1.9 Price Elasticity - Practice Problems (Answers)

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The demand for monthly cell phone plans is given by:

$$q_D = 50 - 0.5p$$

1. Write the *inverse* demand function.

Solution:

$$\begin{aligned} q_D &= 50 - 0.5p \\ q_D + 0.5p &= 50 \\ 0.5p &= 50 - q_D \\ p &= 100 - 2q_D \end{aligned}$$

The choke price is \$100 and the slope is -2.

2. Calculate the price elasticity of demand when the price is \$10. Is this relatively elastic or inelastic?

Solution:

First we need to find q_D at \$10.

$$\begin{aligned} q_D &= 50 - 0.5(10) \\ q_D &= 50 - 5 \\ q_D &= 45 \end{aligned}$$

Now we have the three ingredients to calculate elasticity at \$10:

$$
\begin{aligned}
\epsilon_D &= \frac{1}{slope} \times \frac{p}{q_D} \\
\epsilon_D &= \frac{1}{-2} \times \frac{10}{45} \\
\epsilon_D &= -0.5 \times 0.22 \\
\epsilon_D &= -0.11
\end{aligned}
$$

The demand is relatively inelastic, as $|\epsilon_D| < 1$

3. Calculate the price elasticity of demand when the price is \$70. Is this relatively elastic or inelastic?

Solution: First we need to find q_D at \$70.

$$
\begin{aligned}
q_D &= 50 - 0.5(70) \\
q_D &= 50 - 35 \\
q_D &= 15
\end{aligned}
$$

We already have the slope (since the demand is a straight line), so now we can simply plug into the elasticity formula:

$$
\begin{aligned}
\epsilon_D &= \frac{1}{slope} \times \frac{p}{q_D} \\
\epsilon_D &= \frac{1}{-2} \times \frac{70}{15} \\
\epsilon_D &= -0.5 \times 4.67 \\
\epsilon_D &\approx -2.33
\end{aligned}
$$

The demand is relatively elastic, as $|\epsilon_D| > 1$

4. At what price is demand unit elastic ($\epsilon = -1$)?

Solution:

$$\begin{aligned}
\epsilon_D &= \frac{1}{slope} \times \frac{p}{q_D} && \text{Formula for elasticity} \\
-1 &= -0.5 \times \frac{p}{q_D} && \text{Set } \epsilon_D \text{ equal to } -1 \\
-1 &= -0.5 \times \frac{p}{(50 - 0.5p)} && \text{Plug in demand function for } q_D \\
-1(50 - 0.5p) &= -0.5p && \text{Multiply by term in parentheses} \\
0.5p - 50 &= -0.5p && \text{Distribute the } -1 \\
-50 &= -p && \text{Add } 0.5p \\
p &= \$50 && \text{Divide by } -50
\end{aligned}$$

5. Calculate the total revenue at $10.

Solution: The total revenue is:

$$\begin{aligned}
R &= pq \\
R &= (\$10)(45) \\
R &= \$450
\end{aligned}$$

6. Calculate the total revenue at $70.

Solution: The total revenue is:

$$\begin{aligned}
R &= pq \\
R &= (\$70)(15) \\
R &= \$1,050
\end{aligned}$$

7. Calculate the total revenue at the price you found for question 4.

Solution: That price was $p = \$50$. At this price, we need to find the quantity demanded. We can use the demand function:

$$
\begin{aligned}
q_D &= 50 - 0.5p \\
q_D &= 50 - 0.5(50) \\
q_D &= 50 - 25 \\
q_D &= 25
\end{aligned}
$$

Now that we have price and quantity, revenue is:

$$
\begin{aligned}
R &= pq \\
R &= (\$50)(25) \\
R &= \$1,250
\end{aligned}
$$

This is where revenue is maximized.