

CHUKA



UNIVERSITY

UNIVERSITY EXAMINATIONS

**EXAMINATION FOR THE AWARD OF DEGREE OF MASTER OF
ECONOMICS**

MSEC 832: ECONOMETRICS I**STREAMS:****TIME: 3 HOURS****DAY/DATE: WEDNESDAY 06/10/2021****8.30 A.M. – 11.30 A.M.****INSTRUCTIONS****Answer question ONE and any other THREE****Question one**

a) State the Gauss-Markov Theorem. (2 marks)

b) Consider the following general linear regression model:

$$Y_i = \beta_1 x_{1i} + \beta_2 x_{2i} + \dots + \beta_k x_{ki} + e_i \quad (1.0)$$

$$I = 1, 2, \dots, N$$

$$\text{Or } Y = X\beta + e \quad (1.1)$$

Where the matrices and vectors are conventionally defined.

- i. What are the classical linear regression model assumptions in order to estimate the unknown parameters in (1.0) using OLS? (5 marks)
 - ii. Derive the ordinary least squares (OLS) estimators of β and its variance. (5 marks)
 - iii. Show that the OLS estimator is unbiased. (5 marks)
 - iv. Suppose the error terms (e) in the above the Maximum Likelihood (ML) estimators are equivalent. (5 marks)
- c) State two consequences of violating the assumptions of homoscedasticity. (2 marks)
 - d) Discuss 2 types of specification errors. (4 marks)

- e) Not all variables qualify to be used as instrumental variables. Discuss any two criteria that one must consider in selecting instrumental variables. (2 marks)

Question two

A model of production function given below was again estimated using a different sample data with 30 annual observations

$$\log y_t = \beta_1 + \beta_2 \log L_t + \beta_3 \log K_t + e_t, t = 1, 2, \dots, 30$$

The estimated regression gave the following results:

Correlation between Variables:

$$r_{\log K_t, \log L_t} = 0.91334$$

$$\log \hat{y}_t = 0.98 + 0.81 \log L_t + 0.28 \log K_t \quad R^2 = 0.76 \quad \bar{R}^2 = 0.74$$

$$(0.58) \quad (0.29) \quad (0.28) \quad \hat{\sigma} = 0.33 \quad \text{SSE} = 8.85$$

$$\text{Durbin-Waston Statistics} = 0.33 \quad \text{P-value} = 0.001$$

$$\text{Rho} = 0.77$$

$$\text{Under } H_0: \beta_2 + \beta_3 = 1, F_{1,27} = 0.67$$

- Is multicollinearity likely to be a problem? Explain (5 marks)
- Differentiate the problem of multicollinearity with the problem of model misspecification. (5 marks)
- Briefly, what are the consequences of multicollinearity on least squares estimation? (5 marks)
- Can you recommend ways on how to deal with the problem of multicollinearity? (5 marks)

Question three

- Discuss 4 problems encountered when assumptions of classical linear regression are violated and provide the remedy for each. (10 marks)
- Using data from 1988 for houses sold in Andover, Massachusetts, from Kiel and McClain (1995), the following equation relates housing price (*price*) to the distance from a recently built garbage incinerator (*dist*):

$$\log(\widehat{\text{price}}) = 9.40 + 0.312 \log(\text{dist})$$

$$n = 135 \quad R^2 = 0.162$$

- i. Interpret the coefficient on $\log(dist)$. Is the sign of this estimator what you expect it to be? (3 marks)
- ii. Do you think simple regression provides an unbiased estimator of the ceteris paribus elasticity of prices with respect to $dist$? (Think about the city's decision on where to put the incinerator.) (4 marks)
- iii. What other factors about a house affect its price? Might these be correlated with distance from the incinerator? (3 marks)

Question four

- a) Describe the specific principle and important assumptions when each of the following estimation methods is deemed appropriate to estimate the unknown parameters of (1.1).
 - i. Maximum likelihood estimation (3 marks)
 - ii. Method of moments (MM) (2 marks)
 - iii. Instrumental variable (IV) (3 marks)
 - iv. Generalized method of moments (GMM) (2 marks)

- b) Consider the regression model:

$$y = x\beta + \varepsilon \quad (4.1)$$

where y is $N \times 1$ vector of observations on the dependent variable, y :

X is $N \times K$ matrix of observations on regressors $x_1, x_2, x_3 \dots, x_k$;

β is $K \times 1$ vector of unknown parameters $\beta_1, \beta_2, \beta_3, \dots, \beta_k$; and ε is $N \times 1$ vector of random error terms with zero mean and variance $\sigma^2 I_N$

Using model in (4.1), if some elements of X are endogenous regressors, derive the Two Stage Least Squares (2SLS) estimator for the structural parameters. Denote Z as a matrix of instruments (10 marks)

Question five

- a) Make brief note on the stages of econometrics research (6 marks)

- b) Give an advantage of (i) using least squares estimation over method of moments, and (ii) using method of moments over maximum likelihood estimation. (4 marks)
- c) The table below presents data on a sample of 5 persons randomly drawn from a large firm giving their annual salaries, years of education, and years of experience with the firm they are working for.

Salary (\$'000')	(Y)	40	25	38	28	50
Years of Education (X_1)		3	6	8	10	9
Years of Education (X_2)		35	28	30	42	55

- i. If their annual salaries depended on their years of education and age, use the matrix method to fit a multiple linear regression. (5 marks)
- ii. Compute the coefficient of determination and make a comment on the results. (5 marks)