

$$Y_t = \beta Y_{t-1} + e_t$$

$$Y_t = \delta + \beta Y_{t-1} + e_t$$

$$Y_t = \delta + \beta Y_{t-1} + t e_t$$

$\beta = 1$ unit root

$\beta < 1$ Stationary

$\beta > 1$ explosive

This is at level $\leftarrow$ imp.

DIFFERENCE

MODEL

$$\Delta Y_t = \beta Y_{t-1} - Y_{t-1}$$

$$\Delta Y_t = (\beta - 1) Y_{t-1} + e_t$$

$$Y_t = \delta + Y_{t-1} + e_t$$

$$= \delta + (\beta - 1) Y_{t-1} + e_t$$

$$\Delta Y_t = \delta + (\beta - 1)Y_{t-1} + \alpha + \epsilon_t$$

At first difference

$$H_0: \beta = 0$$

$$H_1: \beta < 0$$

DICKY AND FULLER TEST

$$\Delta Y_t = \beta Y_{t-1} + \epsilon_t$$

$$\Delta Y_t = \delta + \rho Y_{t-1} + \epsilon_t$$

$$\Delta Y_t = \delta + \rho Y_{t-1} + \delta t + \epsilon_t$$

$$\rho = (\beta - 1)$$

1) ESTIMATE THE THREE USING OLS.

2) OBSERVE COEFFICIENT.

3) IF $\rho = 0$, then UNIT ROOT

$p < 0$ Stationary

IF ~~p~~ all the p 's are -ve

or we throw of the equation where p is positive

Then check for the significance using OLS, then throw out.

→ The -ve equation ~~is~~

If it is ~~not~~ significant then throw it off.

DO NOT USE THE NORMAL T-TEST, Check the Critical value for D-F Test

~~p~~

LIMITATION

1) How do we know which is the right model to use

2) The errors should not be serially correlated.

If the errors are serially then the estimator becomes insignificant.

AUGMENTED DICKY-FULLER

TEST.

$$\Delta Y_t = \delta + \rho Y_{t-1} + \alpha_t + \epsilon_t$$

$$\text{If } \delta = \alpha = 0 \quad \text{RWY}$$

$$\delta = 0 \quad \text{RWY}$$

we include lagged value of y_{t-1}

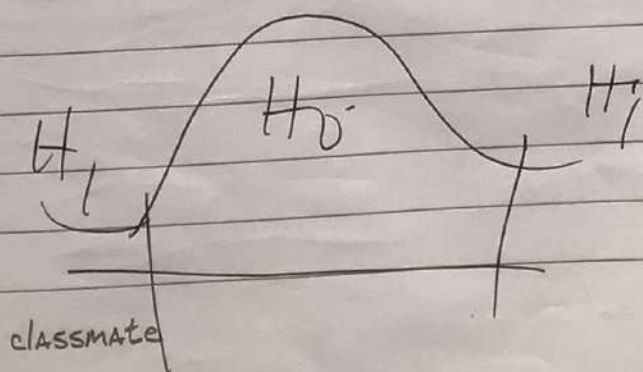
$$\Delta y_t = \delta + \rho y_{t-1} + \epsilon_t$$

$$+ \sum_{n=2}^{k=1} \rho \Delta y_{t-n}$$

take sufficient lag until
we have serial term not
correlated

$$\text{Cor}(\epsilon_i, \epsilon_j) = 0 \quad i \neq j$$

still the critical value of t
test to be used



$$H_1, P < \alpha$$

PHILIPS AND PERRON TEST

In ADF the $e_t \sim \text{i.i.d.}(0, \sigma^2)$

If the assumption fails then
it takes us to PP

$$\Delta Y_t = \delta + \rho Y_{t-1} + \alpha_t + e_t$$

it can be adjusted with
non-parametric test.

the sample test should be
large in ADF

we have to take 4
statistics