FACULTY	**HEALTH SCIENCES AND VETERINARY MEDICINE**		
DEPARTMENT	**VETERINARY PRECLINICAL STUDIES**		
SUBJECT	**BIOMETRY**		
SUBJECT CODE	**V3632EB**		
DATE	**OCTOBER/NOVEMBER 2024**		
DURATION	**3 HOURS**	**MARKS**	**100**

OCTOBER /NOVEMBER FIRST OPPORTUNITY EXAMINATION

QUESTION PAPER

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INSTRUCTIONS

1. While most of the marks will be awarded for a clear and correct and clear method, candidates are advised to ensure that their answers are accurate as well.
2. Number your questions correctly and clearly.
3. This paper consists of **7** pages excluding the cover page.
4. Answer **ALL** Questions in Section A and **ANY THREE** Questions in Section B
5. If the degree of accuracy is not specified, answers must be given to 3 decimal places and
6. Unless specified in a part question, all statistical tests must be performed at a 5% significance level

ADDITIONAL MATERIALS

1. Non-programmable scientific calculators may be used during the examination.
2. List of formulas containing statistical tables to be provided to candidates.

SECTION A [40 marks]

ANSWER ALL QUESTIONS IN THIS SECTION

Question 1 **[20]**

A feeding trial was conducted to study the effect of a bush-based feed diet on the weight gain of 12 sheep of four breeds (Damara, Dorper, Swakara, Crossbred). She recorded the weight of each animal before and 90 days after the commencement of the diet. The data was stored in Microsoft Excel (Table 1) and coded. The breed was coded as follows: 1= Damara, 2 = Swakara, 3 = Dorper and 4 = Crossbred. Patients with and without arthritis were coded as 1 and 0, respectively. Males and Females were coded as 1 and 0, respectively. Diet A is the commercial diet and Diet B is the bush-based diet. In addition, the temperatures of the sheep (°C) were recorded at the beginning of the study.

Table 1: Characteristics of Sheep in the Feeding Trial

ID	Age (weeks)	Sex	Breed	Diet	Initial weight (kg)	Temperature (°C)
1	41	0	1	A	12.6	39.8
2	35	0	2	A	15.6	38.4
3	36	0	3	A	16.8	38.4
4	30	0	4	A	17.6	35.1
5	21	1	1	A	15.0	37.7
6	28	1	2	A	11.1	36.6
7	28	0	3	B	16.7	38.4
8	34	0	4	B	14.5	32.3
9	28	1	1	B	17.5	34.1
10	35	0	2	B	16.7	33.4
11	31	1	3	B	19.9	37.1
12	27	1	4	B	14.1	38.6

(a) Complete the table below for the types of variables in the study (5)

Variable	Data type (qualitative/quantitative)	Measurement scale (nominal/ordinal/interval/ration0
Age	quantitative	(i)
Breed	(ii)	(iii)
Weight	(iv)	ratio
Temperature	quantitative	(v)

(b) State one type of graph can be used to summarise the distribution of the study animals according to their breed (1)

(c) Find the mode for the temperature (1)

(d) Which statistical method can compare the weight across diet, ignoring all the other variables? (1)

(e) Calculate the coefficient of variation for the animals' initial weight (7)

(f) Draw a box and whisker plot for the temperature and comment on the skewness of the data (6)

Question 2 **[10]**

A study was conducted to test the relationship between farm yearly income (N$000) and yearly expenditure (N$000) for 50 communal farms in the Omaheke Region of Namibia. A simple linear regression model was fitted to data collected through a survey to estimate the relationship between income and expenditure and the model summary is shown in the computer output printout is shown below:

Summary output		
Observations	50	
R Square	0.845	
	Coefficients	*Std Error*
Intercept	11.713	5.322
Independent variable	0.247	0.043
$T_{calculated}$	1.677	

Use the output provided to answer the following questions.

(a) Determine the dependent and independent variables for this model (2)

(b) Determine the regression equation to predict the dependent variable from the independent variables, clearly defining your model variables (3)

(c) Interpret the slope coefficient in relation to the problem of interest. (2)

(d) Determine the yearly expenditure for a farm earning N$ 120 000 a year. (1)

(e) Interpret the coefficient of determination and comment on the appropriateness of the simple linear regression in the above context. (2)

Question 3 **[10]**

(a) Clearly define the following terms or phrases as used in probability theory:

(i) Sample space (S) (1)

(ii) Mutually exclusive events (2)

(b) Events A and B are such that P(A) = 0.45, P(B) = 0.35 and P(A U B) = 0.7.

(i) Find the value of $P(A \cap B)$ (without assuming independence). (2)

(ii) Explain why events A and B are not independent. (1)

(iii) Find the value of P(A|B). (2)

(c) State which probability distribution is suitable for modelling each of the following random variables:

(i) (In a series of Bernoulli trials (Independent trials with constant probability p of a success), the random variable X is the number of trials until the first success. (1)

(ii) Each sample of water has a 10% chance of containing a particular organic pollutant. Assume that the samples are independent with regard to the presence of the pollutant. In the next 18 samples, the random variable Y is the number of samples that contain the pollutant. (1)

SECTION B [60 marks]

ANSWER ANY THREE QUESTIONS IN THIS SECTION

Question 4 **[20]**

Students measured the heart girth of goats housed at the Neudamm Farm Small Stock section during a data collection practical. They were tasked with summarising their findings in a frequency distribution table. Their results are summarised in the Table 2.

Table 2: Heart girths circumference for sampled Neudamm Campus goats

Heart girth circumference (cm)	Number of goats
64 – 65	3
66 – 67	6
68 – 69	15
70 – 71	12
72 – 73	4

(a) Construct a cumulative less-than-cumulative frequency distribution and draw an Ogive. (6)

(b) Calculate the mean and mode of the data and interpret each measure. (8)

(c) Calculate the standard deviation of the sample. (4)

(d) Calculate the coefficient of variation and interpret it. (2)

Question 5 **[20]**

(a) What does the significance level (α) mean in hypothesis testing? (2)

(b) A study aimed to determine the effect of a new dietary supplement on weight gain in cattle. Two groups of cattle were compared: 10 cattle were fed the new dietary supplement, 8 cattle were fed the standard diet. Weight gain (in kilograms) was recorded for each cattle over a specified period. The results are given in Table 3.

Table 3: The weight gain for cattle on the new and standard diets

New diet supplement	160	155	162	150	158	165	152	157	160	168
Standard diet	140	145	142	138	143	147	141	146		

(i) Investigate, at the 1% level of significance, the claim that the weight gain for cattle fed with the new diet supplement is higher than that of the cattle fed with the standard diet. (14)

(ii) Assume that the weight gain of the cattle fed with the new diet and standard diet come from a normally distributed population with unknown population variance, construct a 95 % confidence interval for the difference in the population mean weight gains for the cattle fed with the new diet and standard diet. (4)

Question 5 **[20]**

An Agricultural Economist used a simple linear regression model to analyze the relationship between the amount of investment in agricultural machinery (N$000) and the resulting crop yield (tons/ha). The data he collected from 10 farmers is shown in Table 4:

Table 4: Amount invested in machinery and Crop yield

Farm ID	Investment in Machinery ($000)	Crop Yield (tons/ha)
1	20	5
2	25	5.5
3	30	6
4	35	6.5
5	40	6.8
6	45	7
7	50	7.5
8	55	8
9	60	8.3
10	65	8.5

(a) Calculate the product-moment correlation coefficient (r) and test the strength of the relationship between the yield and the amount of money invested in agricultural machinery. (7)

(b) Calculate the equation of the Least Square regression line y on x. (7)

(c) Interpret the regression coefficients you estimated in (b) above (2)

(d) Estimate the crop yield for a farm that invested N$50 000 (2)

(e) Calculate the coefficient of determination (R^2) and explain the goodness of fit (2)

Question 7 **[20]**

A study was conducted to examine the effectiveness of a new vaccine in preventing a particular disease in a population of animals. The study compared the effectiveness of a new vaccine against a standard vaccine by testing the proportion of dogs that remained disease-free after vaccination with each vaccine. 150 dogs were vaccinated with the new vaccine, and 120 of them remained disease-free at the end of the study period while 160 dogs were vaccinated with the standard vaccine, and 100 of them remained disease-free at the end of the period.

(a) Is the new vaccine more effective than the current standard vaccine in preventing a specific disease in dogs? (13)

(b) Define type I and Type II errors and clearly explain the circumstances under which they would have been made in the context of this study (4)

(c) State the conditions necessary for this test to be applied in analysing research data. (3)