



TECHNICAL UNIVERSITY OF MOMBASA

FACULTY OF APPLIED AND HEALTH SCIENCES

DEPARTMENT OF PURE & APPLIED SCIENCES

UNIVERSITY EXAMINATION FOR:

BACHELOR TECHNOLOGY IN INDUSTRIAL MICROBIOLOGY AND

BIOTECHNOLOGY

AAB 4302: BIostatistics & EXPERIMENTAL DESIGN REGULAR PAPER

END OF SEMESTER EXAMINATION

SERIES: DECEMBER 2016

TIME: 2 HOURS

DATE: Pick Date Select Month Pick Year

Instructions to Candidates

You should have the following for this examination

-Answer Booklet, examination pass and student ID

This paper consists of **FIVE** questions. Attempt question ONE (Compulsory) and any other TWO questions.

Do not write on the question paper.

Question ONE

(a) Differentiate between the following

- (i) Parameter and statistics **(2 marks)**
- (ii) Population and sample **(2 marks)**
- (iii) Model I and Model II in ANOVA technique **(2 marks)**

(b) A sample of 100 apples is taken from a load. The apples have the distribution of sizes shown below;

Diameter (cm) 6 7 8 9 10

Frequency (f) 11 21 38 17 13

Determine the mean and median of these diameters. **(3 marks)**

(c) When an experienced kingfisher tries to catch a fish the probability that he is successful is $\frac{1}{3}$.

Find the probability that:

(i) He catches exactly two fish in five attempts **(2marks)**

(ii) He catches at least two fish in five attempt **(2 marks)**

(d) Suppose that the counts on the number of a particular type of bacteria in 1 ml of drinking water tend to be approximately normally distributed with a mean of 85 and a standard deviation of 9. What is the probability that a given 1 ml sample will contain more than 100 bacteria? **(3 marks)**

(e) In order to taste two tooth pastes, a sample of 4 pairs of brothers from 4 different families were picked from a large number of potential families. One brother used crest. The other brother used colgate. The decay level was measured by a dentist after a year. Result were:

	Family 1	Family 2	Family 3	Family 4
Crest	1.3	1.0	1.2	0.9
Colgate	0.8	1.0	0.7	0.7

Test at $\alpha = 0.05$ the claim by colgate that their decay level was lower

(i) Give H_0 and H_a **(1 mark)**

(ii) Compute the test statistics **(4 marks)**

(iii) Give the degree of freedom **(3 marks)**

(iv) Do you reject H_0 or fail to reject H_0 ? **(1 mark)**

(v) Give conclusions **(1 mark)**

(f) A study to determine the effectiveness of a drug (serum) for arthritis resulted in the comparison of two groups each consisting of 200 arthritis patients. One group was inoculated with the serum and other received a placebo. The following results were obtained

	Treated	Untreated
Improved	22	5
Not improved	38	15

Do these data present sufficient evidence to indicate that the serum was effective in improving the condition of arthritis patients. Use $\alpha = 0.05$ **(4 marks)**

Question TWO

(a) In an agricultural experiment the gains in mass in kg, of 100 pigs during a certain period were recorded

Gain Mass	5- 9	10- 14	15- 19	20- 24	25- 29	30- 34
Frequency	2	29	37	16	14	2

- (i) Draw a histogram of these data. **(4 marks)**
- (ii) Obtain the mean and median. Which will you consider to be more appropriate and why. **(6 marks)**
- (iii) Calculate the standard deviation of the distribution **(4 marks)**

(b) In an air-pollution study performed at an experiment station, the following amounts of suspended benzene soluble organic matter (in micrograms per cubic meter) were obtained for eight different samples of air: 2.2, 1.8, 3.1, 2.0, 2.4, 2.0, 2.1, and 1.2. Assuming that the population sample is normal, construct a 95% confidence interval for the corresponding true mean. **(6 marks)**

Question THREE

(a) A clinical trial was carried out to investigate whether there is any evidence of a difference in the effects of melatonin drug and the placebo. 10 patients were observed for one night with the drug and one night with the placebo. The hours of sleep on each are shown in the table below

Patient	Hours of Sleep	
	Drug	Placebo
1	5.2	5.9
2	7.0	7.9
3	8.2	3.9
4	6.6	4.7
5	5.5	5.3
6	7.4	5.4
7	5.3	5.5
8	6.7	6.1
9	7.4	3.8
10	5.8	6.3

- (i) Write down the null and alternative hypothesis for this trial. **(2 marks)**
- (ii) Use an appropriate test statistic to test the hypothesis in (a). (Use $\alpha = 0.05$) **(6 marks)**
- (iii) What assumptions have you made in carrying out this test? **(3 marks)**
- (iv) What conclusions do you draw from these data. **(3 marks)**

(b) A student titres 10ml of 0.1M acid against 0.1 M alkali five times and obtains the following results for the volume of alkali: 9.88, 10.18, 10.23, 10.39, 10.25 ml.

Is there any evidence that these results show a bias from the expected value of 10ml? (6 marks)

Question FOUR

(a) Four chemical plants, producing the same product and owned the same company, discharge effluents into streams in the vicinity of their locations. To check on the extent of the pollution created by the effluents and to determine if this varies from plant to plant, the company collected random samples of liquid waste, five specimens for each of the four plants. The data are shown below:

Plant	Polluting effluents (16/gal of waste)				
A	1.65	1.72	1.50	1.37	1.60
B	1.70	1.85	1.46	2.05	1.80
C	1.40	1.75	1.38	1.65	1.55
D	2.10	1.95	1.65	1.88	2.00

(i) Write down the appropriate model for this experiment, explaining each term in the context of the experiment. (5 marks)

(ii) Analyse the data and complete the ANOVA table. (5 marks)

(iii) Test if there are significant differences in the amount of effluents discharge by the four plants. Use $\alpha = 0.05$. (4 marks)

(b) The table below summarizes the incidence of cerebral tumors in 141 neurosurgical patients.

Site of tumor	Type of tumor		
	Benign	Malignant	Other
Frontal lobes	23	9	6
Temporal lobes	21	4	3
Else where	34	24	17

Test if there is no association between the type and site of tumor. Use $\alpha = 0.05$ (6 marks)

Question FIVE

(a) Some varieties of nematodes, round worms that live in the soil feed upon the roots of lawn grass and other plants. This pest, which is particularly troublesome in warm climates, can be treated by the application of nematodes. Data collected on the percent kill of nematodes for various rates of application (pounds per acre) are as follows:

Rate of application, x	2	2	2	3	3	3	4	4	4	5	5	5
Percent kill, y	50	56	48	63	69	71	86	82	76	94	99	97

- (i) Calculate the coefficient of correlation, r between rates of application (x) and percent kill (y). **(6 marks)**
- (ii) Do the data provide evidence to indicate a linear correlation between y on x . ($\alpha = 0.05$) **(4 marks)**
- (iii) Fit a simple linear regression for the data. **(3 marks)**
- (iv) Give a 95% confidence interval for β . (Do not calculate the C.I) **(2 marks)**

(b) Sample of leaves were collected from two oak trees A and B. The number of galls were counted on each leaf and the mean and standard deviation of the number of galls per leaf was calculated with the results given below:

Trees	A	B
Sample size	60	80
Mean	11.4	10.7
S.d.	2.6	3.1

Assuming Normal distribution, do the data provide evidence at the 5% significance level of different population means for the two trees? **(5 marks)**