

**National University of Lesotho**  
**BA Supplementary Examinations**  
**EC4402: Applied Econometrics**

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August 2023

100 marks

3 Hours

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**Instruction:**

- Answer ALL FOUR questions

### Question 1

(a). Consider a random variable  $Y$  with the following pdf

$$f(y) = \begin{cases} \frac{3}{64}y^2(4-y) & 0 \leq y \leq 1 \\ 0 & \text{elsewhere} \end{cases}$$

- (i). Is  $f(y)$  a proper pdf? [6]
- (ii). What is  $E(Y)$ ? [7]
- (iii). What is  $\text{Var}(Y)$ ? [12]

### Question 2

(a). Suppose you are given the following model of a data sampling process:

$$y = \beta_1 + \beta_2 x_{2i} + \varepsilon_i$$

where

$$\varepsilon_i \stackrel{iid}{\sim} N(0, 1)$$

and you are given the following empirical information:  $Y = \begin{bmatrix} 9 \\ 6 \\ 8 \\ 10 \\ 9 \end{bmatrix}$  and  $X = \begin{bmatrix} 1 & 2 \\ 1 & 1 \\ 1 & 2 \\ 1 & 2 \\ 1 & 1 \end{bmatrix}$

Estimate  $\beta_1$  and  $\beta_2$  by OLS.

[25]

### Question 3

Suppose you are trying to estimate the determinants of earnings from regular employment (i.e. not casual or informal work). Stata output from this sample is given below. The variable  $\logpay93$  is the log of monthly earnings in 1993,  $gender$  is a dummy variable equal to one if the individual is male and  $yrseeduc$  variable is the number of years of education attained.

- (a). Interpret the regression coefficients. [9]
- (b). Estimate the 95% confidence interval for these coefficients and decide which ones are significant at the five percent level? [10]
- (c). Estimate the mean of  $\logpay93$  for the estimation sample. [6]

### Question 4

Suppose we have a random sample  $x_1, x_2, \dots, x_n$  where:

- $x_i = 0$  if a randomly selected student does not own a smart phone, and
- $x_i = 1$  if a randomly selected student does own a smartphone.

Assuming that the  $x_i$  are independent Bernoulli random variables with unknown parameter  $p$ , then the probability mass function of each  $x_i$  is:

$$f(x_i|p) = p^{x_i} (1 - p)^{1-x_i}$$

for  $x_i = 0$  or  $1$  and  $0 < p < 1$

Find the maximum likelihood estimator (MLE) of  $p$ , the proportion of students who own a smart phone. (NB: Show all necessary steps) [25]

## Appendix

### Information for Question 3:

```
. reg logpay93 gender yrseduc age age2 if estimationsample==1
```

Source	SS	df	MS	Number of obs =	249
Model	93.5998135	4	23.3999534	F( 4, 244) =	58.48
Residual	97.6273961	244	.400112279	Prob > F =	0.0000
				R-squared =	0.4895
				Adj R-squared =	0.4811
Total	191.22721	248	.771077458	Root MSE =	.63254

logpay93	Coef.	Std. Err.
gender	.5577941	.0829809
yrseduc	.1626074	.0114353
age	.0681478	.0285284
age2	-.0005143	.0003618
_cons	4.00928	.5500084

```
. summ gender yrseduc age age2 if estimationsample==1
```

Variable	Obs	Mean	Std. Dev.	Min	Max
gender	249	.5943775	.4920011	0	1
yrseduc	249	5.534137	3.752397	0	14
age	249	37.50602	9.44642	19	67
age2	249	1495.578	748.1414	361	4489