

### Assignment 1

Due 26/9/2019

Pizza Shop's manager would like to estimate the company's cost function by using the following observed data under different level of production (Data (a)):

Cost (Baht)	No. of Pizza	Mgmt Style
410,000	4,000	0
600,000	5,000	0
700,000	6,000	0
830,000	7,000	0
940,000	8,000	0
920,000	9,000	0
1,000,000	10,000	0
1,020,000	11,000	1
1,110,000	12,000	1
1,190,000	13,000	1
1,390,000	14,000	1
1,610,000	15,000	1

- (a) Estimate linear cost function using ordinary least squares (OLS) method

$$TC_i = \beta_0 + \beta_1 Q_i + u_i \quad (1)$$

where  $TC_i$  is total cost (baht)  
 $Q_i$  is number of pizza  
 $u_i$  is disturbance term

Evaluate and interpret estimated result.

- (b) Estimate cubic cost function using OLS method

$$TC_i = \beta_0 + \beta_1 Q_i + \beta_2 Q_i^2 + \beta_3 Q_i^3 + u_i \quad (2)$$

Evaluate and interpret estimated result, compare estimated result of cubic cost function with linear cost function in (a) and plot graph of total cost (TC), average cost (AC) and marginal cost (MC) from the two estimated results (a) and (b).

- (c) If you are the manager, which cost function, (a) or (b), are you going to choose? Why?
- (d) Estimate the following cost function using OLS method

$$TC_i = \beta_0 + \beta_1 Q_i + \gamma_1 D_i + u_i \quad (3)$$

where  $D_i$  is management style,  $D=0$  for style A  
 $D=1$  for style B

Determine whether different management style lead to statistically significant different cost functions.

- (e) Estimate the following log-linear cost function using OLS method

$$\ln TC_i = \beta_0 + \beta_1 \ln Q_i + u_i \quad (4)$$

where  $\ln TC_i$  is natural log of  $TC_i$   
 $\ln Q_i$  is natural log of  $Q_i$

Determine whether the estimated cost function is economy of scale or diseconomy of scale.

Furthermore, the manager would also like to determine which factors have impacts on pizza sale volume, thus, the data were observed, including monthly sale volume of the company ( $Q_x$ ), own price ( $P_x$ ), competitor's price ( $P_y$ ), advertising budget ( $Ad$ ), and average income of consumer in that area ( $Inc$ ).

Sale volume ( $Q_x$ )	Own Price ( $P_x$ )	Competitor price ( $P_y$ )	Advertising Budget ( $Ad$ )	Consumer Income ( $Inc$ )
14,210	280	275	9,220	7,400
15,550	250	285	9,440	7,820
17,110	300	320	12,180	8,020
16,320	315	305	11,120	8,840
17,720	250	325	12,880	8,360
17,090	300	315	12,140	8,960
15,560	300	290	10,420	7,980
17,070	280	305	11,580	8,720
17,140	280	325	11,120	8,340
17,940	245	330	12,020	8,240
16,060	305	290	10,140	8,800
15,080	320	280	9,300	8,660
16,180	310	300	11,720	8,200
14,050	270	270	8,560	7,660
18,530	255	330	12,960	8,820

- (f) From law of demand, pizza price has *inverse relationship* with sale volume. Competitor price, advertising budget, and income are *positively related* to sale volume. Construct linear demand function model for pizza and estimate the model using OLS method. Estimate the model using the above data (Data (f)).

$$Q_{x_i} = \beta_0 + \beta_1 P_{x_i} + \beta_2 P_{y_i} + \beta_3 Ad_i + \beta_4 Inc_i + u_i \quad (5)$$

where  $Q_{xi}$  is sale volume (unit)  
 $P_{xi}$  is own price  
 $P_{yi}$  is competitor's price  
 $Ad_i$  is advertising budget  
 $Inc_i$  is average income of consumer in that area  
 $u_i$  is disturbance term

Evaluate and interpret estimated result.

- (g) Predict sale volume given own price = 250, competitor price = 300, advertising budget = 12,000, and consumer income = 10,000
- (h) Estimate log-linear demand model using OLS method:

$$\ln Q_{xi} = \beta_0 + \beta_1 \ln P_{xi} + \beta_2 \ln P_{yi} + \beta_3 \ln Ad_i + \beta_4 \ln Inc_i + u_i \quad (6)$$

where  $\ln Q_{xi}$  is natural log of sale volume  
 $\ln P_{xi}$  is natural log of own price  
 $\ln P_{yi}$  is natural log of competitor's price  
 $\ln Ad_i$  is natural log of advertising budget  
 $\ln Inc_i$  is natural log of average income of consumer in that area  
 $u_i$  is disturbance term

- (1) If the manager would like to raise up the total revenue, which policy, price increase or decrease, should be employed? Why?
- (2) Is product of the competitor substitute or complement product? Why?
- (3) Is pizza of this company normal or inferior goods? Why?
- (i) If competitor price = 300, advertising budget = 10,000, and consumer income = 8,000, determine price and sale volume which lead the company to maximum profit using estimated linear cost function from (a).