Assignment 2

3 Possible Points

This assignment's due date is Monday, June 19th by 8:00 PM. The grading policy for late assignments can be found in the syllabus. You are strongly encouraged to work in groups of up to 4 students, but each of you must submit his/her own version of the assignment. Please put the names of your group members in a comment in the program.

Write a single text file that contains all of your work for this assignment. Name it ps2_[yourlastname].txt - for example, mine would be ps2_hoff.txt The text file should submit all of the commands necessary to answer the questions. Please put the answers to the **bold questions** in a comment line in your text file, even if you think the answer is readily apparent.

This assignment has been designed to investigate the problems of using OLS when serial correlation is present. Additionally, you will investigate ways to identify and remove serial correlation from the data.

Useful R Functions

- `ts.plot()`: allows overlay of time series with different number of time periods.
- `gpars()`: an option in `ts.plot()` that allows you to make your graphs look nice.
- `lag()`: lags a time series object a specified number of lags. NOTE: you'll probably want to use negative values here.
- `cbind()`: brings two or more vectors together.
- `data.frame()`: creates a data.frame object which produces similar results to `cbind()`.
- `shift()`: useful for creating lag and lead variables in a data.frame object. This function can be found on Springboard as it not a default R function.

Getting the Data

- Download and import the data titled ps2.csv from the course website.

Statistical Analysis for $y1$

Visual Identification

- Turn $y1$ into a time series variable and plot it.
- **Does $y1$ exhibit any obvious trending or time series pattern?**
- Estimate the following equation using OLS:

$$y_{1,t} = \beta_0 + \beta_1 x_{1,t} + \beta_2 x_{2,t} + \epsilon_t$$

- **Report the estimates of the coefficients and whether or not they are statistically significant.**
- Use R's `resid()` function to plot the residuals from the above regression. Again you may want to turn the residuals into a time series variable for easier plotting.
- **Does the plot of the residuals suggest that serial correlation is a problem for Equation (1)?**
- Create a plot of the autocorrelation function (ACF) for the residuals.
- **Does the plot of the ACF for the residuals suggest that serial correlation is a problem for Equation (1)?**

Durbin-Watson for $y1$

- **Calculate, report and decide whether or not the residuals from Equation (1) suffer from serial correlation using the Durbin-Watson statistic.** Hint: it may be helpful to turn the residuals into a time series in R - use the `ts()` function. This allows you to use the `lag()` function. Additionally, you could use the `shift()` function if you turn the above items into a `data.frame` object.

Statistical Analysis for $y2$

Visual Identification

- Turn $y2$ into a time series variable and plot it.
- **Does $y2$ exhibit any obvious trending or time series pattern?**
- Estimate the following equation using OLS:

$$y_{2,t} = \alpha + \beta_3 x_{3,t} + \epsilon_t$$

- **Report the estimates of the coefficients and whether or not they are statistically significant.**
- **Does the plot of the residuals suggest that serial correlation is a problem for Equation (2)?**
- Create a plot of the autocorrelation function (ACF) for the residuals.
- **Does the plot of the ACF for the residuals suggest that serial correlation is a problem for Equation (2)?**

Durbin-Watson for $y2$

- **Calculate, report and decide whether or not the residuals from Equation (1) suffer from serial correlation using the Durbin-Watson statistic.** Hint: it may be helpful to turn the residuals into a time series in R - use the `ts()` function. This allows you to use the `lag()` function. Additionally, you could use the `shift()` function if you turn the above items into a `data.frame` object.

Removing the Autocorrelation with a Time Trend

- Add a “time” variable and add it to Equation (2).
- **Using a Durbin-Watson test, does this remove the autocorrelation?**

Removing the Autocorrelation with the Hildreth-Lu Procedure

- Use the Hildreth-Lu procedure on Equation (2), searching by hundredths from 0.65 through 0.70, to remove the autocorrelation.
- **Using a Durbin-Watson test, does this remove the autocorrelation?**
- **Does a plot of the residuals from the Hildreth-Lu look random?**