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M.A / M.Sc SEM II

COURSE NO : ECO-201

GROUP- B (BASIC ECOTRICS)

TOPIC : AUTOCORRELATION

MATERIAL NO : 01

KEY WORDS : AUTOCORRELIATON, D-W TEST

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$E(u_t u_{t-1}) \neq 0$. Autocorrelation

Omitted explanatory variables — quasi autocorrelation

Mis-specification of the math. form of the model

Interpolation in the stat obs. (Smoothing process)

Mis-specification of the true random error term 'u'

(war, drought, strike etc. continues for more than one period. Hence its effect will be on 'u' — for more than one period. Hence the successive error terms may be correlated.

Consequences of Autocorrelation :—

$E(\hat{\beta}) = \beta$ ⟶ Unbiased.
estimate

OLS parameters will have higher variances.
(Min-var prop., BEST prop will not be satisfied).

Var(u_i) may be underestimated.

Prediction will be inefficient.
(based on estimate of OLS technique)

1

$r = \frac{Cov(x,y)}{\sigma_x \sigma_y} = r$

$Cov(x,y) = \frac{\Sigma (x_i - \bar{x})(y_i - \bar{y})}{n}$

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Test of Autocorrelation

Durbin – Watson Test :—

$$d = \frac{\sum_{t=2}^{n} (\hat{u}_t - \hat{u}_{t-1})^2}{\sum_{t=1}^{n} \hat{u}_t^2}$$

$\hat{u}$: OLS estimated residual vector.

$$= \frac{\sum_{t=2}^{n} (\hat{u}_t^2 + \hat{u}_{t-1}^2 - 2\hat{u}_t \hat{u}_{t-1})}{\sum_{t=1}^{n} \hat{u}_t^2}$$

$\hat{u}_t$ = estimated OLS residuals.

For large samples ($n > 30$)

$$\sum_{t=1}^{n} \hat{u}_t^2 = \sum_{t=2}^{n} \hat{u}_t^2 = \sum_{t=2}^{n} \hat{u}_{t-1}^2$$

$$\therefore d = \frac{2\sum_{t=1}^{n} \hat{u}_t^2 - 2\sum_{t=1}^{n} \hat{u}_t \hat{u}_{t-1}}{\sum_{t=1}^{n} \hat{u}_t^2} = 2 - 2\frac{\sum_{t=1}^{n} \hat{u}_t \hat{u}_{t-1}}{\sum_{t=1}^{n} \hat{u}_t^2}$$

$$d = 2(1 - \hat{\rho}) \qquad \text{Again } \hat{\rho} = \frac{\sum \hat{u}_t \hat{u}_{t-1}}{\sum \hat{u}_t^2}$$

$-1 \le \hat{\rho} \le +1$

$0 \le d \le 4$ when $\hat{\rho} = 0$, $d = 2 \rightarrow$ zero autocorrelation

$\hat{\rho} = +1$ $d = 0 \rightarrow$ +ve "

$\hat{\rho} = -1$ $d = 4 \rightarrow$ −ve "

Sampling dist^n of d- statistic.

Total not done only du dL (upper and Lower limits).

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And tabulated by them.

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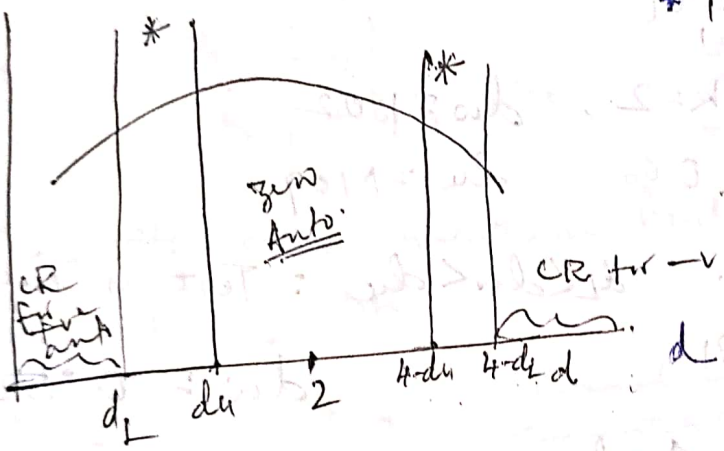
'd' depends on

1) data matrix (X), 2) no. of regressors, k, 3) no. of observations.

CRITICAL REGION of 'd' statistic :

f(d)



* Inconclusive region.

$\hat{\rho} = +1$ d = 0 +ve auto

$\hat{\rho} = -1$ d = 4 -ve auto

$\hat{\rho} = 0$, d = 2.

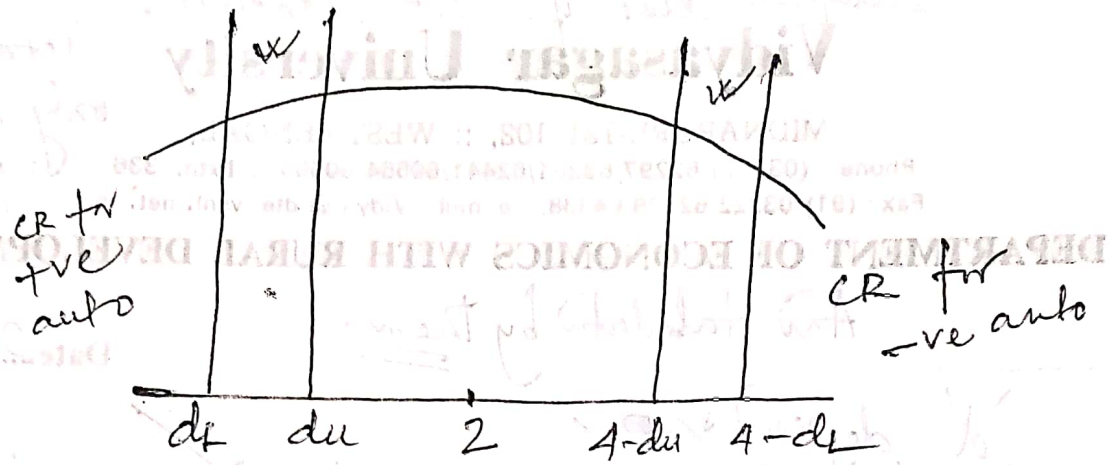
Ex- n = 16, k = 2, DW = 1.02 Table $D_L = 0.66$, $D_U = 1.10$

Here $D_L < dw < D_U$: Test is inconclusive

Ex- DW = 1.81 or DW = 0.150 Then See the text. OR

$$d = \frac{\sum_{t=2}^{n} (\hat{u}_t - \hat{u}_{t-1})^2}{\sum_{t=1}^{n} \hat{u}_t^2} \approx 2(1 - \hat{\rho})$$

3



$$d = \frac{\sum_{t=2}^{n} (\hat{u}_t - \hat{u}_{t-1})^2}{\sum_{t=1}^{n} \hat{u}_t^2}$$

$n = 16, \quad k = 2, \quad d_w = 1.02$

$d_L = 0.66 \quad d_u = 1.109$

$\therefore d_L < d_w < d_u$: Test is inclusive

If $d_w = 1.81$

$d_w = 0.50$

Then $4 - d_L$

$= 4 -$

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REMEDIES :-

a) If due to omitted vars : Then try to include those vars.

$C_t = f(Y_t, Y_{t-1})$

Then $C_t = a + b_0 Y_t + b_1 Y_{t-1} + u_t$: Then watch the value of DW. Take decision.

b) : Try with other mathematical forms and watch the value of DW.

c) $Y_t = \alpha + \beta X_t + u_t$ — Transformation of the model.

$\downarrow$

$Y_t^* = \alpha + \beta X_t^* + v_t$ — Transformed model.

Then apply OLS and get the values of the coefficients.

$\rightarrow E(v_t v_{t-1}) = 0$, apply OLS.

v_t satisfies the assumptions of OLS and we can apply the OLS technique