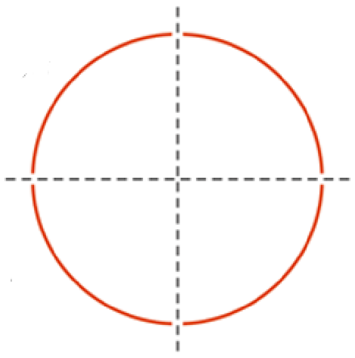
5.2 Analysing Constant Elasticity Model using Simple Linear Regression

Tuesday, 18 October 2022 12:30

Summary

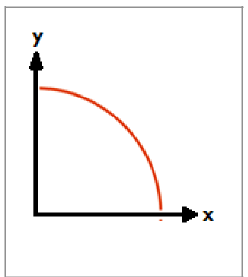
- Transformations
- Transformation on Constant Elasticity Model

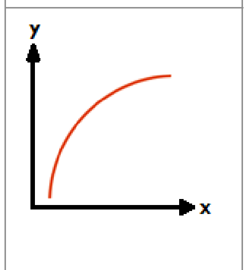
- What transform do we apply on each of these:

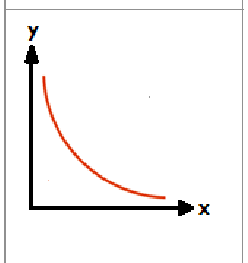


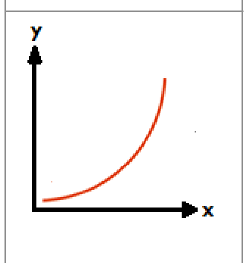
OR:

What transform do we apply on:
(also identify which curve is constant elasticity curve)



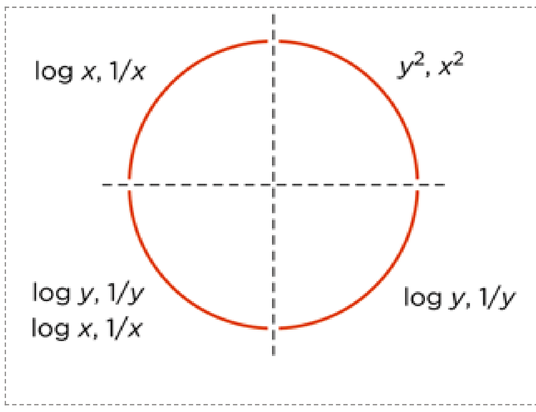






Constant elasticity model

- The constant elasticity model is not linear.
- Transformations allow the use of regression analysis to describe a curved pattern.
- Select the correct transformation --



- We're trying to model constant elasticity model using SLR.
- When we know that the relationship is not linear, we transform the equation, and model the curved pattern.

SLR Equation:

$$y = \beta_0 + \beta_1 x + \varepsilon .$$

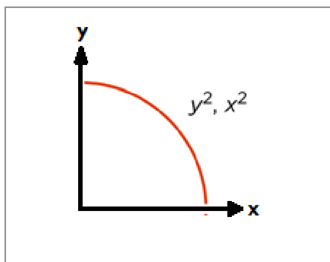
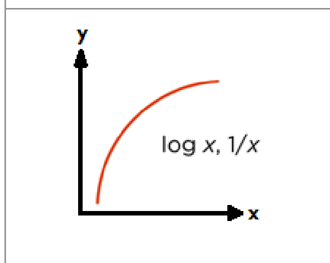
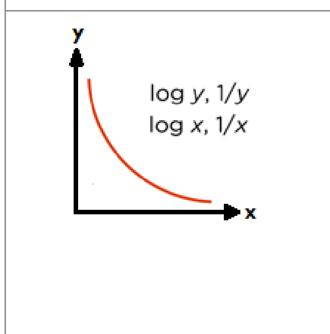
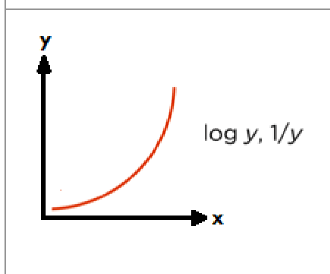
Note: $\varepsilon \to$ Error term

- Constant Elasticity Curve Equation:

$$D(p) = Cp^{-\epsilon} .$$

Note: $\epsilon \to$ Elasticity

- We transform $D(p)$ $(or\ y)$ and p $(or\ x)$ in such a way that we get a linear relationship between them.

	If the relationship between x and y looks like this you use y^2 , x^2 trasformation.
	If it looks like this than transforming only the explanatory variable to $log\,x$ or $\frac{1}{x}$ is sufficient.
	Here, either we can transform: ○ y to $log\,y$ or $\frac{1}{y}$ or ○ x to $log\,x$ or $\frac{1}{x}$. ○ Or do both. ○ Also, when we say that the relationship is of $D(p) = Cp^{-\epsilon}$ (constant elasticity) type, we're essentially talking about above kind of relationship.
	If it looks like this than transforming only the response variable to $log\,y$ or $\frac{1}{y}$ is sufficient.

- After applying log-log transformation, what equation do we get?
- How do you compare this equation with SLR equation?
- And how do find C and ε from this equation?

Constant elasticity model

- Log-log transformation can convert the relationship to a linear one. And we get:

$$Log(D) = Log(C) - \epsilon Log(P).$$

- An example of this is available in the Excel sheet.

- $D(p) = Cp^{-\epsilon}$.
- Take log on both sides we get
  $log(D) = log(C) - \epsilon log(p)$.
  - Here, $log(D) \rightarrow$ Response variable (y)
  - $log(p) \rightarrow$ Explanatory variable (x)
  - and, we've transformed both variables. Now, this relationship looks like a linear relationship. Equivalent to SLR equation.
    $y = \beta_0 + \beta_1 x + \varepsilon$.
  - $\beta_0 = log(C) \rightarrow y$ -intercept or market-size
  - $\beta_1 = -\epsilon \rightarrow$ Slope
- Now, we run SLR over this and get the estimate of β_0 and β_1.
  - $\therefore C = antilog(\beta_0) = e^{\beta_0} = D(1) \rightarrow$ Demand when price = 1.
  - $\varepsilon = -\beta_1 \rightarrow$ Elasticity value.