Causal Inference: Problem Set 13

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Based on Chapter 18 problems of Wooldridge.

1. Suppose that $\{y_t\}$ and $\{x_t\}$ are I(1) series, but $y_t - \beta x_t$ is I(0) for some $\beta \neq 0$. Show that for any $\delta \neq \beta$, $y_t - \delta x_t$ must be I(1).

2. Use the data in HSEINV for this exercise.

   (i) Test for a unit root in *linvpc* (log of housing investment per capita), including a linear time trend and two lags of the change in linvpc.

   (ii) Use the approach from part (i) to test for a unit root in *lprice* (log of the housing price index).

   (iii) Given the outcomes in parts (i) and (ii), does it make sense to test for cointegration between *linvpc* and *lprice*?

3. Use the data in FERTIL3 for this exercise.

   (i) Test for a unit root in *gfr* (general fertility rate), including a linear time trend and one lag of gfr.

   (ii) Use the approach from part (i) to test for a unit root in *pe* (personal tax exemption).

   (iii) Given the outcomes in parts (i) and (ii), does it make sense to test for cointegration between these two variables? If so, apply this test by obtaining the residuals of the regression of gfr on t and pe and using the augmented Dickey-Fuller test with a linear time trend and one lag. Report the conclusion of the test.

4. Use the data in PHILLIPSNEW for this exercise.

   (i) During the lecture, we estimated two models with unemployment and inflation using data 1948-2010. Estimate these two models by using data through 2015. Do the parameter estimates change much compared to earlier estimates from the lecture?

   (ii) Use the results in part (i) to forecast $unem_{2016}$; round to two decimal places. Which model produces a better forecast?

   (iii) Use the equation that includes inf_{t-1}, estimated in part (i), to forecast $unem_{2017}$. You have to use $unem_{2016}$ and inf_{2015} as inputs in forecasting. Next, reestimate the parameters using data through 2016, and use the updated estimates to forecast $unem_{2017}$. Does this reestimation with the extra year of data produce a better forecast?

5. Use the data in BARIUM for this exercise. It includes US imports of Chinese barium chemical.

   (i) Estimate the linear trend model $chnimp = \alpha + \beta t + u_t$ using the first 119 observations (this ecludes last 12 month observations of 1988).

   (ii) Now, estimate AR(1) model for *chnimp*, again excluding last 12 observations. Which model has higher in-sample fit in terms of R^2?

   (iii) Use the models from parts (i)-(ii) to get 12 one-step-ahead forecasts. Compute RMSE and MAE. Which method is better forecaster?

   (iv) Add monthly dummy variables to the regression from part (i). Are these jointly significant?