MANICALAND STATE UNIVERSITY OF APPLIED SCIENCES

FACULTY OF AGRI-BUSINESS & COMMERCE

DEPARTMENT OF AGRICULTURAL ECONOMICS & DEVELOPMENT

MODULE: BIOMETRY

CODE: HACE213

SESSIONAL EXAMINATIONS
OCTOBER 2021

DURATION: 3 HOURS

EXAMINER: DR W. GOVERE

INSTRUCTIONS

1. Answer **All** in Section A
2. Answer **three** questions in Section B.
3. Start a new question on a fresh page
4. Total marks 100

Additional material(s): *Non-programmable electronic scientific calculator, Graph paper, Statistical tables.*

SECTION A (ANSWER ALL QUESTIONS) [40 MARKS]

A1.

Dr Govere was asked to present the performance of his Engineering Mathematics V class in the preliminary examination. There are 40 students in this class. The following are the test scores of his class:

34	42	20	50	17	9	43	34
50	18	35	43	50	23	35	11
37	38	38	39	39	38	39	38
24	29	25	26	28	27	44	44
49	48	46	18	45	46	46	45

(**a**). Construct a numerical frequency table of the test scores by using the classes $9 - 14, \ 15 - 20, \ 21 - 26, \ ...$.
(**b**). Draw a cumulative frequency curve for the data.
(**c**). Using the frequency distribution, calculate the:
   i.   mean,
   ii.   standard deviation,
   iii. median.
   iv. the coefficient of skewness, and interpret.

[3, 4, 3, 4, 3, 2]

A2

a) For each random variable defined here, describe the set of possible values for the variable, and state whether the variable is discrete or continuous.
   i. X = the number of unbroken eggs in a randomly chosen standard egg carton
   ii. U = the total number of coin tosses required for three individuals to obtain a match (*HHH* or *TTT*).

b) Consider the following contingency table:

	Right-handed	Left-handed	TOTAL
Male	0.41	0.08	0.49
Female	0.45	0.06	a
TOTAL	b	0.14	c

i.   Find the values of a, b and c.
ii.   Find the probability that a randomly selected person is
      a) Right-handed given that he is a male;
      b) a female given that she is left-handed
iii.   Are the events being a female and being left handed independent?
      Justify.

[1, 1, 3, 2, 2, 2]

A3

The table below shows the distribution of the sales ($) made by vendors at Sakubva Green market one particular morning:

Sales(x)	40 -60	61 - 80	81 - 100	101 - 150	151 - 200	201-250
Frequency, f	8	5	15	9	13	6

Estimate the   i)   average sales,
               ii) modal sales, and
               iii) median sales

[3, 3, 3]

SECTION B (ANSWER ANY THREE QUESTIONS) [60 MARKS]

B4

(a) The number of wooden chairs made per month by a backyard carpentry shop is a random variable with the following probability distribution.

X	19	20	21	22
$P(X = x)$	0.4	0.25	0.2	0.15

(i). What is the most probable number of chairs produced per month?

(ii). Find the probability that the number of chairs that will be made next month is at least 20.

(iii). Find the probability that the number of chairs produced per month is at most 21.

(iv). Find the expected number of chairs produced per month.

(v). Suppose that the carpentry shop incurs fixed monthly costs of $100 and an additional construction cost of $5 per chair. Find the expected monthly cost of the operation.

(b) In order to find out if males preferred a certain political party compared to women, the following data were obtained from a sample of 1718 eligible voters.

	Party A	Party B	Party C
Male	313	124	391
Female	344	158	388

Test at 5% significance level whether there are differences in the way that males and females vote.

[2, 2, 2, 4, 2, 8]

B5

a) A researcher conducted an experiment to compare two room temperatures for doing a particular type of work. There were 6 rooms available for experimentation. Three randomly selected rooms were set at 60 degrees and the other three were set at 72 degrees. Five workers were put in each room and various measurements were made on each relative to their work performance.

    i.   What are the treatments in this experiment?
    ii.   What are the experimental units?
    iii.   How many replications are there for each treatment?
    iv.   Provide analysis of variance table outlining ONLY the sources of variability and the degrees of freedom.

b) A chemical supply company currently has in stock 100 kg of a certain chemical, which it sells to customers in 5-kg lots. Let X = the number of lots ordered by a randomly chosen customer, and suppose that X has probability mass function (pmf).

x	1	2	3	4
$p(x)$	0.2	0.4	0.3	0.1

Compute $E(X)$ and $Var(X)$.

c) During a Biometry lecture, John receives, on average 7 WhatsApp messages in a 2-hour period. What is the probability that the student will receive exactly 24 WhatsApp messages in an 8-hour period?

[2, 2, 2, 3, 3, 4, 4]

B6

An Agricultural Economist conducted a study of determinants of beginning salary of employees at a local parastatal farm. The following are results of the study.

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.850[a]	.722	.719	1669.215

a. Predictors: (Constant), gender of employees, age of employee (yrs), job category, education level in years, work experience in months

ANOVA[b]

Model	Sum of Squares	df	Mean Square	F	Sig.
1 Regression	3.384E9	5	6.768E8	242.916	.000[a]
Residual	1.304E9	468	2786279.848		
Total	4.688E9	473			

a. Predictors: (Constant), gender of employees, age of employee (yrs), job category, education level in years, work experience in months

b. Dependent Variable: beginning salary

Coefficients^a

Model		B	Std. Error	Beta	t	Sig.
		Unstandardized Coefficients		**Standardized Coefficients**		
1	(Constant)	-1691.162	574.268		-2.945	.003
	age of employee (yrs)	46.933	11.569	.176	4.057	.000
	education level in years	353.379	33.765	.324	10.466	.000
	work experience in months	-17.141	16.232	-.047	-1.056	.292
	job category	1276.973	64.509	.570	19.795	.000
	gender of employees	-1114.159	180.429	-.176	-6.175	.000

a. Dependent Variable: beginning
salary

(**a**) Comment on the strength of the relationship depicted by the predictor variable and independent variables.

(**b**) Write the regression equation from the given output.

(**c**) State the coefficient of determination and interpret its value.

(**d**) Describe the impact of each factor on beginning salaries.

(**e**) Which factor has the greatest influence on beginning salaries of employees at this parastatal? Justify your answer.

(**f**) Conduct an F-test for the overall significance of the regression model.

[2, 2, 3, 5, 3, 5]

B7

In an experiment aimed at inducing growth, 20 plants were grouped into twenty pairs so that two members of each pair were as similar as possible. One plant of each pair was chosen randomly and treated; the other was left as a control. The increase in height (in centimeters) of plants over a two-week period were:

Treated plant	Control plant
7	4
10	6
9	10
8	8
7	5
6	3
8	10
9	8
12	8
13	10

(a) For each pair calculate the difference (d_i) in growth between treated plant and the control plant.

(b) Calculate the mean $(\bar{d})$ of the ten differences in (a)

(c) Calculate the variance $(S_d{}^2)$ of the sample of ten differences in (a)

(d) Calculate the standard error of the mean, $(\bar{d})$.

(e) Test the hypothesis: $H_0: \mu_D = \mu_T - \mu_C = 0$ versus: $H_0: \mu_D \neq 0$ where μ_T and μ_C are the mean induced growth for a treated and untreated plant respectively. Use $\alpha = 0.05$.

(f) Why is it necessary to take differences of observations in this analysis?

(g) Calculate a 95% confidence interval for μ_D .

[3, 2, 3, 2, 5, 2, 3]

END OF QUESTION PAPER