(This assignment is a short assignment by design — for the first three problems, you will simply apply the “gls” function on three of the datasets you used in Assignment 3. However, I urge you to spend time thinking about the differences in the models constructed as part of Assignment 3 and those constructed here.)

Recall the time series model with AR(1) errors:

\[ y_t = X\beta + \epsilon_t, \]
\[ \epsilon_t = \phi \epsilon_{t-1} + a_t, \]  
(1)

where \( a_t \sim iidN(0, \sigma_a^2) \).

In Assignment 3 we estimated Model (1) using the Cochrane-Orcutt procedure. In the first three problems of this assignment, you will estimate the model in (1) using the more general “gls” command in R and with more general error structures. For example, the above model with AR(p) errors is given by

\[ y_t = X\beta + \epsilon_t, \]
\[ \epsilon_t = \phi_1 \epsilon_{t-1} + \phi_2 \epsilon_{t-2} + \cdots + \phi_p \epsilon_{t-p} + a_t. \]  
(2)

To estimate Model (2) using “gls” see Example 3.15 on page 217 of the textbook. Example 3.15 also shows how to display the approximate confidence intervals using the “intervals” command.

1. Fit an appropriate time series regression model to the data appearing in Table E3.5 of the textbook. Use the “gls” command with AR(p) errors. Try \( p = 1, 2, 3 \). How do the estimated standard errors look? What is the smallest \( p \) value for which all 95-percent confidence interval estimates of the \( \phi \)s in the model do not include 0? Compare the model you constructed with the corresponding model in Assignment 3.

2. Do the same for the data appearing in Table E3.6 of the textbook.

3. Do the same for the data appearing in Table B.6 in Appendix B of the textbook.

4. Problem 3.16.

5. Problem 3.19 (a) and Problem 3.19 (b).