3. Suppose the price elasticity of demand for heating oil is 0.2 in the short run and 0.7 in the long run.

    a. If the price of heating oil rises from $1.80 to $2.20 per gallon, what happens to the quantity of heating oil demanded in the short run? In the long run? (Use the midpoint method in your calculations.)

    b. Why might this elasticity depend on the time horizon?

a. short run

$\eta_D = 0.2$

$$\%\Delta P = \frac{P_1 - P_0}{(P_1 + P_0)/2} \times 100$$

$$= \frac{2.2 - 1.8}{2} \times 100$$

$$= 20\%$$

from midpoint method ; $\eta_D = \frac{\%\Delta Q_D}{\%\Delta P}$

$$0.2 = \frac{\%\Delta Q_D}{20\%}$$

$$\%\Delta Q_D = 0.2 \times \frac{20}{100}$$

$$\%\Delta Q_D = 0.04$$

long run

$\eta_D = 0.7$

$$\%\Delta P = \frac{P_1 - P_0}{(P_1 + P_0)/2} \times 100$$

$$= \frac{2.2 - 1.8}{2} \times 100$$

$$= 20\%$$

from midpoint method ; $\eta_D = \frac{\%\Delta Q_D}{\%\Delta P}$

$$0.7 = \frac{\%\Delta Q_D}{20\%}$$

$$\%\Delta Q_D = 0.7 \times \frac{20}{100}$$

$$\%\Delta Q_D = 0.14$$

b. More time create more elasticity because people can find things to used instead of the old one.

7. Suppose that your demand schedule for pizza is as follows:

Price	Quantity Demanded (income = $20,000)	Quantity Demanded (income = $24,000)
$8	40 pizzas	50 pizzas
10	32	45
12	24	30
14	16	20
16	8	12

a. Use the midpoint method to calculate your price elasticity of demand as the price of pizza increases from $8 to $10 if (i) your income is $20,000 and (ii) your income is $24,000.

b. Calculate your income elasticity of demand as your income increases from $20,000 to $24,000 if (i) the price is $12 and (ii) the price is $16.

a $P_0 = 8$, $P_1 = 10$

(i) $Q_0 = 40$, $Q_1 = 32$

$$\text{slope} = \frac{\Delta y}{\Delta x} = \frac{\Delta P}{\Delta Q} = \frac{10-8}{32-40} = -\frac{1}{4}$$

from midpoint method ; $\eta_D = \frac{1}{\text{slope}} \times \frac{P_1 + P_0}{Q_1 + Q_0}$

$$= \frac{1}{-1/4} \times \frac{10+8}{32+40}$$

$$= -\cancel{4} \times \frac{\cancel{18}}{\cancel{72}\ 4} = -1$$

(ii) $Q_0 = 50$, $Q_1 = 45$

$$\text{slope} = \frac{\Delta y}{\Delta x} = \frac{\Delta P}{\Delta Q} = \frac{10-8}{45-50} = -\frac{2}{5}$$

from midpoint method ; $\eta_D = \frac{1}{\text{slope}} \times \frac{P_1 + P_0}{Q_1 + Q_0}$

$$= \frac{1}{-2/5} \times \frac{10+8}{45+50}$$

$$= -\frac{\cancel{5}}{\cancel{2}} \times \frac{\cancel{18}\ 9}{\cancel{95}\ 19} = -\frac{9}{19}$$

b. (i) at $P = 12$

from $\eta_D = \frac{\% \Delta Q_D}{\% \Delta I}$ → income elasticity of demand

$$= \frac{(Q_1 - Q_0)/Q_0 \times 100}{(I_1 - I_0)/I_0 \times 100}$$

$$= \frac{Q_1 - Q_0}{I_1 - I_0} \times \frac{I_0}{Q_0}$$

$$= \frac{30-24}{24000-20000} \times \frac{20000}{24}$$

$$= \frac{\cancel{6}}{\cancel{4000}} \times \frac{\cancel{20000}\ 5}{\cancel{24}\ 4} = 1.25$$

(ii) at $P = 16$

from $\eta_D = \frac{\% \Delta Q_D}{\% \Delta I}$

$$= \frac{(Q_1 - Q_0)/Q_0 \times 100}{(I_1 - I_0)/I_0 \times 100}$$

$$= \frac{Q_1 - Q_0}{I_1 - I_0} \times \frac{I_0}{Q_0}$$

$$= \frac{12-8}{24000-20000} \times \frac{20000}{8}$$

$$= \frac{\cancel{4}}{\cancel{4000}} \times \frac{\cancel{20000}\ 5}{\cancel{8}\ 2} = 2.5$$