Elasticity

Price Elasticity of Demand

Between Two Points

\[ \varepsilon_p = \left| \frac{\% \Delta Q}{\% \Delta P} \right| = \left| \frac{Q_2 - Q_1}{P_2 - P_1} \times \frac{P_1}{Q_1} \right| \]

Between Two Points
(Arc Elasticity/Midpoint Method)

\[ \varepsilon_p = \left| \frac{Q_2 - Q_1}{(Q_2 + Q_1)/2} \times \frac{P_2 - P_1}{(P_2 + P_1)/2} \right| = \left| \frac{Q_2 - Q_1}{Q_2 + Q_1} \times \frac{P_2 - P_1}{P_2 + P_1} \right| \]

Single Point

\[ \varepsilon_p = \frac{1}{-\text{slope}_{PQ}} \times \frac{P}{Q} \]

Q is quantity demanded. P is price.
\( \varepsilon_p > 1 \) is called elastic.
\( \varepsilon_p < 1 \) is called inelastic.
\( \varepsilon_p = 1 \) is called unit elastic. It is also the point on the demand curve (price and quantity) that a producer would choose in order to maximize profit (assuming he/she can choose where on the demand curve to sell).

Income Elasticity of Demand

Between Two Points

\[ \varepsilon_i = \frac{\% \Delta Q}{\% \Delta I} = \frac{Q_2 - Q_1}{I_2 - I_1} \times \frac{I_1}{I_2} \]

Between Two Points
(Arc Elasticity/Midpoint Method)

\[ \varepsilon_i = \left| \frac{Q_2 - Q_1}{(Q_2 + Q_1)/2} \times \frac{I_2 - I_1}{(I_2 + I_1)/2} \right| = \left| \frac{Q_2 - Q_1}{Q_2 + Q_1} \times \frac{I_2 - I_1}{I_2 + I_1} \right| \]

Single Point

\[ \varepsilon_i = \frac{1}{\text{slope}_{IQ}} \times \frac{I}{Q} \]

I is income.
Positive -> Normal Good
Negative -> Inferior Good
Cross-Price Elasticity of Demand

Between Two Points
\[ \varepsilon_{cp} = \frac{\% \Delta Q^X}{\% \Delta P^Y} = \frac{\frac{Q_2^X - Q_1^X}{Q_1^X}}{\frac{P_2^Y - P_1^Y}{P_1^Y}} \]

Between Two Points (Arc Elasticity/Midpoint Method)
\[ \varepsilon_{cp} = \frac{\frac{Q_2^X - Q_1^X}{(Q_2^X + Q_1^X)/2}}{\frac{P_2^Y - P_1^Y}{(P_2^Y + P_1^Y)/2}} = \frac{\frac{Q_2^X - Q_1^X}{Q_2^X + Q_1^X}}{\frac{P_2^Y - P_1^Y}{P_2^Y + P_1^Y}} \]

Single Point
\[ \varepsilon_{cp} = \frac{1}{\text{slope}_{pxq^Y}} \frac{P^Y}{Q^X} \]

X and Y are two different goods.
Positive -> X and Y are substitutes
Negative -> X and Y are complements

Price Elasticity of Supply

Between Two Points
\[ \varepsilon_s = \left| \frac{\% \Delta Q^S}{\% \Delta P} \right| = \left| \frac{\frac{Q_2^S - Q_1^S}{Q_1}}{\frac{P_2 - P_1}{P_1}} \right| \]

Between Two Points (Arc Elasticity/Midpoint Method)
\[ \varepsilon_s = \left| \frac{\frac{Q_2^S - Q_1^S}{(Q_2^S + Q_1^S)/2}}{\frac{P_2 - P_1}{(P_2 + P_1)/2}} \right| = \left| \frac{\frac{Q_2^S - Q_1^S}{Q_2^S + Q_1^S}}{\frac{P_2 - P_1}{P_2 + P_1}} \right| \]

Single Point
\[ \varepsilon_s = \frac{1}{-\text{slope}_{pq^S}} \frac{P}{Q^S} \]

Previously Q stood for quantity demanded. Here, it is quantity supplied (thus the s).
CPI

CPI/Price Index/Inflation Index in Year $Y_{Base\ Year\ B} = \frac{Cost\ of\ Market\ Basket\ in\ Year\ Y}{Cost\ of\ Market\ Basket\ in\ Base\ Year\ B} \times [Scale\ Factor]$

If you are making the CPI, you can choose the scale factor. Remember 1 is the easiest!

---

$Year\ Y\ Real\ Price\ in\ Base\ Year\ B\ Dollars = \frac{Nominal\ Price\ in\ Year\ Y}{CPI\ in\ Year\ Y_{Base\ Year\ B}} \times [Scale\ Factor]$  

Don’t forget the scale factor!

---

Inflation (Rate) = \frac{CPI_{2} - CPI_{1}}{CPI_{1}} \times 100 \quad (all\ prices/overall)$

Inflation (Rate) = \frac{Price_{2} - Price_{1}}{Price_{1}} \times 100 \quad (one\ good)$

This is a percentage (it’s just the percentage change formula). Don’t get this confused with an inflation index (CPI) – 100 is not a scale factor, it’s what we always use in the percentage change formula.
Consumer Theory

Budget Line

\[ I = P_X X + P_Y Y \]
\[ Y = \frac{I}{P_Y} - \frac{P_X}{P_Y} X \]

These are both the same equation but the one on the right is more important because it’s in \( y=mx+b \) form (so it can be used for graphing).

Marginal Rate of Substitution

\[ MRS_{XY} = \frac{MU_X}{MU_Y} = \text{slope of an indifference curve on an X-Y graph} \]

Remember the definition of \( MRS_{XY} \): how much \( Y \) you would give up to get 1 more \( X \) and be just as happy (think of moving down and right on an IC) or how much additional \( Y \) you would need to give up 1 \( X \) and be just as happy (think of moving up and left on an IC).

Maximizing Utility (Optimal Consumption)

\[ \frac{MU_X}{P_X} = \frac{MU_Y}{P_Y} \left( = \frac{MU_Z}{P_Z} = \ldots \right) \]
\[ \frac{P_X}{P_Y} = \frac{MU_X}{MU_Y} \]

Both equations are expressing the same thing, but one might be more convenient depending on what you’re calculating. The right-hand equation is expressing the fact that the budget line is tangent to (has the same slope as) the highest indifference curve on an X-Y graph at the point where utility is being maximized.
Producer Theory

Total Cost \((TC) = \text{Variable Cost} (VC) + \text{Fixed Cost} (FC)\)

\[
\text{Average Total Cost} (ATC) = \frac{TC}{Q}
\]

\[
\text{Average Variable Cost} (AVC) = \frac{VC}{Q}
\]

\[
\text{Average Fixed Cost} (AFC) = \frac{FC}{Q}
\]

\[
\text{Marginal Cost} (MC) = \frac{TC_2 - TC_1}{Q_2 - Q_1}
\]

In the short run, the firm must pay fixed costs and so ignores them.

In the long run, the firm can escape fixed costs and so takes them into account (in other words, all costs are variable).
Perfect Competition

Profit Maximizing Quantity: $P = MC$

Break-Even Price: $ATC = MC$

Shutdown Price: $AVC = MC$

$Profit = Total\ Revenue\ (TR) - Total\ Cost\ (TC) = (P \times Q) - (ATC \times Q)$