**Box-Cox Transformation:**

**(a) Introduction:**

Suppose the tentatively used model is . Two transformations can be used. The first transformation is

, 

The above transformation is also called **Box-Cox transformation.**

**Note: .**

The other transformation is to scale  by

,

where



is the geometric mean of .

The model based on the transformed response is



or

.

**Note: V transformation is usually preferred!!**

**(b) Estimation of :**

From now on, we concentrate on the transformation . The likelihood function is

.

Thus,



Then,

.

Furthermore,



, where .



, where  is the residual sum of square of .

The maximum likelihood estimate (MLE)  of  is the maximizer of the log-likelihood. That is,  maximizes





 can be found by finding the value of  which minimizes

.

**The procedure of finding the approximate value of** 

* **Let , where , *a* is some constant, and *n* is a very large number. For example, as  and , then**

**.**

* **Find all values**

**.**

**The value  corresponding to smallest  is the approximate . That is,**

**.**

****

** confidence interval for** :

**Let  be the maximum likelihood estimate.  confidence interval for**  **consists of those values of**  **satisfying**

**.**

**Note: Sometimes,  is very close to 0, for example, . Then, we might wonder if  or  is more appropriate. Then, we can construct a  confidence interval. Then, we can examine if 0 falls in this interval. If yes, then we use log transformation. Otherwise, we use power transformation, .**

**Note: Several benchmark values of**  **are recommended to examine by using  confidence interval. They are**

****