BUSS 230: Managerial Economics
Fall 2011-2012
Sections 1 to 6
ANSWER KEY: Midterm Review Questions

Question 1

a. Yes, the sign of the estimated coefficient is consistent with theory. The law of demand holds that price and quantity demanded are inversely related and this is what we observe in this estimated demand function.
b. Given the estimated equation (specifically the coefficient on income which is -0.12), X is an inferior good. An increase in income leads to a decrease in the demand for X.
c. Goods X and G are complements. This is indicated by the sign of the coefficient associated with P_G (the coefficient is -30). This, in turn, indicates that an increase in the price of G leads to a decrease in the demand for X.
d. The predicted quantity of Good X is 2600. This is calculated as:
$\hat{Q} = 8000 - 25 \times 12 - 0.12 \times 30000 - 30 \times 50$
e. The elasticities are given by:
E_p = -0.12 = -25×(12/2600) [it is exactly -0.1154]
E_{XG} = -0.58 = -30× (50/2600) [exactly -0.5769]
E_M = -1.38 = -0.12×(30000/2600)
f. 65% of the variation in quantity demanded is “explained” by variation in the independent variables included in this regression. The remaining 35% of the variation remains unexplained.
g. Using the relationship: $F = \dfrac{R^2/(k-1)}{(1-R^2)/(n-k)}$, you can calculate the F-statistic. We have $n=25$ and $k=4$ so that $k-1 = 3$ and $n-k = 21$ and R^2 = 0.65, so that F = 12.976.
h. The appropriate critical value at the 5% level is 3.07. The null is:
i.
$H_0 : a=b=c=d=0$
H_1: H_0 is not true

We reject H_0 if *F-statistic* > *critical value*. In this case 12.976 > 3.07 so the null is rejected at the 5%, and the coefficients are jointly significant.
j. A 20% increase in income will lead to 20%×1.38= 27.6% decrease in the demand for X.
k. A 15% increase in the price of G leads to 15%×0.58 = 8.7% decrease in the demand for X.

Question 2

a. In order to check whether shoe sales exhibit an upward trend we need to consider the sign and the significance of the coefficient associated with the time trend, namely *b*. The estimated coefficient $\hat{b}$ is positive, meaning there is an upward trend in sales. Next, we need to check the significance of the population coefficient.

In other words, we need to test the following null hypothesis:

$$H_0 : b = 0$$
$$H_1 : b \neq 0$$

The critical value of *t* for $28 - 5 = 23$ degrees of freedom and a 5% significance level is 2.069 (from the t-table), while the t-ratio for $\hat{b}$ is 2100/340 = 6.1765 and is much greater than the critical value. (The rejection rule is such that the null is rejected when the absolute value of the t-statistic exceeds the critical value). This leads us to reject the null hypothesis which implies that $\hat{b}$ is significant or equivalently that the time trend enters the regression significantly. Using p-values leads to a similar result. The *p*-value for the time trend (0.0001) indicates strong statistical significance as it is much smaller than $\alpha = 0.05$. Thus, the regression analysis provides very strong statistical evidence of an upward trend in shoe sales.

b. Looking at either *t*-tests (at α = 5% = 0.05 significance level, the critical value being 2.069) or *p*-values for the seasonal dummy variables we have:

For D_1, the null and alternative hypotheses are:

$$H_0 : c_1 = 0$$
$$H_1 : c_1 \neq 0$$

The t-statistic is: t = 2100/340=2.17

Since *t* –statistic = 2.17 > 2.069 we reject the null hypothesis meaning that the dummy variable associated with the first quarter, D_1, is significant.

A similar conclusion is reached with *p*-values. The *p*-value associated with D_1 is 0.404 < 0.05 implying that D_1 is significant.

For D_2, the null and alterative hypotheses are:

$$H_0 : c_2 = 0$$
$$H_1 : c_2 \neq 0$$

The t-statistic is $t = 2.82 > 2.069$ meaning that we reject the null and that D_2 is significant.

or alternatively *p-value* = 0.0098 < 0.05 = α.

For D_3:

$$H_0 : c_3 = 0$$
$$H_1 : c_3 \neq 0$$

The t-statistic is = 4.44 > 2.069; or *p-value* = 0.0002 <0.05 = α meaning that D_3 is significant.

Testing the joint significance of all the variables included in the regression amounts to testing the null and alternative hypotheses that follow:

$H_0 : a = b = c_1 = c_2 = c_3 = 0$
H_1: H_0 is not true

To do that, we can use the p-value associated with the *F*-test. The p-value associated with the *F*-test is 0.0001. Since the p-value is much smaller than the significance level α = 0.05, we reject the null and conclude that all the variables are jointly significant. Alternatively, given the information we possess, we could compute the F-statistic as:

$$F = \frac{R^2/(k-1)}{(1-R^2)/(n-k)}$$

With $n=28$, $k=5$ and $R^2 = 0.9651$. Doing the computations yields an F-statistic of 159.01 which far exceeds the critical value of 2.80 coming from the *F*-table with α= 5% . This again implies that the variables are jointly significant.

Since all seasonal dummy variables are significantly different from zero, the data suggest that athletic shoe sales tend to exhibit a seasonal pattern. The p-value of the F-statistic is 0.0001 is much smaller than a level of significance of 5%. Individual and joint significance point to an important seasonal pattern in sales. *Ceteris paribus*, sales are expected to be 3,280 units higher in quarter 1 than in the quarter 4, 6,250 units higher in the quarter 2 than in quarter 4, and 7,010 units higher in quarter 3 than in the quarter 4.

c. For 2008Q3 and 2009Q2, t = 31 and 34, respectively.

$$Q_{2008Q3} = 184500 + 2100(31) + 3280(0) + 6250(0) + 7010(1) = 256{,}610 \text{ units}$$

$$Q_{2009Q2} = 184500 + 2100(34) + 3280(0) + 6250(1) + 7010(0) = 262{,}150 \text{ units}$$

d. You might be able to improve this forecast equation by adding some additional explanatory variables that affect sales such as the price of the good, income, or a measure of aggregate economic activity.