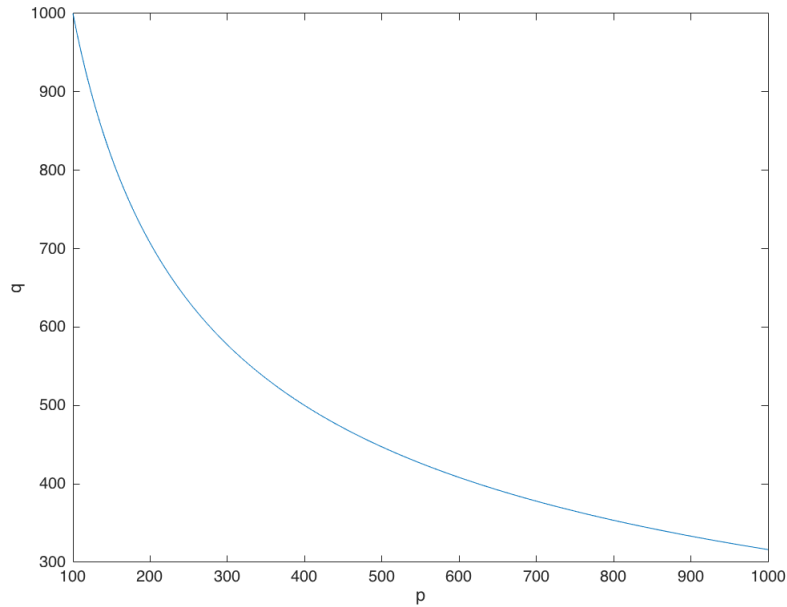
1. To calculate Fred's price elasticity of demand for dinners out, we should use the data for the months of April and June because the (income/**dinner price**/concert price) differs between these months but everything else is the same. Fred's arc price elasticity of demand for dinners out is 1. (2 Points)
2. To calculate Fred's income elasticity of demand for dinners out, we should use the data for the months of April and May because the (**income**/dinner price/concert price) differs between these months but everything else is the same. Fred's arc income elasticity of demand for dinners out is 1. (2 Points)
3. Dinners out are a (**normal**/inferior) good. (2 Points)

Problem 3 (12 Points)

Suppose the demand for a good is

$$q = \frac{10000}{\sqrt{p}} \quad (1)$$

1. Plot this demand curve¹. (2 Points)



2. What is the price elasticity of demand for this good? (2 Points)

0.5

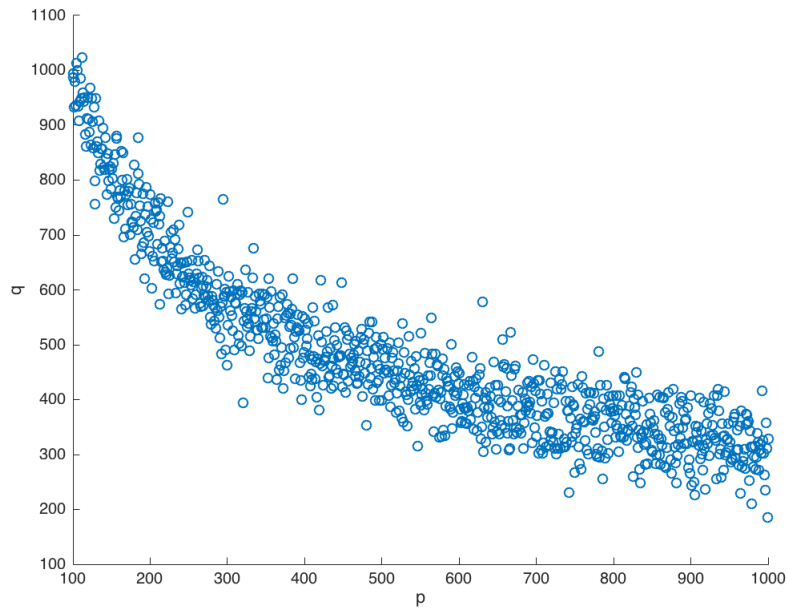
¹For this question, draw p on the x -axis, q on the y -axis, and let p range from 100 to 1000.

In reality, the data we observe are often noisy. They may contain measurement error and unobserved variables. In the presence of measurement error, the relationship between observed prices and quantities can be represented by

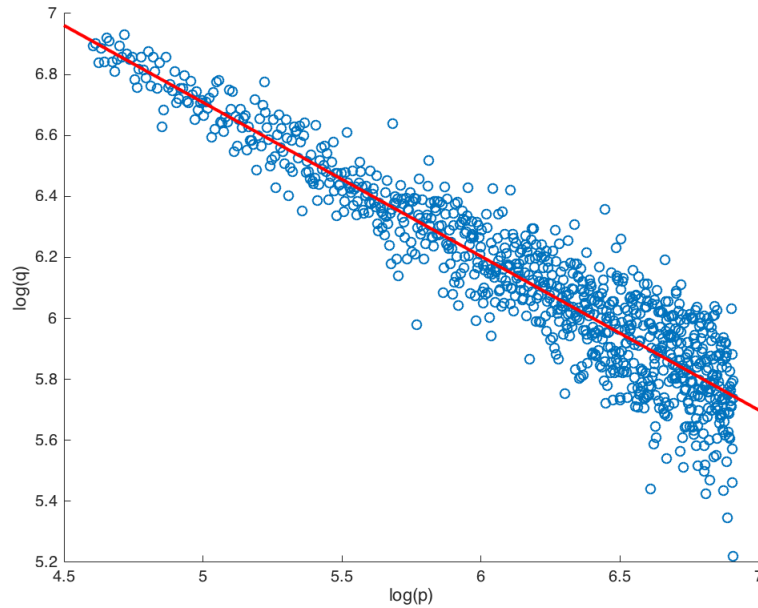
$$q = \frac{10000}{\sqrt{p}} + \epsilon \quad (2)$$

, where ϵ is random noise. “Demand_data.csv” contains data generated from (2). Use the data to answer the following questions:

3. Draw a scatter plot of p and q . (2 Points)



4. Draw a scatter plot of $\log(p)$ vs. $\log(q)$ and add a linear best-fit line. (2 Points)



5. Find out the slope of the linear best-fit line by regressing $\log(q)$ on $\log(p)$. (2 Points)
-0.5
6. How does your answer to question 5 compare with your answer to question 2? Why? (2 Points)

They are equal (in absolute value). This is because $\epsilon_{d,p} = \left| \frac{dq/q}{dp/p} \right| = \left| \frac{d(\ln q)}{d(\ln p)} \right|$.

Remark. Remember the price elasticity of demand, by definition, measures the relationship between percentage change in p and percentage change in q ². This is exactly what a scatter plot of $\log(p)$ and $\log(q)$ shows us. This is because for small r ($|r| \ll 1$), $\log(1+r) \approx r$ ³. Therefore, given a small percentage change in p , say p changes from p to $p(1+r)$ ⁴, $\frac{p(1+r)-p}{p} = r \approx \log(1+r) = \log(p(1+r)) - \log(p)$. Therefore, the scatter plot of $\log(p)$ and $\log(q)$ shows us the relationship between percentage change in p and percentage change in q . Assuming that all data lie on the same demand curve, then (the absolute value of) the slope in the plot of $\log(p)$ vs. $\log(q)$ is by definition the price elasticity of demand.

²i.e., given, say, a 1% increase in p , how much will q change in percentage terms?

³By Taylor expansion, $\log(1+x) = x - \frac{1}{2}x^2 + \frac{1}{3}x^3 \dots \approx x$ for small x .

⁴say, $r = 0.01$: a 1% increase.

Problem 4 (4 Points)

Read the article “[How computer automation affects occupations: Technology, jobs, and skills](#)”.

1. Briefly summarize the article. (2 Points)
2. Why does the author claim that “if a job is only partially automated, employment might actually increase”? According to the author, what determines whether automation will on net increase or decrease available jobs? If you can, use demand and supply diagrams to illustrate your point. (2 Points)

Demand elasticity. If demand is highly elastic, automation decreases cost and thereby significantly increasing demand, leading to an increase in total labor jobs, even if the labor share decreases in production due to automation (Of course, if automation drives labor share to 0 -- meaning labor is no longer needed in production, then this effect will not exist -- hence it is important for automation to be only “partial”)

Problem 5 (4 Points)

Read the article “[An In-Depth Look at the Economics of Bitcoin](#)”.

1. Briefly summarize the article. (2 Points)
2. Explain how supply elasticity affects bitcoin prices and its implications on whether cryptocurrencies like the bitcoin are suitable replacement for real currencies. (2 Points)

Inelastic supply leads to large price variations when demand fluctuates or large price appreciation when demand continues to rise. This makes it difficult for crypto currencies like Bitcoin to be used as real currencies, since it is important for real currencies to have a stable value⁵.

⁵When a currency appreciates too fast, people will save all their currencies and not spend, leading to economic collapse. When a currency depreciates too fast, people will either change their currencies into things that store value better or spend all of their currencies and do not save. This similarly will lead to economic collapse. Hence stable value is an important feature of real currencies.