CNATIONAL UNIVERSITY OF LESOTHO

B.A SUPPLEMENTARY EXAMINATIONS

EC3305: INTRODUCTORY ECONOMETRICS I

AUGUST 2023	**100 MARKS**	**3 HOURS**

INSTRUCTION:

Answer **ANY four** Questions

Question 1

a. Regression analysis can be used to test whether the market efficiently uses information in valuing stocks. For concreteness, let return be the total return from holding a firm's stock over the four-year period from the end of 1990 to the end of 1994. The efficient market hypothesis says that these returns should not be systematically related to the information known in 1990. If firm characteristics known at the beginning of the period help to predict stock returns, then we could use this information in choosing stocks. For 1990, let dkr be a firm's debt-to-capital ratio, let eps denote the earnings per share, let $netinc$ denote net income, and let salary denote total compensation for the CEO.

The following equation was estimated:

$$\widehat{return} = -14.37 + 0.321\ dkr + 0.043\ eps - 0.0051\ netinc + 0.0035\ salary$$
$$\quad (6.89) \quad (0.201) \quad (0.078) \quad (0.0047) \quad (0.0022)$$
$$n = 142, \quad R^2 = 0.0395.$$

i. Test whether the explanatory variables are jointly significant at the 5% level. Is any explanatory variable individually significant? **[6]**

ii. Now, re-estimate the model using the log form for $netinc$ and salary:

$$\widehat{return} = -36.30 + 0.327\ dkr + 0.069\ eps - 4.74 \log(netinc) + 7.24 \log(salary)$$
$$\quad (39.37) \quad (0.203) \quad (0.080) \quad (3.39) \quad (6.31)$$
$$n = 142, \quad R^2 = 0.0330.$$

Do any of your conclusions from part (i.) change? **[4]**

b. Consider the estimated equation, which can be used to study the effects of skipping class on college GPA:

$$\widehat{colGPA} = 1.39 + 0.412\ hsGPA + 0.015\ ACT - 0.083\ skipped$$
$$\quad (0.33) \quad (0.094) \quad (0.011) \quad (0.026)$$
$$n = 141, \quad R^2 = 0.234.$$

i. Using the standard normal approximation, find the 95% confidence interval for β_{hsGPA}. **[5]**

ii. Can you reject the hypothesis $H_0: \beta_{hsGPA} = 0.4$ against the two-sided alternative at the 5% level? Explain. **[5]**

iii. Can you reject the hypothesis $H_0: \beta_{hsGPA} = 1$ against the two-sided alternative at the 5% level? Explain. **[5]**

Question 2

a. Differentiate between applied econometrics and theoretical econometrics. **[3]**
b. Differentiate between experimental and observational data. **[4]**
c. Explain and give an example of the three types of observational data. **[6]**
d. Define and explain six classical assumptions of the regression model. **[12]**

Question 3

a. Given the following joint density function,

$$f(x,y) = \begin{cases} \frac{3}{16}y^2x, & for\ 0 < x < 2, 0 \leq y \leq 2 \\ 0, & otherwise \end{cases}$$

i. Find the conditional joint density function for x given y **[2]**

ii. Find the conditional joint density function for y given x **[2]**

iii. For $f(x,y) = \frac{3}{16}y^2x$, can you say x and y are independent? Explain. **[3]**

b. Consider the following joint probability table,

Table 1: Joint Probability Table

Y	*X*			*f(Y)*
	1	*2*	*3*	
1	0.25	0	0.10	0.35
2	0.05	0.05	0.10	0.20
3	0	0.05	0.20	0.25
4	0	0	0.20	0.20
f(X)	0.30	0.10	0.60	1.00

i. Calculate the covariance of X and Y **[5]**

ii. Find the correlation coefficient $Corr(X,Y)$ **[8]**

c. Consider a basketball player shooting two free throws. Let X be the Bernoulli random variable equal to one if she or he makes the first free throw, and zero otherwise. Let Y be a Bernoulli random variable equal to one if he or she makes the second free throw.

i. Suppose that he or she is an 80% free throw shooter so that $P(X = 1) = P(Y = 1) = 0.80$. What is the probability of the player making both free throws? **[2]**

ii. Now assume the following conditional densities, which means that the probability of the player making the second free throw depends on whether the first free throw was made. Thus, if the first free throw is made, the chance of making the second is 0.85; if the first free throw is missed, the chance of making the second is 0.70.

$$f_{Y|X}(1|1) = .85, f_{Y|X}(0|1) = .15$$

$$f_{Y|X}(1|0) = .70, f_{Y|X}(0|0) = .30.$$

Assume further that the probability of making the first free throw is 0.8, that is, $P(X = 1) = 0.8$. What is the probability of the player making both free throws? **[3]**

Question 4

a. The height of adult males is Normally distributed with mean height $\mu = 174\ cm$ and standard deviation $\sigma = 9.6\ cm$.

   i. Let $\boldsymbol{x}$ represent the height of adult males; What is the probability that a randomly selected man is taller than 180 cm? **[5]**

   ii. Suppose that, from the population of adult males, a random sample of size $n = 36$ is taken, which yielded an average height of 180 cm. Find the 95% confidence interval for μ and interpret. **[5]**

b. The following table contains eight college students' ACT scores and their GPA (grade point average). The grade point average is based on a four-point scale and has been rounded to one digit after the decimal.

Table 2: College students' ACT scores and their GPA

Student	*GPA*	*ACT*
1	2.8	21
2	3.4	24
3	3.0	26
4	3.5	27
5	3.6	29
6	3.0	25
7	2.7	25
8	3.7	30

   i. Estimate the impact of ACT on GPA using OLS. Interpret your results. **[7]**

   ii. How much of the variation in GPA for these eight students is explained by ACT? Explain. **[8]**

Question 5

a. From the estimation of a demand equation for the gasoline market (with n=36) and standard errors in parenthesis

$$\ln(G/pop) = -7.737 - 0.0591\, lnPG + 1.3733\, lnincome - 0.1268\, lnPnc - 0.1187 lnPuc$$
$$(0.6749) \quad (0.03248) \quad (0.075628) \quad (0.12699) \quad (0.081337)$$

   i. Find the 95% critical value from the t-distribution. **[4]**

   ii. Find the 95% confidence interval for β_{inc}. **[6]**

   iii. Is demand for gasoline income inelastic? **[10]**

b. Let X_1, X_2, and X_3 be the numbers of small, medium, and large pizzas, respectively, sold during the day at Mountain Lounge. These are random variables with expected values $E(X_1) = 25$, $E(X_2) = 57$, and $E(X_3) = 40$. The prices of the small, medium, and large pizzas are M5.50, M7.60, and M9.15. What is the expected revenue from sales of pizza? **[5]**

Question 6

The following model is a simplified version of the multiple regression model used by Biddle and Hamermesh (1990) to study the trade-off between time spent sleeping and working and to look at other factors affecting sleep:

$$sleep = \beta_0 + \beta_1 totwrk + \beta_2 educ + \beta_3 age + u$$

where $sleep$ and $totwrk$ (total work) are measured in minutes per week and $educ$ and age are measured in years.

a. If adults trade off sleep for work, what is the sign of β_1? **[2]**
b. What signs do you think β_2 and β_3 will have? **[3]**
c. Given the estimated equation is;

$$\widehat{sleep}_i = 3{,}638.25 - 0.148\, totwrk_i - 11.13\, educ_i + 2.20\, age_i$$

$$n = 706, \qquad R^2 = 0.113.$$

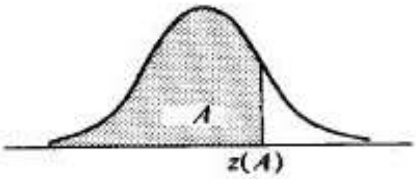
If someone works five more hours per week, by how many minutes is sleep predicted to fall? Is this a large trade-off? **[6]**

d. Discuss the sign and magnitude of the estimated coefficient on $educ$. **[5]**
e. Would you say $totwrk$, $educ$, and age explain much of the variation in $sleep$? **[3]**
f. What other factors might affect the time spent sleeping? Are these likely to be correlated with $totwrk$? **[6]**

Normal Distribution

Table C-1. Cumulative Probabilities of the Standard Normal Distribution.

Entry is area A under the standard normal curve from $-\infty$ to $z(A)$



z	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09
.0	.5000	.5040	.5080	.5120	.5160	.5199	.5239	.5279	.5319	.5359
.1	.5398	.5438	.5478	.5517	.5557	.5596	.5636	.5675	.5714	.5753
.2	.5793	.5832	.5871	.5910	.5948	.5987	.6026	.6064	.6103	.6141
.3	.6179	.6217	.6255	.6293	.6331	.6368	.6406	.6443	.6480	.6517
.4	.6554	.6591	.6628	.6664	.6700	.6736	.6772	.6808	.6844	.6879
.5	.6915	.6950	.6985	.7019	.7054	.7088	.7123	.7157	.7190	.7224
.6	.7257	.7291	.7324	.7357	.7389	.7422	.7454	.7486	.7517	.7549
.7	.7580	.7611	.7642	.7673	.7704	.7734	.7764	.7794	.7823	.7852
.8	.7881	.7910	.7939	.7967	.7995	.8023	.8051	.8078	.8106	.8133
.9	.8159	.8186	.8212	.8238	.8264	.8289	.8315	.8340	.8365	.8389
1.0	.8413	.8438	.8461	.8485	.8508	.8531	.8554	.8577	.8599	.8621
1.1	.8643	.8665	.8686	.8708	.8729	.8749	.8770	.8790	.8810	.8830
1.2	.8849	.8869	.8888	.8907	.8925	.8944	.8962	.8980	.8997	.9015
1.3	.9032	.9049	.9066	.9082	.9099	.9115	.9131	.9147	.9162	.9177
1.4	.9192	.9207	.9222	.9236	.9251	.9265	.9279	.9292	.9306	.9319
1.5	.9332	.9345	.9357	.9370	.9382	.9394	.9406	.9418	.9429	.9441
1.6	.9452	.9463	.9474	.9484	.9495	.9505	.9515	.9525	.9535	.9545
1.7	.9554	.9564	.9573	.9582	.9591	.9599	.9608	.9616	.9625	.9633
1.8	.9641	.9649	.9656	.9664	.9671	.9678	.9686	.9693	.9699	.9706
1.9	.9713	.9719	.9726	.9732	.9738	.9744	.9750	.9756	.9761	.9767
2.0	.9772	.9778	.9783	.9788	.9793	.9798	.9803	.9808	.9812	.9817
2.1	.9821	.9826	.9830	.9834	.9838	.9842	.9846	.9850	.9854	.9857
2.2	.9861	.9864	.9868	.9871	.9875	.9878	.9881	.9884	.9887	.9890
2.3	.9893	.9896	.9898	.9901	.9904	.9906	.9909	.9911	.9913	.9916
2.4	.9918	.9920	.9922	.9925	.9927	.9929	.9931	.9932	.9934	.9936
2.5	.9938	.9940	.9941	.9943	.9945	.9946	.9948	.9949	.9951	.9952
2.6	.9953	.9955	.9956	.9957	.9959	.9960	.9961	.9962	.9963	.9964
2.7	.9965	.9966	.9967	.9968	.9969	.9970	.9971	.9972	.9973	.9974
2.8	.9974	.9975	.9976	.9977	.9977	.9978	.9979	.9979	.9980	.9981
2.9	.9981	.9982	.9982	.9983	.9984	.9984	.9985	.9985	.9986	.9986
3.0	.9987	.9987	.9987	.9988	.9988	.9989	.9989	.9989	.9990	.9990
3.1	.9990	.9991	.9991	.9991	.9992	.9992	.9992	.9992	.9993	.9993
3.2	.9993	.9993	.9994	.9994	.9994	.9994	.9994	.9995	.9995	.9995
3.3	.9995	.9995	.9995	.9996	.9996	.9996	.9996	.9996	.9996	.9997
3.4	.9997	.9997	.9997	.9997	.9997	.9997	.9997	.9997	.9997	.9998

TABLE G.2 Critical Values of the *t* Distribution

	Significance Level				
1-Tailed:	.10	.05	.025	.01	.005
2-Tailed:	.20	.10	.05	.02	.01
Degrees of Freedom					
1	3.078	6.314	12.706	31.821	63.657
2	1.886	2.920	4.303	6.965	9.925
3	1.638	2.353	3.182	4.541	5.841
4	1.533	2.132	2.776	3.747	4.604
5	1.476	2.015	2.571	3.365	4.032
6	1.440	1.943	2.447	3.143	3.707
7	1.415	1.895	2.365	2.998	3.499
8	1.397	1.860	2.306	2.896	3.355
9	1.383	1.833	2.262	2.821	3.250
10	1.372	1.812	2.228	2.764	3.169
11	1.363	1.796	2.201	2.718	3.106
12	1.356	1.782	2.179	2.681	3.055
13	1.350	1.771	2.160	2.650	3.012
14	1.345	1.761	2.145	2.624	2.977
15	1.341	1.753	2.131	2.602	2.947
16	1.337	1.746	2.120	2.583	2.921
17	1.333	1.740	2.110	2.567	2.898
18	1.330	1.734	2.101	2.552	2.878
19	1.328	1.729	2.093	2.539	2.861
20	1.325	1.725	2.086	2.528	2.845
21	1.323	1.721	2.080	2.518	2.831
22	1.321	1.717	2.074	2.508	2.819
23	1.319	1.714	2.069	2.500	2.807
24	1.318	1.711	2.064	2.492	2.797
25	1.316	1.708	2.060	2.485	2.787
26	1.315	1.706	2.056	2.479	2.779
27	1.314	1.703	2.052	2.473	2.771
28	1.313	1.701	2.048	2.467	2.763
29	1.311	1.699	2.045	2.462	2.756
30	1.310	1.697	2.042	2.457	2.750
40	1.303	1.684	2.021	2.423	2.704
60	1.296	1.671	2.000	2.390	2.660
90	1.291	1.662	1.987	2.368	2.632
120	1.289	1.658	1.980	2.358	2.617
∞	1.282	1.645	1.960	2.326	2.576

TABLE G.3a 10% Critical Values of the *F* Distribution

Denominator Degrees of Freedom	Numerator Degrees of Freedom									
	1	2	3	4	5	6	7	8	9	10
10	3.29	2.92	2.73	2.61	2.52	2.46	2.41	2.38	2.35	2.32
11	3.23	2.86	2.66	2.54	2.45	2.39	2.34	2.30	2.27	2.25
12	3.18	2.81	2.61	2.48	2.39	2.33	2.28	2.24	2.21	2.19
13	3.14	2.76	2.56	2.43	2.35	2.28	2.23	2.20	2.16	2.14
14	3.10	2.73	2.52	2.39	2.31	2.24	2.19	2.15	2.12	2.10
15	3.07	2.70	2.49	2.36	2.27	2.21	2.16	2.12	2.09	2.06
16	3.05	2.67	2.46	2.33	2.24	2.18	2.13	2.09	2.06	2.03
17	3.03	2.64	2.44	2.31	2.22	2.15	2.10	2.06	2.03	2.00
18	3.01	2.62	2.42	2.29	2.20	2.13	2.08	2.04	2.00	1.98
19	2.99	2.61	2.40	2.27	2.18	2.11	2.06	2.02	1.98	1.96
20	2.97	2.59	2.38	2.25	2.16	2.09	2.04	2.00	1.96	1.94
21	2.96	2.57	2.36	2.23	2.14	2.08	2.02	1.98	1.95	1.92
22	2.95	2.56	2.35	2.22	2.13	2.06	2.01	1.97	1.93	1.90
23	2.94	2.55	2.34	2.21	2.11	2.05	1.99	1.95	1.92	1.89
24	2.93	2.54	2.33	2.19	2.10	2.04	1.98	1.94	1.91	1.88
25	2.92	2.53	2.32	2.18	2.09	2.02	1.97	1.93	1.89	1.87
26	2.91	2.52	2.31	2.17	2.08	2.01	1.96	1.92	1.88	1.86
27	2.90	2.51	2.30	2.17	2.07	2.00	1.95	1.91	1.87	1.85
28	2.89	2.50	2.29	2.16	2.06	2.00	1.94	1.90	1.87	1.84
29	2.89	2.50	2.28	2.15	2.06	1.99	1.93	1.89	1.86	1.83
30	2.88	2.49	2.28	2.14	2.05	1.98	1.93	1.88	1.85	1.82
40	2.84	2.44	2.23	2.09	2.00	1.93	1.87	1.83	1.79	1.76
60	2.79	2.39	2.18	2.04	1.95	1.87	1.82	1.77	1.74	1.71
90	2.76	2.36	2.15	2.01	1.91	1.84	1.78	1.74	1.70	1.67
120	2.75	2.35	2.13	1.99	1.90	1.82	1.77	1.72	1.68	1.65
∞	2.71	2.30	2.08	1.94	1.85	1.77	1.72	1.67	1.63	1.60

TABLE G.3b 5% Critical Values of the *F* Distribution

Denominator Degrees of Freedom	Numerator Degrees of Freedom									
	1	2	3	4	5	6	7	8	9	10
10	4.96	4.10	3.71	3.48	3.33	3.22	3.14	3.07	3.02	2.98
11	4.84	3.98	3.59	3.36	3.20	3.09	3.01	2.95	2.90	2.85
12	4.75	3.89	3.49	3.26	3.11	3.00	2.91	2.85	2.80	2.75
13	4.67	3.81	3.41	3.18	3.03	2.92	2.83	2.77	2.71	2.67
14	4.60	3.74	3.34	3.11	2.96	2.85	2.76	2.70	2.65	2.60
15	4.54	3.68	3.29	3.06	2.90	2.79	2.71	2.64	2.59	2.54
16	4.49	3.63	3.24	3.01	2.85	2.74	2.66	2.59	2.54	2.49
17	4.45	3.59	3.20	2.96	2.81	2.70	2.61	2.55	2.49	2.45
18	4.41	3.55	3.16	2.93	2.77	2.66	2.58	2.51	2.46	2.41
19	4.38	3.52	3.13	2.90	2.74	2.63	2.54	2.48	2.42	2.38
20	4.35	3.49	3.10	2.87	2.71	2.60	2.51	2.45	2.39	2.35
21	4.32	3.47	3.07	2.84	2.68	2.57	2.49	2.42	2.37	2.32
22	4.30	3.44	3.05	2.82	2.66	2.55	2.46	2.40	2.34	2.30
23	4.28	3.42	3.03	2.80	2.64	2.53	2.44	2.37	2.32	2.27
24	4.26	3.40	3.01	2.78	2.62	2.51	2.42	2.36	2.30	2.25
25	4.24	3.39	2.99	2.76	2.60	2.49	2.40	2.34	2.28	2.24
26	4.23	3.37	2.98	2.74	2.59	2.47	2.39	2.32	2.27	2.22
27	4.21	3.35	2.96	2.73	2.57	2.46	2.37	2.31	2.25	2.20
28	4.20	3.34	2.95	2.71	2.56	2.45	2.36	2.29	2.24	2.19
29	4.18	3.33	2.93	2.70	2.55	2.43	2.35	2.28	2.22	2.18
30	4.17	3.32	2.92	2.69	2.53	2.42	2.33	2.27	2.21	2.16
40	4.08	3.23	2.84	2.61	2.45	2.34	2.25	2.18	2.12	2.08
60	4.00	3.15	2.76	2.53	2.37	2.25	2.17	2.10	2.04	1.99
90	3.95	3.10	2.71	2.47	2.32	2.20	2.11	2.04	1.99	1.94
120	3.92	3.07	2.68	2.45	2.29	2.17	2.09	2.02	1.96	1.91
∞	3.84	3.00	2.60	2.37	2.21	2.10	2.01	1.94	1.88	1.83