# University of Notre Dame
# Department of Finance
# Economics of the Firm
# Fall 2009

**Suggested Solutions to Practice Questions for Chapters 3,4,5**

**Chapter 3:**

2) If the price elasticity is -2.2 and the price drop is equal to 20%,

$$\%\Delta Q = \varepsilon_P \%\Delta P = -2.2(-20) = 44\%$$

Sales should rise by 44%.

3)

Here we have an observation for the price change and an observation for a drop in sales. We could calculate arc elasticity:

***Arc Elasticity***

$$\%\Delta Q = \frac{Q_2 - Q_1}{\frac{Q_2 + Q_1}{2}} = \frac{1.75 - 2.25}{\frac{1.75 + 2.25}{2}} = -.25$$

$$\%\Delta P = \frac{P_2 - P_1}{\frac{P_2 + P_1}{2}} = \frac{1{,}800 - 1{,}500}{\frac{1{,}800 + 1{,}500}{2}} = .18$$

$$\varepsilon = \frac{\%\Delta Q}{\%\Delta P} = \frac{-.25}{.18} = 1.38$$

8) Here we have the demand function:

$$Q = 2{,}000 + 15Y - 5.5P$$

First, calculate the quantity demanded:

$$Q = 2{,}000 + 15(15) - 5.5(150) = 1400$$

a) For price elasticity:

$$\varepsilon_P = \frac{\Delta Q}{\Delta P}\left(\frac{P}{Q}\right) = -5.5\left(\frac{150}{1400}\right) = -.589$$

b) For income elasticity:

$$\varepsilon_P = \frac{\Delta Q}{\Delta I}\left(\frac{I}{Q}\right) = 15\left(\frac{15}{1400}\right) = .16$$

12) Given the following demand curve:

$$Q = 16{,}415.21 - 131.372P$$

First, let's calculate the two points on the demand curve:

**P=$1.00**

$$Q = 16{,}415.21 - 131.372(100) = 3{,}278.01$$

**P=$.80**

$$Q = 16{,}415.21 - 131.372(80) = 5{,}905.45$$

a) First, the point elasticitites

**P=$1.00**

$$\varepsilon_P = \frac{\Delta Q}{\Delta P}\left(\frac{P}{Q}\right) = -131.372\left(\frac{100}{3{,}278.01}\right) = -4.01$$

**P=$.80**

$$\varepsilon_P = \frac{\Delta Q}{\Delta P}\left(\frac{P}{Q}\right) = -131.372\left(\frac{80}{5{,}905.45}\right) = -1.78$$

b) Now, the arc elasticity:

***Arc Elasticity***

$$\%\Delta Q = \frac{Q_2 - Q_1}{\frac{Q_2 + Q_1}{2}} = \frac{3278 - 5901}{\frac{3278 + 5901}{2}} = -.57$$

$$\%\Delta P = \frac{P_2 - P_1}{\frac{P_2 + P_1}{2}} = \frac{100 - 80}{\frac{100 + 80}{2}} = .22$$

$$\varepsilon = \frac{\%\Delta Q}{\%\Delta P} = \frac{-.57}{.22} = -2.59$$

**Chapter 4:**

2) a) Given the nature of the problem, the independent variable would be annual income while amount of life insurance is the dependant variable.

b) See excel file

c) the estimated equation is $INS = 11.14 + 1.49(Income)$

Every $1,000 increase in annual income raises the amount of insurance purchased by $1,490

d) (see excel file): With a t-statistic of 2.64, there is a 2.47% chance that the coefficient on income is zero.

e) The coefficient of determination is .41 (see excel file)

f) The sum of squared error for the regression is 13087 while the sum of squared errors for the residuals is 18787. If we divide each by its degrees of freedom (1 for the regression and 10 for the residuals), we get an F statistic of 6.96. The interpretation is that there is a 2.4% chance that all the coefficients are zero. Note that this is the same as the T-test because there is only one variable.

g) First, let's get the forecast for an individual with income of $80,000

$$INS = 11.14 + 1.49(80) = 130.34$$

Our forecast would be $130,340 of insurance. An *approximate* 95% confidence interval would be +/- 2 times the standard error of 43. Therefore, $130,340 +/- $86,000.

3) See excel file

b) Coefficient of Determination = .74, T-Stat = -6.09

c) We have a regression equation of: $Q = 29 - .19(P)$

For every 1 cent increase in price, quantity drops by .19 (every dollar increase in price costs us 19 sales).

At a price of 50 cents, $Q = 29 - .19(50) = 19.5$

$$\varepsilon = \frac{\Delta Q}{\Delta P}\frac{P}{Q} = -.19\left(\frac{50}{19.5}\right) = -.48$$

8) We have the following regression equation:

$$Q_D = 10{,}425 - 2{,}910P_X + .028A + 11{,}100P_{op}$$

a) Again, first calculate the quantities demanded at prices of $5 and $10.

**P = $5**

$$Q_D = 10{,}425 - 2{,}910(5) + .028(1{,}000{,}000) + 11{,}100(.05) = 24{,}425$$

**P=$10**

$$Q_D = 10{,}425 - 2{,}910(10) + .028(1{,}000{,}000) + 11{,}100(.05) = 9{,}875$$

Now, the elasticities:

**P=$5**

$$\varepsilon_P = \frac{\Delta Q}{\Delta P}\left(\frac{P}{Q}\right) = -2{,}910\left(\frac{5}{24{,}425}\right) = -.56$$

**P=$10**

$$\varepsilon_P = \frac{\Delta Q}{\Delta P}\left(\frac{P}{Q}\right) = -2{,}910\left(\frac{10}{9{,}875}\right) = -2.95$$

b) If advertising is $2,000,000

$$Q_D = 10{,}425 - 2{,}910(5) + .028(2{,}000{,}000) + 11{,}100(.05) = 52{,}430$$

$$\varepsilon_A = \frac{\Delta Q}{\Delta A}\left(\frac{A}{Q}\right) = .028\left(\frac{2{,}000{,}000}{52{,}430}\right) = 1.068$$

c) If we calculate the t-stats for each variable:

Price: $\left(\frac{2910}{1010}\right) = 2.88$

Advertising: $\left(\frac{.028}{.004}\right) = 7$

Population: $\left(\frac{11100}{3542}\right) = 3.13$

With all the t-stats well above 2, we can reject the hypothesis that there is no relationship.

11) We have the following equation:

$$\log Q = a - 2.174\log P + .461\log I + 1.909\log P_m$$

With the equation in log linear form, the coefficients are interpreted as elasticities;

a) A 1% rise in price lowers quantity by 2.174% (Price elasticity)
b) A 1% rise in income raises quantity by .461% (Income elasticity)
c) A 1% rice in the price of meat raises quantity by 1.909% (Cross price elasticity)
d) Demand is very price elastic (elasticity higher than 1), relatively income inelastic (less than one) and a substitute for meat (positive elasticity).

**Chapter 5:**

3) We have the following forecast model (X represents month – January = 0):

$$N = 1{,}000 + 9X$$

a) To forecast, plug the month number into the forecast equation, and then use the seasonal adjustment factor:

| **Month** | **"Raw" Value** | **Adjustment Factor** | **Forecast** |
|---|---|---|---|
| January (0) | 1,000 | 1.05 | 1,050 |
| April (3) | 1,027 | .85 | 873 |
| July (6) | 1,054 | 1.04 | 1,096 |
| November (10) | 1,090 | .95 | 1,036 |
| December (11) | 1,099 | .75 | 824 |

b) To get the new adjustment factor, take the ratio of actual to forecast and then average

| **Year** | **Forecast** | **Actual** | **Ratio** |
|---|---|---|---|
| 2006 | 1,045 | 1,096 | 1.048 |
| 2005 | 937 | 993 | 1.059 |
| 2004 | 829 | 897 | 1.08 |
| 2003 | 721 | 751 | 1.041 |
| 2002 | 613 | 628 | 1.024 |
| 2001 | 505 | 560 | 1.11<br>**Average = 1.06** |

A 6% upward adjustment.

5) See excel sheet for data. I would use the exponential smoothing with w = .3 because it has the lowest RMSE.

6) We have the following forecast equation:

$$Q_D = 18{,}000 + .4N - 350P_M + 90P_S$$

a) For our sales forecast, plug in the data

$$Q_D = 18{,}000 + .4(15{,}000) - 350(50) + 90(55) = 11{,}450$$

b) A drop in the price of a surefire trimmer by $5 will lower forecasted sales by 90*5 = 450 units.

c) A 30% reduction in new homes (.30)(15,000) = 4500 will lower sales by 4500*.4 = 1800 units.

10) We have the following forecasting equation:

$$Y_t = 8.25 + .125t - 2.75D_{1t} + .25D_{2t} + 3.50D_{3t}$$

For 2006:

| **Quarter** | **Value for t** | **Value for D1** | **Value for D2** | **Value For D3** | **Forecast** |
|---|---|---|---|---|---|
| 1 | 21 | 1 | 0 | 0 | 13.625 |
| 2 | 22 | 0 | 1 | 0 | 11.25 |
| 3 | 23 | 0 | 0 | 1 | 14.625 |
| 4 | 24 | 0 | 0 | 0 | 11.25 |

11) We have the following demand:

$$Q = 7{,}000 - 550P + 210I + 425P_C$$

a) For our forecast: $Q = 7{,}000 - 550(3) + 210(15) + 425(4) = 10{,}200$

b) $Q = 7{,}000 - 550(3) + 210(13) + 425(7) = 11{,}055$