Time Series Data and Serial Correlation

1. (Adapted from C11.5, C12.1) Suppose we are interested in how personal tax exemptions (*pe*) affect the general fertility rate (*gfr*). Use the data in FERTIL3.RAW for this exercise.
2. Estimate the following equation:

*gfrt = β0 + β1 pet + β2ww2t + β3pillt + εt*

where *ww2* is a dummy variable for the years 1941-1945, and *pil*l is a dummy variable that is equal to one for the years 1963 on (after the pill was available). Discuss the significance of the coefficients and interpret their magnitudes.

1. Fertility may react to personal exemptions with a lag. Reestimate your equation adding 2 lags of *pe* (*pet-1*and *pet-2*). Are these variables jointly significant? What are the degrees of freedom of your F-test and why?
2. What are the first order autocorrelations () for *gfr* and *pe*? What do these suggest about possible unit root(s)? What does this suggest about your OLS results in (i)?
3. Re-estimate (i) using first differences—that is, changes in *gft* and changes in *pe*. (Do not difference *ww2* and *pill*.) How does the effect of *pe* compare with your estimates in levels in (i)?
4. Reestimate (ii) using first differences of *gft*, *pe*, and lagged *pe*. (Again, do not difference *ww2* and *pill*.) Interpret the coefficients and comment on their statistical significance.
5. Add a linear time trend to the model in (v). Is a time trend necessary in the first-difference equation?
6. Using the model in (vi), test for whether there is AR(1) serial correlation in the errors.
7. Suppose we are interested in how laws and economic conditions might affect driving behavior. Use TRAFFIC2.RAW (monthly observations from CA from Jan 1981-Dec 1989) to answer these questions.
	1. The variable *prcfat* is the percentage of accidents resulting in at least on fatality. Note that this variable is a percentage, not a proportion. What is the average of this variable over this period?
	2. Run a regression of *prcfat* on a linear time trend, 11 monthly dummies (set January as your base month), *wkends*, *unem*, *spdlaw*, and *beltlaw*. Discuss the estimated effects of *unem*, *spdlaw*, and *beltlaw*. Do the signs and magnitudes make sense to you?
	3. Test the errors for AR(1) serial correlation.
	4. Re-estimate the model accounting to serial correlation.
	5. Compute the first order autocorrelations () for *unem* and *prcfat*. What do these suggest about possible unit root(s)?

* 1. Estimate the model in (ii) using first differences for unem and prcfat (Do not difference the month or policy variables.) Compare your results to those in (ii).
1. Use the data in PHILIPS.RAW for this exercise. (This follows several of the examples in Wooldridge, but using the full set of the data, rather than only through 1996.)

The Phillips curve posits a relationship between unemployment and inflation:

$$inf\_{t}-inf\_{t}^{e}=β\_{1}\left(unem\_{t}-μ\_{0}\right)+e\_{t}$$

Here $inf\_{t}^{e}$ is the expected rate of inflation for year t that was formed in year t-1. The above formulation posits that there is a relationship between unanticipated inflation (deviations from expectations) and cyclical unemployment—deviations of unemployment in year t from the natural rate of unemployment, $μ\_{0}$. One assumption of this model is that the natural rate of unemployment is constant.

Under the adaptive expectations model, current expected values of inflation depend on recently observed inflation, resulting in the following:

$inf\_{t}-inf\_{t-1}=β\_{0}+β\_{1}\left(unem\_{t}\right)+e\_{t}$ = $∆inf\_{t}=β\_{0}+β\_{1}\left(unem\_{t}\right)+e\_{t}$

where $β\_{0}=-β\_{1}μ\_{0}$

1. Estimate the effect of unemployment on the levels of inflation (rather than the change in inflation). Interpret the coefficients. Using your estimates, calculate the natural rate of unemployment.

1. Obtain the residuals from this estimation. Is there evidence of serial correlation in these residuals?
2. Re-estimate this model accounting for serial correlation using the Prais-Winsten method of FGLS. Comment on the difference in coefficient estimates.
3. Then estimate the adaptive expectations model: $∆inf\_{t}=β\_{0}+β\_{1}\left(unem\_{t}\right)+e\_{t}$

Obtain the residuals from this estimation? Is there evidence of serial correlation in these residuals? If there is, re-estimate the model.

1. An alternative model (the expectations augmented Phillips curve) allows the natural rate of unemployment to depend on past levels of unemployment. Reestimate the above model using *changes* in unemployment rather than levels as the independent variable. Comment on the difference between your results here and those in (a).
2. Compute a first order autocorrelation for unem. Is the root close to one? (Not asking for a formal test here.)
3. Based on what you found from your various estimation results using different models and on the autocorrelations in errors and in the series, explain the pattern of your results. What would you concludeabout which model is most appropriate?