Lecture 24

Using the Augmented Dickey-Fuller Test to Determine Whether to Difference Data or Not

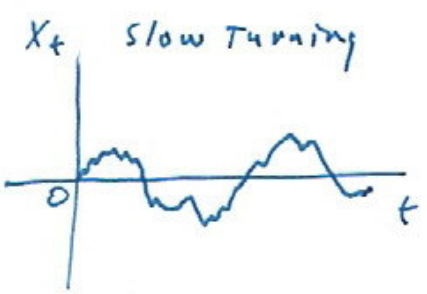
There are three separate cases of interest to us:

Case 1

Slow-turning Around Zero Value (H_0)

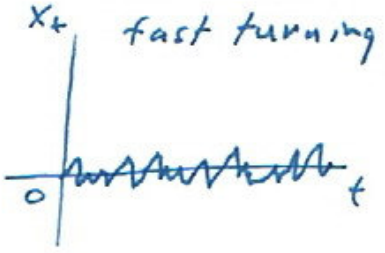
versus

Fast-turning Around Zero Value (H_1)



Difference Data: I(1)

(H_0)



Don't Difference Data: I(0)

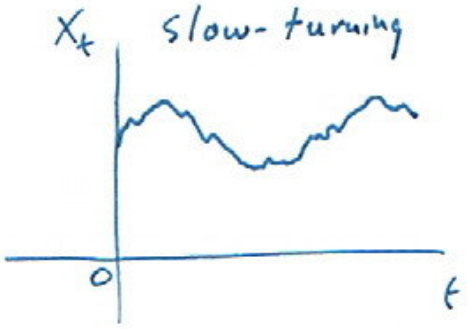
(H_1)

Case 2

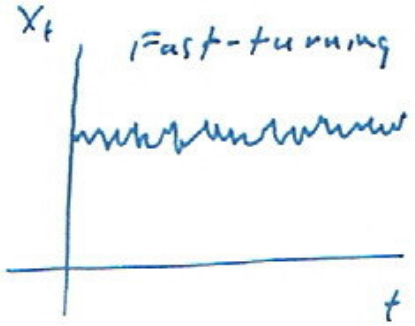
Slow-turning Around Non-Zero Value (H_0)

versus

Fast-turning Around Non-zero Value (H_1)



Difference Data: I(1)
(H_0)



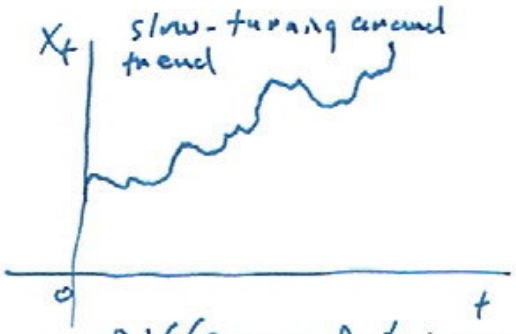
Don't Difference
Data: I(0)
(H_1)

Case 3

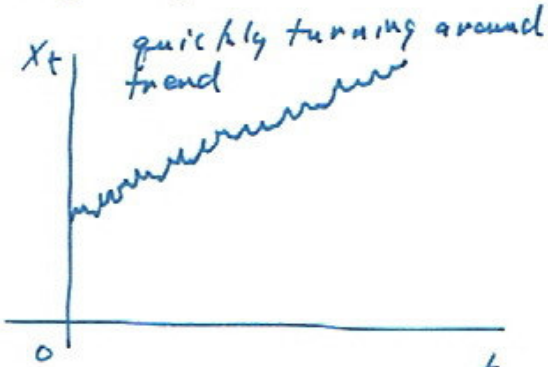
Slow-turning Around Trend (H_0)

versus

Fast-turning Around Trend (H_1)



Difference Data: I(1)
(H_0)



Trend stationary Data:
Detrend it (H_1)

These various cases are demonstrated in class using the data generated by the SAS program Learn Unit Root. sas and the unit root test software available in EVIEWS. Also see the EVIEWS program fertil3.wf1 for unit root tests on the data there. The ADF tests for the GFR and PE variables in fertil3.wf1 are reproduced below.

For the test equations for the ADF tests of the various cases see my Word file "Time Series Regression Notes" posted on the web.

Augmented Dickey-Fuller Unit Root Test on GFR

Null Hypothesis: GFR has a unit root
Exogenous: Constant, Linear Trend
Lag Length: 4 (Automatic based on SIC, MAXLAG=11)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-1.882944	0.6523
Test critical values:	1% level	-4.100935	
	5% level	-3.478305	
	10% level	-3.166788	

*MacKinnon (1996) one-sided p-values.

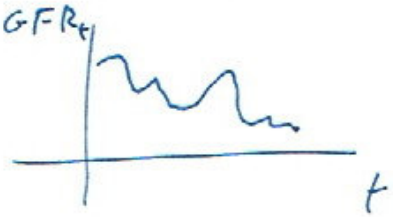
Augmented Dickey-Fuller Test Equation
Dependent Variable: D(GFR)
Method: Least Squares
Date: 11/26/04 Time: 15:08
Sample(adjusted): 6 72
Included observations: 67 after adjusting endpoints

Variable	Coefficient	Std. Error	t-Statistic	Prob.
GFR(-1)	-0.057197	0.030377	-1.882944	0.0646
D(GFR(-1))	0.363162	0.123401	2.942956	0.0046
D(GFR(-2))	-0.200330	0.130360	-1.536746	0.1296
D(GFR(-3))	0.224156	0.128581	1.743304	0.0864
D(GFR(-4))	0.221310	0.125433	1.764365	0.0828
C	6.062794	3.573233	1.696725	0.0949
@TREND(1)	-0.025612	0.028083	-0.912000	0.3654

R-squared	0.256517	Mean dependent var	-0.829851
Adjusted R-squared	0.182168	S.D. dependent var	4.366679
S.E. of regression	3.948965	Akaike info criterion	5.683391
Sum squared resid	935.6593	Schwarz criterion	5.913732
Log likelihood	-183.3936	F-statistic	3.450198
Durbin-Watson stat	2.115648	Prob(F-statistic)	0.005401

Case 3

Data is slowly turning around downward trend



Accept H_0: Data needs to be differenced (i.e. has "unit root")

(5)

Augmented Dickey-Fuller Unit Root Test on PE

Null Hypothesis: PE has a unit root
Exogenous: Constant
Lag Length: 1 (Automatic based on SIC, MAXLAG=11)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-1.871395	0.3438
Test critical values:	1% level	-3.527045	
	5% level	-2.903566	
	10% level	-2.589227	

*MacKinnon (1996) one-sided p-values.

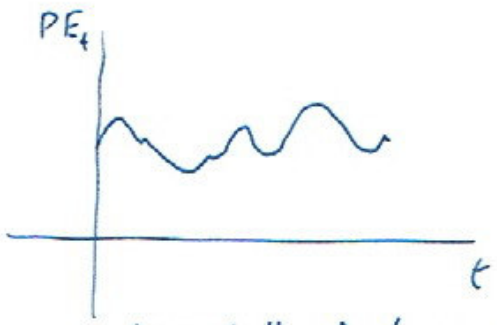
Augmented Dickey-Fuller Test Equation
Dependent Variable: D(PE)
Method: Least Squares
Date: 11/26/04 Time: 15:09
Sample(adjusted): 3 72
Included observations: 70 after adjusting endpoints

Variable	Coefficient	Std. Error	t-Statistic	Prob.
PE(-1)	-0.059278	0.031676	-1.871395	0.0657
D(PE(-1))	0.249315	0.116383	2.142193	0.0358
C	6.919772	3.827148	1.808075	0.0751

R-squared	0.101219	Mean dependent var	1.198571
Adjusted R-squared	0.074390	S.D. dependent var	17.91193
S.E. of regression	17.23282	Akaike info criterion	8.573420
Sum squared resid	19896.99	Schwarz criterion	8.669784
Log likelihood	-297.0697	F-statistic	3.772721
Durbin-Watson stat	1.968603	Prob(F-statistic)	0.028016

Case 2

Data is slow-turning around a non-zero value



Accept H_0: Data needs to be differenced.