



W1-2-60-1-6

JOMO KENYATTA UNIVERSITY

OF

AGRICULTURE AND TECHNOLOGY

University Examinations 2021/2022

FOURTH YEAR FIRST SEMESTER EXAMINATION FOR THE
DEGREE OF BACHELOR OF OPERATIONS RESEARCH
STA 2450: MANPOWER PLANNING

DATE: APRIL 2022

TIME: 2 HOURS

INSTRUCTIONS: Attempt question One and any other Two

QUESTION ONE (COMPULSORY)

- a) Explain the general skills that managers ought to possess to perform their roles effectively. (10 marks) ✓
- b) Explain the relevance of Fayol's 14 principles of management to organizations today (10 marks) ✓
- c) Examine the internal and external factors that may affect the operations of an organization. (10 marks)

QUESTION TWO

- a) Explain the various ways in which an organization can choose to departmentalize its activities. (10 marks) ✓
- b) Examine the importance of control as a management function. (10 marks) ✓

QUESTION THREE

- a) Explain the factors that would influence management decision to either centralize or decentralize an organization. (10marks).
- b) Explain how an organization can motivate its employees using Abraham Maslow's hierarchy of needs theory. (10marks)

QUESTION FOUR

- a. Explain the key steps involved in effectively planning for an organization. (10marks)
- b. Examine the factors that would influence decision on the appropriate span of control/^{or}management to adopt. (10marks)



WI-2-60-1-6

**JOMO KENYATTA UNIVERSITY OF AGRICULTURE AND TECHNOLOGY
University Examinations 2021/2022**

**YEAR IV SEMESTER I EXAMINATION FOR THE DEGREE OF BACHELOR OF
SCIENCE IN ACTUARIAL SCIENCE/FINANCIAL ENGINEERING/
STATISTICS/BIOSTATISTICS/OPERATIONS RESEARCH**

HRD 2401: ENTREPRENEURSHIP SKILLS

DATE: APRIL, 2022

TIME: 2 HOURS

INSTRUCTIONS: ANSWER QUESTION ONE AND ANY OTHER TWO QUESTIONS

QUESTION ONE

Read the following case study and answer the questions that follow it, that is questions a (i), (ii) and (iii) respectively.

Two businessmen, Smith and Joseph, were sitting in the “Wazalendo Restaurant”, having tea. The point of their discussion was how each of them had started their business. The two friends owned business in Commercial Street in Nairobi. Smith owns the “Wazalendo Restaurant” and Joseph owns a large hardware which specializes in fabricated metal products and building materials.

Smith: Having worked as a Head Waiter at Hotel Jupiter for five years, I decided that I wanted to have a business of my own. I knew I could succeed in a restaurant business because I had served many customers and was now aware of their needs and expectations. I visited many restaurants and hotels with the city and noticed that they were always crowded during lunch and dinner time. I used to pass near Commercial Street Matatu Termini and I was amazed at the large crowd of people around this place. I resigned from job, rented this place and started “Wazalendo Restaurant”.

Joseph: “I am a welder by Professional and I did my training at Kabete Technical Training institute. I started by working for my uncle who had four welding machines. He had many customers ordering steel window frames, beds, gates, containers, etc. After three years, I bought my own welding machine and started my own business. The market was there and one could see the city expanding rapidly in terms of infrastructure, building and industries. After five years, I had six welding machines and ten employees. I was getting large orders from building contractors and hardware stores. It was then that I decided to open a hardware store so that I could cater for more customers”.

QUESTIONS

a) i. What is a business opportunity? [2 marks]

ii. How did Smith identify his opportunity? [4 marks]

b

iii. What was Joseph's source(s) of business opportunity [4 marks]

b) Explain the statement "desirability of new venture formation" in the context of entrepreneurial decision process [10 marks] ✓ 3 ✓

c) Describe the components of the enterprise culture [10 marks] ✓

QUESTION TWO

a) Discuss the importance of self-employment to an individual [12 marks]

b) Distinguish between a social entrepreneur and a hustler entrepreneur [8 marks] ✓

QUESTION THREE ✓

a) Explain the roles of an entrepreneur [10 marks] ✓

b) Describe characteristics of appropriate technology [10 marks] ✓ 20

QUESTION FOUR

a) Evaluate any five reasons for small business failure in Kenya [10 marks] ✓

b) Describe a sole Proprietorship [2 marks] ✓ 20

c) State both advantage and disadvantage of a sole proprietorship [8 marks] ✓

QUESTION FIVE

a) Describe the steps involved in the decision -making process ✓ [14 marks] ✓ 20

b) Explain the importance of a business plan ✓ [6 marks] ✓



$$\begin{aligned} -1 \frac{25}{450} &= \\ -1.571 \times 2 &= -20.4 \\ -23.33 & \end{aligned}$$

W1-2-60-1-6

JOMO KENYATTA UNIVERSITY
OF
AGRICULTURE AND TECHNOLOGY

UNIVERSITY EXAMINATIONS 2021/2022

FOURTH YEAR FIRST SEMESTER EXAMINATION FOR THE DEGREE OF
BACHELOR OF SCIENCE IN OPERATIONS RESEARCH

STA 2451: COMPUTATIONAL MATHEMATICS

DATE: APRIL 2022

TIME: 2 HOURS

INSTRUCTIONS: Answer Question ONE and any other TWO questions.

Question One (Compulsory – 30 Marks)

(a) Define the following terms

- i) Order of a Partial differential equation [1 Mark]
ii) Critical Point of a function $f(x, y, z)$ [1 Mark]

(b) Classify the partial differential equation

$$xy \frac{\partial^2 u}{\partial x^2} - (x^2 - y^2) \frac{\partial^2 u}{\partial x \partial y} - xy \frac{\partial^2 u}{\partial y^2} + y \frac{\partial u}{\partial x} - x \frac{\partial u}{\partial y} = 2(x^2 - y^2)$$

into hyperbolic, parabolic or elliptic. Is it linear or nonlinear? Explain. [4 marks]

(c) Find the general solution of the Lagrange's equation $y^2 \frac{\partial z}{\partial x} - xy \frac{\partial z}{\partial y} = 2x(1 - y)$. [6 Marks]

(d) Use the method of separation of variables to solve the equation $\frac{\partial u}{\partial x} = 2 \frac{\partial u}{\partial t} + u$ subject to the initial condition $u(x, 0) = 6e^{-3x}$. [6 Marks]

(e) A multinational refreshments firm has 68 thousand dollars available to produce the maximum possible number of bottles. Its production function is

$$f(x, y) = 60x + 90y - 2x^2 - 3y^2$$

where x and y are the required inputs. The inputs prices are 2 thousand dollars per each unit of x and 4 thousand dollars per each unit of y . Given the budget restriction, find the maximum possible number of bottles that can be produced. [6 Marks]

(f) Given the differential equation $y'' - y = x$ subject to the boundary conditions $y(0) = 0$ and $y(1) = 0$, use central finite difference scheme with $h = \frac{1}{4}$ to estimate $y(0.75)$ correct to five decimal places. [6 Marks]

Question Two (20 Marks)

- (a) A European research program has 6 hundred thousand euros available to finance research projects on renewable energies. Two teams present their projects and their estimated incomes (derived from the property rights of new discoveries) are given by the functions

$$I_1(x) = 2x^{1/2} \text{ and } I_2(y) = \frac{4}{3}y^{3/4}$$

where x is the monetary assignation to the first team (in hundreds of thousands of euros) and y is second team's assignation. The program seeks to determine the optimal distribution of quantities x and y to maximize the joint income. By means of the Lagrange multiplier, formulate and solve the problem. Hence, find the maximum joint income.

[8 Marks]

- (b) Find the characteristics and reduce the following differential equation into the appropriate canonical form. Hence, obtain the general solution.

[12 Marks] ✓

$$2\frac{\partial^2 u}{\partial x^2} - 4\frac{\partial^2 u}{\partial x \partial y} - 6\frac{\partial^2 u}{\partial y^2} + \frac{\partial u}{\partial x} = 0$$

$\sqrt{2/3}$

$\frac{3}{2}$

Question Three (20 Marks)

- (a) A corporation manufactures a product at two locations. The cost functions for producing x_1 units at location 1 and x_2 units at location 2 are given by

$$C_1 = 0.05x_1^2 + 15x_1 + 5400 \quad \text{and} \quad C_2 = 0.03x_2^2 + 15x_2 + 6100,$$

respectively, and the total revenue function is

$$R = [225 - 0.4(x_1 + x_2)](x_1 + x_2)$$

Find the production levels at the two locations that will maximize the profit given by $P(x_1, x_2) = R - C_1 - C_2$.

94, 157 [8 Marks] ✓

- (b) Use the method of separation of variables to solve the one-dimensional heat equation

$$\frac{\partial u}{\partial t} = \frac{\partial^2 u}{\partial x^2}, \quad 0 < x < 2, t > 0$$

14, 825

subject to the boundary conditions $u(0, t) = 0$, $u(2, t) = 0$ and the initial condition $u(x, 0) = 3 \sin(2\pi x)$.

[12 Marks]

Question Four (20 Marks)

94, 157

- (a) Obtain a central finite difference scheme for the boundary value problem below

151 940

$$\begin{aligned} \frac{\partial u}{\partial x} &= 2\frac{\partial u}{\partial y} + u; \quad (x, y) \in (0, 2) \times (0, 1) \\ u(0, y) &= u(2, y) = 0; \quad y \in (0, 1) \\ u(x, 0) &= u(x, 1) = 0; \quad x \in (0, 2) \end{aligned}$$

-23.33

Use uniform grids in x and y with $\Delta x = 0.5$ and $\Delta y = 0.25$.

[8 Marks] ✓

- (b) Solve the equation $2x^2r - 5xys + 2y^2t + 2(px + qy) = 0$ using Monge's method. [12 Marks] ✓



**JOMO KENYATTA UNIVERSITY
OF
AGRICULTURE AND TECHNOLOGY
UNIVERSITY EXAMINATIONS 2021/2022**

**FOURTH YEAR FIRST SEMESTER EXAMINATION FOR
THE DEGREE OF BACHELOR OF SCIENCE IN STATISTICS/BACHELOR
OF SCIENCE IN FINANCIAL ENGINEERING/ BACHELOR OF SCIENCE
IN BIOSTATISTICS/ BACHELOR OF SCIENCE IN ACTUARIAL SCIENCE.**

STA 2408: REGRESSION MODELLING II

DATE: APRIL 2022

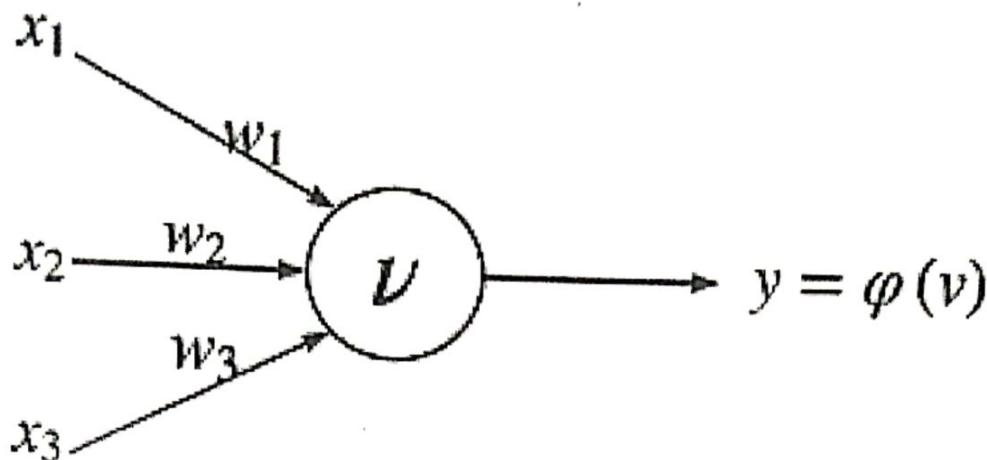
TIME: 2 HOURS

INSTRUCTIONS TO CANDIDATES:

1. Answer question *ONE* (section A) and any other two questions in section B.
2. Show all your workings
3. All questions except question one carry equal marks

QUESTION ONE(30 MARKS)

- (a) (i) Differentiate between Parametric regression and non parametric regression. (2marks)
- (ii) Explain what is a training set and how is it used to train neural networks? (4marks) (4)
- (b) In Kernel regression estimation, one may choose a deterministic or stochastic design depending on the type of the problem at hand.
- (i) Describe a deterministic design model and give its kernel estimate of the mean function. (3marks) ✓
- (ii) Describe a stochastic design model and give its kernel estimate of the mean function. (3marks) ✓
- (c) (i) Below is a diagram of a single artificial neuron (unit)



The node has three inputs $x = (x_1, x_2, x_3)$ that receive only binary signals (either 0 or 1). How many different input patterns can this code receive? What if the node had four inputs? Five? Can you give a formula that computes the number of binary input patterns for a given number of inputs.

(3marks) ✓

- (ii) Suppose that a credit card company decided to deploy a new system for assessing credit worthiness of its customers. The new system is using a feed-forward neural network with a supervised learning algorithm. Suggest in a form of essay what should the bank have before the system can be used? Discuss the problem associated with this requirement. (3marks) ✓
- (d) Explain steps for fitting local polynomial curve (7marks) ✓
- (e) Let $\sum_{i=1}^5 (X_i, Y_i)$ be $\{(1, 5), (7, 12), (3, 1), (2, 0), (5, 4)\}$. Compute (K-NN estimate) \hat{M}_{kx} for $x=4$ and $k=3$ (5marks) ✓

QUESTION TWO (20 MARKS)

- (a) Let $X_1, X_2 \in [0, 1]$ and $\begin{cases} Z = 1, & \text{if } X_1 = 1 \text{ or } X_2 = 1 \\ Z = 0, & \text{if } X_1 = 0 \text{ or } X_2 = 0 \end{cases}$

be the logical XOR classification to be learned by a perception. The training set then consists of input vectors including the first co-ordinate $x_0 = 1$;

$$X^1 = \begin{pmatrix} 1 \\ 1 \\ 0 \end{pmatrix}, X^2 = \begin{pmatrix} 1 \\ 0 \\ 1 \end{pmatrix}, X^3 = \begin{pmatrix} 1 \\ 1 \\ 1 \end{pmatrix}, X^4 = \begin{pmatrix} 1 \\ 0 \\ 0 \end{pmatrix}$$

with correction classification $Z^{(1)} = Z^{(2)} = Z^{(3)} = 1, Z^{(4)} = 0$.

The perception with weights $\omega_0, \omega_1, \omega_2$ classifies an object as 1 if and only if $\omega_0 x_0 + \omega_1 x_1 + \omega_2 x_2 > 0$ and as 0 elsewhere. Taking $\omega = (0, 0, 0)^t$ as initial weight and $\eta = 1$ as relaxation factor, train the perception and find the weight that achieves correct classification for all input vectors in the training set.

(12marks) ✓

- (b) We have a sample (X_i, Y_i) , $i = 1, 2, \dots, n$ from an NWR model $Y_i = m(X_i) + \epsilon_i$ where $E(\epsilon_i|X_1, \dots, X_n) = 0$ and $E(\epsilon_i^2|X_1, \dots, X_n) = \sigma^2(X_i)$ and X_1, X_2, \dots, X_n has a pdf $f(x)$. Moreover, $E(\epsilon_i \epsilon_j|X_1, \dots, X_n) = 0$ for $i \neq j$. Define

$$C_1(h) = -\frac{2}{n} \sum_{j=1}^n \epsilon_j [\hat{m}_h(X_j) - m(X_j)], \quad C_2(h) = -\frac{2}{n} \sum_{j=1}^n \epsilon_j [\hat{m}_h^{(-j)}(X_j) - m(X_j)]$$

Where $\hat{m}_h(X_j)$ is the N-W estimator of $m(x)$ at X_j and $\hat{m}_h^{(-j)}(X_j)$ is the N-W of $m(x)$ at X_j obtained using all the data except (X_j, Y_j) .

Find the asymptotic expression of $E(C_1(h)|X_1, \dots, X_n)$

(8marks) ✓

20

QUESTION THREE (20 MARKS)

- (a) The height of a child at different ages Estimate the height of the child as an adult of 30

t(years)	0	5.0	8.0	12	16	18
H(inches)	20	36.2	52	60	69.2	70

years of age using the growth model, $H = \frac{a}{1+be^{-ct}}$.

(4marks) ✓

- (b) There is a functional relationship between the mass density p of air and the altitude h above the sea level.

Altitude above the sea level, h (km)	0.32	0.64	1.28	1.60
Mass Density, $\rho(kg/m^3)$	1.15	1.10	1.05	0.95

In the regression model $\rho = k_1 e^{-k_2 h}$, the constant k_2 is found as $k_2 = 0.1315$. assuming that the mass density of air at the top of the atmosphere is $\frac{1}{1000^{th}}$ of the mass density of air at the sea level.

Calculate the altitude in kilometers of the top of the atmosphere.

(7marks) ✓

- (c) Draw a well labelled diagram of a neural network with two hidden layers and X_1, X_2 and X_3 as the input variables

(4marks) ✓

- (d) Neural networks models are widely used in solving various classification and forecasting problems. State and explain the advantages and disadvantages of this models

(5marks) ✓

QUESTION FOUR (20 MARKS)

- (a) State and explain how to check the assumptions for linear mixed model

(5marks)

- (b) The data set below contains measurements of results from an experiment done at five different temperature levels. The variables are y = yield and x = temperature in degrees Fahrenheit.

Temp(x)	50	50	50	70	70	70	80	80	80	90	90	90	100	100	100
Yield(y)	3.3	2.8	2.9	2.3	2.6	2.1	2.5	2.9	2.4	3.0	3.1	2.8	3.3	3.5	3.0

(i) Read the following data and draw a scatter plot using R code (2marks)

(ii) Both the linear fit and quadratic fit was fitted and below are the R output for both linear and quadratic fit.

Based on polynomial regression write down the fitted model and interpret the parameters (1marks)

Figure 1: Linear Fit table

Coefficients:

	Estimate	Std. Error	t value	Pr(> t)
(Intercept)	2.306306	0.469075	4.917	0.000282 ***
temp	0.006757	0.005873	1.151	0.270641

Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ',' 1

Residual standard error: 0.3913 on 13 degrees of freedom

Multiple R-Squared: 0.09242, Adjusted R-squared: 0.0226

F-statistic: 1.324 on 1 and 13 DF, p-value: 0.2706

Figure 2: Quadratic Fit table

Coefficients:

	Estimate	Std. Error	t value	Pr(> t)
(Intercept)	7.9604811	1.2589183	6.323	3.81e-05 ***
temp	-0.1537113	0.0349408	-4.399	0.000867 ***
temp2	0.0010756	0.0002329	4.618	0.000592 ***

Signif. codes: 0 '****' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ',' 1

Residual standard error: 0.2444 on 12 degrees of freedom

Multiple R-Squared: 0.6732, Adjusted R-squared: 0.6187

F-statistic: 12.36 on 2 and 12 DF, p-value: 0.001218

Figure 3: ANOVA TABLE
Analysis of Variance Table

Response: yield

Df	Sum Sq	Mean Sq	F value	Pr(>F)
Regression	2	1.47656	0.73828	12.36 0.001218 **
Residuals	12	0.71677	0.05973	

(iii) Are both temperature and temperature squared significant in predicting yield? Explain (2marks)

- (iv) Using both the three tables (Linear fit, quadratic/polynomial and ANOVA), Provide and advice on which fit is much better. (6marks)
- (c) The following result are from a perspective study that were considered in building a logistic regression model for predicting capsule=1 that included psa, age, and gleason in the model(model 1). Part of the resulting SAS output follows:

Figure 1: Model 1

Criterion	Model Fit Statistics		Intercept and Covariates
	Intercept Only	Intercept	
AIC		514.289	411.208
SC		518.229	426.969
-2 Log L		512.289	403.208

Parameter	Analysis of Maximum Likelihood Estimates				$P > Chi^2_{df}$
	DF	Estimate	Error	Chi-Square	
Intercept	1	-6.3896	1.4976	18.2045	<.0001
psa	1	0.0266	0.00894	8.8442	0.0029
age	1	-0.0208	0.0188	1.2351	0.2664
gleason	1	1.0790	0.1611	44.8373	<.0001

- (i) Write the resulting logistic regression equation for model 1 [1 mark] ✓
- (ii) What is the predicted probability of having a capsule=1 for a 69-year old man with psa level of 10mg/ml and a gleason score of 5, according to model 1? [1 mark] ✓
- (iii) What does the intercept from the model tell you? [1 mark] ✓
- (iv) Calculate the odds ratio and 95% confidence interval for psa from the model.
Interpret. [1 mark] ✓

GOOD LUCK:



WI-2-60-1-6

JOMO KENYATTA UNIVERSITY

OF

AGRICULTURE AND TECHNOLOGY

UNIVERSITY EXAMINATIONS 2021/2022

FOUTH YEAR SEMESTER ONE EXAMINATIONS FOR THE DEGREE OF
 BACHELOR OF SCIENCE IN STATISTICS AND BACHELOR OF SCIENCE IN
 OPERATION RESEARCH

STA 2411: DESIGN AND ANALYSIS OF EXPERIMENT II

DATE: APRIL 2022TIME: 2 HOURS*INSTRUCTIONS: Attempt section A and any other two questions in section B.*SECTION A (30 MARKS)

QUESTIONS ONE (30 MARKS)

- (a) Define each of them of the following terms as used in design and analysis of experiment
- (i) Randomization [1 mark]
 - (ii) Confounding [1 mark]
 - (iii) Blocking [1 mark]
 - (iv) Nested design [1 mark]
 - (v) Split- plot design [1 mark]
- (b) Write a linear model representing split- plot design and explain each component of the model [5 marks]
- (c) Write R program to carry out the analysis of two factor- factorial design assuming the factors under consideration are A and B with both factor having 5 levels of treatremant [4 marks]
- (d) A company that produces seasoning oils from ginger roots at three production plants uses four different grades of the roots. The management suspects that the yields from the four grades of roots are different. Since the skills at the plants vary, a study was carried out with each production plant processing the four grades of roots in unequal replicates. Three different batches of the four grades of root were used at the three plants. The data show percentage yield: Analyze the data. Based on incomplete unbalanced Two-Stage Nested Design [7 marks]

Production plants	I				II				III			
	Root grades	1	2	3	4	1	2	3	4	1	2	3
	20	20	33	22	22	40	21	41	28	19	30	29
	21	27	41	24	23	38	36	43	26	32	35	38
	30	32	36	31	28	33	34	44	24	25	37	40
	47			28	24			41	21			27

- (e) Consider a company that buys raw material in batches from three different suppliers. The purity of this raw material varies considerably, which causes problems in manufacturing the finished product. Four batches of raw material are selected at random from each supplier, and three determinations of purity are made on each batch.

Batches	Supplier 1		Supplier 2		Supplier 3	
	1	2	1	2	1	2
	12	8	14	12	14	16
	9	9	15	10	10	15
	11	10	13	11	12	15
	12	8	14	13	11	14

- (i) Identify the design for this experiment [1 mark]
 (ii) Write the statistical design for this experiment [2 marks]
 (iii) Analyse the data to determine whether the variability in purity is attributable to differences between the suppliers [6 marks]

SECTION B (40 MARKS)

QUESTIONS TWO (20 MARKS)

- (a) State the main assumptions in 2^k factorial design [3 marks]
 (b) An engineer is interested in the effects of cutting speed (A), tool geometry (B), and cutting angle (C) on the life (in hours) of a machine tool. Two levels of each factor are chosen, and three replicates of a 2^3 factorial design are run. The results are as follows:

A	B	C	Treatment combinations	Replicates		
				II	III	III
-	-	-	(I)	22	31	25
+	-	-	a	32	43	29
-	+	-	b	34	34	50
+	+	-	ab	55	47	46
-	-	+	c	44	45	38
+	-	+	ac	40	37	36
-	+	+	bc	60	50	54
+	+	+	abc	39	41	47

- (i) Estimate the factor effects and comments on their values [3 marks]
- (ii) Use the analysis of variance to confirm your conclusions for part [4 marks]
- (iii) Write down a regression model for predicting tool life (in hours) based on the results of this experiment. [2 marks]
- (iv) Suppose that only a one-half fraction of the 2^3 design could be run. Construct the design and perform the analysis, using the data from replicate I. [8 marks]

QUESTIONS THREE (20 MARKS)

- (a) For 2^4 factorial experiments describes a study on the yield of maize production based on four factors. The factors studied and their levels are as follows:

Factors	Low level (-)	High level (+)
A: amount of rainfall (mm)	87	93
B: amount of fertilizer (min)	15	30
C: soil Ph value	35	45
D: temperature ($^{\circ}\text{C}$)	60	70

- (i) Write the treatment combinations [2 marks]
- (ii) Set up the 2^4 experiment in this problem in two blocks with ABCD confounded. [4 marks]
- (iii) Analyze the data from this design and comment on the largeness block effect [6 marks] ✓
- (b) A nickel-titanium alloy is used to make components for jet turbine aircraft engines. Cracking is a potentially serious problem in the final part because it can lead to non-recoverable failure. A test is run at the parts producer to determine the effect of four factors on cracks. The four factors are pouring temperature titanium content (B), heat treatment method (C), and amount of grain refiner used (D). Two replicates of a 2^4 design are run, and the length of crack (in mm) induced in a sample coupon subjected to a standard test is measured. Suppose that only a one-half fraction of the 2^4 design could be run. Construct the design and perform the analysis, using the data from replicate I. [8 marks]

A	B	C	D	Treatment combinations	Replicates	
					I	II
-	-	-	-	(l)	7.037	6.376
+	-	-	-	a	14.707	15.219
-	+	-	-	b	11.635	12.089
+	+	-	-	ab	17.273	17.815
-	-	+	-	c	10.403	10.151
+	-	+	-	ac	4.368	4.098
-	+	+	-	bc	9.360	9.253
+	+	+	-	abc	13.440	12.923
-	-	-	+	d	8.561	8.951
+	-	-	+	ad	16.867	17.052
-	+	-	+	bd	13.876	13.658
+	+	-	+	abd	19.824	19.639
-	-	+	+	cd	11.846	12.337
+	-	+	+	acd	6.125	5.904
-	+	+	+	bcd	11.190	10.935
+	+	+	+	abcd	15.653	15.053

QUESTIONS FOUR (20 MARKS)

- (a) A 2^3 factorial experiment was carried out on methods of cultivating sunflower. The factors were ✓
- (i) Fertilizers applied in spring or summer
 - (ii) Spraying or nonspraying
 - (iii) Irrigation or lack of irrigation

The experiment was performed twice, and the percentage of poor quality sunflower was observed in each case. Analyze the data fully, stating your conclusions clearly. Suggest the treatment combinations that are significant. [10 marks]

	Replicate	Spring		Summer	
		Spray	Nonspray	Spray	Nonspray
Irrigated	1	20.5	28.7	26.2	37.5
	2	19.7	31.3	29.9	35
Nonirrigated	1	24.8	21.8	19.7	29.4
	2	26.5	26	27.0	26.6

- (b) A company producing Akwette cloth wished to purchase a new set of weaving machines. A dealer presented the company with four types of weaving machines and asked them to make a choice. The company invited five machinists for interview with a view to employing the most skilled. The ✓

manager of the company, who wishes to make his decision scientifically, engaged a statistician to design an experiment which would help him to test the machines as well as the machinists. As part of the experiment, each candidate was asked to produce three pieces of a specified size of cloth on each of the machines, and the time taken for each of these candidates to produce each of these pieces of cloth was recorded as shown in the following table. The statistician used Two-Factor Factorial design to study the performances of men and machines analyze the data and draw appropriate conclusion

[10 marks] ✓

Machinists (M1)	Machines (M2)				Total
	I	II	III	IV	
I	43, 47, 48 (138)	60, 64, 68 (192)	46, 50, 55 (151)	59, 52, 54 (165)	646
II	50, 56, 48 (154)	79, 73, 75 (227)	65, 68, 62 (195)	60, 63, 61 (184)	760
III	72, 64, 75 (211)	80, 88, 84 (252)	62, 70, 73 (205)	70, 71, 76 (217)	885
IV	77, 73, 78 (228)	79, 87, 80 (246)	61, 67, 69 (197)	68, 75, 79 (222)	893
V	67, 73, 66 (206)	84, 80, 80 (244)	69, 83, 74 (226)	62, 60, 57 (179)	855
Total	937	1161	974	967	4039

73 588 1

5 x 4 x 3



Jomo Kenyatta University of Agriculture and Technology

Fourth Year Continuous Assessment Test for Degree of Bachelor of Science in Biostatistics

STA 2407 Multivariate Methods

Date: March 16, 2022

Time: 1 Hour

Instruction: Answer All Questions

Question One (15 marks)

- (a) Define briefly multivariate analysis. Hence describe briefly the following multivariate statistical analysis methods.
- Multivariate Analysis of Variance [2 marks]
 - Conjoint analysis [2 marks]
 - Multivariate Analysis of Covariance [1 mark]
- (b) The sample observations for the variables X_1 , X_2 and X_3 were collected and recorded below

X_1	2	2	2	2	2	2	4	4	4	4	4	4
X_2	1	2	3	2	5	3	4	4	4	4	4	0
X_3	3	3	5	5	5	5	5	6	6	6	6	6

Determine the following

- Whether the sample is drawn from normal distribution population with mean $\mu' = \begin{bmatrix} 3 \\ 3 \\ 4 \end{bmatrix}$ at $\alpha = 0.05$ level of significance. [3 marks] 3
 - The 95% confidence interval for the means. [2 marks] 1
- (c) The data of samples from two populations were collected and recorded for characteristics X_1 and X_2 as $n_1 = 30$, $\bar{x}_1 = \begin{bmatrix} 5 \\ 4 \end{bmatrix}$, $s_1 = \begin{bmatrix} 2 & -1 \\ 1 & 3 \end{bmatrix}$, $n_2 = 30$, $\bar{x}_2 = \begin{bmatrix} 4 \\ 5 \end{bmatrix}$, $s_2 = \begin{bmatrix} 4 & 1 \\ 1 & 5 \end{bmatrix}$. Determine the following
- Whether the two populations have same mean at $\alpha = 0.05$ level of significance. [3 marks] 2
 - The 95% confidence interval for the differences in means. [2 marks] 2

Question Two (15 marks)

- (a) Derive the expression of the discriminant function and explain how it may be used to classify the sample observations from a population to the groups. [5 marks]

- (b) The random variables X_1 , X_2 , and X_3 have the variance-covariance matrix $\Sigma = \begin{bmatrix} 2 & 1 & 0 \\ 1 & 2 & -1 \\ 0 & -1 & 2 \end{bmatrix}$. Determine the new factors if the factors X_1 , X_2 and X_3 are to be grouped into the economic and demographic factors using the centroid factor analysis method. [5 marks] 3

- (c) Determine the canonical correlations and coefficients for the first canonical variates of the correlation

matrix given as $R = \begin{bmatrix} 1.0 & 0.8 & : & 0.8 & 0.8 \\ 0.8 & 1.0 & : & 0.8 & 0.8 \\ \dots & \dots & \dots & \dots & \dots \\ 0.8 & 0.8 & : & 1.0 & 0.8 \\ 0.8 & 0.8 & : & 0.8 & 1.0 \end{bmatrix}$ [5 marks] 4