Concordia University
Department of Economics

Econ 324 **Ivan Tchinkov**
Economic Data Analysis **Fall 2018**

Problem Set # 1

(due Monday, Oct. 15 in class)

FIRST NAME: _____ **LAST NAME:**_____

STUDENT NUMBER: _____

I. True/False/Uncertain - Briefly explain. No credit without an explanation (5 marks each).

1. The Durbin-Watson test for serial correlation is invalid when there is a lagged dependent variable as explanatory variable.

   False/Uncertain. Since the DW d-statistic is biased towards 2 (i.e. no serial correlation), it cannot be relied on if it fails to find serial correlation. The opposite is not a problem - if a biased not to find serial correlation DW d-stat finds it nevertheless, then serial correlation must be present.

2. A unit root, AR(1) model can be expressed as a distributed lag in the error term.

   True. Set intercept to zero for simplicity and assume it is a unit root, then lag it to get: $Y_t = Y_{t-1} + e_t$ **and** $Y_{t-1} = Y_{t-2} + e_{t-1}$**, substitute the second into the first and get:** $Y_t = Y_{t-2} + e_t + e_{t-1}$**, continue this until you get:** $Y_t = Y_1 + e_t + e_{t-1} + e_{t-2} + ...$ **So, the unit root AR(1) model was transformed into a distributed lag of the error term.**

3. In the polynomial lag model, if both γ_1 and γ_2 are positive, then the effect of a change in X on Y is decreasing over time.

   False. In the polynomial lag model, the restriction for the slope coefficients is given by $\beta_i = \gamma_0 + \gamma_1 i + \gamma_2 i^2$ **. So, if both** γ_1 **and** γ_2 **are positive, then the beta coefficients are getting increasingly higher over time, thus the effect of X on Y is increasingly higher over time.**

4. The autocorrelation function of a trend stationary process has a low rate of decay (i.e. decreases slowly).

   True. Trend stationary process is a non-stationary one, since there is a deterministic trend. As all non-stationary processes, its autocorrelation function will have a slow rate of decay, i.e. the autocorrelation coefficients will decrease slowly with the lag length.

5. A unit root process and a stationary process are cointegrated.

   False/Uncertain. Unlikely, since a unit root process is trending and a stationary one is not, thus we cannot expect to have cointegration between them. Cointegration might be found between 2 or more unit root processes.

II. Problems - Use Stata for all your computations. You have to show your work. No credit without an explanation (15 marks each).

1. Find data on four time-series variables of your choice. Use any data source you like (including the sources posted on Moodle), but explain in detail how you got the data, so that your work can be replicated. Use Stata to do the following:

   (a) Report time line graphs for the four variables and discuss your findings. (3 marks)
   Give full marks if graphs of all time series variables are presented in Stata. Variables that appear to be trending or "wondering" are expected to be non-stationary or trend stationary. Variables that are not are expected to be stationary.

   (b) Report time line graphs for the first difference in the four variables and discuss your findings. (4 marks)
   Give full marks if graphs of the first differences of all time series variables are presented in Stata. Variables that appeared to be trending or "wondering" before are expected to look like stationary.

   (c) Construct the auto-correlation function of each variable and explain your findings. (4 marks)
   Autocorrelation function for non-stationary data is expected to have coefficients that are declining slowly, but are otherwise very high. For stationary coefficients - they are expected to be small and follow a random pattern.

   (d) Construct a scatter plot of each pair of variables and discuss your findings. (4 marks)
   Give full marks if all six scatter plots are presented with some reasonable discussion about what they show.

2. Use the file "324 exercise.xls" posted on Moodle. Consider the real stock market price monthly data for the period 1871 to 2010 (Use p=4). For this exercise use the monthly data **starting** from January 1940 onward.

   (a) Test the real stock price for unit root non-stationarity. What do you conclude? (4 marks)
   Based on final specification of AR(4) model with determininstic trend, one fails to reject the null of unit root since the t-stat is -2.301 (see separate Stata output).

   (b) Take the first difference of the real stock market price and test it for unit root. What do you conclude? Does it conform to your expectations and what is the implication for the Efficient Market Hypothesis (that the stock market is unpredictable)? (4 marks)
   Based on final specification including 2 lags of the second difference in the stock price and without time trend, one rejects the null of unit root in the difference of the stock market price (t-stat=-15.769, see separate Stata output). So it is stationary, thus confirming the unpredictability of changes in the stock market price.

   (c) Regress the change in real stock market price on a constant and a time variable. Is time a good predictor of the stock market? (3 marks)
   No, it is not, since we get a p-value of 0.465, making time an insignificant variable in explaining changes in stock market prices.

   (d) Take any 30 year plus period of the real stock market price changes and regress it on variables of your choice which you think are good predictors of the stock market like dividends, earnings, interest rates, inflation rates, etc. You can use the data in the "324 exercise.xls" file, or find data on your own for the variables you wish. Comment on the strength of the explanatory power of the variables you have chosen in explaining stock market price changes. (4 marks)
   Using the entire sample from 1940m1 onwards, the changes in dividends are not statistically significant (p-value=0.415), but changes in earnings are strongly significant (p-value=0.000). But they explain about 6.5% of the variation in changes in the stock market prices, which is relatively small amount.

3. Use the variables Y = percentage change in sales and X = percentage change in computer purchases in data set COMPUTE1.xls and do the following:

   (a) Establish whether Y and X have unit roots. Then begin with $ADL(3,3)$ model with deterministic trend and find a suitable specification. (9 marks)

   Based on the Stata output file results, both Y and X are indeed stationary, since we reject the null of unit root in both.

   The appropriate lag length for the ADL(p,q) is (2,1), without any time trend (see separate Stata output file).

   (b) Calculate the long run multiplier for the model estimated in part (a). (6 marks)

   The estimate of the long run multiplier from the above specification is .5568. (Give full marks if students get the wrong specification above, and calculate a long run multiplier based on their specification, even though it is different from the number .5568).

4. The data set WP.xls contains annual data from 1857-1987 on wages (X) and the consumer price index for UK (Y). It is commonly thought that wage pressures are a prime cause for inflation.

   (a) Construct a time series plot of the data. Do they both seem to be trending? Do they seem to be trending together? (3 marks)

   Yes, they seem to be trending and trending together (see Stata output file).

   (b) Carry out unit root test on both series. Report your findings. (3 marks)

   Unit root tests confirm that both are unit root non-stationary (see Stata output file).

   (c) Carry out a cointegration test**.** Report your findings. (3 marks)

   Based on an Engle-Granger test for cointegration, we cannot reject the null (at both 5% and 1%) that the series are not cointegrated (see Stata output file).

   (d) Difference the data to obtain ΔX and ΔY. Repeat part (a) and (b) with these new variables. Report your findings. (3 marks)

   The differenced variables do not seem to be trending, and we can reject the null of unit root in both (see Stata output file).

   (e) Specify and estimate a ADL(p,q) model with the new variables ΔX and ΔY. Discuss your results. (3 marks)

   Based on an ADL(1,0) without time trend, we get the long-term multiplier to be .84, i.e. a 10 percentage points (p.p.) increase in wages is associated with about 8.4 p.p increase in inflation in the long-run (see Stata output file)..

5. Use the data on consumption (Y) and personal income (X) from the data set INCOME.xls. Assume that Y and X are cointegrated.

   (a) Estimate an Error Correction Model. Begin with a model with $p = q = 4$ and then carry out statistical tests to find an appropriate ECM. (9 marks)

   The sequential testing procedure leads us to the cointegrating equation and ECM(3, 2) without time trend shown in the separate Stata output file.

   (b) What is the speed of adjustment to a short-run disequilibrium? (6 marks)

   The estimate of the error correction term is -0.049, which indicates a slow adjustment to equilibrium of about 5% per period.