



Econometrics 2, Class 1

Problem Set #8
November 7, 2005



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We go through 8.1 and 8.2 on the blackboard.



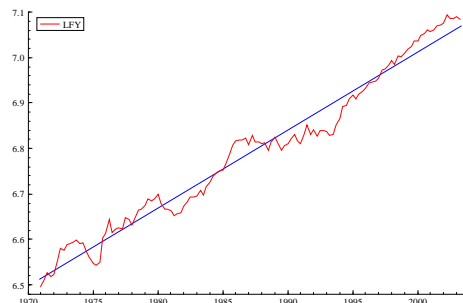
8.3 Unit Roots in Danish Macro-Variables

- We use the same dataset as last time.
- This time I choose to analyze the log of real GDP, lgy .



(1) Is there a trend?

- You can select "Scatter plot with regression line" in GiveWin's graphics window.
- The series seems to be fluctuating around a trend, so the Dickey-Fuller regression should include a trend. (Theoretically sound!)
- The relevant alternative is trend stationarity.





The augmented Dickey-Fuller test

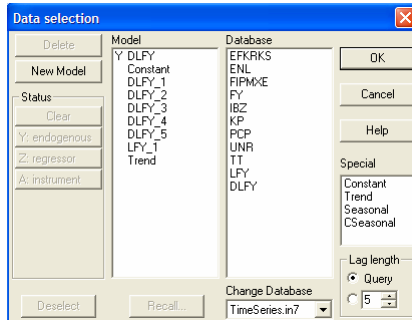
- The standard DF regression with a constant and a trend is
$$\Delta f y_t = \delta + \pi f y_{t-1} + \gamma t + \varepsilon_t$$
- In order to be sure that the error term is white noise, we add extra lags: the augmented DF test.
- The augmented DF regression is thus
$$\Delta f y_t = \delta + \pi f y_{t-1} + \gamma t + \varepsilon_t + \Delta f y_{t-1} + \Delta f y_{t-2} + \Delta f y_{t-3} + \dots$$
- If there is trend stationarity, Π must be significantly different from zero.
- The null hypothesis is $\Pi=0$, i.e. that there *is* a unit root.



(2) How many lags to include?

- Verbeek suggests that we perform a range of tests with different numbers of lags.
- But be careful! Too few lags will lead to autocorrelation in the error term, and too many will lead to inefficiency. So use the standard general-to-specific approach.
- Start with many lags, and delete those that are insignificant (one at a time!).

PcGive: Model – Single-equation Dynamic Modelling...



Select OLS for estimation.

Output for augmented D-F with 5 lags



EQ (1) Modelling DLFY by OLS (using TimeSeries.in7)
The estimation sample is: 1972 (3) to 2003 (2)

	Coefficient	Std. Error	t-value	t-prob	Part.R^2
DLFY_1	0.0463433	0.09172	0.505	0.614	0.0022
DLFY_2	0.140930	0.09137	1.54	0.126	0.0201
DLFY_3	0.0252953	0.09165	0.276	0.783	0.0007
DLFY_4	-0.00620050	0.09208	-0.0673	0.946	0.0000
DLFY_5	-0.00114229	0.09138	-0.0125	0.990	0.0000
Constant	0.731368	0.2927	2.50	0.014	0.0511
LFY_1	-0.111988	0.04504	-2.49	0.014	0.0506
Trend	0.000488604	0.0001932	2.53	0.013	0.0522
sigma	0.0119884	RSS	0.0166717078		
R^2	0.0681475	F(7,116) =	1.212 [0.302]		
log-likelihood	376.74	DW	2.04		
no. of observations	124	no. of parameters	8		
mean(DLFY)	0.00428117	var(DLFY)	0.000144282		

The fifth lag is insignificant, so we can try deleting it.

Is this significantly different from zero?

N.B. The t-statistics are not t-distributed, so do not use *t-prob*!



ADF(4) & ADF(3)

	Coefficient	Std.Error	t-value	t-prob	Part.R^2
DLFY_1	0.0464605	0.09085	0.511	0.610	0.0022
DLFY_2	0.141034	0.09060	1.56	0.122	0.0203
DLFY_3	0.0253094	0.09125	0.277	0.782	0.0007
DLFY_4	-0.00611631	0.09144	-0.0669	0.947	0.0000
Constant	0.732282	0.2822	2.60	0.011	0.0544
LFY_1	-0.112130	0.04341	-2.58	0.011	0.0539
Trend	0.000489198	0.0001865	2.62	0.010	0.0555

	Coefficient	Std.Error	t-value	t-prob	Part.R^2
DLFY_1	0.0470285	0.09007	0.522	0.603	0.0023
DLFY_2	0.141066	0.09022	1.56	0.121	0.0203
DLFY_3	0.0258684	0.09049	0.286	0.775	0.0007
Constant	0.737332	0.2707	2.72	0.007	0.0591
LFY_1	-0.112910	0.04164	-2.71	0.008	0.0587
Trend	0.000492419	0.0001794	2.74	0.007	0.0600

The fourth and third lags are insignificant...



ADF(2) & ADF(1)

	Coefficient	Std.Error	t-value	t-prob	Part.R^2
DLFY_1	0.0470422	0.08972	0.524	0.601	0.0023
DLFY_2	0.139194	0.08963	1.55	0.123	0.0199
Constant	0.717556	0.2607	2.75	0.007	0.0598
LFY_1	-0.109856	0.04009	-2.74	0.007	0.0594
Trend	0.000479772	0.0001732	2.77	0.007	0.0606

	Coefficient	Std.Error	t-value	t-prob	Part.R^2
DLFY_1	0.0379802	0.09005	0.422	0.674	0.0015
Constant	0.625027	0.2553	2.45	0.016	0.0476
LFY_1	-0.0955442	0.03924	-2.43	0.016	0.0471
Trend	0.000419805	0.0001698	2.47	0.015	0.0485

...as are the second and first!



DF

```
EQ(10) Modelling DLFY by OLS (using TimeSeries.in7)
The estimation sample is: 1972 (3) to 2003 (2)

      Coefficient  Std.Error  t-value  t-prob  Part.R^2
Constant      0.600882    0.2480    2.42    0.017   0.0463
LFY_1         -0.0918100   0.03810   -2.41   0.017   0.0458
Trend          0.000404139   0.0001652  2.45   0.016   0.0472

sigma          0.0118696   RSS          0.0170472712
R^2            0.0471556   F(2,121) =    2.994 [0.054]
log-likelihood  375.359     DW           1.96
no. of observations 124   no. of parameters 3
mean(DLFY)      0.00428117  var(DLFY)    0.000144282

AR 1-5 test:   F(5,116) = 0.57451 [0.7194]
ARCH 1-4 test: F(4,113) = 1.6674 [0.1625]
Normality test: Chi^2(2) = 8.5946 [0.0136]*
hetero test:   F(4,116) = 2.9463 [0.0232]*
hetero-X test: F(5,115) = 2.3453 [0.0456]*
RESET test:    F(1,120) = 0.19527 [0.6594]
```

It is important that there is no autocorrelation in order to be able to use DF. The null of no autocorrelation is accepted.

You get this output by choosing Test - Test Summary.



(3) Result

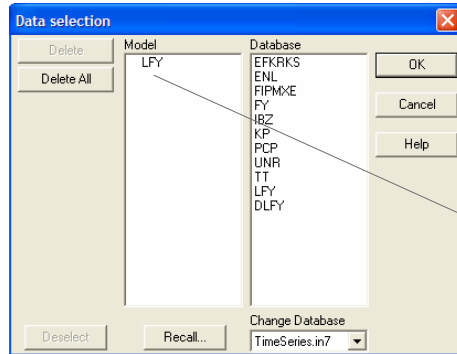
DF: -2.4 should be compared to a critical value of approx. -3.45. We cannot reject the null of a unit root.

Table 8.2: 1% and 5% critical values for a Dickey-Fuller test

Sample size	No constant No trend		Constant No trend		Constant Trend	
	1%	5%	1%	5%	1%	5%
$T = 25$	-2.66	-1.95	-3.75	-3.00	-4.38	-3.60
$T = 50$	-2.62	-1.95	-3.58	-2.93	-4.15	-3.50
$T = 100$	-2.60	-1.95	-3.51	-2.89	-4.04	-3.45
$T = 250$	-2.58	-1.95	-3.46	-2.88	-3.99	-3.43
$T = 500$	-2.58	-1.95	-3.44	-2.87	-3.98	-3.42
$T = \infty$	-2.58	-1.95	-3.43	-2.86	-3.96	-3.41



The easy way...



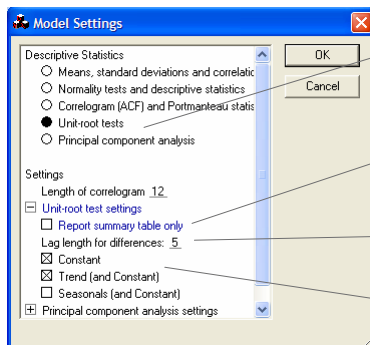
Of course PcGive can do all this automatically.

- 1) Package – Descriptive Statistics
- 2) Model – Formulate...

N.B. The original variable (not *dlfy*)!



Select Unit-root tests



We want unit-root tests.

This decides whether we want to try less lags. Here we choose not to.

You can choose how many lags you want here.

We want both constant and trend.



The output (with 5 lags)

```
Augmented Dickey-Fuller test for LFY; regression of DLFY on:

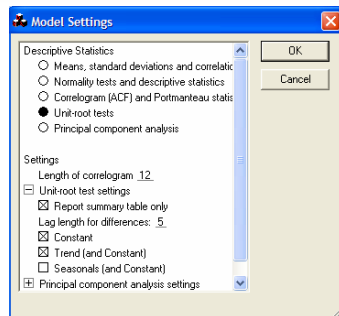
                Coefficient      Std.Error      t-value
LFY_1            -0.11199         0.045041       -2.4864
Constant         0.73137           0.29265        2.4991
Trend            0.00048860       0.00019324     2.5285
DLFY_1           0.046343         0.091718       0.50528
DLFY_2           0.14093          0.091370       1.5424
DLFY_3           0.025295         0.091652       0.27599
DLFY_4           -0.0062005         0.092078      -0.067339
DLFY_5           -0.0011423         0.091380      -0.012500

sigma = 0.0119884  DW = 2.04  DW-LFY = 0.00647  ADF-LFY = -2.486
Critical values used in ADF test: 5%=-3.446, 1%=-4.034
RSS = 0.01667170775 for 8 variables and 124 observations
```

The test statistic and the critical values are here!



With summary table



Remember to be careful using this output. Use the general-to-specific approach.

These statistics follow a standard t-distribution and can be used to see whether the extra lags are necessary.

Unit-root tests (using TimeSeries.in7)
The sample is 1972 (3) - 2003 (2)

```
LFY: ADF tests (T=124, Constant+Trend; 5%=-3.45, 1%=-4.03)
D-lag  t-adf      beta Y_1  sigma  t-DY_lag  t-prob      AIC  F-prob
5      -2.486      0.88801  0.01199  -0.01250  0.9900      -8.785
4      -2.583      0.88787  0.01194  -0.06689  0.9468      -8.801  0.9900
3      -2.712      0.88709  0.01189   0.2859   0.7755      -8.818  0.9977
2      -2.740      0.89014  0.01184   1.553   0.1231      -8.833  0.9935
1      -2.435      0.90446  0.01191   0.4218  0.6740      -8.829  0.6567
0      -2.410      0.90819  0.01187   0.0000  0.9900      -8.844  0.7587
```



(4) If you have time...

- Try this again with another time series.



Next time

- More Dickey-Fuller.
- We start on cointegration.