1. Solve the following difference equations:
   (a) $y_t = 20 + .4y_{t-1}, \quad y_0 = 100$
   (b) $y_t = 20 + 1.4y_{t-1}, \quad y_{t+n} = 100$
   (c) $y_t = 20 + y_{t-1}, \quad y_0 = 100$
   (d) $y_t = y_{t-1} + \varepsilon_t, \quad y_0 = 100$
   (e) $y_t = \alpha y_{t-1} + \varepsilon_t, \quad |\alpha| < 1$
   (f) $y_t = \alpha y_{t-1} + \varepsilon_t, \quad \alpha = 1$

2. Consider the "cobweb model" of demand and supply:

$$\begin{aligned} d_t &= a - \gamma p_t \\ s_t &= b + \beta p_t^* + \varepsilon_t, \quad \beta > 0 \\ d_t &= s_t \\ p_t^* &= p_{t-1} \end{aligned}$$

   where d is demand, s is supply, p is price, and p^* is the anticipated price.

   (a) Program these equations into a spreadsheet (e.g., Excel) or a program like R, if you prefer. Assume values for all of the unknown parameters. Based on your assumed parameters, calculate the following:
      - The contemporaneous impact of a supply shock on the price, i.e. $\frac{\partial p_t}{\partial \varepsilon_t}$. This is called the **impact multiplier**. This will be a number.
      - The future effect on price of a supply shock, i.e. $\frac{\partial p_{t+1}}{\partial \varepsilon_t}$. The time path of this (i.e., the value at the various $t+i$) is called the **impact response function**. Show this in a graph.

   (b) Change your assumed values, and recalculate the IM and the IRF. Explain how your results differ.
   (c) Why do you think this is called the cobweb model?

3. Download the file `sometimeseriesdata.csv`, and import it into Stata. Determine the appropriate order of the ARMA(p,q) model (that is, is it an AR(1), or an MA(1), or ...) for each of the variables named after a person in our class (t is the time index variable).

   [Hint: Inspect the autocorrelation functions and the partial autocorrelation functions, in conjunction with the information in table 2.1 of your text.] [Stata hint: when using Stata's time series commands, you must tell Stata what the time variable is, using the command `tsset`—for these data, use `tsset t`. To generate the ACF and PACF for variable *burk* use the command `corrgram burk` for a "dirty" display, and `ac burk` and `pac burk` for a pretty display.]

4. Download a macroeconomic variable of interest, and import it into Stata. Write one sentence about why you choose the variable you did. Produce a nice-looking and well-labeled plot of the data. Also produce the ACF and PACF for the variable, and discuss what you think might be an appropriate model (this will probably be less clear than it was for the simulated data in the previous problem—don't worry, just do your best!).

   [Hint: FRED (Federal Reserve Economic Data) is a good online source for macroeconomic data.]

5. For this exercise you will estimate two models of U.S. inflation: a purely autoregressive model, and a Phillips curve type model (that is, where inflation is based on lagged values of unemployment as well as inflation).

   Begin by downloading the relevant data on the GDP deflator and the civilian unemployment rate from FRED. The common sample for these two series is 1948 through 2007. Convert the unemployment rate to quarterly observations by averaging. Convert the GDP deflator to annualized growth rate form.

   (a) Estimate the pure autoregressive model using the AIC statistic to choose the appropriate lag length. [Stata hint: Remember to set the time variable. Also, know that `L.x` is the lagged value of x.] [Analysis hint: A *smaller* AIC indicates a better fit, *for a given number of observations*. Be sure that you when choosing a model based on the AIC you are using the same number of observations to evaluate each model!]

   (b) Are you concerned that there was some kind of structural change over this period? That is, do you think the parameters may have changed substantially over this period? Split the sample at 1984:1, and re-estimate your chosen model from the previous step for both the pre-1984:1 and post-1984:1 subsamples. [Pro tip: A way to do this rigorously is to do a Chow test, however you can just do it informally for this problem, as I don't know whether you covered the Chow test in your earlier metrics class.]

   (c) Estimate the Phillips curve model with inflation regressed on lagged inflation and lagged unemployment. Use the AIC statistic to choose the lag length, adding lags of each symmetrically (otherwise it can get a little crazy). Report only the final model.

   (d) Estimate the Phillips Curve model over two sub-samples: 1947.1 to 1989.4 and 1990.1 to 2007.4 (use the same lag lengths that you found for part (iii)). For each subsample compute the sum of the coefficients on lagged unemployment and test the null hypothesis that each sum equals zero. Interpret the sums. What has happened to the slope of the Phillips curve across the two samples? [Think about this for a bit and I will give you a hint if needed!]