Problem 1 (Wooldridge, Problem 10.2, Page 371-372)
Let \( g_{GDP_t} \) denote the annual percentage change in gross domestic product and let \( int_t \) denote a short-term interest rate. Suppose that \( g_{GDP_t} \) is related to interest rates by

\[
g_{GDP_t} = \alpha_0 + \delta_0 int_t + \delta_1 int_{t-1} + u_t,
\]

where \( u_t \) is uncorrelated with \( int_t, int_{t-1}, \) and all other past values of interest rates. Suppose that the Federal Reserve follows the policy rule:

\[int_t = \gamma_0 + \gamma_1 (g_{GDP_{t-1}} - 3) + v_t,
\]

where \( \gamma_1 > 0 \). (When last year’s GDP growth is above 3%, the Fed increases interest rates to prevent an “overheated” economy.) If \( v_t \) is uncorrelated with all past values of \( int_t \) and \( u_t \), argue that \( int_t \) must be correlated with \( u_{t-1} \). (Hint: Lag the first equation for one time period and substitute for \( g_{GDP_{t-1}} \) in the second equation.) Which Gauss-Markov assumption does this violate?

Problem 2 (Wooldridge, Problem 11.1, Page 401)
Let \( \{x_t : t = 1, 2, \ldots\} \) be a covariance stationary process and define \( \gamma_h = Cov(x_t, x_{t+h}) \) for \( h \geq 0 \). [Therefore \( \gamma_0 = Var(X_t). \)] Show that \( Corr(x_t, x_{t+h}) = \gamma_h/\gamma_0 \).

Problem 3 (Wooldridge, Problem 11.2, Page 401)
Let \( \{e_t : t = -1, 0, 1, \ldots\} \) be a sequence of independent, identically distributed random variables with mean zero and variance one. Define a stochastic process by

\[
x_t = e_t - (1/2) e_{t-1} + (1/2) e_{t-2}, t = 1, 2, ...
\]

(i) Find \( E(x_t) \) and \( Var(x_t) \). Do either of these depend on \( t \)?

(ii) Show that \( Corr(x_t, x_{t+1}) = -1/2 \) and \( Corr(x_t, x_{t+2}) = 1/3 \). (Hint: It is easiest to use the formula in Problem 11.1.)

(iii) What is \( Corr(x_t, x_{t+h}) \) for \( h > 2 \)?

(iv) Is \( \{x_t\} \) an asymptotically uncorrelated process?
Problem 4 (Wooldridge, Problem 11.5, Page 402)

For the U.S. economy, let \( gprice \) denote the monthly growth in the overall price level and let \( gwage \) be the monthly growth in hourly wages. [These are both obtained as differences of logarithms: \( gprice = \Delta \log(\text{price}) \) and \( gwage = \Delta \log(\text{wage}) \).] Using the monthly data in WAGEPRC.RAW, we estimate the following distributed lag model:

\[
\hat{gprice} = -0.00093 + 0.119 \text{ gwage} + 0.097 \text{ gwage}_{-1} + 0.040 \text{ gwage}_{-2} \\
+ 0.038 \text{ gwage}_{-3} + 0.081 \text{ gwage}_{-4} + 0.107 \text{ gwage}_{-5} + 0.095 \text{ gwage}_{-6} \\
+ 0.104 \text{ gwage}_{-7} + 0.103 \text{ gwage}_{-8} + 0.150 \text{ gwage}_{-9} + 0.110 \text{ gwage}_{-10} \\
+ 0.103 \text{ gwage}_{-11} + 0.016 \text{ gwage}_{-12}
\]

\( n = 273, R^2 = .317, \bar{R}^2 = .283. \)

(i) Sketch the estimated lag distribution. At what lag is the effect of \( gwage \) on \( gprice \) largest? Which lag has the smallest coefficient?

(ii) For which lags are the t statistics less than two?

(iii) What is the estimated long-run propensity? Is it much different than one? Explain what the LRP tells us in this example.

(iv) What regression would you run to obtain the standard error of the LRP directly?

(v) How would you test the joint significance of six more lags of \( gwage \)? What would be the dfs in the F distribution? (Be careful here; you lose six more observations.)