

4. Incorrect. The answer is true not false. To see why this is the case,

$$\text{when } \lambda=1: \frac{y^\lambda - 1}{\lambda} = \frac{y-1}{1} = y-1$$

$$\text{when } \lambda=-1: \frac{y^{-\lambda} - 1}{-1} = \frac{1/y - 1}{-1} = 1 - 1/y$$

$$\text{when } \lambda=2: \frac{y^2 - 1}{2} = \frac{y^2}{2} - \frac{1}{2}$$

We have an even more interesting case when $\lambda \rightarrow 0$, then the function goes to $\ln(y)$

$$\frac{y^0 - 1}{0} = \frac{1-1}{0} = \frac{0}{0}$$

In this case, our function is undefined. However, l'Hôpital, a clever Frenchman, has published the following relationship that allows us to figure out what the above function equals as $\lambda \rightarrow 0$. His rule says that if:

$$\lim_{x \rightarrow a} f(x) = 0, \quad \lim_{x \rightarrow a} g(x) = 0, \quad \text{and} \quad \lim_{x \rightarrow a} \frac{f'(x)}{g'(x)} = L, \quad \text{then} \quad \lim_{x \rightarrow a} \frac{f(x)}{g(x)} = L$$

So take the above Box-Cox function and take the derivative of the top and bottom with respect to λ :

$$\lim_{\lambda \rightarrow 0} \frac{\partial(y^\lambda - 1) / \partial \lambda}{\partial \lambda / \partial \lambda} = \lim_{\lambda \rightarrow 0} \frac{y^\lambda \ln y}{1} = \ln y$$

Thus, the Box Cox transformation when $\lambda \rightarrow 0$, gives us the log function. We can put the Box-Cox transformation into a demand equation as follows:

$$\frac{Q^\lambda - 1}{\lambda} = \beta_1 + \beta_2 \frac{P^\lambda - 1}{\lambda} + \beta_3 \frac{Y^\lambda - 1}{\lambda} + \beta_4 \frac{X^\lambda - 1}{\lambda}$$

Where Q equals quantity demanded, Y equals income and X represents other variables related to demand. Techniques exist to econometrically choose the β s and the λ , or even to estimate a model with a different λ for each variable.