SECTION A.

Q1 i) Define the term operations research.

ii) Give a detailed   description of the origin of operations research .

iii) Explain the methodology of operations research.

iv) Define the following terms as used in operations research

Model,   Objective function,   Constraints ,   Model formulation,   Feasible solution, Transportation problems,   Allocation problems, Non-negative conditions.

v) State and explain the operations research techniques.

Q2 i) Discuss the significance of operations research.

ii) Identify the limitations of operations research.

iii) Outline and briefly explain the five principle phases of operations research.

iv) Define the term linear programming and outline the five steps followed when formulating a linear programming model mathematically.

v) List the basic properties of linear programming models discussing also the assumptions of linear programming models.

Q3) A farmer has 10 acres to plant in wheat and rye. He has to plant at least 7 acres. However, he has only $1200 to spend and each acre of wheat costs $200 to plant and each acre of rye costs $100 to plant. Moreover, the farmer has to get the planting done in 12 hours and it takes an hour to plant an acre of wheat and 2 hours to plant an acre of rye. If the profit is $500 per acre of wheat and $300 per acre of rye how many acres of each should be planted to maximize profits?

Q4). A gold processor has two sources of gold ore, source A and source B. In order to kep his plant running, at least three tons of ore must be processed each day. Ore from source A costs $20 per ton to process, and ore from source B costs $10 per ton to process. Costs must be kept to less than $80 per day. Moreover, Federal Regulations require that the amount of ore from source B cannot exceed twice the amount of ore from source A. If ore from source A yields 2 oz. of gold per ton, and ore from source B yields 3 oz. of gold per ton, how many tons of ore from both sources must be processed each day to maximize the amount of gold extracted subject to the above constraints?

Q5) .A publisher has orders for 600 copies of a certain text from San Francisco and 400 copies from Sacramento. The company has 700 copies in a warehouse in Novato and 800 copies in a warehouse in Lodi. It costs $5 to ship a text from Novato to San Francisco, but it costs $10 to ship it to Sacramento. It costs $15 to ship a text from L-odi to San Francisco, but it costs $4 to ship it from Lodi to Sacramento. How many copies should the company ship from each warehouse to San Francisco and Sacramento to fill the order at the least cost?

Q6) A company is involved in the production of two items (X and Y). The resources need to produce X and Y are twofold, namely machine time for automatic processing and craftsman time for hand finishing. The table below gives the number of minutes required for each item:

		Machine time	Craftsman time
Item	X	13	20
	Y	19	29

The company has 40 hours of machine time available in the next working week but only 35 hours of craftsman time. Machine time is costed at £10 per hour worked and craftsman time is costed at £2 per hour worked. Both machine and craftsman idle times incur no costs. The revenue received for each item produced (all production is sold) is £20 for X and £30 for Y. The company has a specific contract to produce 10 items of X per week for a particular customer.

Formulate the problem of deciding how much to produce per week as a linear program.

Solve this linear program graphically.

$Q7$) A company has four factories and three warehouses located in market areas. The capacities of supply points are [350 450 520 340] and the demands of the destination are[460 500 480]. The cost associated with transporting one unit of the resource from a supply point to a destination is as follows

	D1	D2	D3
S1	3	2	1
S2	1	1	2
S3	2	1	1
S4	1	2	3

By making the initial allocation using North West Corner Rule, Least Cost Method and Vogel Approximation Method determine optimal allocation that minimises the transportation cost

Q8) i) Define a transportation problem.

ii) Consider the transportation problem presented in the following table:

Destination

Origin	1	2	3	Supply
1	2	7	4	50
2	3	3	1	80
3	5	4	7	70
4	1	6	2	140
Demand	70	90	180	340

Use North West Corner Rule to determine the initial feasible minimum cost of transportation hence use MODI(Modified Distributed Algorithm) to determine the optimal solution.

Use Least Cost Method to determine the minimum cost of transportation.

Use Vogel Approximation Method to determine the minimum cost of transportation

SECTION B

($Q1$) Explain ways in which the CPM type of networks differ from PERT   networks

$Q2$) A small project is composed of 8 activities whose time estimates   are listed below

	Activity		Time in weeks		
	i	j	Optimistic(a)	Most likely(M)	Pessimistic(b)
A	1	2	2	5	8
B	2	3	4	7	10
C	2	4	4	9	11
D	3	5	6	10	20
E	4	6	1	3	5
F	4	5	3	6	9
G	5	7	4	5	12
H	6	7	6	8	10

i)   Develop a PERT   network for the project .
ii)   Determine the expected value and the variance for every activity.
iii)   Calculate EST and LCT for every node.
iv)   Find the critical path for the project .
v)   Compute the probability of completing the project in 36 weeks   .

Q3) A small project is composed of seven activities whose time estimates in hours are given below.

Activity	1-2	1-3	1-4	2-5	3-5	4-6	5-6
a	1	1	2	1	2	2	3
b	7	7	8	1	14	8	15
M	1	4	2	1	5	5	6

a=optimistic time.

b=pessimistic time

M=Most likely time.

   i)   Draw the project network.
   ii)   Find the expected duration and variance of each activity.
   iii)   Determine the critical path.
   iv)   Find the expected project completion time.
   v)   Calculate the probability that the project will be completed three weeks earlier than expected.
   vi)   If the project's due date is 18 weeks, find the probability of not meeting the due date.

Q4) A small project is composed of 7 activities whose time estimates in weeks are listed below:

Activity	Predecessors	Optimistic	Most likely	Pessimistic
A	-	1	2	4
B	-	5	6	7
C	-	2	4	5
D	A	1	3	4
E	C	4	5	7
F	A	3	4	5
G	B,D,E	1	2	3

   i)   Draw the network.
   ii)   Calculate the expected duration and variance of every task.
   iii)   Determine the critical path.
   iv)   Calculate the expected project duration and the variance of the project duration based on network analysis.
   v)   Calculate the probability that the project will be completed on or before a deadline of 10 weeks

Q5) A certain industrial project has the following data.

Activity (i,j)	A	B	C	D	E	F	G	H	I	J	K	L	M
Predecessor(s)	-	-	A	A	B	B	D,E	D,E	D,E	C,G	F,I	C,G	J,H,K
t_0	7	5	8	12	12	14	3	16	4	14	13	6	16
t_m	8	9	10	14	14.5	15	5	22	7	17	16	8	18
t_p	9	10	12	16	17	16	7	25	10	20	22	13	26

a) Explain the meaning of three time estimates

$$t_0, \quad t_m, \quad t_p$$

b) Construct the network diagram.
c) Find the critical path
d) For each activity , compute the expected time and variance.
e) Find the expected project duration and its variance.
f) Determine the probability of completing the project within 25 weeks.

SECTION C

Write a program in R-studio to solve a given linear programming problem using graphical method (use a particular example either a maximization problem or a minimization problem) hence give the output in word or pdf using R-Mackdown technique.

Write a program in R-studio to create a data frame of all the public university vice chancellors in Kenyan public universities in Kenya indicating their genders and their highest level of education including the course they did hence give the output in word or pdf using R-Mackdown technique.

Write a program in R-studio to create a matrix of 3 rows of elements between 1 and 10 , determine the inverse of the matrix, its transpose and its eigen values hence give the output in word or pdf using R-Mackdown technique.