# Assignment 02, Question 3

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## Question 3

We have the log linear regression equation:

$$\ln Q_{it} = 915 - 1.5 \ln P_{it} - .3 \ln P_{ct} + .9 \ln P_{st} + .009 \ln Y_t + .045 \ln AD_t \tag{1}$$

```
beta_Pi <- -1.5
beta_Pc <- -.3
beta_Ps <- .9
beta_Y <- .009
beta_AD <- .045
Pi2013 <- 200  # Average market price of (i) in 2013
Qi2013 <- 55000 # Average quantity demanded of (i) in 2013
Y2013 <- 120000 # Average income in 2013
```

### a. With respect to price, what kind of good is $(i)$. For a high demand season, should the company increase the price or decrease it?

To determine what kind of good is $(i)$ w.r.t. $P_{it}$, we find the price elasticity of $i$ as follow:

```
epsilon_Pi <- beta_Pi * Pi2013 / Qi2013  # Price elasticity of (i)
```

$$\begin{aligned} \epsilon_{P_{it}} &= \hat{\beta}_{P_{it}} \frac{\overline{P}}{\overline{Q_i}} \\ &= (-1.5) \frac{200}{5.5 \times 10^4} \\ &= -0.0054545 \end{aligned} \tag{2}$$

Since $|\epsilon_{P_{it}}| < 1$, $(i)$ is a price inelastic (necessity) good, i.e. price increases leads to total revenue increases. Thus, for a high demand season, the company should increase the price to increase their total revenue.

## b. With respect to income, what kind of good is $(i)$.

To determine what kind of good is $(i)$ w.r.t. $Y_t$, we find the income elasticity of $i$ as follow:

```
epsilon_Y <- beta_Y * Y2013 / Qi2013  # Income elasticity of (i)
```

$$\begin{aligned}\epsilon_{Y_t} =& \hat{\beta}_{Y_t} \frac{\overline{Y}}{\overline{Q_i}} \\ =& (0.009) \frac{1.2 \times 10^5}{5.5 \times 10^4} \\ =& 0.0196364\end{aligned} \tag{3}$$

Since $\epsilon_{Y_t} < 1$, thus $(i)$ is an income inelastic good (necessity), i.e. a jump in income is less than proportionate than the increase in the quantity demanded.

## c. Is the amount of money spent on advertising right amount? Should the company spend more on advertising or less? Why?

```
beta_AD <- .045
AD2013 <- 2800000  # Ad spent for 2013

epsilon_AD <- beta_AD * AD2013 / Qi2013  # Advertising elasticity of demand in 2013
```

We have the advertising elasticity of demand as follow:

$$\begin{aligned}\epsilon_{AD_t} =& \hat{\beta}_{AD_t} \frac{\overline{AD}}{\overline{Q_i}} \\ =& (0.045) \frac{2.8 \times 10^6}{5.5 \times 10^4} \\ =& 2.2909091\end{aligned} \tag{4}$$

We can see that quantity demanded of $(i)$ is advertising elastic so the company should spend more as it would lead to revenue increases.

The optimum advertising amount in 2013 is:

```
AD_2013Optimum <- Pi2013 * Qi2013 * epsilon_AD / abs(epsilon_Pi)
```

$$\begin{aligned}AD^*_{2013} =& P_{it} Q_{it} \frac{\epsilon_{AD}}{|\epsilon_{P_{it}}|} \\ =& (200)(5.5 \times 10^4) \frac{(2.2909091)}{|(-0.0054545)|} \\ =& 4.62 \times 10^9\end{aligned} \tag{5}$$

## d. What is your forecast of the quantity demanded for 2014?

```
# Changes from 2013 to 2014
delta_Pi <- .05  # Price of good (i) increases 5%
delta_Y <- .04  # Income growth 4 %
delta_Ps <- .1  # 10% tax add on to price of substitute good

delta_Qi <- beta_Pi*delta_Pi + beta_Ps*delta_Ps + beta_Y*delta_Y
```

We have the forecast % change in $Q_i$ for 2014 as follow:

$$\begin{aligned} \%\Delta Q_i =& \hat{\beta}_{P_{it}} \Delta P_{it} + \hat{\beta}_{P_{st}} \Delta P_{st} + \hat{\beta}_{Y_t} \Delta Y_t \\ =& (-1.5)(0.05) + (0.9)(0.1) + (0.009)(0.04) \\ =& 0.01536 \\ =& 1.536\% \end{aligned} \tag{6}$$

```
Qi2014 <- Qi2013*(1+delta_Qi)
```

Thus, the quantity demanded of $(i)$ increases by 1.536% from 2013 to 2014 or $5.58448 \times 10^4$.

## e. What is the optimum amount of advertiising spending for 2014?

The optimum advertising amount in 2013 is:

```
Pi2014 <- Pi2013 * (1+delta_Pi)  # Price of (i) in 2014

AD_2014Optimum <- Pi2014 * Qi2014 * epsilon_AD / abs(epsilon_Pi)
```

$$\begin{aligned} AD^*_{2014} =& P_{it} Q_{it} \frac{\epsilon_{AD}}{|\epsilon_{P_{it}}|} \\ =& (210)(5.58448 \times 10^4) \frac{(2.2909091)}{|(-0.0054545)|} \\ =& 4.9255114 \times 10^9 \end{aligned} \tag{7}$$