COLORADO STATE UNIVERSITY
DEPARTMENT OF AGRICULTURAL & RESOURCE ECONOMICS

Exam 2 **Agricultural & Resource Economics / Economics 535** *S.R. Koontz*
Fall 2022 **Applied Econometrics**

This exam is worth 100 points. The points allocated to each question are listed with the question number. Use your time appropriately. Show the work necessary to communicate clear answers each question. Good answers always communicate.

1. (25 pts.) Serial correlation is a common problem in econometric models that use time series data.

a. What is serial correlation and how does it impact OLS estimates?

b. Suppose you have 40 observations of quarterly data, that your model has three explanatory variables, and the DW-d for your model is DW-d = 1.450. Briefly, interpret the statistic and draw any conclusion.

c. Suppose the auxiliary regression results from the Breusch-Godfrey test is as follows

$$e_t = 0.0 + \underset{(0.035)}{0.700\, e_{t-1}} + \underset{(0.450)}{0.015\, e_{t-2}} - \underset{(0.680)}{0.050\, e_{t-3}} - \underset{(0.020)}{0.25\, e_{t-4}} + x_t\varphi + v_t$$

where p-values are reported, the last term are the variables from the original model required with this test, and the $R^2 = 0.368$. Conduct the test and describe the serial correlation.

d. The Cochrane-Orcutt procedure is an empirical implementation of Generalized Differencing and is programmed into most econometric software. Likewise, the Prais-Winsten transformation is also programmed. Describe both and discuss important concepts implemented.

2. (25 pts.) A graduate student discussed the following model with me. He was estimating a model of the median home value for a cross-sectional and time-series sample of all counties in the U.S. over six years. His data contain a natural experiment whereby a subsidy provided by the government for insurance was substantially reduced. The model is written as

$$y_{it} = \beta_0 + \beta_1\, x_{1it} + \beta_2\, x_{2it} + (\Sigma\, \alpha_i\, D_i) + (\Sigma\, \theta_t\, D_t) + e_{it}$$

where i = 1,...,N and t = 1,...,T. The N are all counties in the U.S. and T are the number of quarterly observations for the six years. The first explanatory variable (x_{1it}) is the variable that measures the policy change. The two terms in parentheses are fixed effects by county and by quarter. The model was run with and without the second explanatory variable (x_{2it}). That variable is an index of home values in the 12 regions of the U.S. as defined by the Federal Reserve Bank. It measures the trend and cyclical nature of home values.

a. Interpret β_1 in the two versions of the model.

b. What do the θ's measure in the two versions of the model?

c. Suppose the student also considers using Generalize Least Squares and the weighting matrix is as follows

$$\Omega = \begin{bmatrix} \sigma_1^2 I_T & \cdots & 0 \\ \vdots & \ddots & \vdots \\ 0 & \cdots & \sigma_N^2 I_T \end{bmatrix}.$$

Briefly, describe the problem or problems that this specification addresses.

3. (15 pts.) You are studying an industry where the level of output is dependent on capital investments over previous years. The dependent variable is output and x_t denotes investment expenditures in year *t*. You have the following model

$$y_t = \beta_0 + \beta_1 x_{t-1} + \beta_2 x_{t-2} + \beta_3 x_{t-3} + \beta_4 x_{t-4} + z_t\alpha + e_t$$

where the term in the model after the distributed lag variables denotes other explanatory variables and their coefficients.

a. Interpret the last marginal impact precisely.

b. Construct and interpret the cumulative impact.

c. Describe your strategy for estimating this model. (Assume there are no violations of the OLS assumptions.)

4. (15 pts) One of your fellow graduate students is interested in estimating a model of an expenditure function. Your colleague has surveyed a sample of consumers, asked about expenditures, and asked about characteristics that describe their socio-economic background and values. The model is specified as follows

$$y_i = \beta_0 + \beta_1 x_{1i} + \ldots + \beta_k x_{ki} + e_i \qquad i = 1,\ldots,N.$$

However, a substantial portion of the sample revealed zero expenditure. The remainder had positive values. Your colleague was going to use OLS.

a. How can you communicate to them that OLS is biased? Your colleague suggests dropping the zero observations and using the sample with the positive expenditures. Does this address the bias problem?

b. Outline the Heckman 2-Step model and the test for bias.

5. (20 pts) Below is a simple Probit model of willingness to pay for a public good

$$z_i = \underset{(10.00)}{23.00} - \underset{(0.06)}{0.25}\, x_{1i} + \underset{(0.02)}{0.05}\, x_{2i}$$

where z_i is the latent variable measuring the choice, the actual dependent variable $y_i = 1$ if the respondent surveyed said "yes" to being willing to pay the bid amount offered and 0 otherwise, x_{1i} = the bid amount offered, and x_{2i} = income. The sample average of $y = 0.70$, $x_1 = 100$, and $x_2 = 50$. (The bid is in dollars and income is in thousands.) And $f(z) = \exp(-z^2/2)/\sqrt{2\pi}$.

a. Calculate the change in probability of saying yes given a change in the bid amount. Interpret the measure with precision.

b. What is the income where the typical respondent is more likely to say yes?

c. As opposed to making use of Probit, or Logit, can this model be estimated with OLS? Any cautions?