COLORADO STATE UNIVERSITY
DEPARTMENT OF AGRICULTURAL & RESOURCE ECONOMICS

Problem Set 3a **Agricultural & Resource Economics / Economics 535** *S.R. Koontz*
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Regression, Serial Correlation, and Heteroskedasticity

Provide answers to the following questions in a word-processed document. This problem set is to be a team effort between two individuals. Each team must submit a unique assignment. However, you may work with other students. Show the work necessary to communicate clear answers each question. Good answers always communicate. This complete problem set is worth 50 points. Round all reported statistics to the fourth decimal.

The objective of this problem set is to address the problem of serial correlation and heteroskedasticity in applied regression analysis. You will need to estimate regressions, test for serial correlation or heteroskedasticity, and re-estimate regressions correcting for each problem using econometric software. You will then compare the estimates and conclusions of hypotheses tests across the methods.

A. The first part of this problem set is organized around the beef demand models estimated in *Problem Set 2* and addresses serial correlation. Answer the following questions.

1. Report the OLS regression results for the following the beef demand equation

$$\ln(y_t) = \beta_0 + \beta_1 \ln(x_{1t}) + \beta_2 \ln(x_{2t}) + \beta_3 \ln(x_{3t}) + \beta_4 \ln(x_{4t}) + e_t$$

where y = per capita consumption of beef, lbs.
x_1 = real beef price, cents per lb.
x_2 = real pork price, cents per lb.
x_3 = real chicken price, cents per lb.
x_4 = real disposable personal income, dollars.

Write the estimates in equation form. Report the standard error and p-value of each coefficient under the estimate. (See equation 5.11.1 on page 129 in Gujarati for an example. P-values and t-statistics are redundant – only report p-values.) Also report the regression F-statistic, its p-value, the model R^2, and the root error variance estimate.

2. Using the Durbin-Watson *d* statistic, test for serial correlation in the error term of the model. Report the test statistic and critical values. State the conclusion of the test.

3. Using the Breusch-Godfrey test (See Gujarati pages 438-440), test for serial correlation in the error term. Use $p = 2$. Report the test statistics and p-values. State the test conclusion.

4. Re-estimate the model correcting for first-order serial correlation. Report the coefficient estimates, standard errors and p-values, regression F-statistic, p-value, model R^2, and root error variance. Also report the serial correlation coefficient estimate, standard error, and p-value.

5. Discuss the difference in results across the two regressions. Do the coefficient estimates change? What about the standard errors and p-values? What about the F-statistic, p-value, model R^2, and root error variance? There is no need to state every number. Rather, what general patterns do

you observe across the two methods? How did correcting for serial correlation affect the economic interpretation of the model (i.e., does the economic interpretation of the coefficient estimates agree with *a priori* expectations based on consumer theory)?

6. Using the prices and income for 2010, calculate the expected value of beef consumption measured in pounds per capita. Be careful, do not forget error from 2009. Show your work.

7. Test for a structural change in the demand function during and after 1981. Assume the change occurs in 1981 and persists all years thereafter. Use dummy variables in a Chow Test. Is there evidence of structural change? Compare the Chow test statistics without and with a correction for first-order serial correlation. Do not report the results of regressions, just report the statistics and p-values of the tests for structural change with and without the correction for serial correlation. Comment on the difference in test results.

8. As opposed to a one-time change in the demand function, the structural change could be due to a gradual change in consumer tastes and preferences. Incorporate three trend variables into the model, estimate the regression, and report the regression results. The first trend variable should be the observation number, the second should be the observation number squared, and the third should be the observation number cubed. Report the results of the OLS model and the model corrected for first-order serial correlation. Comment on the difference in results across the regressions.

9. The following question is important – examine the elasticities for the models without and with the trend variables, both not corrected and corrected for serial correlation. Make a table of elasticities across the four models. Which model has more economic content? Also present the serial correlation coefficient estimate. Include it in the table.