QUESTION ONE

Let X = Number of 0.2 litre bottles
Y = Number of 0.3 litre bottles
Ƶ = Number of 0.5 litre bottles

0.45x + 0.75y + 0.6Ƶ = 3825
0.30x + 0.15y + 0.75Ƶ = 2025
but X = 1500

0.75y + 0.6Ƶ = 3150
0.15y + 0.75Ƶ =1572 x 5
0.75y + 3.75Ƶ = 7875
0.75y + 0.60Ƶ = 3150
3.15Ƶ = 4725
Ƶ = 1500 bottles

0.75y + 0.06(1500) = 3150
y = 3000 bottles

(b) Difference between input-output analysis and Markov analysis – input – output analysis shows the interdependence of sectors in an economy.

Forecasted levels of output required for each sector so as to satisfy both intermediate and final demand can be calculated if we are given the technical coefficient matrix and the forecasted levels of final demand. $X = (1 - A)^{-1}D$

Markov analysis is a probabilistic system whereby the state of a given phenomenon in future can be predicted from the current state and transition matrix (initial state vector)(Transition matrix) = (Future state vector)

(c) (i) Input ratio is the proportion of inputs an industry receives from another industry or from itself.

(ii) Interpretation of the column of motor vehicles:
- Motor vehicles receive 17% of its inputs from itself.
- Motor vehicles receive 25% of its inputs from electricity.
- Motor vehicles receives 50% of its inputs from steel.
- Interpretation of the row for motor vehicles.
  + 17% of motor vehicle output is distributed to itself.
  + 25% of motor vehicle output is distributed to electricity.
  + 25% of motor vehicle output is distributed to steel.

(iii) Total output = $(1 - A)^{-1}X$

$$= \begin{bmatrix} 3.08 & 1.98 & 2.15 \\ 2.64 & 3.41 & 2.70 \\ 3.96 & 3.19 & 4.46 \end{bmatrix} \begin{bmatrix} 216 \\ 240 \\ 360 \end{bmatrix} = \begin{bmatrix} 1914.48 \\ 2360.64 \\ 3226.50 \end{bmatrix}$$

Proportion of primary inputs are:
Motor vehicles = 1 – (0.17 + 0.25 + 0.5) = 0.08
Electricity = 1 – (0.25 + 0.25 + 0.33) = 0.17
Steel = 1 – (0.25 + 0.33 + 0.33) = 0.09

Therefore primary inputs required are:
Motor vehicles = 0.08 × 1914.48 = Shs. 153.1584 million
Electricity = 0.17 × 2360.64 = Shs. 401.3088 million
Steel = 0.09 × 3226.56 = Shs. 290.3904 million

(iv) Assumptions of input/output analysis:
- Each industry produce a single homogenous product.
- The output of each industry is subject to constant return.
- Each industry requires a fixed input ratio to meet its demand.
- No new industries are allowed.

QUESTION TWO

(a) Regression equation, $\hat{y} = 15.7588 - 6.25485X_1 + 0.0851136X_2 + 5.86599X_3$

(b) The regression analysis provide useful information
$r = 0.921265 \Rightarrow R^2 = 0.85$
- The regression equation explains about 85% of the variation in sales.
- There is a high positive linear relationship between the sales and the independent variables.

(c) Generally the bigger the value of F, the better the predictor readers rating have a small value of F compared with the other decision variables. Curves have a bigger F value. This implies that curves are important for sales prediction.

(d) $\propto = 5\%$

$\propto/2 = 0.025$ } t – Critical = 2.12
dif = 20 – 4 = 16

95% confidence interval $= -6.25485 \pm 2.12 \times 0.961897$
$= -6.25485 \pm 2.03922$
$= -8.29407 < B_1 < -4.21563$

We are 95% confident that a cover by artist B instead of artist A reduces sales by between 4216 and 8294 copies.

(e) 95% confidence interval $= 5.86599 \pm 2112 \times 0.922233$
$= 5.86599 \pm 1.95513$
$= 3.911 < B_3 < 7.821$

We are 95% confident that using short descriptions by Editor D instead of Editor C will increase sales by 3911 and 7821 copies.

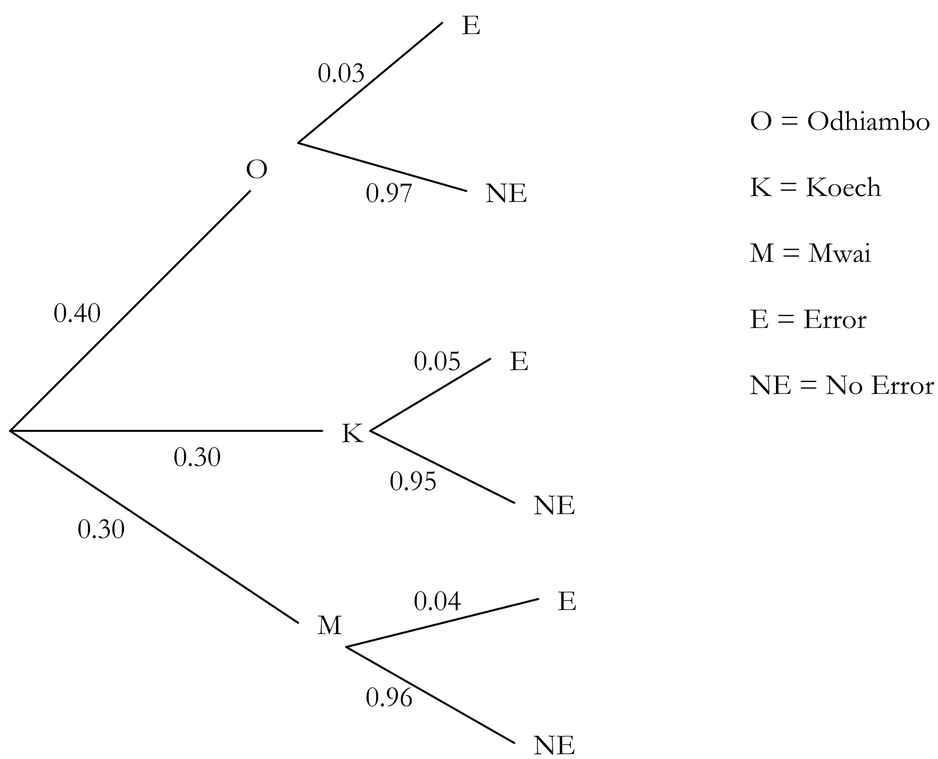
QUESTION THREE

(a) (i) General form of Bayes theorem:
If A and B are related events then:

$$P(B|A) = \frac{P(A|B) \times P(B)}{P(A)}$$

$$P(A) = P(A|B_1)P(B_1) + P(A|B_2)P(B_2) + \ldots\ldots. + P(A|B_N)P(B_N)$$

(ii) Importance of Bayes theorem to a business manager.
- Its used in revision of probabilities.
- Business events keep on changing
- Bayes theorem helps managers to update their projections using available additional information.



$$P(E) = (0.4 \times 0.03) + (0.3 \times 0.05) + (0.3 \times 0.04) = 0.039 = 3.9\%$$

(iii) $(K \text{ or } M|E) = P(K|E) + P(M|E)$

$$= \frac{P(K \,\&\, E)}{P(E)} + \frac{P(M \,\&\, E)}{P(E)}$$

$$= \frac{0.3 \times 0.05}{0.039} + \frac{0.3 \times 0.04}{0.039}$$

$$= 0.3846 + 0.3077$$

$$= 0.6923$$

(c)

Project X				Project Y			
X_1	P_1	P_1X_1	$(X_1-\bar{X})^2Pi$	yi	Pi	P_1y_1	$(Y_1-\bar{Y})^2$ Pi
1500	0.25	375	3,285,156.25	-10,000	0.25	-2,500	57,191,406.25
5000	0.50	2500	7,812.50	5,000	0.50	2500	7,812.50
9000	0.25	2250	3,753,906.25	20,500	0.25	5125	59,097,626.25
	$\bar{X}$ =	5125	$6x^2$ = 7,046,875		$\bar{Y}$ =	5,125	$6y^2$=116,296,875
6x = Shs. 2,655 million				6y = Shs. 10,784 million			

Since the two projects have the same expected net present value $(\bar{X}=\bar{Y})$ we choose project x because 6x < 6y.

QUESTION FOUR

(a) Difference between paired t-test and two sample t-test.

- Paired t-test is used for the mean of differences where samples are not independent.
- Two-sample t-test is used to test for the difference in means where samples are independent.

Trend wear of trendy tyres	**Trend wear of Road master tyres**	**Differences (d)**	**$(d - \bar{d})^2 = (d+0.021)^2$**
1.08	1.12	- 0.04	0.000361
1.06	1.09	- 0.03	0.000081
1.24	1.16	0.08	0.010201
1.20	1.24	- 0.04	0.000361
1.17	1.23	- 0.06	0.001521
1.21	1.25	- 0.04	0.000361
1.18	1.20	- 0.02	0.000001
1.10	1.15	- 0.05	0.000841
1.22	1.19	0.03	0.002601
1.09	1.13	- 0.04	0.000361
	Σ	- 0.21	

Mean: $\bar{d} = \frac{\sum d}{n} = \frac{-0.21}{10} = -0.021$

Standard deviation $S = \sqrt{\frac{\sum(d-\bar{d})^2}{n-1}} = \sqrt{\frac{0.01669}{9}} = 0.0431$

H_0: d = 0 (Trendy tyres not superior or the two are equally superior)

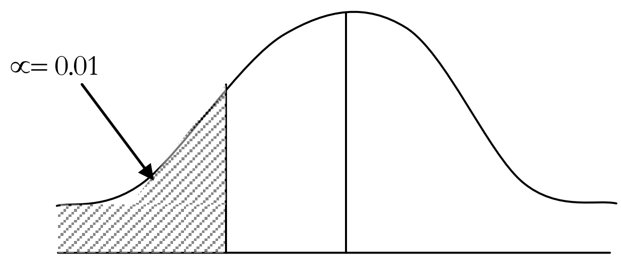
H_1: d < 0 (Trendy tyres are superior)

Test statistics, t – calculated

$= \frac{\bar{d}}{S/\sqrt{n}} = \frac{-0.021 \times \sqrt{10}}{0.0431} = -1.54$

$\propto = 0.01$ } t - Critical = $t_{0.99}$ = 2.82

d.f. = 10 – 9 = 9



T = - 2.82

Decision Rule: Reject H_0 if t – calculated < - 2.82

Since – 1.54 > - 2.82, we fail to reject H_0 and conclude that trendy tyres are not superior.

(ii) Assumptions made

- Trend wear is normally distributed.

QUESTION FIVE

(a) Principal components of a time series are:

- Secular trend (T)
- Seasonal variation (S)
- Cyclic variation (C)
- Random variation (R)

(b) (i) Difference between multiplicative and additive models:

- Multiplicative model expresses the time series model as a product of the four principle components.

  That is Y = TSCR
- Additive model expresses the time series model as a sum of the four principle components.

  That is Y = T + C + R + S

(ii) Conditions under which each model is used;
- Multiplicative model is used if the four principle components are not independent.
- Additive model is used when the four principle components are independent.

(c) (i) Purpose of seasonal index
- Used to evaluate seasonal effects on a time series.
- Used to adjust trend forecasts.
- Used to deseasonalise data.

(ii)

Year	Quarter (Q)	Sales (Y)	Uncentred 4 – Quarter MA	Centred 4 – Quarter M.A	Difference Y - MA
2001	1	55.0	-	-	-
	2	76.5	67.625	-	-
	3	61.2	67.475	67.55	- 6.36
	4	77.8	64.825	66.15	11.65
2002	1	54.4	62.700	63.76	- 9.36
	2	65.9	63.600	63.15	2.75
	3	52.7	64.825	64.21	- 11.51
	4	81.4	69.150	66.99	14.41
2003	1	59.3	75.600	72.38	- 13.08
	2	83.2	78.500	77.05	6.15
	3	78.5	-	-	-
	4	92.0	-	-	-

Subsidiary Table

Year	Quarter 1	Quarter 2	Quarter 3	Quarter 4
2001	-	-	- 6.35	11.65
2002	- 9.36	2.75	- 11.51	14.41
2003	- 13.08	6.15	-	-
Total	- 22.44	8.90	- 17.86	26.06
Average Seasonal Index	- 11.22	4.45	- 8.93	13.03

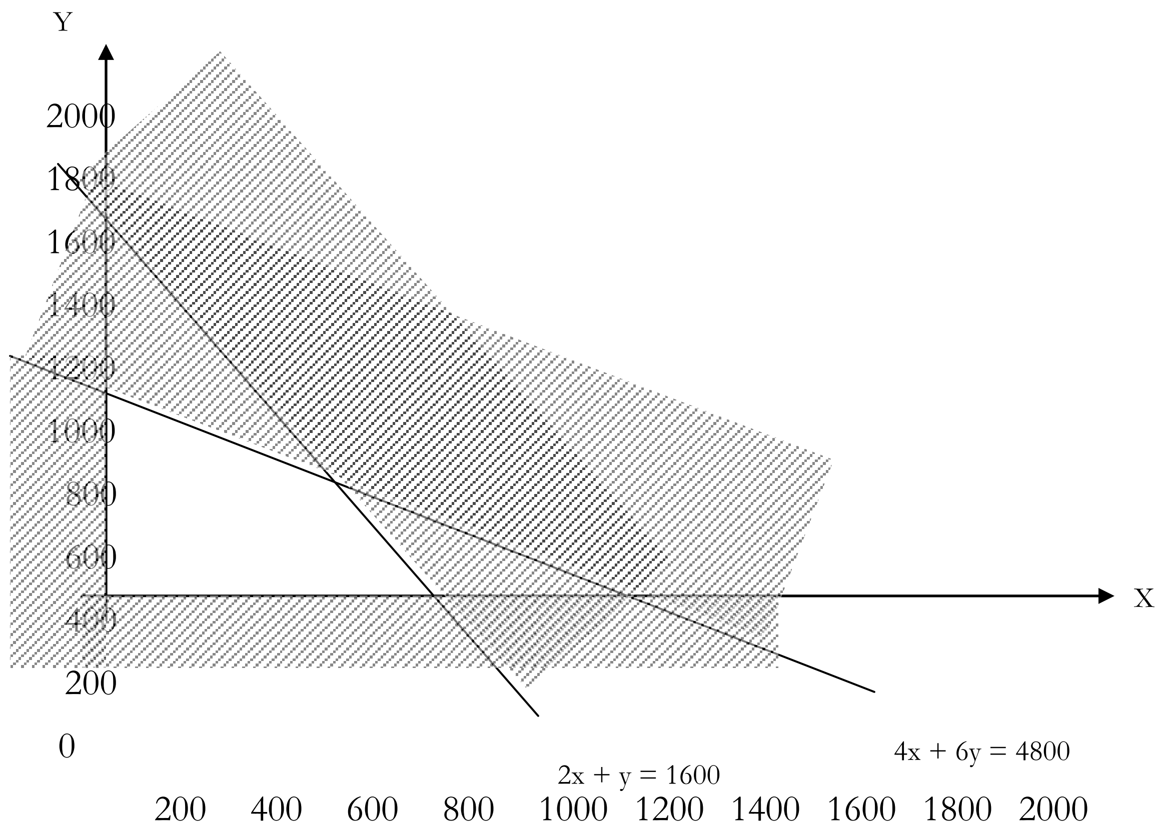
QUESTION SIX

(a) Let: X = Number of mountain bikes
Y = Number of racing bikes
P = Total contribution

Unit contribution of mountain bikes = 6,375 – (4 $\times$ 750 + 2 $\times$ 375) = Shs. 2,625
Unit contribution of racing bikes = 9,000 – (6 $\times$ 750 + 1 x 375) = Shs. 4,125

Max. $P = 2{,}625x + 4{,}125y$
Subject to:
1. $4x + 6y \leq 4{,}800$
2. $2x + y \leq 1{,}600$
3. $x, y \geq 0$

X	0	1200
Y	800	0
X	0	800
X	1600	0



Conner Point (X, Y)	P = 2625x + 4125y
A (0, 800)	P = Shs. 3,300,000
B (600, 400)	P = Shs. 3,225,000
C (800, 0)	P = Shs. 2,100,000

Optimal solution

X = 0 mountain bikes Y = 800 Racing bikes

Max. P = Shs. 3,300,000

(b) Yes. Simplex method can be used

(c) Assumptions of linear programming

- All functions are linear and can be stated mathematically
- Coefficients of the decision variables are known with certainty.
- Resources and decision variables can be added linearly
- Decision variables are divisible
- Proportionality
- There is only one objective

- All decision variables are positive.

QUESTION SEVEN

(a) The limitation of using the expected monetary value criterion in decision making is that it ignores the variation in risk among alternative decisions.

Project A				**Project B**			
X_1	P_1	P_1X_1	$(X_1 - \overline{X})^2 P_1$	y_1	P_1	P_1y_1	$(y_1 - \overline{y})^2 P_1$
2.00	0.6	1.200	0.0104544	1.8	0.20	0.36	0.052020
2.24	0.3	0.672	0.0034992	2.4	0.75	1.80	0.006075
2.60	0.1	0.260	0.0219024	3.0	0.05	0.15	0.023805
	$\overline{X}_A =$	2.132	$\delta_A^2 = 0.035856$		$\overline{Y}_B$	2.31	$\delta_B^2 = 0.0819$

(i) Expected cost of alternative A_1 X_A = Shs. 2.132 million
Expected cost of alternative B_1 Y_B = Shs. 2310 million
Cost of mechanics = Shs. 25,000 $\times$ 5 $\times$ 12 = Shs. 1.5 million
Total cost of alternative B = 2.31 + 1.5 = Shs. 3.81 million

Recommendation
Adopt alternative A since it is the least expensive.

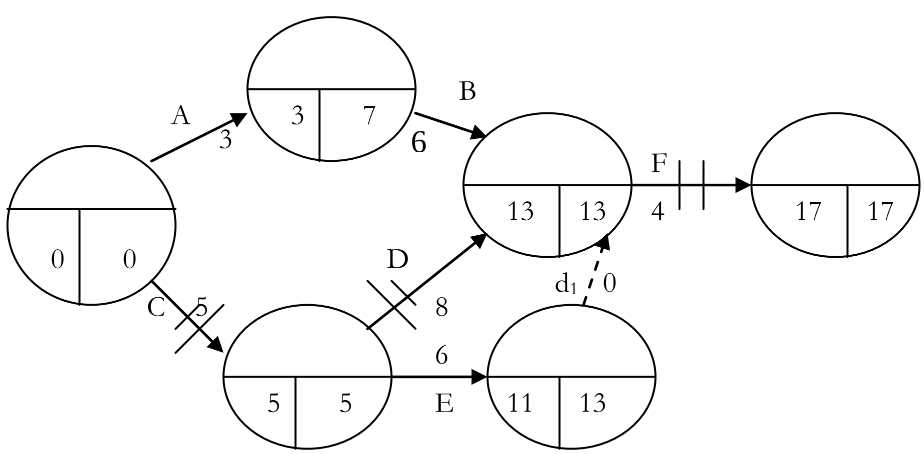
(ii) $\overline{X} = 2.132$ $\quad \overline{Y}_B = 2.31$

$\delta_A = 0.1894$ $\quad \delta_B = 0.2862$

$C.V_A = \frac{0.1894}{2.132} \times 100 = 8.88\%$ $\quad C.V_B = \frac{0.2862}{2.31} \times 100 = 12.3\%$

(iii) Alternative A is better because it has a lower risk.

QUESTION EIGHT



Normal completion time = 17 weeks
Critical activities are C, D and F

(b) (i)

Activity	Time Reduction	Cost (Shs.)	Slope
A	0	-	
B	2	45,000	
C	2	30,000	
D	1	60,000	
E	2	22,500	
F	2	75,000	

Path	Time	Crash C by 2	Crash D by 1	Crash F by 2
G, D, F	17	15	14	12
A, B, F	13	13	13	11
G, E, F	15	13	13	11
Additional		2 x 30 = 60	60 + 60 $\times$1 = 120	120 + 75 $\times$2 = 270

Cost Shs. '000'

Shortest

(ii) Additional cost if the project is crashed = Shs. 270,000

(c) Cost slope is the additional cost that is incurred when an activity time is reduced by one unit.

$$\text{Cost slope} = \frac{\text{Crash cost - Normal cost}}{\text{Normal time - Crash time}}$$

(d) Assumptions made when crashing
- Cost slope is constant
- There is a direct relationship between time and costs