[Frequently Asked Questions]

Autoregressive and Distributed Lag Models

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Frequently Asked Questions

Q1. Explain what do u mean by DL model?

A1. Model $Y_t = \alpha_0 + \beta_0 X_t + \beta_1 X_{t-1} + U_t$ is a DL model. The successive impacts of current and past year explanatory variables on the dependent variables are presented in the model. An extension is Infinitely DL model given as

$Y_t = \alpha_0 + (\beta_0 X_t + \beta_1 X_{t-1} + \beta_2 X_{t-2} + \cdots \; up\ to\ \infty) + U_t$

Q2. what is meant by AR model?

A2. An autoregressive model is expressed by $Y_t = \alpha + \beta X_t + \delta Y_{t-1} + U_t$. It is ARM of first order and here the impact on the dependent variable is attributed due to the change in current year explanatory variable and last year's dependent variable.

Q3 What is Koyck's transformation?

A3. Koyck considered an Infinitely distributed lag model $Y_t = \alpha + (\beta_0 X_t + \beta_1 X_{t-1} + \beta_2 X_{t-2} + \cdots \; up\ to\ \infty) + U_t$ and by assuming $\beta_K = \beta_0 \lambda^k$ $(0 < \lambda < 1)$, thus Beta coefficients are declining geometrically, he obtained the transformed model as $Y_t = \alpha(1-\lambda) + \beta_0 X_t + \lambda Y_{t-1} + \vartheta_t$ Where $\vartheta_t = U_t - \lambda U_{t-1}$

Thus IDLM is converted into ARM.

Q4 what are the reasons for lag?

A4. Some reasons for lag are (1) Psychological (2) Technological (3) Institutional

Q5. Why adhoc estimation to DL model is not advisable?

A5. It is due the following reasons. (1). There is no indication beforehand as to the maximum length of the lag. (2) Model becomes complex to understand and estimate. (3) When step by step regression exercise is carried out, degrees of freedom reduces and hence the conclusions are unreliable. (4) Successive lag values are generally highly correlated. This causes multicollinearity problem leading to inefficient estimation.

Q6. What is Durbin's h statistic test?

A6. It is an extension of DW test. It is a normality test used for large samples and can detect the auto correlation in AR model.

h is defined by the relation $h \doteqdot \left(1-\frac{d}{2}\right).\sqrt{\frac{n}{1-n[V(\hat{\alpha}_2)]}}$

n = sample size, d= DW statistic $V(\hat{\alpha}_2) =$ Estimated Variance of $\hat{\alpha}_2$

Here $h \sim N(0,1)$ (which is coefficient attached to the lag term Y_{t-1})

It is a normality test for testing $H_0: \rho = 0$ Vs $H_1: \rho \neq 0$ (ρ = Autocorrelation coefficient) If h is significant we reject H_0.

Q7. What is AEM?

A7. It is an application of Koyck's system.

Model: $Y_t = \beta_0 + \beta_1 X_t^* + U_t$

Where X_t^* = Anticipated rate of interest at time t

This is generally not directly observable. Hence an assumption $X_t^* = \gamma X_t + (1-\gamma)X_{t-1}^*$ $(0 < \gamma \leq 1)$ can resolve this problem and the model form becomes. (γ is coefficient of expectation)

$Y_t = \gamma\beta_0 + \beta_1\gamma X_t + (1-\gamma)Y_{t-1} + \vartheta_t$

Where $\vartheta_t = U_t - \lambda U_{t-1}$

Q8. What is PAM?

A8. Unlike AEM, here dependent variable is not observable.

Model: $Y_t^* = \beta_0 + \beta_1 X_t^* + U_t$

Where Y_t^* =Anticipated output at time t Which is directly not observable.

Nerlove assumed partial adjustment as

$Y_t - Y_{t-1} = \delta(Y_t^* - Y_{t-1})$

Where $0 < \delta \leq 1$ is the coefficient of adjustment.

This brings in the model as

$Y_t = \delta\beta_0 + \delta\beta_1 X_t + (1-\delta)Y_{t-1} + \delta U_t$

Which is similar to Koyck's system model.

Q9. What is IVM as used for AR models?

A9. It is an approach to introduce a proxy variable in the system for facilitating the estimation procedure. Such variable is called Instrumental variable and estimators so obtained are called Instrumental variables Estimators.

Q10. Define (i) Mean lag (ii) Median lag and give their formula for Koyck's system.

A10. Mean Lag It is the length of time, it takes for a unit change in the explanatory variable to the dependent variable Y. For Koyck's system, Mean Lag = $\frac{\lambda}{(1-\lambda)}$

Median Lag: Median Lag is the time required for the first half of the total change in Y following a unit sustained change in X.