**AGEC5213: *ECONOMETRIC METHODS***
**Spring 2019**

**PROBLEM SET NO. 5- due on April 29, 2018**

**Part I. Autocorrelation test, GLS and MLE (10 points)**

Consider a wheat acreage model $\ln(A_t) = \beta_1 + \beta_2\ln(P_t) + e_t$ where $A_t$ was area of wheat (in thousands of hectares) sown in Oklahoma in year $t$ and $P_t$ was the price of wheat. This specification was, in fact, a simplification of a slightly more general specification; the price of wheat was measured relative to the price of Barley. Specifically, let

$W_t$ = price of in year $t$ (dollar/ton), and
$B_t$ = price of jute in year $t$ (dollar/ton).

The price that was utilized was $P_t = W_t / B_t$ . Since barley is the crop which competes with wheat for the use of the land, it is the price of wheat *relative* to the price of barley that affects farmers' decisions about how much wheat to plant. Data on $A_t$ , $W_t$ and $B_t$ appear in the file, HW5-DATA1.xls

(a) Consider the model
$$\ln(A_t) = \beta_1 + \beta_2\ln(W_t) + \beta_3\ln(B_t) + e_t$$
Give interpretations for $\beta_2$ and $\beta_3$. Show that this model is equivalent to the original model if $\beta_2 = -\beta_3$.

(b) Estimate the model in part (a) using least squares and test for the presence of autocorrelated errors using the DW test at the 5% significance level.

(c) Re-estimate the model assuming the existence of AR(1) errors (GLS). Are there any noticeable changes in the results?

(d) Using the estimation results from (b) and (c), test $H_0$: $\beta_2 = -\beta_3$ against $H_1$: $\beta_2 \neq -\beta_3$ at the 5% significance level. Do hypothesis test results differ between (b) and (c)?

(e) Predict $\ln(A)$ for the next two years assuming that $W_{T+1} = W_{T+2} = 500$ and $B_{T+1} = B_{T+2} = 500$.

**Part II. Two-Stage Least Square Estimation (5 points)**

Y K L P R W

Consider the following production functions as:

$$\ln(Y_t) = \beta_1 + \beta_2 \ln(K_t) + \beta_3 \ln(L_t) + e_{1t} \qquad (1)$$
$$\ln(K_t) = \alpha_1 + \alpha_2 \ln(P_t) + \alpha_3 \ln(Y_t) + \alpha_4 \ln(R_t) + e_{2t} \qquad (2)$$
$$\ln(L_t) = \lambda_1 + \lambda_2 \ln(P_t) + \lambda_3 \ln(Y_t) + \lambda_4 \ln(W_t) + e_{3t} \qquad (3),$$

where $Y_t$ , $K_t$ and $L_t$ are output, capital input, and labour input, and $P_t$ , $R_t$ and $W_t$ are corresponding prices. Given that $Y_t$ , $K_t$ and $L_t$ are simultaneously determined by equations (1), (2) and (3), and $P_t$ , $R_t$ and $W_t$ are determined from outside, it seems appropriate to treat the three equations as a simultaneous system where $Y_t$ , $K_t$ and $L_t$ are the endogenous variables and $P_t$ , $R_t$ and $W_t$ are exogenous variables. Data for this example (23 observations) are in the file *HW5-DATA2*

Y = output
K = Capital input
L = labor input

P = Price output.
R = Price of capital input.
W = price of labor input.

(a) Is the production function (1) identified?
(b) Find OLS estimates of the production function, and comment the problem of OLS.
(c) Find two stage least squares estimates of $\beta_2$ and $\beta_3$. Comment on the results.

**Part III. Instrumental Variable/Two-Stage Least Square Estimation (5 points)**

Consider a production function for local beer production as:

$$Y_t = \beta_1 + \beta_2 mgt_t + \beta_3 cap_t + \beta_4 lab_t + e_{1t},$$

where $y_t$ is an index of beer output for *t-th* brewery, taking into account both quantity and quality, $mgt_t$, is a variable reflecting the efficiency of management, $cap_t$ and $lab_t$ are indices of capital input and labor inputs. Because Kelly cannot get data an management efficiency, $mgt_t$, she collects data on the number of years of experience on the brewery business ($xpert_t$) of each brewery manager and uses that variable in place of $mgt_t$. Data for this example (75 observations) are in the file *HW5-DATA3*

(a) Estimate the equation using OLS.
(b) Estimate the instrumental variable/2SLS with instruments age, cap, lab, trend, and trend2, and compare the results with OLS results.
(c) Run Hausman test to check on the validity of the instrumental variables.