Period Year | outstanding debt | interest | annual payment | principal repaid | balance

$$FV = PV(1+r)^n$$

(b) The team loses [5Marks]

vi) Give that the team wins ,what is the probability that it played under bad weather [4marks]

[Total marks 25]

Question Four

(a) Determine the area of the Z- score

$P(-2.23 \leq Z \leq 2.23)$ [3marks]

(b) An electrical firm supplies bulbs that have a length of life that is approximately normally distributed with a standard deviation of 20 hours. If a random sample of 40 bulbs has an average of life of 800hours.

(i)find a 95% confidence interval for the population mean life of all bulbs supplied by the firm [5marks]

(ii)find a 99% confidence interval for the population mean life of all bulbs supplied by the firm [5marks]

(c) The time needed to service a car at the filling station is exponential random variable with a mean of 2 minutes. Determine the probability that a newly arriving car will be serviced as follows:

(i) Within 1 minute? [3marks]

(ii) Atleast 120 seconds? [4marks]

(iii) Between 1 and 2 minutes? [5marks]

[Total marks 25]

Question Five

(a) Suppose you want to be deposit k200 in the bank that pays 6% interest rate per annum for 10 years.Find the future value of this deposit after 10 years? [5marks]

(b) Ms Kahilu borrows k20000 from a bank at an interest rate of 10% and agrees to make equal annual payments for 5years

(i) Calculate the equalannual payment [6marks]

(ii) Prepare a loan amortisation schedule for Ms kahilu [14marks

[Total Marks 25]

\ Question Six

(a) The profit to be realised from a certain business venture to the nearest k1000 are believed to follow the probability distribution shown below:

X	-2000	-1000	0	1000	2000	3000
P(X = x)	0.2	0.25	0.1	0.15	K	0.05

(i)Calculate the value of k [3marks

(ii) Find The probability thatthe business venture

(a) Makes a loss [2marks]

(b) Realises profit of at least k2000 [2marks]

(iii) Find (a) the expected earnings [3marks]

(b)standard deviation [4marks]

(b) Suppose the investment project has the following cashflows:

Years	Cashflows (k000)
0	-300
1	90
2	110
3	130
4	140

Assuming 8% discount factor compounded annually, calculate the net present value of this project and interpret it. [11 marks]

[Total marks 25]

Calculate the

(i) Range [2marks]

(ii) Mean [5marks]

(iii) Variance [5marks]

(iv) Standard deviation [4marks]

(v) Coefficient variation [4 marks]

[Total Marks 25]

Question Three

(a) Evaluate $7p_2$ [3marks]

(b) How many different committees of 4 businesswoman can be chosen 8 businesswoman [3marks]

(c) In how many ways can 8 boxes of sweets be arranged on a shelf in a shop [3marks]

(d) A market survey of 900 people found the following facts about the ability to recall a television commercial for a product and the actual purchase of the product.

	Recalled	Did Not Recall	Total
Purchased	175	115	290
Did Not Purchase	275	335	610
Total	450	450	900

Let A denote the event that a person could recall the television commercial and B denote the event that a person purchased the product.

(i) Find P(A)

(II) Find P(B) [2marks]

(iii) Find P(A∩B) [2marks]

(iv) Are A and B independent events? Use probability values to explain [2marks]

(v) What is the probability that a person who recalled seeing the television commercial actually purchased the product [5marks]

[5marks]

[Total marks 25]

Question one

(a) Evaluate -42 -(-40) [2marks]

(b) Find $\frac{dy}{dx}$ *for the equation* $y = x^3 + 2x^2 - 7x - 5$ [3marks]

(c) Express the $3\log_{10} 2 + \frac{1}{2}\log_{10} b - 2$ as a single logarithm [5marks]

(d) Solve the equation $x^2 + 5x + 6 = 0$ [5marks]

(e) Use any method to solve the following system of equation.

$x - 3y + z = 4$

$2x - 8y + 8z = -2$

$-6x + 3y - 15z = 9$ [10marks]

Total marks 25

Question Two

(a) Classify the following variables as qualitative or quantitative

(i) The colour of one's eyes [1mark]

(ii) The brand of the car owned by someone [1mark]

(iii) Prime numbers less than ten [1mark]

(iv) Marital status [1mark]

(v) The volume of water in a storage tank [1mark]

(b) Below are marks obtained by 100 students in BBA1 August intake in a mathematics test.

Marks obtained	Frequency
$0 \le x \le 20$	12
$20 \le x \le 40$	19
$40 \le x \le 60$	29
$60 \le x \le 80$	34
$80 \le x \le 100$	6

Question one

(a) Evaluate 12 +(-10) **[2marks]**

(b) Find the integral of $\int (4x^3 + 2x^2 - 6x + 3)dx$ **[3marks]**

(c) Express the $\log_{10} 2 + \log_{10} b$ as a single logarithm **[3marks]**

(d)A company has three plants. Each plant employs manager, foreman and skilled labourers as follows:

	Plant A	Plant B	Plant C
Managers	1	2	1
Foreman	4	6	4
Skilled labour	80	96	75

If managers are paid k350 a week, foreman k275 and skilled labour k200. Use matrices to find the total payroll of each plant **[6marks]**

(e) Use any method to solve the following system of equation.

$$4x + y + 3z = 8$$
$$-2x + 5y + z = 4$$
$$3x + 2y + 4z = 9$$

$x = 1$
$y = 1$
$z = 1$

[10marks]

Total marks

25

Question Two

(a) Classify the following variables as discrete or continuous

(i) The weight of a person **[1mark]**
(ii) Total scores for the game between Zambia vs Algeria **[1mark]**
(iii) Prime numbers less than ten **[1mark]**
(iv) The earning per month for the government worker **[1mark]**
(v) The capacity of water in a dam **[1mark]**

(b) The annual profits made by a random sample of 37 companies in the textiles industry are shown in the table below:

Profit (k000)	Number of companies
$10 \leq x \leq 20$	3
$20 \leq x \leq 30$	7
$30 \leq x \leq 40$	12
$40 \leq x \leq 50$	10
$50 \leq x \leq 60$	5

Calculate the

(i) Mean **[4marks]**

(ii) Median **[3marks]**

(iii) Variance **[5marks]**

(iv) Standard deviation **[4marks]**

(v) Coefficient variation **[4 marks]**

[Total Marks 25]

Question Three

(a)Evaluate $11p_2$ **[2marks]**

(b) How many different committees of 3 businessman can be chosenfrom 7 businessman **[2marks]**

(c) In how many ways can 8 boxes of sweets be arranged on a shelf in a shop **[3marks]**

(d) The sports team is interested in whether the weather has an effect on their result. The results are summarised in the table

	Good weather	Bad weather	totals
Win	12	4	16
lose	5	10	15
totals	17	14	31

(i) Find the probability of the team winning **[2marks]**

ii) What is the probability of the team playing in bad weather **[2marks]**

iii) Giventhat the team played in good weather, what is the probability that i

(a) The team wins **[5marks]**

14

QUESTION ONE

a) Find the value of $(2x)^0 + 3$ **[2marks]**

b) Solve the equation $5x + 7 = 2 - 3(x - 2)$ **[3marks]**

c) Given that $A^T = \begin{bmatrix} 2 & 11 \\ 0 & 2 \\ -3 & 5 \end{bmatrix}$, Find A **[2marks]**

d) For the production function $Q = 200K^{\frac{1}{4}}L^{\frac{2}{3}}$. Find the out put Q when k= 16, L = 27 **[4marks]**

e) During a recession the firm's revenue decline continuously so that the revenue ,TR , (measured in million of kwachas) in years time is modelled by;

$TR = 10e^{-0.25t}$

i) Calculate the current revenue and the revenue in three years **[4marks]**

ii) After how many years will the revenue decline to k1.75 million **[4marks]**

f) Solve the following simultaneous equation using any method

$$x + 2y + 2z = 7$$

$$4x + 5y + z = 11$$

$$7x - 4y - z = 1$$

[6marks]

[Total marks 25]

QUESTION TWO

a) The cell phone industry providers in Zambia are currently dominated by MTN, Airtel and Zamtel. In a survey conducted by the BBA September intake student at Chalimbana University to determine the number of subscribers revealed the following:

Provider	Number of subscriber
MTN	50
Airtel	30
Zamtel	20

i) Use a pie chart to represent the above data **[5 marks]**

ii) Which provider has the largest market share **[1 mark]**

QUESTION ONE

a) Find the value of $(2x)^0 + 3$ [2marks]

b) Solve the equation $5x + 7 = 2 - 3(x - 2)$ [3marks]

c) Given that $A^T = \begin{bmatrix} 2 & 11 \\ 0 & 2 \\ -3 & 5 \end{bmatrix}$, Find A [2marks]

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$$4x + 5y + z = 11$$

$$7x - 4y - z = 1$$

[6marks]

[Total marks 25]

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Provider	Number of subscriber
MTN	50
Airtel	30
Zamtel	20

i) Use a pie chart to represent the above data [5 marks]

ii) Which provider has the largest market share [1 mark]

b) Classify the following as either quantitative or qualitative

i) Colour of your eyes **[1mark]**

ii) Volume of water in a quarter tank **[1mark]**

iii) Gender **[1mark]**

iv) Marital status **[1mark]**

c) The following are the marks obtained BBA Students in maths test 40, 65, 35, 20, 65, 70, 80.

Compute the following descriptive statistics for these data:

i) The range **[2marks]**

ii) Sample mean **[3marks]**

iii) The variance **[3 marks]**

iv) Sample standard deviation **[3marks]**

iv) The mean absolute deviation **[4 marks]**

[Total marks 25]

QUESTION THREE

a) Determine the area of the Z- score $P(-1.25 \leq Z \leq 1.25)$ **[3marks]**

b) An electrical firm supplies bulbs that have a length of life that is approximately normally distributed with a standard deviation of 20 hours. If a random sample of 40 bulbs has an average of life of 800hours.

(i)find a 95% confidence interval for the population mean life of all bulbs supplied by the firm **[5marks]**

(ii)find a 99% confidence interval for the population mean life of all bulbs supplied by the firm . **[5marks]**

(c) The time needed to service a car at the filling station is exponential random variable with a mean of 2 minutes. Determine the probability that a newly arriving car will be serviced as follows:

(i) Within 1 minute? **[3marks]**

(ii) Atleast 120 seconds? [4marks]

(iii) Between 1 and 2 minutes? [5marks]

[Total marks 25]

QUESTION FOUR

a)Find the value of i) 8! [2marks]

ii)$10p_3$ [2makrs]

b)Suppose that we two events, A and B, with P(A) = 0.5, P(B) =0.60 and P(A∩B) = 0.40 .

a) Find i) P(A/B) [3marks]

ii)P(B/A) [3marks]

b) Are A and B independent events? Why or why not? [2marks]

A new drug for a covid is known to be effective in 70% of the cases treated. If Six patients suffering from the disease are to be treated.

i)Find the probability that a) 4 patients will be successfully treated [3marks]

b) Atleast 2 patients will be successfully treated [4marks]

ii) Calculate a) the mean [3marks]

b)the variance [3marks]

[Total marks 25]

QUESTION FIVE

(a) Ms eccah had k120000.00 in the Atlasmara bank after saving for 5 years at an interest rate of 12%. How much was her initial deposit? [5marks]

(b) Chalimbana complex borrows k20000 from a bank at an interest rate of 10% per annum and agrees to make equal semi-annual payments for 3years

(i) Calculate the equal semi-annual payment [6marks]

(ii) Prepare a loan amortisation schedule for this complex [14marks]

[Total Marks 25]

QUESTION SIX

(a) The profit to be realised from a certain business venture to the nearest k100 are believed to follow the probability distribution shown below;

X	-200	-100	0	100	200	300
P(X = x)	0.2	0.25	0.1	0.15	K	0.05

(i)Calculate the value of k **[3marks]**

(ii) Find The probability that the business venture

(a) Makes a loss **[2marks]**

(b) Realises profit of at least k2000 **[2marks]**

(i) Find (a) the expected earnings **[3marks]**

(b)Standard deviation **[4marks]**

(b) Upon the presidential directive for paying the retirees, one of the retirees want to invest his lump sum in a project that has the following cashflows;

Years	Cashflows (k000)
0	-200
1	80
2	90
3	100
4	120

Assuming 9% discount factor compounded annually, calculate the net present value of this project and what advise can you give to this retiree? **[11 marks]**

[Total marks 25]

Question one

(a) Evaluate 12 +(-10) **[2marks]**

(b) Find the integral of $\int(4x^3 + 2x^2 - 6x + 3)dx$ **[3marks]**

(c) Express the $\log_{10} 2 + \log_{10} b$ as a single logarithm **[3marks]**

(d)A company has three plants. Each plant employs manager, foreman and skilled labourers as follows:

	Plant A	Plant B	Plant C
Managers	1	2	1
Foreman	4	6	4
Skilled labour	80	96	75

If managers are paid k350 a week, foreman k275 and skilled labour k200. Use matrices to find the total payroll of each plant **[6marks]**

(e) Use any method to solve the following system of equation.

$$4x + y + 3z = 8$$
$$-2x + 5y + z = 4$$
$$3x + 2y + 4z = 9$$

[10marks]

Total marks 25

Question Two

(a) Classify the following variables as discrete or continuous

(i) The weight of a person **[1mark]**

(ii) Total scores for the game between Zambia vs Algeria **[1mark]**

(iii) Prime numbers less than ten **[1mark]**

(iv) The earning per month for the government worker **[1mark]**

(v) The capacity of water in a dam **[1mark]**

(b) The annual profits made by a random sample of 37 companies in the textiles industry are shown in the table below:

Profit (k000)	Number of companies
$10 \leq x \leq 20$	3
$20 \leq x \leq 30$	7
$30 \leq x \leq 40$	12
$40 \leq x \leq 50$	10
$50 \leq x \leq 60$	5

Calculate the

(i) Mean [4marks]

(ii) Median [3marks]

(iii) Variance [5marks]

(iv) Standard deviation [4marks]

(v) Coefficient variation [4 marks]

[Total Marks 25]

Question Three

(a)Evaluate $11p_{2}$ [2marks]

(b) How many different committees of 3 businessman can be chosenfrom 7 businessman [2marks]

(c) In how many ways can 8 boxes of sweets be arranged on a shelf in a shop [3marks]

(d) The sports team is interested in whether the weather has an effect on their result. The results are summarised in the table

	Good weather	Bad weather	totals
Win	12	4	16
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totals	17	14	31

(i) Find the probability of the team winning [2marks]

ii) What is the probability of the team playing in bad weather [2marks]

iii) Give that the team played in good weather, what is the probability that i

(a) The team wins [5marks]

(b) The team loses [5Marks]

vi) Give that the team wins ,what is the probability that it played under bad weather [4marks]

[Total marks 25]

Question Four

(a) Determine the area of the Z- score

$P(-2.23 \leq Z \leq 2.23)$ **[3marks]**

(b) An electrical firm supplies bulbs that have a length of life that is approximately normally distributed with a standard deviation of 20 hours. If a random sample of 40 bulbs has an average of life of 800hours.

(i)find a 95% confidence interval for the population mean life of all bulbs supplied by the firm **[5marks]**

(ii)find a 99% confidence interval for the population mean life of all bulbs supplied by the firm **[5marks]**

(c) The time needed to service a car at the filling station is exponential random variable with a mean of 2 minutes. Determine the probability that a newly arriving car will be serviced as follows:

(i) Within 1 minute? **[3marks]**

(ii) Atleast 120 seconds? **[4marks]**

(iii) Between 1 and 2 minutes? **[5marks]**

[Total marks 25]

Question Five

(a) Suppose you want to be deposit k200 in the bank that pays 6% interest rate per annum for 10 years.Find the future value of this deposit after 10 years? **[5marks]**

(b) Ms Kahilu borrows k20000 from a bank at an interest rate of 10% and agrees to make equal annual payments for 5years

(i) Calculate the equalannual payment **[6marks]**

(ii) Prepare a loan amortisation schedule for Ms kahilu [14marks

[Total Marks 25]

Question Six

(a) The profit to be realised from a certain business venture to the nearest k1000 are believed to follow the probability distribution shown below;

X	-2000	-1000	0	1000	2000	3000
P(X = x)	0.2	0.25	0.1	0.15	K	0.05

(i)Calculate the value of k [3marks

(ii) Find The probability thatthe business venture

(a) Makes a loss **[2marks]**

(b) Realises profit of at least k2000 **[2marks]**

(iii) Find (a) the expected earnings **[3marks]**

(b)standard deviation **[4marks]**

(b) Suppose the investment project has the following cashflows;

Years	Cashflows (k000)
0	-300
1	90
2	110
3	130
4	140

Assuming 8% discount factor compounded annually, calculate the net present value of this project and interpret it.

[11 marks]

[Total marks 25]

Chalimbana University

SCHOOL OF LEADERSHIP AND BUSINESS MANAGEMENT

BMT1100 ASSIGMENT 1&2

Due dates : Assignment one -hard in on open date.

Assignment two – two weeks after the date of opening

ASSIGMENT ONE

1.(a)Differentiate $x^3 + 2x^2 - 7x - 3$

(b)Evaluate the determinant of the following matrix and find its inverse

$$D=\begin{bmatrix}1 & 0 & -2\\ 2 & 2 & 3\\ 1 & 3 & 2\end{bmatrix}$$

2.Two events A and B are such that $P(A) = \frac{1}{4}$, $P(A|B) = \frac{1}{2}$ and $P(B|A) = \frac{2}{3}$

(i) Are A and B independent events?

(ii) Are A and B mutually exclusive events?

(iii) Find $P(B \cap A)$

(iv) Find P(B)

3. The random variable X has the following distribution for x = 1,2,3,4

X	1	2	3	4
P(X = x)	0.05	0.35	k	0.1

(a) Find the value of k

(b) Calculate the (i) expected value

ASSIGMENT TWO

1.Given the standard normal distribution , find

(a) $P(Z > 1.64)$

(b) The value of a such that $P(Z < a) = 0.0427$

(c) The value of a such that $P(-0.93 < Z < a) = 0.7735$

2.If X is normally distributed with mean 50 and standard deviation 5

Find (i) $P(X < 47)$ (ii) $P(X > 55)$ (iii) $P(48 \leq X \leq 57)$

3. A University has found that 20% of its students withdraw without completing the introductory statistics course. Assume that 20 students have registered for the course this semester.

(i) What is the probability that three or fewer will withdraw?

(ii) What is the probability that exactly five will withdraw?

(iii) What is the probability that more than four will withdraw?

(iv) What is the expected number of withdraw?

4.In order to start his own Fashion Technical business, Chikondi borrowed K25,000 from his bank at a stated interest rate of 6% and agreed to repay the loan in equal monthly instalments over 2 years.

Required:

(a) Calculate the effective annual rate of interest.

(b) Calculate Chikondi's required monthly payments.

(c) Prepare an amortization schedule for the loan

(d) What is the difference between the effective annual rate and nominal rate of interest?

5. In a survey of 35 employees of a certain firm carried out in Chirqawe, 21 employees said they were willing to publicly disclose their HIV/AIDS status. Find the 95% confidence interval for the proportion of all employees who were willing to disclose their HIV/AIDS status.

(ii) variance

(iii) standard deviation

4. At a jewellery store , a sample of sales were classified as follows:

Value of sales (kwacha)	Number of sales
15-25	10
25-35	35
35-45	40
45-55	10
55-65	8
65-75	7

(i) Plot the histogram
(ii) Calculate the sample mean
(iii) Calculate the mode
(iv) Calculate the mediam
(v) Calculate the variance
(vi) Calculate the standard deviation
(vii) Calculate the mean deviation
(viii) Calculate the coefficient of variation.

1. Evaluate $8p_2$

$$\frac{n!}{(n-r)!} = \frac{8!}{(8-2)!} = \frac{8\times7\times6\times5\times4\times3\times2\times1}{6\times5\times4\times3\times2\times1}$$ [2marks]

2. A delegation of 3 students is to be chosen from a class of 15.

In how many ways can this be done?

$$\frac{n!}{r!(n-r)!} = \frac{15!}{3!(15-3)!}$$ [2marks]

i) The class consists of 10 girls and 5 boys .if two of the delegates are to be girls and the other is to be a boy, in how many ways can this be done?

$$10C_2 \times 5C_1 = \frac{10!}{2!(10-2)!} \times \frac{5!}{1!(5-1)!} = \frac{120}{24} \times \frac{3628800}{80640} = 5\times45 = 225$$ [3marks]

ii) If the delegation is to include at least one boy and at least one girl, in how many ways can this be done?

$$10C_3 \times 5C_2 = \frac{n!}{r!(n-r)!} = \frac{10!}{3!(10-3)!} \times \frac{5!}{2!(5-2)!}$$

$$\frac{3628800}{34240} \times \frac{120}{12} = 120 \times 10 = 1200$$ [4marks]

3. An ice cream vendor's daily sales vary with the weather as shown below:

weather	probability	Sales(k)
Suny	0.2	500
Cloudy	0.4	300
rainy	0.4	100

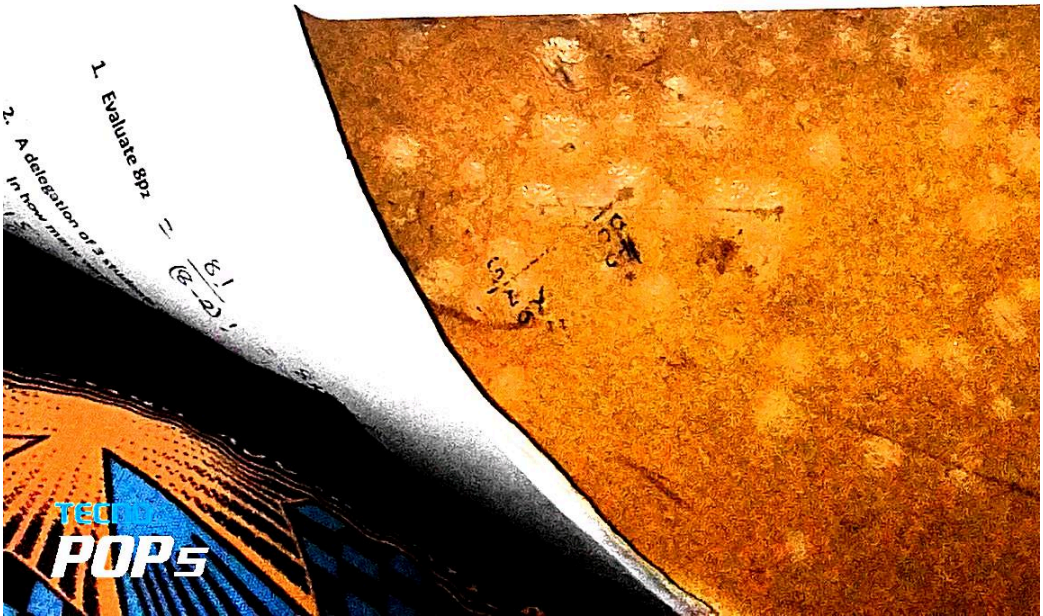
ie i) vendor's expected daily sales

fx	fx^2
00	50,000
20	36,000
0	4,000

$$\text{mean} = \frac{\Sigma fx}{\Sigma f}$$

$$\frac{260}{1}$$ [4marks]

$$\bar{x} = 260$$



1. Evaluate $_8P_2 = \frac{8!}{(8-2)!} = \frac{8\times7\times6!}{6!} = 56$ [2marks]

2. A delegation of 3 students is to be chosen from a class of 15.

In how many ways can this be done?

$$_{15}C_3 = \frac{15!}{3!(15-3)!} = 455$$

[2marks]

i) The class consists of 10 girls and 5 boys .if two of the delegates are to be girls and the other is to be a boy, in how many ways can this be done?

$$_{10}C_2 \times {}_5C_1 = \frac{10!}{2!(10-2)!} \times \frac{5!}{1!(5-1)!} = 45\times5 = 225$$

[3marks]

ii) If the delegation is to include at least one boy and at least one girl, in how many ways can this be done?

$$_{10}C_1 \times {}_5C_2 \text{ or } {}_{10}C_2 \times {}_5C_1$$

$$\frac{10!}{1!(10-1)!} \times \frac{5!}{2!(5-2)!} + \frac{10!}{2!(10-2)!} \times \frac{5!}{1!(5-1)!} = 10\times10 + 225 = 325$$

[4marks]

3. An ice cream vendor's daily sales vary with the weather as shown below:

weather	probability	Sales(k)
Sunny	0.2	500
Cloudy	0.4	300
rainy	0.4	100

Calculate the i) vendor's expected daily sales

$$E(x) = 0.2\times500 + 0.4\times300 + 0.4\times100$$

$$= 260$$

[4marks]

median $= L + \left(\frac{\frac{n}{2} - cf}{f}\right) c$

ii) median

$= 30 + \left(\frac{37}{2} - 10\right) 10$

$= 30 + (8.5)10$

$= 30 + (85) = \underline{115}$

[4marks]

iii) standard deviation

Variance $= \frac{\Sigma fx^2 - \frac{(\Sigma fx)^2}{\Sigma f}}{\Sigma f - 1}$

$= \frac{55,125 - \frac{(1365)^2}{37}}{}$

$= 55,125 - 1,863225$

~~$= 50357.43$~~

$= 55125 - 50357.43$

$= 4767.57$

Standard deviation $= \sqrt{\text{Variance}}$

Standard deviation $= \sqrt{4767.57}$

S.D $= \underline{69.047}$

[5 marks]

Happy Easter holiday

Variance $= \frac{\sum fx^2 - \frac{(\sum fx)^2}{\sum f}}{\sum f - 1} = \frac{90,000 - \frac{(260)^2}{1}}{1-1}$

ii)standard deviation of daily sales

90000 − 67600 = 22,400

Variance = 22,400

S.D = $\sqrt{Variance}$ = $\sqrt{22,400}$

S.D = 149.666

[6marks]

4. The annual profits made by a random sample of 37 companies in the textiles industry are shown in the table below;

Profit (k000)	Number of companies
10 ≤ x ≤ 20	3
20 ≤ x ≤ 30	7
30 ≤ x ≤ 40	12
40 ≤ x ≤50	10
50 ≤ x ≤60	5

Calculate the i) mean

x	f	fx	cf	fx^2
15	3	45	3	675
25	7	175	10	4375
35	12	420	22	14,700
45	10	450	32	20,250
55	5	275	37	15,125
	$\sum f = 37$	$\sum fx = 1365$		$\sum fx^2$ 55,125

mean = $\bar{x} = \frac{\sum fx}{\sum f}$

$\bar{x} = \frac{1365}{37}$

$\bar{x}$ = 36.89

[6marks]

64

23/24

Question one

(a) Evaluate 12 +(−10)

(b) Find the integral of $\int (4x^3 + 2x^2$

(c) Express ...

Question one

(a) Evaluate 12 +(-10) **[2marks]**

(b) Find the integral of $\int (4x^3 + 2x^2 - 6x + 3)dx$ **[3marks]**

(c) Express the $\log_{10} 2 + \log_{10} b$ as a single logarithm **[3marks]**

(d)A company has three plants. Each plant employs manager, foreman and skilled labourers as follows:

	Plant A	Plant B	Plant C
Managers	1	2	1
Foreman	4	6	4
Skilled labour	80	96	75

If managers are paid k350 a week, foreman k275 and skilled labour k200. Use matrices to find the total payroll of each plant **[6marks]**

(e) Use any method to solve the following system of equation.

$$4x + y + 3z = 8$$
$$-2x + 5y + z = 4$$
$$3x + 2y + 4z = 9$$

[10marks]

Total marks

25

Question Two

(a) Classify the following variables as discrete or continuous

(i) The weight of a person **[1mark]**

(ii) Total scores for the game between Zambia vs Algeria **[1mark]**

(iii) Prime numbers less than ten **[1mark]**

(iv) The earning per month for the government worker **[1mark]**

(v) The capacity of water in a dam **[1mark]**

(b) The annual profits made by a random sample of 37 companies in the textiles industry are shown in the table below:

SECTION A: [60 marks - Answer all questions: compulsory]

1. The following data sets are returns on investment obtained from a company that invested into two products.

   Product A: 34, 42, 36, 38, 45, 40, 32, 34, 39, 41

   Product B: 21, 24, 32, 64, 50, 35, 28, 30, 42, 55

   a. Calculate the mean score for each product
   b. Find the standard deviation for each product
   c. Calculate the coefficient of variation (CV) for each product.
   d. Using the answers obtained in part (c) above or otherwise, which product was more consistent in their returns? Justify your answer. **[20 marks]**

2. The amounts (K'000) randomly deposited by workers at a named bank in Kitwe are as follows:

34	28	46	37	33	24	29	45	37	34
32	25	50	54	32	36	38	41	38	44
28	43	40	49	30	46	27	34	61	33

   a. Display the data presented above on a stem and leaf display
   b. Find
      i. Mean
      ii. Variance
      iii. Standard deviation **[20 Marks]**

3. The number of Covid-19 vaccines manufactured by a pharmaceutical company per month is a random variable with the following probability distribution.

Number of Covid-19 Vaccines Manufactured (X)	19	20	21	22
P(X =x)	0.4	K	0.2	0.15

   a. Calculate the value of K
   b. Find the probability that the number of Covid-19 vaccines that will be manufactured next month is at least 20
   c. Find the probability that the number of Covid-19 vaccines manufactured per month is at most 21
   d. Find the expected number of Covid-19 vaccines manufactured per month. **[20 Marks]**

SECTION B: [40 marks – Answer All Any Two questions in this section]
Each Question Carry Equal Marks in this Section

1. (a) Compute the exact value of each of the following:
   (i) C_3^7
   (ii) 6!
   (iii) $\ln e^{4x} = 8$

   (b) Given a random variable X which is normally distributed with mean 15 and standard deviation 10, find:
   i. P (X < 20)
   ii. P (X > 12)

16335-

iii. $P(12 < X < 20)$

[20 Marks]

2. An indigenous Zambian Investor wants to decide which of the three sectors he should invest his money. The profit from each sector is dependent on the changes in demand during the investment periods. The investor has categorised changes in demand as high, medium, low. His estimated profit for each sector is shown in the table below:

Changes in Demand	Agriculture Sector	Energy Sector	Tourism Sector
High	$8,000	$3,500	$5,000
Medium	$4,500	$4,500	$5,000
Low	$2,000	$5,000	$4,000

If the investor wishes to invest his money only in one sector, decide which sector will be his choice using:

a) Maximax Criterion (Optimistic Approach)
b) Maximin Criterion (Conservative Approach)
c) Minimax Criterion (Regret Approach)

[20 Marks]

3. A new Covid-19 vaccine is 0.7 effective of the disease cases treated. Six patients suffering from Covid-19 are to be treated.
Find

a) The mean of the number of patients successfully treated
b) The variance of the number of patients successfully treated
c) The standard deviation of the number of patients successfully treated **[20 marks]**

4. Answer all parts in this question.

a) State any four properties of a normal distribution
b) Solve the equations simultaneously using Cramer's Rule

$$4x+y+z=0$$
$$2x+3x+z=0$$
$$x+y+0z=1$$

$$x-2y-3z=0$$
$$3x+5y+2z=0$$
$$2x+3y-z=2$$

c) Comment on the major difference between standard deviation and standard error.

5. In this question, use as much information on the sheet of formulae as possible.

a) What do you consider to be the main difference between type I and Type II errors in Hypothesis testing?
b) An investment analyst claims that the average annual return on services in the tourism industry is 12%. You want to test whether this claim is true. You collect a random sample of 36 services in the tourism industry and find that the average annual return is 10% with a standard deviation of 3%. Use a 5% level of significance to test the analyst's claim.

[20 Marks]

FUTURE BOSS

END OF EXAMINATION

#TAG

1. a) Which of the following variables are discrete and which are continuous

i) Number of accidents per week on great east road = discrete [1mark]

ii) Volume of water in a quarter tank = discrete [1mark]

iii) Quantity of natural gas used per month for heating an apartment building [1mark] = discrete

iv) The weight of a person = Continuous [1mark]

b) During a certain month sales man's weekly incomes were as follows: 180,165,190, 170 and 200. Compute the following descriptive statistics for these data:

i) range [2marks]

range = max − min value

range = 200 − 165 = 35

ii) Sample mean [3marks]

$$\text{mean} = \frac{\Sigma x}{n} = \frac{905}{5} = 181$$

iii) sample standard deviation [4marks]

$$\text{Variance} = \frac{\Sigma x^2 - \frac{(\Sigma x)^2}{n}}{n-1} = \frac{164{,}675 - \frac{(905)^2}{5}}{5-1} = \frac{164{,}675 - 163{,}805}{4} = 205$$

$$\sigma = \sqrt{\text{Variance}} = \sqrt{205} \quad \sigma = 14.317$$

2. The probability distribution of a random variable X is given by:

X	-1	0	1	2
P(X=x)	0.03	0.70	k	0.09

Calculate i) the value of k [2marks]

$0.03 + 0.70 + k + 0.09 = 1$

$0.85 + k = 1 \Rightarrow k = 1 - 0.85$

$k = 0.18$

ii) the expected value [3 marks]

Expected value = Σx

Expected value = 2

(iii) the variance

Σx^2

which are continuous
d – discrete

[1mar
[1mark
ing an apartment building
[1mark]
llows: 180,165,190,

iii) the variance

$= \frac{\Sigma x^2 - \frac{(\Sigma x)^2}{n}}{n-1} = \frac{6 - \frac{(4)^2}{4}}{3} = \frac{5}{3}$

$= \frac{6 - \frac{(2)^2}{4}}{4-1} = \frac{6-1}{3}$

$= 1.6667$

Variance $= 1.6667$ [4marks]

iv) the standard deviation

$\sigma = \sqrt{\text{variance}}$ $\sigma = 1.2909$

$= \sqrt{1.66666}$

[2marks]

3. IF 80% of the bolts produced by a machine are good, determine the probability that out of 4 bolts chosen at random

$n = 4$
$p = 80\%$
$q = 20\%$

[1 mark]

(i) One bolt will be defective

$P(x=1) = {}^nC_r p^r q^{n-r} = {}^4C_1 p^1 q^{4-1} = {}^4C_1 (0.8)^1 (0.2)^3$

$= 4 \times 0.8 \times 0.008$ $P(x=1) = 0.0256\%$

[1 mark]

(ii) Zero bolt will be defective

$P(x=0) = {}^4C_0 p^0 q^{4-0} = {}^4C_0 (0.8)^0 (0.2)^4 = 1 \times 1 \times 0.0016$

$P(x=0) = 0.0016\%$

(iii) At most two bolts will be defective

[4marks]

$P(x \leq 2) = [{}^4C_0 p^0 q^{4-0} + {}^4C_1 p^1 q^{4-1}] - 1$

$[{}^4C_0 (0.8)^0 (0.2)^4 + {}^4C_1 (0.8)^1 (0.2)^3] - 1$

$[0.0256 + 0.0016] - 1$

$P(x \leq 2) = 0.9728$

4. (a) A financial adviser wants to create a portfolio consisting of eight stocks and bonds. If twelve stocks and seven bonds are acceptable for the portfolio, in how ways can the portfolio be created?

$^{12}C_8 \times {}^{7}C_{7}$

$495 \times 35 = 17,325$ ways [3 marks]

(b) An opinion survey of 250 adults resident of Chalimbana was conducted. Each person was asked their opinion about the contribution to construct a new hostile at Chalimbana University and the response are shown in the table below.

	favour	Oppose	Total
Male	85	45	130
Female	65	55	120
total	150	100	250

Suppose an adult resident is chosen at random,

(i) find the probability of choosing a male adult resident

$P(\text{choosing a male adult}) = \frac{130}{250}$ [2marks]

(ii) find the probability of choosing an adult who is opposing

$P(\text{choosing an opposing adult}) = \frac{100}{250}$ [2 marks]

(iii) find the probability of choosing an adult in favour, given that the adult is female

Let A be p(choosing an adult in favour) Let B be p(choosing a female)

$P(A/B) = \frac{P(A \cap B)}{P(B)} = \frac{65/250}{120/250} = \frac{0.26}{0.48}$ $P(A/B) = \frac{13}{24}$ [6marks]

5. a)The time needed to service a car at the filling station is exponential random variable with a mean of 2 minutes. Determine the probability that a newly arriving car will be serviced as follows:

(i) Within 1 minute? [3marks]

$P(x = 1\text{min}) = \frac{\lambda^{x} e^{-\lambda}}{x!} = \frac{2^{1} e^{-2}}{1!} = \frac{1.86466}{1!} = 1.86466$

(ii) Atleast 120 seconds? (4marks)

$P(x=2) = \frac{2^2 e^{-2}}{2!} = \frac{4 \times 0.135335}{2}$

(iii) Between 1 and 2 minutes? (4marks)

b) Given that $Z \sim N(0,1)$. find: a) $P(Z > -1.65)$ (3marks)

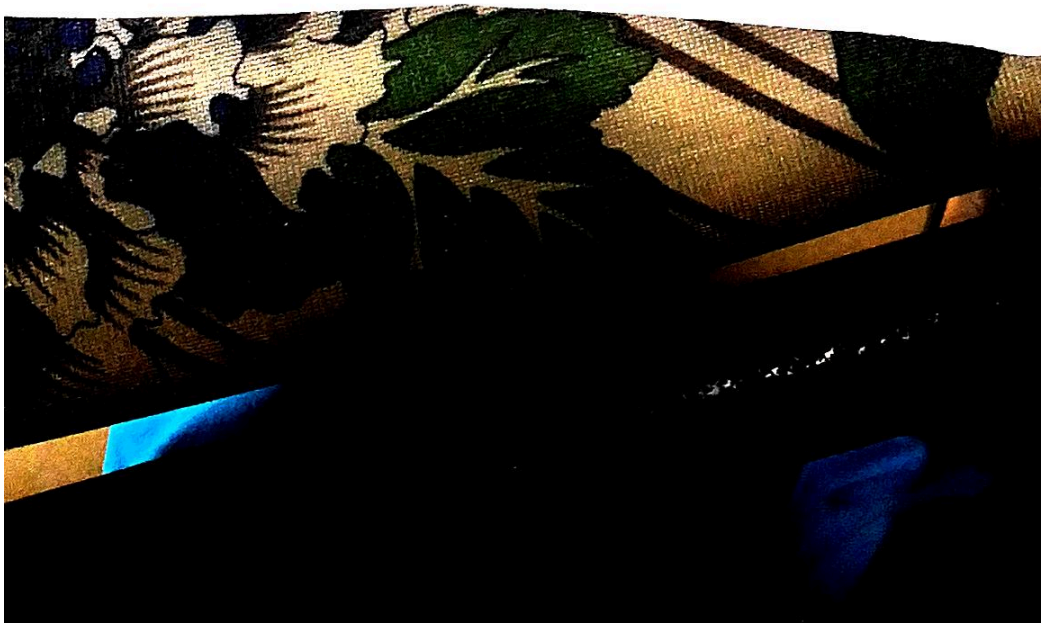
$P(Z > -1.65) = 0.4515$

b) $P(-2.56 < Z < 2.56)$ (3marks)

$P(-2.56 < Z < 2.56) = 0.4948 + 0.4948 = 0.9896$

t-distribution

				Confidence Level						
	60%	70%	80%	85%	90%	95%	98%	99%	99.8%	99.9%
2 Tailed	0.40	0.30	0.20	Level of Significance						
1 Tailed	0.20	0.15	0.10	0.15	0.10	0.05	0.02	0.01	0.002	0.001
				0.075	0.05	0.025	0.01	0.005	0.001	0.0005
df										
1	1.376	1.963	3.133	4.195	6.320	12.69	31.81	63.67	—	—
2	1.060	1.385	1.883	2.278	2.912	4.271	6.816	9.520	19.65	26.30
3	0.978	1.250	1.637	1.924	2.352	3.179	4.525	5.797	9.937	12.39
4	0.941	1.190	1.533	1.778	2.132	2.776	3.744	4.596	7.115	8.499
5	0.919	1.156	1.476	1.699	2.015	2.570	3.365	4.030	5.876	6.835
6	0.906	1.134	1.440	1.650	1.943	2.447	3.143	3.707	5.201	5.946
7	0.896	1.119	1.415	1.617	1.895	2.365	2.999	3.500	4.783	5.403
8	0.889	1.108	1.397	1.592	1.860	2.306	2.897	3.356	4.500	5.039
9	0.883	1.100	1.383	1.574	1.833	2.262	2.822	3.250	4.297	4.780
10	0.879	1.093	1.372	1.559	1.813	2.228	2.764	3.170	4.144	4.586
11	0.875	1.088	1.363	1.548	1.796	2.201	2.719	3.106	4.025	4.437
12	0.873	1.083	1.356	1.538	1.782	2.179	2.682	3.055	3.930	4.318
13	0.870	1.079	1.350	1.530	1.771	2.160	2.651	3.013	3.852	4.221
14	0.868	1.076	1.345	1.523	1.761	2.145	2.625	2.977	3.788	4.141
15	0.866	1.074	1.341	1.517	1.753	2.131	2.603	2.947	3.733	4.073
16	0.865	1.071	1.337	1.512	1.746	2.120	2.584	2.921	3.687	4.015
17	0.863	1.069	1.333	1.508	1.740	2.110	2.567	2.899	3.646	3.965
18	0.862	1.067	1.330	1.504	1.734	2.101	2.553	2.879	3.611	3.922
19	0.861	1.066	1.328	1.500	1.729	2.093	2.540	2.861	3.580	3.884
20	0.860	1.064	1.325	1.497	1.725	2.086	2.529	2.846	3.552	3.850
21	0.859	1.063	1.323	1.494	1.721	2.080	2.518	2.832	3.528	3.820
22	0.858	1.061	1.321	1.492	1.717	2.074	2.509	2.819	3.505	3.792
23	0.857	1.060	1.319	1.489	1.714	2.069	2.500	2.808	3.485	3.768
24	0.857	1.059	1.318	1.487	1.711	2.064	2.493	2.797	3.467	3.746
25	0.856	1.058	1.316	1.485	1.708	2.060	2.486	2.788	3.451	3.725
26	0.856	1.058	1.315	1.483	1.706	2.056	2.479	2.779	3.435	3.707
27	0.855	1.057	1.314	1.482	1.703	2.052	2.473	2.771	3.421	3.690
28	0.855	1.056	1.313	1.480	1.701	2.048	2.468	2.764	3.409	3.674
29	0.854	1.055	1.311	1.479	1.699	2.045	2.463	2.757	3.397	3.660
30	0.854	1.055	1.310	1.477	1.697	2.042	2.458	2.750	3.386	3.646
40	0.851	1.050	1.303	1.468	1.684	2.021	2.424	2.705	3.307	3.551
50	0.849	1.047	1.299	1.462	1.676	2.009	2.404	2.678	3.262	3.496
60	0.848	1.045	1.296	1.458	1.671	2.000	2.391	2.661	3.232	3.460
70	0.847	1.044	1.294	1.456	1.667	1.994	2.381	2.648	3.211	3.435
80	0.846	1.043	1.292	1.453	1.664	1.990	2.374	2.639	3.196	3.417
90	0.846	1.042	1.291	1.452	1.662	1.987	2.369	2.632	3.184	3.402
100	0.845	1.042	1.290	1.451	1.660	1.984	2.365	2.626	3.174	3.391
∞	0.842	1.036	1.282	1.440	1.645	1.960	2.327	2.576	3.091	3.291



	0	0.01	0.02	0.03	0.04	0.05	0.06	0.07	0.08	0.09
0	0	0.004	0.008	0.012	0.016	0.0199	0.0239	0.0279	0.0319	0.0359
0.1	0.0398	0.0438	0.0478	0.0517	0.0557	0.0596	0.0636	0.0675	0.0714	0.0753
0.2	0.0793	0.0832	0.0871	0.091	0.0948	0.0987	0.1026	0.1064	0.1103	0.1141
0.3	0.1179	0.1217	0.1255	0.1293	0.1331	0.1368	0.1406	0.1443	0.148	0.1517
0.4	0.1554	0.1591	0.1628	0.1664	0.17	0.1736	0.1772	0.1808	0.1844	0.1879
0.5	0.1915	0.195	0.1985	0.2019	0.2054	0.2088	0.2123	0.2157	0.219	0.2224
0.6	0.2257	0.2291	0.2324	0.2357	0.2389	0.2422	0.2454	0.2486	0.2517	0.2549
0.7	0.258	0.2611	0.2642	0.2673	0.2704	0.2734	0.2764	0.2794	0.2823	0.2852
0.8	0.2881	0.291	0.2939	0.2967	0.2995	0.3023	0.3051	0.3078	0.3106	0.3133
0.9	0.3159	0.3186	0.3212	0.3238	0.3264	0.3289	0.3315	0.334	0.3365	0.3389
1	0.3413	0.3438	0.3461	0.3485	0.3508	0.3531	0.3554	0.3577	0.3599	0.3621
1.1	0.3643	0.3665	0.3686	0.3708	0.3729	0.3749	0.377	0.379	0.381	0.383
1.2	0.3849	0.3869	0.3888	0.3907	0.3925	0.3944	0.3962	0.398	0.3997	0.4015
1.3	0.4032	0.4049	0.4066	0.4082	0.4099	0.4115	0.4131	0.4147	0.4162	0.4177
1.4	0.4192	0.4207	0.4222	0.4236	0.4251	0.4265	0.4279	0.4292	0.4306	0.4319
1.5	0.4332	0.4345	0.4357	0.437	0.4382	0.4394	0.4406	0.4418	0.4429	0.4441
1.6	0.4452	0.4463	0.4474	0.4484	0.4495	0.4505	0.4515	0.4525	0.4535	0.4545
1.7	0.4554	0.4564	0.4573	0.4582	0.4591	0.4599	0.4608	0.4616	0.4625	0.4633
1.8	0.4641	0.4649	0.4656	0.4664	0.4671	0.4678	0.4686	0.4693	0.4699	0.4706
1.9	0.4713	0.4719	0.4726	0.4732	0.4738	0.4744	0.475	0.4756	0.4761	0.4767
2	0.4772	0.4778	0.4783	0.4788	0.4793	0.4798	0.4803	0.4808	0.4812	0.4817
2.1	0.4821	0.4826	0.483	0.4834	0.4838	0.4842	0.4846	0.485	0.4854	0.4857
2.2	0.4861	0.4864	0.4868	0.4871	0.4875	0.4878	0.4881	0.4884	0.4887	0.489
2.3	0.4893	0.4896	0.4898	0.4901	0.4904	0.4906	0.4909	0.4911	0.4913	0.4916
2.4	0.4918	0.492	0.4922	0.4925	0.4927	0.4929	0.4931	0.4932	0.4934	0.4936
2.5	0.4938	0.494	0.4941	0.4943	0.4945	0.4946	0.4948	0.4949	0.4951	0.4952
2.6	0.4953	0.4955	0.4956	0.4957	0.4959	0.496	0.4961	0.4962	0.4963	0.4964
2.7	0.4965	0.4966	0.4967	0.4968	0.4969	0.497	0.4971	0.4972	0.4973	0.4974
2.8	0.4974	0.4975	0.4976	0.4977	0.4977	0.4978	0.4979	0.4979	0.498	0.4981
2.9	0.4981	0.4982	0.4982	0.4983	0.4984	0.4984	0.4985	0.4985	0.4986	0.4986
3	0.4987	0.4987	0.4987	0.4988	0.4988	0.4989	0.4989	0.4989	0.499	0.499

S TATISTICAL FORMULAE

(a) Descriptive statistics

i) Mean $=\frac{\Sigma x}{n}$ ungrouped data

ii) Mean $=\frac{\Sigma fx}{\Sigma f}$ grouped data

iii) $\text{Var}(x) = E(x^2) - (E(x))^2$

iv) Variance $s^2 = \frac{\Sigma x^2 - \frac{(\Sigma x)^2}{n}}{n-1}$

v)

(b) Conditional Probability

i) $P(A/B) = \frac{P(A \cap B)}{P(B)}$

ii) $P(A \cap B) = P(A)\ X\ P(B)$

(c) Financial mathematics

i) $FV = PV(1+r)^n$ where FV is the future value

PV is the present value

n is the number of years for the investment.

r is the interest rate for the period

ii) $A = P + Prt$ Where P is the principle amount,

r is the interest rate for the time period t

iii) $FV = \frac{A[(1+r)^n - 1]}{r}$ where , A is an annuity cash flow.

iv) $PV = \frac{A[1-(1+r)^{-n}]}{r}$

(ii) Prepare [illegible]tisation schedule for Ms kahilu **[14marks**

[Total Marks 25]

Question Six

(a) The profit to be realised from a certain business venture to the nearest k1000 are believed to follow the probability distribution shown below;

X	-2000	-1000	0	1000	2000	3000
P(X = x)	0.2	0.25	0.1	0.15	K	0.05

(i)Calculate the value of k **[3marks**

(ii) Find The probability thatthe business venture

(a) Makes a loss **[2marks]**

(b) Realises profit of at least k2000 **[2marks]**

(iii) Find (a) the expected earnings **[3marks]**

(b)standard deviation **[4marks]**

(b) Suppose the investment project has the following cashflows;

Years	Cashflows (k000)
0	-300
1	90
2	110
3	130
4	140

Assuming 8% discount factor compounded annually, calculate the net present value of this project and interpret it. **[11 marks]**

[Total marks 25]

(b) The team loses [5Marks]

vi) Give that the team wins ,what is the probability that it played under bad weather [4marks]

[Total marks 25]

Question Four

(a) Determine the area of the Z- score

$P(-2.23 \leq Z \leq 2.23)$ [3marks]

(b) An electrical firm supplies bulbs that have a length of life that is approximately normally distributed with a standard deviation of 20 hours. If a random sample of 40 bulbs has an average of life of 800hours.

(i)find a 95% confidence interval for the population mean life of all bulbs supplied by the firm [5marks]

(ii)find a 99% confidence interval for the population mean life of all bulbs supplied by the firm [5marks]

(c) The time needed to service a car at the filling station is exponential random variable with a mean of 2 minutes. Determine the probability that a newly arriving car will be serviced as follows:

(i) Within 1 minute? [3marks]

(ii) Atleast 120 seconds? [4marks]

(iii) Between 1 and 2 minutes? [5marks]

Question Five [Total marks 25]

(a) Suppose you want to be deposit k200 in the bank that pays 6% interest rate per annum for 10 years.Find the future value of this deposit after 10 years? [5marks]

(b) Ms Kahilu borrows k20000 from a bank at an interest rate of 10% and agrees to make equal annual payments for 5years

(i) Calculate the equalannual payment [6marks]

Profit (k000)	Number of companies
$10 \leq x \leq 20$	3
$20 \leq x \leq 30$	7
$30 \leq x \leq 40$	12
$40 \leq x \leq 50$	10
$50 \leq x \leq 60$	5

Calculate the

(i) Mean **[4marks]**

(ii) Median **[3marks]**

(iii) Variance **[5marks]**

(iv) Standard deviation **[4marks]**

(v) Coefficient variation **[4 marks]**

[Total Marks 25]

Question Three

(a)Evaluate $11p_2$ **[2marks]**

(b) How many different committees of 3 businessman can be chosenfrom 7 businessman **[2marks]**

(c) In how many ways can 8 boxes of sweets be arranged on a shelf in a shop **[3marks]**

(d) The sports team is interested in whether the weather has an effect on their result. The results are summarised in the table

	Good weather	Bad weather	totals
Win	12	4	16
lose	5	10	15
totals	17	14	31

(i) Find the probability of the team winning **[2marks]**

ii) What is the probability of the team playing in bad weather **[2marks]**

iii) Give that the team played in good weather, what is the probability that i

(a) The team wins **[5marks]**

Question one

(a) Evaluate 12 +(-10) **[2marks]**

(b) Find the integral of $\int (4x^3 + 2x^2 - 6x + 3)dx$ **[3marks]**

(c) Express the $\log_{10} 2 + \log_{10} b$ as a single logarithm **[3marks]**

(d)A company has three plants. Each plant employs manager, foreman and skilled labourers as follows:

	Plant A	Plant B	Plant C
Managers	1	2	1
Foreman	4	6	4
Skilled labour	80	96	75

If managers are paid k350 a week, foreman k275 and skilled labour k200. Use matrices to find the total payroll of each plant **[6marks]**

(e) Use any method to solve the following system of equation.

$$4x + y + 3z = 8$$
$$-2x + 5y + z = 4$$
$$3x + 2y + 4z = 9$$

[10marks]

Total marks 25

Question Two

(a) Classify the following variables as discrete or continuous

(i) The weight of a person **[1mark]**

(ii) Total scores for the game between Zambia vs Algeria **[1mark]**

(iii) Prime numbers less than ten **[1mark]**

(iv) The earning per month for the government worker **[1mark]**

(v) The capacity of water in a dam **[1mark]**

(b) The annual profits made by a random sample of 37 companies in the textiles industry are shown in the table below:

STATISTICAL FORMULAE

(a) Descriptive statistics

i) Mean $= \frac{\Sigma x}{n}$ ungrouped data

ii) Mean $= \frac{\Sigma fx}{\Sigma f}$ grouped data

iii) $\text{Var(x)} = \text{E}(x^2) - (E(x))^2$

iv) Variance $s^2 = \frac{\Sigma x^2 - \frac{(\Sigma x)^2}{n}}{n-1}$

(b) Conditional Probability

i) $\text{P}(A/B) = \frac{P(A \cap B)}{P(B)}$

ii) $\text{P}(A \cap B) = P(A)\ X\ P(B)$

(c) Financial mathematics

i) $FV = PV(1+r)^n$ where FV is the future value

PV is the present value

n is the number of years for the investment.

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ii) $A = \text{P} + \text{Prt}$ Where P is the principle amount,

r is the interest rate for the time period t

iii) $FV = \frac{A[(1+r)^n - 1]}{r}$

iv) $PV = \frac{A[1-(1+r)^{-n}]}{r}$ where , A is an annuity cash flow.

FV = PV $(1+r)^n$

PV = FV $(1+r)^n$

= focast and planning.

= Need Clarification

= Supplier Selection / evaluation.

= Contract or purchasing order generation.

=

=

Question Six

(a) The probability distribution of a random variable X is given by;

x	0	1	2	3	4
P(X = x)	0.2	0.15	0.34	k	0.1

Calculate (i) the value of k [3marks]

(ii) the expected value [4marks]

(iii) the variance [5marks]

(iv) Standard deviation [2marks]

(b) Suppose the investment project has the following cash flows;

years	Cash flows (k000)	Discov D.F	P.V
0	-400		
1	120		
2	130		
3	140		
4	150		

Assuming 8% discount factor compounded annually, calculate the net present value of this project and interpret it.

[11 marks]

[Total marks 25]

0.2 + 0.5 + 0.34 + 0.1

1 − 0.79

= 0.21

NPV

Projo

Question Four

(a) Determine the area of the Z- score

(i) P (Z > 2.04)

(ii) P (Z < 1.45) [5marks]

(iii) P (-1.23 < Z < 1.14) [4marks]

[4marks]

(b) A University has found that 20% of its students withdraw without completing the introductory statistical course. Assume that 20 students have registered for the course this semester.

(i) What is the probability that three or fewer will withdraw? [5marks]

(ii) What is the probability that exactly five will withdraw? [4marks].

(iii) What is the expected number of withdraw? [3marks]

[Total marks 25]

Question Five

(a) Suppose you want to have k20000 in the bank that pays 6% interest rate per annum after 5years. How much are you supposed to deposit now? [5marks]

(b) A woman borrows k15000 at an interest rate of 10% and agrees to make equal semi-annually payments for 3 years

(i) Calculate the equal semi-annul payment

(ii) Prepare a loan amortisation schedule [6marks]

[14marks]

[Total Marks 25]

-0.05) - 6

Calculate the

(i) Range [2marks]

(ii) Mean [5marks]

(iii) Variance [5marks]

(iv) Standard deviation [4marks]

(v) Coefficient variation [4 marks]

[Total Marks 25]

Question Three

(a)Evaluate $7p_2$ [3marks]

(b) How many different committees of 4 businesswoman can be chosen 8 businesswoman [3marks]

(c) In how many ways can 8 boxes of sweets be arranged on a shelf in a shop [3marks]

(d) A market survey of 900 people found the following facts about the ability to recall a television commercial for a product and the actual purchase of the product.

	Recalled	Did Not Recall	Total
Purchased	175	115	290
Did Not Purchase	275	335	610
Total	450	450	900

Let A denote the event that a person could recall the television commercial and B denote the event that a person purchased the product.

(i) Find P(A) [2marks]

(ii) Find P(B) [2marks]

(iii) Find $P(A \cap B)$ [2marks]

(iv) Are A and B independent events? Use probability values to explain [5marks]

(v) What is the probability that a person who recalled seeing the television commercial actually purchased the product [5marks]

[Total marks 25]

Question one

(a) Evaluate -42 –(-40) **[2marks]**

(b) Find $\frac{dy}{dx}$ *for the equation* $y = x^3 + 2x^2 - 7x - 5$ **[3marks]**

(c) Express the $3\log_{10} 2 + \frac{1}{2}\log_{10} b - 2$ as a single logarithm **[5marks]**

(d) Solve the equation $x^2 + 5x + 6 = 0$ **[5marks]**

(e) Use any method to solve the following system of equation.

$x - 3y + z = 4$

$2x - 8y + 8z = -2$

$-6x + 3y - 15z = 9$

[10marks]

Total marks 25

Question Two

(a) Classify the following variables as qualitative or quantitative

(i) The colour of one's eyes **[1mark]**

(ii) The brand of the car owned by someone **[1mark]**

(iii) Prime numbers less than ten **[1mark]**

(iv) Marital status **[1mark]**

(v) The volume of water in a storage tank **[1mark]**

(b) Below are marks obtained by 100 students in BBA1 August intake in a mathematics test?

Marks obtained	Frequency
$0 \leq x \leq 20$	12
$20 \leq x \leq 40$	19
$40 \leq x \leq 60$	29
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(i) Calculate the equal semi-annul payment [6marks]

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[Total Marks 25]

1.Given that A = $\begin{bmatrix} 2 & 11 \\ -3 & 0 \\ 5 & 9 \end{bmatrix}$ and B = $\begin{bmatrix} 1 & 2 & 3 \\ 2 & 1 & 1 \\ 3 & 1 & -2 \end{bmatrix}$

Find (i) A^T **[2marks]**

(ii)BA **[3marks]**

(iii) A^2 **[3marks]**

2. A person wants to k2000 in his bank account in 5 years. How much should he deposit in the bank account that pays 10% interest rate if compounding is done

a) Yearly **[2marks]**
b) Quarterly **[2marks]**
c) Monthly **[2marks]**
d) Continuously **[2marks]**

3. Solve the system of simultaneous equation using cramer's rule

$$x + 2y + 3z = 9$$
$$2x - y + z = 8$$
$$3x - z = 3$$

[6marks]

4. (a) find the value of $(179)^0 + 1$ **[3marks]**

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0	-400
1	120
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Assuming 8% discount factor compounded annually, calculate the net present value of this project and interpret it. **[10 marks**

End :All the best

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(i) Calculate the equal semi-annul payment [6marks]

(ii) Prepare a loan amortisation schedule [14marks]

[Total Marks 25]

1. Evaluate a) $\log_{10} 100$

[2marks]

b) 24-(-10)

[1mark]

2. A person borrows k1000 from a bank at 10% p.a to be paid after 1 year.
   How much will s/he pay if compounding is done

   i) Once per year

[2marks]

   ii) Monthly

[2marks]

   iii) continously

[2marks]

3. Find the quadratic equation that has roots 6 and -1

[3marks]

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(b) The team loses [5Marks]

vi) Give that the team wins ,what is the probability that it played under bad weather [4marks]

[Total marks 25]

Question Four

(a) Determine the area of the Z- score

$P(-2.23 \leq Z \leq 2.23)$ **[3marks]**

(b) An electrical firm supplies bulbs that have a length of life that is approximately normally distributed with a standard deviation of 20 hours. If a random sample of 40 bulbs has an average of life of 800hours.

(i)find a 95% confidence interval for the population mean life of all bulbs supplied by the firm **[5marks]**

(ii)find a 99% confidence interval for the population mean life of all bulbs supplied by the firm **[5marks]**

(c) The time needed to service a car at the filling station is exponential random variable with a mean of 2 minutes. Determine the probability that a newly arriving car will be serviced as follows:

(i) Within 1 minute? $P(x \geq a) e^{-\lambda a}$ **[3marks]**

(ii) Atleast 120 seconds? $P(x \geq a) 1 - e^{-\lambda a}$ **[4marks]**

(iii) Between 1 and 2 minutes? $P(a \leq x \leq b) = e^{-\lambda a} - e^{-\lambda b}$ **[5marks]**

[Total marks 25]

Question Five

(a) Suppose you want to be deposit k200 in the bank that pays 6% interest rate per annum for 10 years.Find the future value of this deposit after 10 years? **[5marks]**

(b) Ms Kahulu borrows k20000 from a bank at an interest rate of 10% and agrees to make equal annual payments for 5years

(i) Calculate the equalannual payment **[6marks]**

(ii) Prepare a loan amortisation schedule for Ms kalulu [14marks

[Total Marks 25]

Question Six

(a) The profit to be realised from a certain business venture to the nearest k1000 are believed to follow the probability distribution shown below;

X	-2000	-1000	0	1000	2000	3000
P(X = x)	0.2	0.25	0.1	0.15	K	0.05

(i)Calculate the value of k [3marks

(ii) Find The probability thatthe business venture

(a) Makes a loss [2marks]

(b) Realises profit of at least k2000 [2marks]

(iii) Find (a) the expected earnings [3marks]

(b)standard deviation [4marks]

(b) Suppose the investment project has the following cashflows;

Years	Cashflows (k000)
0	-300
1	90
2	110
3	130
4	140

Assuming 8% discount factor compounded annually, calculate the net present value of this project and interpret it. [11 marks]

[Total marks 25]

Profit (k000)	Number of companies
$10 \leq x \leq 20$	3
$20 \leq x \leq 30$	7
$30 \leq x \leq 40$	12
$40 \leq x \leq 50$	10
$50 \leq x \leq 60$	5

Calculate the

(i) Mean [4marks]

(ii) Median [3marks]

$30 + \left(\frac{\frac{31}{2} - 10}{12}\right)10$

[5marks]

(iii) Variance

$30 + \left(\frac{18.5 - 10}{12}\right)10$

[4marks]

(iv) Standard deviation [4 marks]

(v) Coefficient variation

$30 + \left(0.70833\right)10$

[Total Marks 25]

$30 + 7.0833$

37.0833

Question Three

(a) Evaluate $11p$ 2 [2marks]

(b) How many different committees of 3 businessman can be chosenfrom 7 businessman [2marks]

(c) In how many ways can 8 boxes of sweets be arranged on a shelf in a shop [3marks]

(d) The sports team is interested in whether the weather has an effect on their result. The results are summarised in the table

	Good weather	Bad weather	totals
Win	12	4	16
lose	5	10	15
totals	17	14	31

(i) Find the probability of the team winning [2marks]

ii) What is the probability of the team playing in bad weather [2marks]

iii) Give that the team played in good weather, what is the probability that i [5marks]

(a) The team wins

iii. $P(12 < X < 20)$ **[20 Marks]**

2. An indigenous Zambian Investor wants to decide which of the three sectors he should invest his money. The profit from each sector is dependent on the changes in demand during the investment periods. The investor has categorised changes in demand as high, medium, low. His estimated profit for each sector is shown in the table below:

Changes in Demand	Agriculture Sector	Energy Sector	Tourism Sector
High	$8,000	$3,500	$5,000
Medium	$4,500	$4,500	$5,000
Low	$2,000	$5,000	$4,000

If the investor wishes to invest his money only in one sector, decide which sector will be his choice using:

a) Maximax Criterion (Optimistic Approach)
b) Maximin Criterion (Conservative Approach)
c) Minimax Criterion (Regret Approach) **[20 Marks]**

3. A new Covid-19 vaccine is 0.7 effective of the disease cases treated. Six patients suffering from Covid-19 are to be treated.
Find

a) The mean of the number of patients successfully treated
b) The variance of the number of patients successfully treated
c) The standard deviation of the number of patients successfully treated **[20 marks]**

4. Answer all parts in this question.

a) State any four properties of a normal distribution
b) Solve the equations simultaneously using Cramer's Rule

$$4x + y + z = 0$$
$$2x + 3x + z = 0$$
$$x + y + 0z = 1$$

c) Comment on the major difference between standard deviation and standard error.

5. In this question, use as much information on the sheet of formulae as possible.

a) What do you consider to be the main difference between type I and Type II errors in Hypothesis testing?
b) An investment analyst claims that the average annual return on services in the tourism industry is 12%. You want to test whether this claim is true. You collect a random sample of 36 services in the tourism industry and find that the average annual return is 10% with a standard deviation of 3%. Use a 5% level of significance to test the analyst's claim. **[20 Marks]**

1333.33332

END OF EXAMINATION

Write Question 2 Section A as well !!!

SECTION A: [60 marks - Answer all questions: compulsory]

1. The following data sets are returns on investment obtained from a company that invested into two products.

   Product A: 34, 42, 36, 38, 45, 40, 32, 34, 39, 41
   Product B: 21, 24, 32, 64, 50, 35, 28, 30, 42, 55

   a. Calculate the mean score for each product
   b. Find the standard deviation for each product
   c. Calculate the coefficient of variation (CV) for each product.
   d. Using the answers obtained in part (c) above or otherwise, which product was more consistent in their returns? Justify your answer. **[20 marks]**

2. The amounts (K'000) randomly deposited by workers at a named bank in Kitwe are as follows:

34	28	46	37	33	24	29	45	37	34
32	25	50	54	32	36	38	41	38	44
28	43	40	49	30	46	27	34	61	33

   a. Display the data presented above on a stem and leaf display
   b. Find
      i. Mean
      ii. Variance
      iii. Standard deviation **[20 Marks]**

3. The number of Covid-19 vaccines manufactured by a pharmaceutical company per month is a random variable with the following probability distribution.

Number of Covid-19 Vaccines Manufactured (X)	19	20	21	22
P(X =x)	0.4	K	0.2	0.15

   a. Calculate the value of K
   b. Find the probability that the number of Covid-19 vaccines that will be manufactured next month is at least 20
   c. Find the probability that the number of Covid-19 vaccines manufactured per month is at most 21
   d. Find the expected number of Covid-19 vaccines manufactured per month. **[20 Marks]**

SECTION B: [40 marks – Answer All Any Two questions in this section]
Each Question Carry Equal Marks in this Section

1. (a) Compute the exact value of each of the following:
   (i) C_3^7
   (ii) $6!$
   (iii) $\ln e^{4x} = 8$

   (b) Given a random variable X which is normally distributed with mean 15 and standard deviation 10, find:
   i. $P(X < 20)$
   ii. $P(X > 12)$

Profit (k000)	Number of companies
$10 \leq x \leq 20$	3
$20 \leq x \leq 30$	7
$30 \leq x \leq 40$	12
$40 \leq x \leq 50$	10
$50 \leq x \leq 60$	5

Calculate the

(i) Mean **[4marks]**

(ii) Median **[3marks]**

(iii) Variance **[5marks]**

(iv) Standard deviation **[4marks]**

(v) Coefficient variation **[4 marks]**

[Total Marks 25]

Question Three

(a)Evaluate $11p_{2}$ **[2marks]**

(b) How many different committees of 3 businessman can be chosenfrom 7 businessman **[2marks]**

(c) In how many ways can 8 boxes of sweets be arranged on a shelf in a shop **[3marks]**

(d) The sports team is interested in whether the weather has an effect on their result. The results are summarised in the table

	Good weather	Bad weather	totals
Win	12	4	16
lose	5	10	15
totals	17	14	31

(i) Find the probability of the team winning **[2marks]**

ii) What is the probability of the team playing in bad weather **[2marks]**

iii) Give that the team played in good weather, what is the probability that i

(a) The team wins **[5marks]**

4. (a) A financial adviser wants to create a portfolio consisting of eight stocks and four bonds. If twelve stocks and seven bonds are acceptable for the portfolio, in how many ways can the portfolio be created?

$^{12}C_8 \times {}^{7}C_4 = 17325$

[3 marks]

(b) An opinion survey of 250 adults resident of Chalimbana was conducted. Each person was asked their opinion about the contribution to construct a new hostile at Chalimbana University and the response are shown in the table below.

	favour	Oppose	Total
Male	85	45	130
Female	65	55	120
total	150	100	250

Suppose an adult resident is chosen at random,

(i) find the probability of choosing a male adult resident

$P(\text{male}) = \frac{130}{250} \quad \frac{13}{25}$ [2marks]

(ii) find the probability of choosing an adult who is opposing

$P(\text{opposing}) = \frac{100}{250} \quad \frac{2}{5}$

[2 marks]

(iii) find the probability of choosing an adult in favour, given that the adult is female

let F represent favour

fe represent female

$\frac{65}{120}$

$P(F/Fe) = \frac{P(F \cap Fe)}{P(Fe)}$

$\frac{\frac{65}{250}}{\frac{120}{250}} \quad \frac{65}{250} \times \frac{250}{120} \quad \frac{65}{120} \quad \frac{13}{24}$

[6marks]

5. a)The time needed to service a car at the filling station is exponential random variable with a mean of 2 minutes. Determine the probability that a newly arriving car will be serviced as follows:

(i) Within 1 minute?

[3marks]

$P(X \leq 1) = 1 - e^{-\lambda a}$

$= 1 - e^{-\frac{1}{2} \times 1}$

$= 1 - e^{-0.5}$

$= 0.3935$

(ii) Atleast 120 seconds? [4marks]

$P(x \geq 2) = e^{-\frac{1}{2} \times 2}$

e^{-1}

$= 0.36788$

(iii) Between 1 and 2 minutes? [5marks]

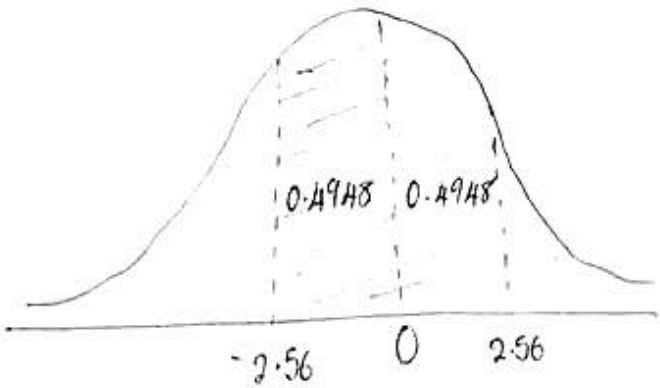
$P(1 \leq x \leq 2) = e^{-\frac{1}{2}} - e^{-\frac{1}{2} \times 2}$

$0.60653 - 0.3679 = 0.2356$

b) Given that Z=N(0,1). find a) P(z > -1.65) [2marks]

$0.4505 + 0.5 = 0.9505$

b) P(-2.56 < Z < 2.56) [3marks]



$P = 0.4948 + 0.4948$

$= 0.9868$

1. a)Which of the following variables are discrete and which are continuous

i) Number of accidents per week on great east road Discrete [1mark]

ii) Volume of water in a quarter tank Continuous [1mark]

iii) Quantity of natural gas used per month for heating an apartment building [1mark] Continuous

iv) The weight of a person Continuous [1mark]

b) During a certain month sales man's weekly incomes were as follows: 180,165,190, 170 and 200. Compute the following descriptive statistics for these data:

i) range $200 - 165 = 35$ [2marks]

ii) Sample mean $= \frac{\Sigma x}{n} = \frac{180 + 165 \cdots + 200}{5} = \frac{905}{5} = 181$

iii) sample standard deviation [3marks]

$$(S) = \sqrt{\frac{\Sigma x^2 - \frac{(\Sigma x)^2}{n}}{n-1}}$$

$$= \sqrt{\frac{164625 - \frac{(905)^2}{5}}{4}}$$

$$= 16.3178$$ [4marks]

2. The probability distribution of a random variable X is given by:

X	-1	0	1	2
P(X=x)	0.03	0.70	k	0.09

Calculate i) the value of k

$0.03 + 0.70 + 0.09 + k = 1$

$k = 1 - 0.82$ [2marks]

$= 0.18$ [3 marks]

ii) the expected value

$E(X) = -1 \times 0.03 + 0 \times 0.70 + 1 \times 0.18 + 2 \times 0.09$

$= 0.33$

STATISTICAL FORMULAE

(a) Descriptive statistics

i) Mean $= \frac{\sum x}{n}$ ungrouped data

ii) Mean $= \frac{\sum fx}{\sum f}$ grouped data

iii) $\text{Var}(x) = E(x^2) - (E(x))^2$

iv) Variance $s^2 = \frac{\sum x^2 - \frac{(\sum x)^2}{n}}{n-1}$

(b) Conditional Probability

i) $P(A/B) = \frac{P(A \cap B)}{P(B)}$

ii) $P(A \cap B) = P(A) \, X \, P(B)$

(c) Financial mathematics

i) $FV = PV(1 + r)^n$ where FV is the future value

PV is the present value

n is the number of years for the investment.

r is the interest rate for the period

ii) $A = P + Prt$ Where P is the principle amount,

r is the interest rate for the time period t

iii) $FV = \frac{A[(1+r)^n - 1]}{r}$ where , A is an annuity cash flow.

iv) $PV = \frac{A[1-(1+r)^{-n}]}{r}$

QUESTIONS

1. Africans are social beings like other people in the world who believe in humanity and brotherhood. They express social ethics in many proverbs.

a. Discuss any five proverbs in a local language and translate it in English which can help your learners to live morally upright in society **(25 marks).**

2. Discuss the role of Education, Media and Civil society in impacting morals and values in school going children as well as adults **(25 marks).**

3. Character education holds that widely shared, pivotally important core ethical values such as caring, honesty, fairness, responsibility and respect for self and others form the basis of good character.

a. Discuss the pillars of character education and its importance to the students.

b. Explain the types of Ethics and how they can help students to have good conduct for themselves **(25 marks)**

4. There are 3 principle types of values which humans have which play an important role in our lives but they do not play equal roles in the formation of moral standards and moral norms. Discuss these values **(25 marks).**

5. Explain 4 professional codes of ethics for teachers. Discuss professional responsibility of a teacher **(25 marks).**

6. With the aid of the diagram, discuss the visual elements of culture. Explain the strong and weak cultures in an institution **(25 marks).**

7. Justify why we should have Ethics, Morals and Values education in the school curriculum **(25 marks).**

8. Examination malpractice is any form of deliberate cheating on examinations which provides one or more candidates with an unfair advantage of disadvantage.

a. Discuss the forms of malpractice found in schools and you can overcome them **(25 marks).**

9. Discipline is the process of teaching a child what type of behavior is acceptable and unacceptable. Discuss the 5 theories of discipline and explain how you should behave as a teacher when dealing with different cases. **(25 marks)**

GOOD LUCK!!!!

iii) the variance $= E(X^2) - (EX)^2$

$= 0^2 \times 0.03 + 0^2 \times 0.7 + 1^2 \times 0.18 + 2^2 \times 0.09 - (0.33)^2$

$= 0.57 - (0.33)^2$

$= 0.4611$

[4marks]

iv) the standard deviation $SS = \sqrt{Var(x)}$

$= \sqrt{0.4611}$

$= 0.6790$

[2marks]

3.IF 80% of the bolts produced by a machine are good, determine the probability that out of 4 bolts chosen at random

(i) One bolt will be defective [1 mark]

$P(x=1) = {}^nC_r P^r q^{n-r}$

$q = 0.8$

$P = 1 - 0.8$

$= 0.2$

$n = 4$

${}^4C_1 \times (0.2)^1 (0.8)^{4-1}$

$= 0.4096$

(ii) Zero bolt will be defective [1 mark]

$P(x=0) = {}^4C_0 (0.2)^0 (0.8)^4$

0.4096

(iii) At most two bolts will be defective [4marks]

$P(x \leq 2) = P(x=0) + P(x=1) + P(x=2)$

$= {}^nC_r P^r q^{n-r} + {}^nC_r P^r q^{n-r} + {}^nC_r P^r q^{n-r}$

$= {}^4C_0 * (0.2)^0 \times (0.8)^4 + {}^4C_1 (0.2)^1 (0.8)^3 + {}^4C_2 (0.2)^2 (0.8)^2$

$= 0.4096 + 0.4096 + 0.1536$

$= 0.9728$

$= \frac{40\,320}{} \times$

Question one

(a) Evaluate 12 +(-10) [2marks]

(b) Solve the equation $2x = 18$ [3marks]

(c) Express the $\log_{10} 2 + \log_{10} b$ as a single logarithm [3marks]

(d) Given that $A = \begin{bmatrix} 2 & 3 \\ -1 & 4 \\ 2 & 5 \end{bmatrix}$ and $B = \begin{bmatrix} 3 & 5 \\ 0 & 2 \\ 1 & -2 \end{bmatrix}$

Find (i) A^T [3marks]

(ii) $B - A$ [4marks]

(e) Use any method to solve the following system of equation

$x - 3y + z = 4$

$2x - 8y + 8z = -2$

$-6x + 3y - 15z = 9$ [10marks]

Total marks 25

Question Two

(a) Classify the following variables as discrete or continuous

(i) The weight of a person [1mark]

(ii) Total scores for the game between Zambia vs Algeria [1mark]

(iii) Prime numbers less than ten [1mark]

(iv) The earning per month for the government worker [1mark]

(v) The capacity of water in a dam [1mark]

(b) Below are the scores obtained by students in BBA1 in statistics exam.

90, 80,75, 80, 65, 70, 60, 55, 40

Calculate the

(i) Range [2marks]

(ii) Mean [5marks]

(iii) Variance [5marks]

[5Marks]

(b) The team loses

vi) Give that the team wins ,what is the probability that it played under bad weather [4marks]

[Total marks 25]

Question Four

(a) Determine the area of the Z- score [3marks]

$P(-2.23 \leq Z \leq 2.23)$

(b) An electrical firm supplies bulbs that have a length of life that is approximately normally distributed with a standard deviation of 20 hours. If a random sample of 40 bulbs has an average of life of 800hours.

(i)find a 95% confidence interval for the population mean life of all bulbs supplied by the firm [5marks]

(ii)find a 99% confidence interval for the population mean life of all bulbs supplied by the firm [5marks]

(c) The time needed to service a car at the filling station is exponential random variable with a mean of 2 minutes. Determine the probability that a newly arriving car will be serviced as follows:

(i) Within 1 minute? [3marks]

(ii) Atleast 120 seconds? [4marks]

(iii) Between 1 and 2 minutes? [5marks]

[Total marks 25]

Question Five

(a) Suppose you want to be deposit k200 in the bank that pays 6% interest rate per annum for 10 years.Find the future value of this deposit after 10 years? [5marks]

(b) Ms Kahilu borrows k20000 from a bank at an interest rate of 10% and agrees to make equal annual payments for 5years

(i) Calculate the equalannual payment [6marks]

(iv) Standard deviation [4marks]

(v) Coefficient variation [4 marks]

[Total Marks 25]

Question Three

(a)Evaluate $11p_2$ [2marks]

(b) How many different committees of 3 businessman can be chosen from 7 businessman [2marks]

(c) In how many ways can 8 boxes of sweets be arranged on a shelf in a shop [3marks]

(d) Two events A and B are such that $P(A) = \frac{1}{4}$, $P(A/B) = \frac{1}{2}$ and $P(B) = \frac{2}{3}$

i) Are A and B independent events? Use probability values to explain [4marks]

ii) Find $P(A \cap B)$ [4marks]

iii) Are A and B mutually exclusive events? Use probability values to explain [4marks]

iv) Find P(B) [3Marks]

v) Find $P(A \cup B)$ [3marks]

[Total marks 25]

Question Four

(a) Determine the area of the Z- score

(i) $P(Z > 1.64)$ [4marks]

(ii) $P(Z < 1.45)$ [4marks]

(iii) $P(-2.23 < Z < 1.14)$ [5marks]

(b) A University has found that 10% of its students withdraw without completing the introductory statistical course. Assume that 40 students have registered for the course this semester.

(i) What is the probability that three or fewer will withdraw? [5marks]

(ii) What is the probability that exactly five will withdraw? [4marks]

(iii) What is the expected number of withdraw? [3marks]

[Total marks 25]

(ii) Prepare a loan amortisation schedule for Ms kahilu **[14marks**

[Total Marks 25]

Question Six

(a) The profit to be realised from a certain business venture to the nearest k1000 are believed to follow the probability distribution shown below;

X	-2000	-1000	0	1000	2000	3000
P(X = x)	0.2	0.25	0.1	0.15	K	0.05

(i)Calculate the value of k **[3marks**

(ii) Find The probability thatthe business venture

(a) Makes a loss **[2marks]**

(b) Realises profit of at least k2000 **[2marks]**

(iii) Find (a) the expected earnings **[3marks]**

(b)standard deviation **[4marks]**

(b) Suppose the investment project has the following cashflows;

Years	Cashflows (k000)
0	-300
1	90
2	110
3	130
4	140

Assuming 8% discount factor compounded annually, calculate the net present value of this project and interpret it. **[11 marks]**

[Total marks 25]

S TATISTICAL FORMULAE

(a) Descriptive statistics

i) Mean $=\frac{\Sigma x}{n}$ ungrouped data

ii) Mean $=\frac{\Sigma fx}{\Sigma f}$ grouped data

iii) $\text{Var}(x) = E(x^2) - (E(x))^2$

iv) Variance $s^2 = \frac{\Sigma x^2 - \frac{(\Sigma x)^2}{n}}{n-1}$

v)

(b) Conditional Probability

i) $P(A/B) = \frac{P(A \cap B)}{P(B)}$

ii) $P(A \cap B) = P(A)\ X\ P(B)$

(c) Financial mathematics

i) $FV = PV(1 + r)^n$ where FV is the future value

PV is the present value

n is the number of years for the investment.

r is the interest rate for the period

ii) $A = P + Prt$ Where P is the principle amount,

r is the interest rate for the time period t

iii) $FV = \frac{A[(1+r)^n - 1]}{r}$ where , A is an annuity cash flow.

iv) $PV = \frac{A[1-(1+r)^{-n}]}{r}$

Question one

(a) Evaluate 12 +(-10) **[2marks]**

(b) Find the integral of $\int(4x^3 + 2x^2 - 6x + 3)dx$ **[3marks]**

(c) Express the $\log_{10} 2 + \log_{10} b$ as a single logarithm **[3marks]**

(d)A company has three plants. Each plant employs manager, foreman and skilled labourers as follows:

	Plant A	Plant B	Plant C
Managers	1	2	1
Foreman	4	6	4
Skilled labour	80	96	75

If managers are paid k350 a week, foreman k275 and skilled labour k200. Use matrices to find the total payroll of each plant **[6marks]**

(e) Use any method to solve the following system of equation.

$$4x + y + 3z = 8$$
$$-2x + 5y + z = 4$$
$$3x + 2y + 4z = 9$$

[10marks]

Total marks

25

Question Two

(a) Classify the following variables as discrete or continuous

(i) The weight of a person **[1mark]**

(ii) Total scores for the game between Zambia vs Algeria **[1mark]**

(iii) Prime numbers less than ten **[1mark]**

(iv) The earning per month for the government worker **[1mark]**

(v) The capacity of water in a dam **[1mark]**

(b) The annual profits made by a random sample of 37 companies in the textiles industry are shown in the table below:

ii. $\alpha^2 + \beta^2$

SECTION B: 60 MARKS

Answer Any Three Questions of Your Choice.

Each Question Carries 20 Marks

QUESTION ONE

The commissions (in dollars) earned by a sample of 15 airtime vendors in one month were:

78	50	65	79	54	80	102	45	75
98	86	92	60	72	75	80	97	66

a) Find
   i. Mean
   ii. Standard deviation **[5 Marks]**

b) Draw a box –and –whisker plot of the above commissions earned **[5 Marks]**

c) Extrapolate any three real life business applications of the mean and deviation. **[5 Marks]**

QUESTION TWO

The reduction in sales of 7 randomly selected products of Goldman Group of Companies were re

and after advertisement.

Before Advertisement	14	18	21	15	17	19	23

d) The roots of the equation $3x^2 + 4x - 5 = 0$ are α, β. Find the values of the

i. $\frac{1}{\alpha} + \frac{1}{\beta}$

ii. $\alpha^2 + \beta^2$

[5 Marks]

SECTION B: 60 MARKS

Answer Any Three Questions of Your Choice.

Each Question Carries 20 Marks

QUESTION ONE

The commissions (in dollars) earned by a sample of 15 airtime vendors in one month were:

78	50	65	79	94	80	102	45	75
98	86	92	69	72	75	80	97	66

a) Find

i. Mean

ii. Standard deviation **[10 Marks]**

b) Draw a box –and –whisker plot of the above commissions earned **[5 Marks]**

c) Extrapolate any three real life business applications of the mean and standard deviation. **[5 Marks]**

QUESTION TWO

The reduction in sales of 7 randomly selected products of Goldman Group of Companies were noted before and after advertisement.

Before Advertisement	14	18	21	15	17	19	23
After Advertisement	13	15	20	15	16	16	21

[illegible] interval of the mean decline in sales of the 7 randomly selected products of [illegible] **[20 marks]**

Question Four

(a) Determine the area of the Z- score

(i) P (Z > 2.04) [5marks]

(ii) P (Z < 1.45) [4marks]

(iii) P (-1.23 < Z < 1.14) [4marks]

(b) A University has found that 20% of its students withdraw without completing the introductory statistical course. Assume that 20 students have registered for the course this semester.

(i) What is the probability that three or fewer will withdraw? [5marks]

(ii) What is the probability that exactly five will withdraw? [4marks]

(iii) What is the expected number of withdraw? [3marks]

[Total marks 25]

Question Five

(a) Suppose you want to have k20000 in the bank that pays 6% interest rate per annum after 5years. How much are you supposed to deposit now? [5marks]

(b) A woman borrows k15000 at an interest rate of 10% and agrees to make equal semi-annually payments for 3 years

(i) Calculate the equal semi-annul payment [6marks]

(ii) Prepare a loan amortisation schedule [14marks]

[Total Marks 25]

a) Solve the equations simultaneously using Cramer's Rule

$x + 2y + 3z = 17$
$3x + 2y + z = 11$
$x - 3y + z = -5$

b) The number of wooden chairs made by School of Vocation and Practical Skills Education ... month is a randomly variable with the following probability distribution

X	19	20	21	22
P(X = x)	0.4	k	0.3	0.15

i. Calculate the value of K
ii. Find the probability that the number of chairs that will be made next month is at least ...
iii. Find the probability that the number of chairs produced per month is at most 21
iv. Find the expected number of chairs produced per month
v. Suppose that the School of Vocation and Practical Skills Education workshop incurs f... monthly costs of $100 and an additional construction cost of $5 per chair. Find the expected monthly cost of the operation. **[20 Marks]**

QUESTION FIVE

a) Given a random variable X which is normally distributed with mean 15 and standard deviation 5, find

i. $P(X < 20)$
ii. $P(X > 12)$
iii. $P(12 < X < 20)$

[7 Marks]

b) Solve the equations simultaneously using Cramer's Rule

$x + 2y + 3z = 17$
$3x + 2y + z = 11$
$x - 3y + z = -5$

[5 Marks]

c) The following data give the quarterly sales figures for a retail outlet for the period 2017 to 2019

Year	Quarter 1	Quarter 2	Quarter 3	Quarter 4
2017	14	12	33	6
2018	16	35	36	7
2019	15	38	41	8

i. Calculate four-point moving averages for the series.
ii. Plot the four-point MA series on the same graph as the original series.

[8 Marks]

THE END

Life time (thousands of km)	Number of Tyres
20 – 30	6
30 – 40	11
40 – 50	18
50 – 60	12
60 – 70	7
70 - 80	6

Calculate

(a) The mean;

(b) The median; and

(c) The standard deviation of the life time of the tyres.

Section B (60 marks). You may attempt any three questions bein number them B4 to B7. Each question carries 20 marks.

iii) the variance $= E[X^2] - (E[X])^2$

$= (-1)^2 \times 0.03 + 0^2 \times 0.7 + 1^2 \times 0.18 + 2^2 \times 0.09 - (0.33)^2$

$= 0.57 - (0.33)^2$

$= 0.4611$

[4marks]

iv) the standard deviation $SS = \sqrt{Var(X)}$

$= \sqrt{0.4611}$

$= 0.6790$

[2marks]

3.IF 80% of the bolts produced by a machine are good, determine the probability that out of 4 bolts chosen at random

(i) One bolt will be defective [1 mark]

$P(x=1) = {}^nC_r\, p^r q^{n-r}$

$q = 0.8$

$p = 1 - 0.8$

$= 0.2$

$n = 4$

${}^4C_1 \times (0.2)^1 (0.8)^{4-1}$

$= 0.4096$

(ii) Zero bolt will be defective [1 mark]

$P(x=0) = {}^4C_0 (0.2)^0 (0.8)^4$

0.4096

(iii) At most two bolts will be defective [4marks]

$P(x \leq 2) = P(X=0) + P(X=1) + P(X=2)$

$= {}^nC_r\, p^r q^{n-r} + {}^nC_r\, p^r q^{n-r} + {}^nC_r\, p^r q^{n-r}$

$= {}^4C_0 * (0.2)^0 \times (0.8)^4 + {}^4C_1 (0.2)^1 (0.8)^3 + {}^4C_2 (0.2)^2 (0.8)^2$

$= 0.4096 + 0.4096 + 0.1536$

$= 0.9728$

Life time (thousands of km)	Number of Tyres
20 – 30	6
30 – 40	11
40 – 50	18
50 – 60	12
60 – 70	7
70 - 80	6

Calculate

(a) The mean;

(b) The median; and

(c) The standard deviation of the life time of the tyres.

SECTION A: [60 marks - Answer all questions compulsory]

1. The following data sets are returns on investment obtained from a company that [illegible] into two products.

   Product A: 34, 42, 36, 38, 45, 40, 32, 34, 39, 41
   Product B: 21, 24, 32, 64, 50, 15, 28, 30, 42, 55

   a. Calculate the mean score for each product
   b. Find the standard deviation for each product
   c. Calculate the coefficient of variation (CV) for each product.
   d. Using the answers obtained in part (c) above or otherwise, which product [illegible] more consistent in their returns? Justify your answer. [20 marks]

2. The amounts (K'000) randomly deposited by workers at a named bank in Kitwe are as follows:

34	28	46	37	33	24	29	45	37	34
32	25	50	54	32	36	38	41	38	44
28	43	40	49	30	46	27	34	61	33

   a. Display the data presented above on a stem and leaf display
   b. Find
      i. Mean
      ii. Variance
      iii. Standard deviation

[20 Marks]

Write Question 2 Section A as well !!!

SECTION A: [60 marks - Answer all questions: compulsory]

1. The following data sets are returns on investment obtained from a company that invested into two products.

   Product A: 34, 42, 36, 38, 45, 40, 32, 34, 39, 41
   Product B: 21, 24, 32, 64, 50, 35, 28, 30, 42, 55

   a. Calculate the mean score for each product
   b. Find the standard deviation for each product
   c. Calculate the coefficient of variation (CV) for each product.
   d. Using the answers obtained in part (c) above or otherwise, which product was more consistent in their returns? Justify your answer. **[20 marks]**

2. The amounts (K'000) randomly deposited by workers at a named bank in Kitwe are as follows:

34	28	46	37	33	24	29	45	37	34
32	25	50	54	32	36	38	41	38	44
28	43	40	49	30	46	27	34	61	33

   a. Display the data presented above on a stem and leaf display
   b. Find
      i. Mean
      ii. Variance
      iii. Standard deviation **[20 Marks]**

3. The number of Covid-19 vaccines manufactured by a pharmaceutical company per month is a random variable with the following probability distribution.

Number of Covid-19 Vaccines Manufactured (X)	19	20	21	22
P(X =x)	0.4	K	0.2	0.15

   a. Calculate the value of K
   b. Find the probability that the number of Covid-19 vaccines that will be manufactured next month is at least 20
   c. Find the probability that the number of Covid-19 vaccines manufactured per month is at most 21
   d. Find the expected number of Covid-19 vaccines manufactured per month. **[20 Marks]**

SECTION B: [40 marks – Answer All Any Two questions in this section]
Each Question Carry Equal Marks in this Section

1. (a) Compute the exact value of each of the following:
   (i) C_3^7
   (ii) $6!$
   (iii) $\ln e^{4x} = 8$

   (b) Given a random variable X which is normally distributed with mean 15 and standard deviation 10, find:
   i. $P(X < 20)$
   ii. $P(X > 12)$

SECTION A: [60 marks - Answer all questions compulsory]

1. The following data sets are returns on investment obtained from a company that ... into two products.

   Product A: 34, 42, 36, 38, 45, 40, 32, 34, 39, 41
   Product B: 21, 24, 32, 64, 50, 35, 28, 30, 42, 55

   a. Calculate the mean score for each product
   b. Find the standard deviation for each product
   c. Calculate the coefficient of variation (CV) for each product.
   d. Using the answers obtained in part (c) above or otherwise, which product ... more consistent in their returns? Justify your answer. [20 marks]

2. The amounts (K'000) randomly deposited by workers at a named bank in Kitwe are as follows:

34	28	46	37	33	24	29	45	37	34
32	25	50	54	32	36	38	41	38	44
28	43	40	49	30	46	27	34	61	33

   a. Display the data presented above on a stem and leaf display
   b. Find
      i. Mean
      ii. Variance
      iii. Standard deviation [20 Marks]

3. The number of Covid-19 vaccines manufactured by a pharmaceutical company per month is a random variable with the following probability distribution.

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   c. Find the probability that the number of Covid-19 vaccines manufactured per month is at most 21
   d. Find the expected number of Covid-19 vaccines manufactured per month. [20 Marks]

SECTION B: [40 marks – Answer All Any Two questions in this section]
Each Question Carry Equal Marks in this Section

1. (a) Compute the exact value of each of the following:

   (i) C_3^7

   (ii) $6!$

   (iii) $\ln e^{4x} = 8$

(b) Given a random variable X which is normally distributed with mean 15 and standard deviation 10, find:

   i. $P(X < 20)$
   ii. $P(X > 12)$

16335 -

i. Normal distribution and Poisson distribution
ii. Prediction and Forecasting
iii. Time Series and Index Numbers [5 Marks]

iii) The roots of the equation $3x^2 + 4x - 5 = 0$ are α, β. Find the values of the following:

i. $\frac{1}{\alpha} + \frac{1}{\beta}$

ii. $\alpha^2 + \beta^2$ [5 Marks]

SECTION B: 60 MARKS

Answer Any Three Questions of Your Choice.

Each Question Carries 20 Marks

QUESTION ONE

The commissions (in dollars) earned by a sample of 15 airtime vendors in one month were:

78	50	65	79	54	80	102	45	75
98	86	92	69	72	75	80	97	66

a) Find
   i. Mean
   ii. Standard deviation [10 Marks]

b) Draw a box –and –whisker plot of the above commissions earned [5 Marks]

c) Extrapolate any three real life business applications of the mean and standard deviation [5 Marks]

QUESTION TWO

The reduction in sales of 7 randomly selected products of Goldman Group of Companies were noted before and after advertisement.

Before Advertisement	14	18	21	15	17	19	23
After Advertisement	13	15	20	15	16	16	21

Find a 95% confidence interval of the mean decline in sales of the 7 randomly selected products of Goldman Group of Companies. [20 marks]

QUESTION THREE

Joseph and Joyce scored the following marks from the 10 sampled end –of–semester Business Mathematics and Statistics tests they wrote during their secondary education. The tests were marked out of 50.

Joseph:	35	26	41	38	36	48	37	30	35	24
Joyce:		24	28	24	21	27	26	24	28	22	23

Calculate the Coefficient of Variation for each set of tests. Whose performance is more consistent? Justify your answer [20 marks]

QUESTION FOUR

223 217 12696

a) Solve the equations simultaneously using Cramer's Rule

$x + 3y + 2z = 17$
$3x + 2y + z = 11$
$x - 3y + z = 5$

b) The number of wooden chairs made by School of Vocation and Practical Skills Education ... month is a randomly variable with the following probability distribution.

X	19	20	21	22
P(X = x)	0.4	k	0.2	0.15

i. Calculate the value of k
ii. Find the probability that the number of chairs that will be made next month is at least ...
iii. Find the probability that the number of chairs produced per month is at most 21
iv. Find the expected number of chairs produced per month
v. Suppose that the School of Vocation and Practical Skills Education workshop incurs fixed monthly costs of K100 and an additional construction cost of K5 per chair. Find the expected monthly cost of the operation. **[20 Marks]**

QUESTION FIVE

a) Given a random variable X which is normally distributed with mean 15 and standard deviation 5, find

i. $P(X < 20)$
ii. $P(X > 12)$
iii. $P(12 < X < 20)$

[7 Marks]

b) Solve the equations simultaneously using Cramer's Rule

$x + 2y + 3z = 17$
$3x + 2y + z = 11$
$x - 3y + z = 5$

[5 Marks]

c) The following data give the quarterly sales figures for a retail outlet for the period 2017 to 2019

Year	Quarter 1	Quarter 2	Quarter 3	Quarter 4
2017	14	12	13	6
2018	16	15	36	7
2019	15	18	41	8

i. Calculate four-point moving averages for the series.
ii. Plot the four-point MA series on the same graph as the original series.

[8 Marks]

THE END

Question Six

(a) The probability distribution of a random variable X is given by;

x	0	1	2	3	4
$P(X = x)$	0.2	0.15	0.34	k	0.1

Calculate (i) the value of k [3marks]

(ii) the expected value [4marks]

(iii) the variance [5marks]

(iv) Standard deviation [2marks]

(b) Suppose the investment project has the following cash flows;

years	Cash flows (k000)
0	-400
1	120
2	130
3	140
4	150

Assuming 8% discount factor compounded annually, calculate the net present value of this project and interpret it. **[11 marks]**

[Total marks 25]

(c) Prepare a loan amortisation schedule for Ms kahilu [11marks]

Question Six

[Total Marks 25]

(a) The profit to be realised from a certain business venture to the nearest k1000 are believed to follow the probability distribution shown below;

X	-2000	-1000	0	1000	2000	3000
P(X = x)	0.2	0.25	0.1	0.15	K	0.05

(i)Calculate the value of k [3marks

(ii) Find The probability thatthe business venture

(a) Makes a loss [2marks]

(b) Realises profit of at least k2000 [2marks]

(iii) Find (a) the expected earnings [3marks]

(b)standard deviation [4marks]

(b) Suppose the investment project has the following cashflows;

Years	Cashflows (k000)
0	-300
1	90
2	110
3	130
4	140

Assuming 8% discount factor compounded annually, calculate the net present value of this project and interpret it. [11 marks]

[Total marks 25]

$$\begin{vmatrix} 8 & 1 & 3 \\ 4 & 5 & 1 \\ 9 & 2 & 4 \end{vmatrix} \qquad \begin{matrix} + & - & + \\ - & + & - \\ + & - & + \end{matrix}$$

$-5(15)-1(7)$

$+3($

$-4\begin{vmatrix} 1 & 3 \\ 2 & 4 \end{vmatrix} + 5\begin{vmatrix} 8 & 3 \\ 9 & 4 \end{vmatrix} - 3\begin{vmatrix} 4 & 5 \\ 9 & 2 \end{vmatrix}$ $\quad 8(18)-7$

$-4(6\times4)-6) + 5(32-27) - 3(5-45)$

(iii) Prepare a loan amortisation schedule for Ms kahilu [4marks]

Question Six [Total Marks 25]

(a) The profit to be realised from a certain business venture to the nearest k1000 are believed to follow the probability distribution shown below;

X	-2000	-1000	0	1000	2000	3000
P(X = x)	0.2	0.25	0.1	0.15	K	0.05

(i)Calculate the value of k [3marks

(ii) Find The probability thatthe business venture

(a) Makes a loss [2marks]

(b) Realises profit of at least k2000 [2marks]

(iii) Find (a) the expected earnings [3marks]

(b)standard deviation [4marks]

(b) Suppose the investment project has the following cashflows;

Years	Cashflows (k000)
0	-300
1	90
2	110
3	130
4	140

Assuming 8% discount factor compounded annually, calculate the net present value of this project and interpret it. [11 marks]

[Total marks 25]

$$\begin{vmatrix} 8 & 1 & 3 \\ 4 & 5 & 1 \\ 9 & 2 & 4 \end{vmatrix} \quad \begin{matrix} + & - & + \\ - & + & - \\ + & - & + \end{matrix}$$

$-4\begin{vmatrix} 1 & 3 \\ 2 & 4 \end{vmatrix} + 5\begin{vmatrix} 8 & 3 \\ 9 & 4 \end{vmatrix} - 3\begin{vmatrix} 4 & 5 \\ 9 & 2 \end{vmatrix}$

$-4(6-6) + 5(32-27) - 3(15-45)$

$0 + 25 - 11.5$

(ii) Prepare a loan amortization schedule for Ms kabala [14marks

[Total Marks 25

Question Six

(a) The profit to be realised from a certain business venture to the nearest k1000 are belie
follow the probability distribution shown below,

X	-2000	-1000	0	1000	2000	3000
P(X = x)	0.2	0.25	0.1	0.15	K	0.05

(i)Calculate the value of k [3mar

(ii) Find The probability thatthe business venture

(a) Makes a loss [2mark

(b) Realises profit of at least k2000 [2mar

(iii) Find (a) the expected earnings [3mar

(b)standard deviation [4ma

(b) Suppose the investment project has the following cashflows;

Years	Cashflows (k000)
0	-300
1	90
2	110
3	130
4	140

Assuming 8% discount factor compounded annually, calculate the net present val
project and interpret it. [11

[Total m

[3marks]

(d) The sports team is interested in whether the weather has an effect on their result. The results are summarised in the table

	Good weather	Bad weather	totals
Win	12	4	16
lose	5	10	15
totals	17	14	31

(i) Find the probability of the team winning **[2marks]**

ii) What is the probability of the team playing in bad weather **[2marks]**

iii) Give that the team played in good weather, what is the probability that i

(a) The team wins **[5marks]**

Question Four

(a) Determine the area of the Z- score

(i) $P(Z > 2.04)$ [5marks]

(ii) $P(Z < 1.45)$ [4marks]

(iii) $P(-1.23 < Z < 1.14)$ [4marks]

(b) A University has found that 20% of its students withdraw without completing the introductory statistical course. Assume that 20 students have registered for the course this semester.

(i) What is the probability that three or fewer will withdraw? [5marks]

(ii) What is the probability that exactly five will withdraw? [4marks]

(iii) What is the expected number of withdraw? [3marks]

[Total marks 25]

Question Five

Standard Normal (Z) Table

	0	0.01	0.02	0.03	0.04	0.05	0.06	0.07	0.08	0.09
0	0	0.004	0.008	0.012	0.016	0.0199	0.0239	0.0279	0.0319	0.0359
0.1	0.0398	0.0438	0.0478	0.0517	0.0557	0.0596	0.0636	0.0675	0.0714	0.0753
0.2	0.0793	0.0832	0.0871	0.091	0.0948	0.0987	0.1026	0.1064	0.1103	0.1141
0.3	0.1179	0.1217	0.1255	0.1293	0.1331	0.1368	0.1406	0.1443	0.148	0.1517
0.4	0.1554	0.1591	0.1628	0.1664	0.17	0.1736	0.1772	0.1808	0.1844	0.1879
0.5	0.1915	0.195	0.1985	0.2019	0.2054	0.2088	0.2123	0.2157	0.219	0.2224
0.6	0.2257	0.2291	0.2324	0.2357	0.2389	0.2422	0.2454	0.2486	0.2517	0.2549
0.7	0.258	0.2611	0.2642	0.2673	0.2704	0.2734	0.2764	0.2794	0.2823	0.2852
0.8	0.2881	0.291	0.2939	0.2967	0.2995	0.3023	0.3051	0.3078	0.3106	0.3133
0.9	0.3159	0.3186	0.3212	0.3238	0.3264	0.3289	0.3315	0.334	0.3365	0.3389
1	0.3413	0.3438	0.3461	0.3485	0.3508	0.3531	0.3554	0.3577	0.3599	0.3621
1.1	0.3643	0.3665	0.3686	0.3708	0.3729	0.3749	0.377	0.379	0.381	0.383
1.2	0.3849	0.3869	0.3888	0.3907	0.3925	0.3944	0.3962	0.398	0.3997	0.4015
1.3	0.4032	0.4049	0.4066	0.4082	0.4099	0.4115	0.4131	0.4147	0.4162	0.4177
1.4	0.4192	0.4207	0.4222	0.4236	0.4251	0.4265	0.4279	0.4292	0.4306	0.4319
1.5	0.4332	0.4345	0.4357	0.437	0.4382	0.4394	0.4406	0.4418	0.4429	0.4441
1.6	0.4452	0.4463	0.4474	0.4484	0.4495	0.4505	0.4515	0.4525	0.4535	0.4545
1.7	0.4554	0.4564	0.4573	0.4582	0.4591	0.4599	0.4608	0.4616	0.4625	0.4633
1.8	0.4641	0.4649	0.4656	0.4664	0.4671	0.4678	0.4686	0.4693	0.4699	0.4706
1.9	0.4713	0.4719	0.4726	0.4732	0.4738	0.4744	0.475	0.4756	0.4761	0.4767
2	0.4772	0.4778	0.4783	0.4788	0.4793	0.4798	0.4803	0.4808	0.4812	0.4817
2.1	0.4821	0.4826	0.483	0.4834	0.4838	0.4842	0.4846	0.485	0.4854	0.4857
2.2	0.4861	0.4864	0.4868	0.4871	0.4875	0.4878	0.4881	0.4884	0.4887	0.489
2.3	0.4893	0.4896	0.4898	0.4901	0.4904	0.4906	0.4909	0.4911	0.4913	0.4916
2.4	0.4918	0.492	0.4922	0.4925	0.4927	0.4929	0.4931	0.4932	0.4934	0.4936
2.5	0.4938	0.494	0.4941	0.4943	0.4945	0.4946	0.4948	0.4949	0.4951	0.4952
2.6	0.4953	0.4955	0.4956	0.4957	0.4959	0.496	0.4961	0.4962	0.4963	0.4964
2.7	0.4965	0.4966	0.4967	0.4968	0.4969	0.497	0.4971	0.4972	0.4973	0.4974
2.8	0.4974	0.4975	0.4976	0.4977	0.4977	0.4978	0.4979	0.4979	0.498	0.498
2.9	0.4981	0.4982	0.4982	0.4983	0.4984	0.4984	0.4985	0.4985	0.4986	0.4986
3	0.4987	0.4987	0.4987	0.4988	0.4988	0.4989	0.4989	0.4989	0.499	0.499

t-distribution

	Confidence Level									
	60%	70%	80%	85%	90%	95%	98%	99%	99.8%	99.9%
	Level of Significance									
2 Tailed	0.40	0.30	0.20	0.15	0.10	0.05	0.02	0.01	0.002	0.001
1 Tailed	0.20	0.15	0.10	0.075	0.05	0.025	0.01	0.005	0.001	0.0005
df										
1	1.376	1.963	3.133	4.195	6.320	12.69	31.81	63.67		
2	1.060	1.386	1.883	2.378	2.912	4.271	6.816	9.520	19.65	26.30
3	0.978	1.250	1.637	1.924	2.352	3.179	4.525	5.797	9.937	12.39
4	0.941	1.190	1.533	1.778	2.132	2.776	3.744	4.596	7.115	8.499
5	0.919	1.156	1.476	1.699	2.015	2.570	3.365	4.030	5.876	6.835
6	0.906	1.134	1.440	1.650	1.943	2.447	3.143	3.707	5.201	5.946
7	0.896	1.119	1.415	1.617	1.895	2.365	2.999	3.500	4.783	5.403
8	0.889	1.108	1.397	1.592	1.860	2.306	2.897	3.356	4.500	5.039
9	0.883	1.100	1.383	1.574	1.833	2.262	2.822	3.250	4.297	4.780
10	0.879	1.093	1.372	1.559	1.812	2.228	2.764	3.170	4.144	4.586
11	0.876	1.088	1.363	1.548	1.796	2.201	2.719	3.106	4.025	4.437
12	0.873	1.083	1.356	1.538	1.782	2.179	2.682	3.055	3.930	4.318
13	0.870	1.079	1.350	1.530	1.771	2.160	2.651	3.013	3.852	4.221
14	0.868	1.076	1.345	1.523	1.761	2.145	2.625	2.977	3.788	4.141
15	0.866	1.074	1.341	1.517	1.753	2.131	2.603	2.947	3.733	4.073
16	0.865	1.071	1.337	1.512	1.746	2.120	2.584	2.921	3.687	4.015
17	0.863	1.069	1.333	1.508	1.740	2.110	2.567	2.899	3.646	3.965
18	0.862	1.067	1.330	1.504	1.734	2.101	2.553	2.879	3.611	3.922
19	0.861	1.066	1.328	1.500	1.729	2.093	2.540	2.861	3.580	3.884
20	0.860	1.064	1.325	1.497	1.725	2.086	2.529	2.846	3.552	3.850
21	0.859	1.063	1.323	1.494	1.721	2.080	2.518	2.832	3.528	3.820
22	0.858	1.061	1.321	1.492	1.717	2.074	2.509	2.819	3.505	3.792
23	0.857	1.060	1.319	1.489	1.714	2.069	2.500	2.808	3.485	3.768
24	0.857	1.059	1.318	1.487	1.711	2.064	2.492	2.797	3.467	3.746
25	0.856	1.058	1.316	1.485	1.708	2.060	2.486	2.788	3.451	3.725
26	0.856	1.058	1.315	1.483	1.706	2.056	2.479	2.779	3.435	3.707
27	0.855	1.057	1.314	1.482	1.703	2.052	2.473	2.771	3.421	3.690
28	0.855	1.056	1.313	1.480	1.701	2.048	2.468	2.764	3.409	3.674
29	0.854	1.055	1.311	1.479	1.699	2.045	2.463	2.757	3.397	3.660
30	0.854	1.055	1.310	1.477	1.697	2.042	2.458	2.750	3.386	3.646
31	0.853	1.054	1.309	1.476	1.696	2.040	2.453	2.744	3.375	3.633
32	0.853	1.054	1.309	1.475	1.694	2.037	2.449	2.738	3.365	3.622
33	0.853	1.053	1.308	1.474	1.692	2.035	2.445	2.733	3.356	3.611
34	0.852	1.052	1.307	1.473	1.691	2.032	2.441	2.728	3.348	3.601
35	0.852	1.052	1.306	1.472	1.690	2.030	2.438	2.724	3.340	3.591
36	0.852	1.052	1.306	1.471	1.688	2.028	2.434	2.719	3.333	3.582
37	0.851	1.051	1.305	1.470	1.687	2.026	2.431	2.715	3.326	3.574
38	0.851	1.051	1.304	1.469	1.686	2.024	2.429	2.712	3.319	3.566
39	0.851	1.050	1.304	1.468	1.685	2.023	2.426	2.708	3.313	3.558
40	0.851	1.050	1.303	1.468	1.684	2.021	2.424	2.705	3.307	3.551
41	0.850	1.050	1.303	1.467	1.683	2.020	2.421	2.702	3.301	3.544
42	0.850	1.049	1.302	1.466	1.682	2.018	2.418	2.698	3.296	3.538
43	0.850	1.049	1.302	1.465	1.681	2.017	2.416	2.695	3.291	3.532
44	0.850	1.049	1.301	1.465	1.680	2.015	2.414	2.692	3.286	3.526
45	0.850	1.049	1.301	1.464	1.679	2.014	2.412	2.690	3.281	3.520
46	0.850	1.048	1.300	1.463	1.679	2.013	2.410	2.687	3.277	3.515
47	0.849	1.048	1.300	1.463	1.678	2.012	2.408	2.685	3.273	3.510
48	0.849	1.048	1.299	1.462	1.677	2.011	2.407	2.682	3.269	3.505
49	0.849	1.048	1.299	1.462	1.677	2.010	2.405	2.680	3.265	3.500
50	0.849	1.047	1.299	1.461	1.676	2.009	2.403	2.678	3.261	3.496
51	0.849	1.047	1.298	1.461	1.675	2.008	2.402	2.676	3.258	3.492
52	0.849	1.047	1.298	1.460	1.675	2.007	2.400	2.674	3.255	3.488
53	0.848	1.047	1.298	1.460	1.674	2.006	2.399	2.672	3.251	3.484
54	0.848	1.047	1.297	1.460	1.674	2.005	2.397	2.670	3.248	3.480
55	0.848	1.046	1.297	1.459	1.673	2.004	2.396	2.668	3.245	3.476
56	0.848	1.046	1.297	1.459	1.673	2.003	2.395	2.667	3.242	3.473
57	0.848	1.046	1.297	1.459	1.672	2.002	2.394	2.665	3.239	3.470
58	0.848	1.046	1.296	1.458	1.672	2.002	2.392	2.663	3.237	3.466
59	0.848	1.046	1.296	1.458	1.671	2.001	2.391	2.662	3.234	3.463
60	0.848	1.045	1.296	1.458	1.671	2.000	2.390	2.660	3.232	3.460
61	0.848	1.045	1.296	1.457	1.670	2.000	2.389	2.659	3.229	3.457
62	0.847	1.045	1.295	1.457	1.670	1.999	2.388	2.657	3.227	3.454
63	0.847	1.045	1.295	1.457	1.669	1.998	2.387	2.656	3.225	3.452
64	0.847	1.045	1.295	1.456	1.669	1.998	2.386	2.655	3.223	3.449
65	0.847	1.045	1.295	1.456	1.669	1.997	2.385	2.654	3.220	3.447
66	0.847	1.045	1.295	1.456	1.668	1.997	2.384	2.652	3.218	3.444
67	0.847	1.044	1.294	1.456	1.668	1.996	2.383	2.651	3.216	3.442
68	0.847	1.044	1.294	1.455	1.668	1.995	2.382	2.650	3.214	3.439
69	0.847	1.044	1.294	1.455	1.667	1.995	2.382	2.649	3.213	3.437
70	0.847	1.044	1.294	1.455	1.667	1.994	2.381	2.648	3.211	3.435
71	0.847	1.044	1.294	1.455	1.667	1.994	2.380	2.647	3.209	3.433
72	0.847	1.044	1.293	1.454	1.666	1.993	2.379	2.646	3.207	3.431
73	0.847	1.044	1.293	1.454	1.666	1.993	2.379	2.645	3.206	3.429
74	0.847	1.044	1.293	1.454	1.666	1.993	2.378	2.644	3.204	3.427
75	0.846	1.044	1.293	1.454	1.665	1.992	2.377	2.643	3.202	3.425
76	0.846	1.043	1.293	1.454	1.665	1.992	2.376	2.642	3.201	3.423
77	0.846	1.043	1.293	1.453	1.665	1.991	2.376	2.641	3.199	3.421
78	0.846	1.043	1.292	1.453	1.665	1.991	2.375	2.640	3.198	3.420
79	0.846	1.043	1.292	1.453	1.664	1.990	2.374	2.640	3.197	3.418
80	0.846	1.043	1.292	1.453	1.664	1.990	2.374	2.639	3.195	3.416
81	0.846	1.043	1.292	1.453	1.664	1.990	2.373	2.638	3.194	3.415
82	0.846	1.043	1.292	1.452	1.664	1.989	2.373	2.637	3.193	3.413
83	0.846	1.043	1.292	1.452	1.663	1.989	2.372	2.636	3.191	3.412
84	0.846	1.043	1.292	1.452	1.663	1.989	2.372	2.636	3.190	3.410
85	0.846	1.042	1.292	1.452	1.663	1.988	2.371	2.635	3.189	3.409
86	0.846	1.042	1.291	1.452	1.663	1.988	2.370	2.634	3.188	3.407
87	0.846	1.042	1.291	1.452	1.663	1.988	2.370	2.634	3.187	3.406
88	0.846	1.042	1.291	1.452	1.662	1.987	2.369	2.633	3.185	3.405
89	0.846	1.042	1.291	1.452	1.662	1.987	2.369	2.632	3.184	3.403
90	0.846	1.042	1.291	1.452	1.662	1.987	2.368	2.632	3.183	3.402
91	0.846	1.042	1.291	1.452	1.662	1.986	2.368	2.631	3.182	3.401
92	0.846	1.042	1.291	1.451	1.662	1.986	2.368	2.630	3.181	3.399
93	0.846	1.042	1.291	1.451	1.661	1.986	2.367	2.630	3.180	3.398
94	0.845	1.042	1.291	1.451	1.661	1.986	2.367	2.629	3.179	3.397
95	0.845	1.042	1.291	1.451	1.661	1.985	2.366	2.629	3.178	3.396
96	0.845	1.042	1.290	1.451	1.661	1.985	2.366	2.628	3.177	3.395
97	0.845	1.042	1.290	1.451	1.661	1.985	2.365	2.627	3.176	3.394
98	0.845	1.042	1.290	1.451	1.661	1.984	2.365	2.627	3.175	3.393
99	0.845	1.042	1.290	1.451	1.660	1.984	2.365	2.626	3.175	3.392
100	0.845	1.042	1.290	1.451	1.660	1.984	2.365	2.626	3.174	3.391
∞	0.842	1.036	1.282	1.440	1.645	1.960	2.327	2.576	3.091	3.291

t-distribution

	Confidence Level									
	60%	70%	80%	85%	90%	95%	98%	99%	99.8%	99.9%
	Level of Significance									
2 Tailed	0.40	0.30	0.20	0.15	0.10	0.05	0.02	0.01	0.002	0.001
1 Tailed	0.20	0.15	0.10	0.075	0.05	0.025	0.01	0.005	0.001	0.0005
df										
1	1.376	1.963	3.133	4.195	6.320	12.69	31.81	63.67	—	—
2	1.060	1.385	1.883	2.278	2.912	4.271	6.816	9.520	19.65	26.30
3	0.978	1.250	1.637	1.924	2.352	3.179	4.525	5.797	9.937	12.39
4	0.941	1.190	1.533	1.778	2.132	2.776	3.744	4.596	7.115	8.499
5	0.919	1.156	1.476	1.699	2.015	2.570	3.365	4.030	5.876	6.835
6	0.906	1.134	1.440	1.650	1.943	2.447	3.143	3.707	5.201	5.946
7	0.896	1.119	1.415	1.617	1.895	2.365	2.999	3.500	4.783	5.403
8	0.889	1.108	1.397	1.592	1.860	2.306	2.897	3.356	4.500	5.039
9	0.883	1.100	1.383	1.574	1.833	2.262	2.822	3.250	4.297	4.780
10	0.879	1.093	1.372	1.559	1.813	2.228	2.764	3.170	4.144	4.586
11	0.875	1.088	1.363	1.548	1.796	2.201	2.719	3.106	4.025	4.437
12	0.873	1.083	1.356	1.538	1.782	2.179	2.682	3.055	3.930	4.318
13	0.870	1.079	1.350	1.530	1.771	2.160	2.651	3.013	3.852	4.221
14	0.868	1.076	1.345	1.523	1.761	2.145	2.625	2.977	3.788	4.141
15	0.866	1.074	1.341	1.517	1.753	2.131	2.603	2.947	3.733	4.073
16	0.865	1.071	1.337	1.512	1.746	2.120	2.584	2.921	3.687	4.015
17	0.863	1.069	1.333	1.508	1.740	2.110	2.567	2.899	3.646	3.965
18	0.862	1.067	1.330	1.504	1.734	2.101	2.553	2.879	3.611	3.922
19	0.861	1.066	1.328	1.500	1.729	2.093	2.540	2.861	3.580	3.884
20	0.860	1.064	1.325	1.497	1.725	2.086	2.529	2.846	3.552	3.850
21	0.859	1.063	1.323	1.494	1.721	2.080	2.518	2.832	3.528	3.820
22	0.858	1.061	1.321	1.492	1.717	2.074	2.509	2.819	3.505	3.792
23	0.857	1.060	1.319	1.489	1.714	2.069	2.500	2.808	3.485	3.768
24	0.857	1.059	1.318	1.487	1.711	2.064	2.493	2.797	3.467	3.746
25	0.856	1.058	1.316	1.485	1.708	2.060	2.486	2.788	3.451	3.725
26	0.856	1.058	1.315	1.483	1.706	2.056	2.479	2.779	3.435	3.707
27	0.855	1.057	1.314	1.482	1.703	2.052	2.473	2.771	3.421	3.690
28	0.855	1.056	1.313	1.480	1.701	2.048	2.468	2.764	3.409	3.674
29	0.854	1.055	1.311	1.479	1.699	2.045	2.463	2.757	3.397	3.660
30	0.854	1.055	1.310	1.477	1.697	2.042	2.458	2.750	3.386	3.646
40	0.851	1.050	1.303	1.468	1.684	2.021	2.424	2.705	3.307	3.551
50	0.849	1.047	1.299	1.462	1.676	2.009	2.404	2.678	3.262	3.496
60	0.848	1.045	1.296	1.458	1.671	2.000	2.391	2.661	3.232	3.460
70	0.847	1.044	1.294	1.456	1.667	1.994	2.381	2.648	3.211	3.435
80	0.846	1.043	1.292	1.453	1.664	1.990	2.374	2.639	3.196	3.417
90	0.846	1.042	1.291	1.452	1.662	1.987	2.369	2.632	3.184	3.402
100	0.845	1.042	1.290	1.451	1.660	1.984	2.365	2.626	3.174	3.391
∞	0.842	1.036	1.282	1.440	1.645	1.960	2.327	2.576	3.091	3.291

2 Tailed	0.40	0.30	0.20	0.15	0.10	0.05	0.02	0.01	0.002	0.001
1 Tailed	0.20	0.15	0.10	0.075	0.05	0.025	0.01	0.005	0.001	0.0005
df				Level of Significance						
1	1.376	1.963	3.133	4.195	6.320	12.69	31.81	63.67	—	—
2	1.060	1.385	1.883	2.278	2.912	4.271	6.816	9.520	19.65	26.30
3	0.978	1.250	1.637	1.924	2.352	3.179	4.525	5.797	9.937	12.39
4	0.941	1.190	1.533	1.778	2.132	2.776	3.744	4.596	7.115	8.499
5	0.919	1.156	1.476	1.699	2.015	2.570	3.365	4.030	5.876	6.835
6	0.906	1.134	1.440	1.650	1.943	2.447	3.143	3.707	5.201	5.946
7	0.896	1.119	1.415	1.617	1.895	2.365	2.999	3.500	4.783	5.403
8	0.889	1.108	1.397	1.592	1.860	2.306	2.897	3.356	4.500	5.039
9	0.883	1.100	1.383	1.574	1.833	2.262	2.822	3.250	4.297	4.780
10	0.879	1.093	1.372	1.559	1.813	2.228	2.764	3.170	4.144	4.586
11	0.875	1.088	1.363	1.548	1.796	2.201	2.719	3.106	4.025	4.437
12	0.873	1.083	1.356	1.538	1.782	2.179	2.682	3.055	3.930	4.318
13	0.870	1.079	1.350	1.530	1.771	2.160	2.651	3.013	3.852	4.221
14	0.868	1.076	1.345	1.523	1.761	2.145	2.625	2.977	3.788	4.141
15	0.866	1.074	1.341	1.517	1.753	2.131	2.603	2.947	3.733	4.073
16	0.865	1.071	1.337	1.512	1.746	2.120	2.584	2.921	3.687	4.015
17	0.863	1.069	1.333	1.508	1.740	2.110	2.567	2.899	3.646	3.965
18	0.862	1.067	1.330	1.504	1.734	2.101	2.553	2.879	3.611	3.922
19	0.861	1.066	1.328	1.500	1.729	2.093	2.540	2.861	3.580	3.884
20	0.860	1.064	1.325	1.497	1.725	2.086	2.529	2.846	3.552	3.850
21	0.859	1.063	1.323	1.494	1.721	2.080	2.518	2.832	3.528	3.820
22	0.858	1.061	1.321	1.492	1.717	2.074	2.509	2.819	3.505	3.792
23	0.857	1.060	1.319	1.489	1.714	2.069	2.500	2.808	3.485	3.768
24	0.857	1.059	1.318	1.487	1.711	2.064	2.493	2.797	3.467	3.746
25	0.856	1.058	1.316	1.485	1.708	2.060	2.486	2.788	3.451	3.725
26	0.856	1.058	1.315	1.483	1.706	2.056	2.479	2.779	3.435	3.707
27	0.855	1.057	1.314	1.482	1.703	2.052	2.473	2.771	3.421	3.690
28	0.855	1.056	1.313	1.480	1.701	2.048	2.468	2.764	3.409	3.674
29	0.854	1.055	1.311	1.479	1.699	2.045	2.463	2.757	3.397	3.660
30	0.854	1.055	1.310	1.477	1.697	2.042	2.458	2.750	3.386	3.646
40	0.851	1.050	1.303	1.468	1.684	2.021	2.424	2.705	3.307	3.551
50	0.849	1.047	1.299	1.462	1.676	2.009	2.404	2.678	3.262	3.496
60	0.848	1.045	1.296	1.458	1.671	2.000	2.391	2.661	3.232	3.460
70	0.847	1.044	1.294	1.456	1.667	1.994	2.381	2.648	3.211	3.435
80	0.846	1.043	1.292	1.453	1.664	1.990	2.374	2.639	3.196	3.417
90	0.846	1.042	1.291	1.452	1.662	1.987	2.369	2.632	3.184	3.402
100	0.845	1.042	1.290	1.451	1.660	1.984	2.365	2.626	3.174	3.391
∞	0.842	1.036	1.282	1.440	1.645	1.960	2.327	2.576	3.091	3.291

Table entry for p and C is the critical value t^* with probability p lying to its right and probability C lying between $-t^*$ and t^*.

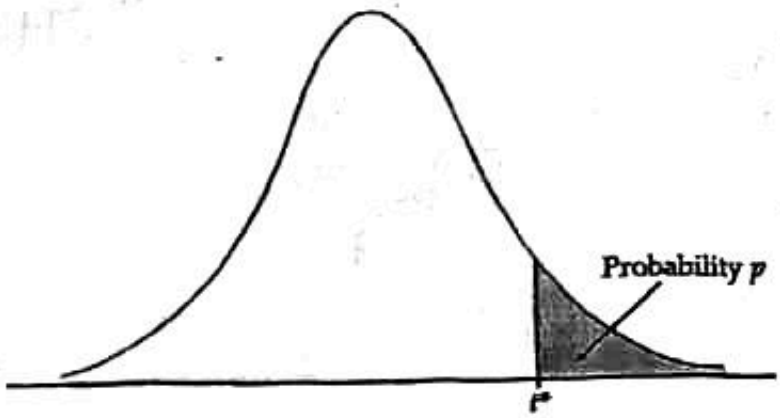

TABLE D

t distribution critical values

	Upper-tail probability p										
df	.25	.20	.15	.10	.05	.025	.02	.01	.005	.0025	.001
1	1.000	1.376	1.963	3.078	6.314	12.71	15.89	31.82	63.66	127.3	318.3
2	0.816	1.061	1.386	1.886	2.920	4.303	4.849	6.965	9.925	14.09	22.33
3	0.765	0.978	1.250	1.638	2.353	3.182	3.482	4.541	5.841	7.453	10.21
4	0.741	0.941	1.190	1.533	2.132	2.776	2.999	3.747	4.604	5.598	7.173
5	0.727	0.920	1.156	1.476	2.015	2.571	2.757	3.365	4.032	4.773	5.893
6	0.718	0.906	1.134	1.440	1.943	2.447	2.612	3.143	3.707	4.317	5.208
7	0.711	0.896	1.119	1.415	1.895	2.365	2.517	2.998	3.499	4.029	4.785
8	0.706	0.889	1.108	1.397	1.860	2.306	2.449	2.896	3.355	3.833	4.501
9	0.703	0.883	1.100	1.383	1.833	2.262	2.398	2.821	3.250	3.690	4.297
10	0.700	0.879	1.093	1.372	1.812	2.228	2.359	2.764	3.169	3.581	4.144
11	0.697	0.876	1.088	1.363	1.796	2.201	2.328	2.718	3.106	3.497	4.025
12	0.695	0.873	1.083	1.356	1.782	2.179	2.303	2.681	3.055	3.428	3.930
13	0.694	0.870	1.079	1.350	1.771	2.160	2.282	2.650	3.012	3.372	3.852
14	0.692	0.868	1.076	1.345	1.761	2.145	2.264	2.624	2.977	3.326	3.787
15	0.691	0.866	1.074	1.341	1.753	2.131	2.249	2.602	2.947	3.286	3.733
16	0.690	0.865	1.071	1.337	1.746	2.120	2.235	2.583	2.921	3.252	3.686
17	0.689	0.863	1.069	1.333	1.740	2.110	2.224	2.567	2.898	3.222	3.646
18	0.688	0.862	1.067	1.330	1.734	2.101	2.214	2.552	2.878	3.197	3.611
19	0.688	0.861	1.066	1.328	1.729	2.093	2.205	2.539	2.861	3.174	3.579
20	0.687	0.860	1.064	1.325	1.725	2.086	2.197	2.528	2.845	3.153	3.552
21	0.686	0.859	1.063	1.323	1.721	2.080	2.189	2.518	2.831	3.135	3.527
22	0.686	0.858	1.061	1.321	1.717	2.074	2.183	2.508	2.819	3.119	3.505
23	0.685	0.858	1.060	1.319	1.714	2.069	2.177	2.500	2.807	3.104	3.485
24	0.685	0.857	1.059	1.318	1.711	2.064	2.172	2.492	2.797	3.091	3.467
25	0.684	0.856	1.058	1.316	1.708	2.060	2.167	2.485	2.787	3.078	3.450
26	0.684	0.856	1.058	1.315	1.706	2.056	2.162	2.479	2.779	3.067	3.435
27	0.684	0.855	1.057	1.314	1.703	2.052	2.158	2.473	2.771	3.057	3.421
28	0.683	0.855	1.056	1.313	1.701	2.048	2.154	2.467	2.763	3.047	3.408
29	0.683	0.854	1.055	1.311	1.699	2.045	2.150	2.462	2.756	3.038	3.396
30	0.683	0.854	1.055	1.310	1.697	2.042	2.147	2.457	2.750	3.030	3.385
40	0.681	0.851	1.050	1.303	1.684	2.021	2.123	2.423	2.704	2.971	3.307
50	0.679	0.849	1.047	1.299	1.676	2.009	2.109	2.403	2.678	2.937	3.261
60	0.679	0.848	1.045	1.296	1.671	2.000	2.099	2.390	2.660	2.915	3.232
80	0.678	0.846	1.043	1.292	1.664	1.990	2.088	2.374	2.639	2.887	3.195
100	0.677	0.845	1.042	1.290	1.660	1.984	2.081	2.364	2.626	2.871	3.174
1000	0.675	0.842	1.037	1.282	1.646	1.962	2.056	2.330	2.581	2.813	3.098
z^*	0.674	0.841	1.036	1.282	1.645	1.960	2.054	2.326	2.576	2.807	3.091
	50%	60%	70%	80%	90%	95%	96%	98%	99%	99.5%	99.8%
	Confidence level C										

Standard Normal Distribution Table (Right-Tail Probabilities)

z	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09
0.0	.5000	.4960	.4920	.4880	.4840	.4801	.4761	.4721	.4681	.4641
0.1	.4602	.4562	.4522	.4483	.4443	.4404	.4364	.4325	.4286	.4247
0.2	.4207	.4168	.4129	.4090	.4052	.4013	.3974	.3936	.3897	.3859
0.3	.3821	.3783	.3745	.3707	.3669	.3632	.3594	.3557	.3520	.3483
0.4	.3446	.3409	.3372	.3336	.3300	.3264	.3228	.3192	.3156	.3121
0.5	.3085	.3050	.3015	.2981	.2946	.2912	.2877	.2843	.2810	.2776
0.6	.2743	.2709	.2676	.2643	.2611	.2578	.2546	.2514	.2483	.2451
0.7	.2420	.2389	.2358	.2327	.2296	.2266	.2236	.2206	.2177	.2148
0.8	.2119	.2090	.2061	.2033	.2005	.1977	.1949	.1922	.1894	.1867
0.9	.1841	.1814	.1788	.1762	.1736	.1711	.1685	.1660	.1635	.1611
1.0	.1587	.1562	.1539	.1515	.1492	.1469	.1446	.1423	.1401	.1379
1.1	.1357	.1335	.1314	.1292	.1271	.1251	.1230	.1210	.1190	.1170
1.2	.1151	.1131	.1112	.1093	.1075	.1056	.1038	.1020	.1003	.0985
1.3	.0968	.0951	.0934	.0918	.0901	.0885	.0869	.0853	.0838	.0823
1.4	.0808	.0793	.0778	.0764	.0749	.0735	.0721	.0708	.0694	.0681
1.5	.0668	.0655	.0643	.0630	.0618	.0606	.0594	.0582	.0571	.0559
1.6	.0548	.0537	.0526	.0516	.0505	.0495	.0485	.0475	.0465	.0455
1.7	.0446	.0436	.0427	.0418	.0409	.0401	.0392	.0384	.0375	.0367
1.8	.0359	.0351	.0344	.0336	.0329	.0322	.0314	.0307	.0301	.0294
1.9	.0287	.0281	.0274	.0268	.0262	.0256	.0250	.0244	.0239	.0233
2.0	.0228	.0222	.0217	.0212	.0207	.0202	.0197	.0192	.0188	.0183
2.1	.0179	.0174	.0170	.0166	.0162	.0158	.0154	.0150	.0146	.0143
2.2	.0139	.0136	.0132	.0129	.0125	.0122	.0119	.0116	.0113	.0110
2.3	.0107	.0104	.0102	.0099	.0096	.0094	.0091	.0089	.0087	.0084
2.4	.0082	.0080	.0078	.0075	.0073	.0071	.0069	.0068	.0066	.0064
2.5	.0062	.0060	.0059	.0057	.0055	.0054	.0052	.0051	.0049	.0048
2.6	.0047	.0045	.0044	.0043	.0041	.0040	.0039	.0038	.0037	.0036
2.7	.0035	.0034	.0033	.0032	.0031	.0030	.0029	.0028	.0027	.0026
2.8	.0026	.0025	.0024	.0023	.0023	.0022	.0021	.0021	.0020	.0019
2.9	.0019	.0018	.0018	.0017	.0016	.0016	.0015	.0015	.0014	.0014
3.0	.0013	.0013	.0013	.0012	.0012	.0011	.0011	.0011	.0010	.0010
3.1	.0010	.0009	.0009	.0009	.0008	.0008	.0008	.0008	.0007	.0007
3.2	.0007	.0007	.0006	.0006	.0006	.0006	.0006	.0005	.0005	.0005
3.3	.0005	.0005	.0005	.0004	.0004	.0004	.0004	.0004	.0004	.0003
3.4	.0003	.0003	.0003	.0003	.0003	.0003	.0003	.0003	.0003	.0002

1.6 Hypothesis Testing

1.6.1 Tests concerning the mean of a single population

Test statistic for testing for the mean of a single population

When σ is known	When σ is unknown
Case I: n is large or small	**Case II: n is large**
$Z_{cal} = \frac{\bar{x} - \mu_0}{\sigma/\sqrt{n}} \sim N(0,1)$	$Z_{cal} = \frac{\bar{x} - \mu_0}{s/\sqrt{n}} \sim N(0,1)$
	Case III: n is small
	$T_{cal} = \frac{\bar{x} - \mu_0}{s/\sqrt{n}} \sim t(n-1)$

1.6.2 Tests concerning means of two populations

When the variances (σ_1^2 and σ_2^2) are known, the test statistic is given by:

$$Z_{cal} = \frac{(\bar{x}_1 - \bar{x}_2) - (\mu_1 - \mu_2)}{\sqrt{(\frac{\sigma_1^2}{n_1} + \frac{\sigma_2^2}{n_2})}}$$

When variances are unknown but samples are large (both n_1 and n_2 are greater than 30), th test statistic is given by:

$$Z_{cal} = \frac{\bar{x}_1 - \bar{x}_2}{\sqrt{\left(\frac{s_1^2}{n_1} + \frac{s_2^2}{n_2}\right)}}$$

When variances are unknown and sample sizes are small, and assuming that populations a normally distributed with homogeneous variance, the test statistic is:

$$T_{cal} = \frac{\bar{x}_1 - \bar{x}_2}{\sqrt{\left(\frac{s_p^2}{n_1} + \frac{s_p^2}{n_2}\right)}}$$

1.6.3 Test concerning a population proportion

The test statistic for testing for a proportion of a single population is given by:

$$z_{cal} = \frac{\hat{p} - p_0}{\sqrt{\frac{p_0 q_0}{n}}}$$

When populations variances are unknown and samples are large, a $100(1-\alpha)\%$ confidence interval for $\mu_1-\mu_2$ is given by:

$$(\bar{x}_1-\bar{x}_2)\pm z_{\frac{\alpha}{2}}\sqrt{\frac{s_1^2}{n_1}+\frac{s_2^2}{n_2}}$$

When populations variances are unknown and samples are small, that is $n_1, n_2 < 30$, a $100(1-\alpha)\%$ confidence interval for $\mu_1-\mu_2$ is given by

$$(\bar{x}_1-\bar{x}_2)-t_{\frac{\alpha}{2}}(n_1+n_2-2)\sqrt{\frac{s_1^2}{n_1}+\frac{s_2^2}{n_2}}$$

Pooled variance $S_p^2=\dfrac{(n_1-1)S_1^2+(n_2-1)S_2^2}{n_1+n_2-2}$

A $100(1-\alpha)\%$ confidence interval for the mean difference of the paired observations is given by:

$$\bar{d}\pm t_{\frac{\alpha}{2}}(n-1)\frac{S_d}{\sqrt{n}}$$

The minimum sample size necessary to ensure that the error in estimating μ will not exceed a specified amount e is given by:

$$n=\left[\frac{Z_{\alpha/2}\times\sigma}{e}\right]^2$$

A $100(1-\alpha)\%$ confidence interval for the population proportion p is given by:

$$\hat{p}\pm Z_{\alpha/2}\times\sqrt{\frac{\hat{p}(1-\hat{p})}{n}}$$

For large samples, the confidence interval estimate for (p_1-p_2) is given by:

$$(\hat{p}_1-\hat{p}_2)\pm z_{\frac{\alpha}{2}}\sqrt{\frac{\hat{p}_1\hat{q}_1}{n_1}+\frac{\hat{p}_2\hat{q}_2}{n_2}}$$

When samples are small $(n_1, n_2 < 30)$ we use the t-distribution. A confidence interval for p_1-p_2 is given by:

$$(\hat{p}_1-\hat{p}_2)\pm t_{\frac{\alpha}{2}}(n_1+n_2-2)\sqrt{\frac{\hat{p}_1\hat{q}_1}{n_1}+\frac{\hat{p}_2\hat{q}_2}{n_2}}$$

The minimum sample size required to estimate the population proportion to be within a specified amount e with $100(1-\alpha)\%$ confidence is given by:

$$n=\frac{\hat{p}(1-\hat{p})Z_{\alpha/2}^2}{e^2}$$

$$n=\left[\frac{Z_{\alpha/2}}{2e}\right]^2$$

Binomial probability distribution

$$P(X=x)=\binom{n}{x}p^x(1-p)^{n-x} \qquad \text{for } x=0, 1, 2, \ldots n.$$

If X~ B (n, p), then

$E(X) = n\,p$

$Var(X) = n\,p\,(1-p)$

Poisson probability distribution

$$P(X=x)=\frac{e^{-\lambda}\lambda^x}{x!} \qquad \text{for } x=0, 1, 2, \ldots$$

If X~ $P_o(\lambda)$, then the mean and variance of X both equal to λ

1.4 Normal Distribution

An arbitrary normal value X is transformed to a standard normal variable Z by the transformation

$$Z=\frac{X-\mu}{\sigma}$$

1.5 Statistical Estimation

1.5.1 Point estimators

Sample mean, $\bar{x}=\frac{1}{n}\sum x_i$

Sample variance, $s^2=\frac{1}{n-1}(\sum x_i^2-\frac{(\sum x_i)^2}{n})$

Sample population proportion, $\hat{p}=\frac{k}{n}$

1.5.2 Confidence interval estimation

If the population standard deviation σ is known, a $100(1-\alpha)\%$ confidence interval for μ given by:

$$\bar{x}\pm Z_{\alpha/2}\times\frac{\sigma}{\sqrt{n}}$$

If the population standard deviation σ is unknown and $n\geq 30$, then a $100(1-\alpha)\%$ confidence interval for population mean μ is given by:

$$\bar{x}\pm Z_{\alpha/2}\times\frac{s}{\sqrt{n}}$$

If the population standard deviation σ is unknown and $n<30$, then a $100(1-\alpha)\%$ confidence interval for μ is given by:

$$\bar{x}\pm t_{\alpha/2}(n-1)\times\frac{s}{\sqrt{n}}$$

When populations variances are known, a $100(1-\alpha)\%$ confidence interval for $\mu_1-\mu$ given by:

$$(\bar{x}_1-\bar{x}_2)\pm z_{\frac{\alpha}{2}}\sqrt{\frac{\sigma_1^2}{n_1}+\frac{\sigma_1^2}{n_2}}$$

Binomial probability distribution

$$P(X=x)=\binom{n}{x}p^x(1-p)^{n-x} \qquad \text{for x = 0, 1, 2,... n.}$$

If X~ B (n, p), then

E(X) = n p

Var(X) = n p (1 – p)

Poisson probability distribution

$$P(X=x)=\frac{e^{-\lambda}\lambda^x}{x!} \qquad \text{for x = 0, 1, 2, ...}$$

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If the population standard deviation σ is unknown and $n\geq 30$, then a $100(1-\alpha)\%$ confidence interval for population mean μ is given by:

$$\bar{x}\pm Z_{\alpha/2}\times\frac{s}{\sqrt{n}}$$

If the population standard deviation σ is unknown and $n<30$, then a $100(1-\alpha)\%$ confidence interval for μ is given by:

$$\bar{x}\pm t_{\alpha/2}(n-1)\times\frac{s}{\sqrt{n}}$$

When populations variances are known, a $100(1-\alpha)\%$ confidence interval for $\mu_1-\mu_2$ is given by:

$$(\bar{x}_1-\bar{x}_2)\pm z_{\frac{\alpha}{2}}\sqrt{\frac{\sigma_1^2}{n_1}+\frac{\sigma_1^2}{n_2}}$$

When populations variances are unknown and samples are large, a $100(1-\alpha)\%$ confidence interval for $\mu_1-\mu_2$ is given by:

$$(\bar{x}_1-\bar{x}_2)\pm z_{\frac{\alpha}{2}}\sqrt{\frac{s_1^2}{n_1}+\frac{s_2^2}{n_2}}$$

When populations variances are unknown and samples are small, that is $n_1, n_2 < 30$, a $100(1-\alpha)\%$ confidence interval for $\mu_1-\mu_2$ is given by

$$(\bar{x}_1-\bar{x}_2)-t_{\frac{\alpha}{2}}(n_1+n_2-2)\sqrt{\frac{s_1^2}{n_1}+\frac{s_2^2}{n_2}}$$

Pooled variance $S_p^2=\dfrac{(n_1-1)S_1^2+(n_2-1)S_2^2}{n_1+n_2-2}$

A $100(1-\alpha)\%$ confidence interval for the mean difference of the paired observations is given by:

$$\bar{d}\pm t_{\frac{\alpha}{2}}(n-1)\frac{S_d}{\sqrt{n}}$$

The minimum sample size necessary to ensure that the error in estimating μ will not exceed a specified amount e is given by:

$$n=\left[\frac{Z_{\alpha/2}\times\sigma}{e}\right]^2$$

A $100(1-\alpha)\%$ confidence interval for the population proportion p is given by:

$$\hat{p}\pm Z_{\alpha/2}\times\sqrt{\frac{\hat{p}(1-\hat{p})}{n}}$$

For large samples, the confidence interval estimate for (p_1-p_2) is given by:

$$(\hat{p}_1-\hat{p}_2)\pm z_{\frac{\alpha}{2}}\sqrt{\frac{\hat{p}_1\hat{q}_1}{n_1}+\frac{\hat{p}_2\hat{q}_2}{n_2}}$$

When samples are small $(n_1, n_2 < 30)$ we use the t-distribution. A confidence interval for p_1-p_2 is given by:

$$(\hat{p}_1-\hat{p}_2)\pm t_{\frac{\alpha}{2}}(n_1+n_2-2)\sqrt{\frac{\hat{p}_1\hat{q}_1}{n_1}+\frac{\hat{p}_2\hat{q}_2}{n_2}}$$

The minimum sample size required to estimate the population proportion to be within a specified amount e with $100(1-\alpha)\%$ confidence is given by:

$$n=\frac{\hat{p}(1-\hat{p})Z_{\alpha/2}^2}{e^2}$$

$$n=\left[\frac{Z_{\alpha/2}}{2e}\right]^2$$

1.6 Hypothesis Testing

1.6.1 Tests concerning the mean of a single population

Test statistic for testing for the mean of a single population

When σ is known	When σ is unknown
Case I: n is large or small $Z_{cal} = \frac{\bar{x} - \mu_0}{\sigma/\sqrt{n}} \sim N(0,1)$	**Case II:** n is large $Z_{cal} = \frac{\bar{x} - \mu_0}{s/\sqrt{n}} \sim N(0,1)$ **Case III:** n is small $T_{cal} = \frac{\bar{x} - \mu_0}{s/\sqrt{n}} \sim t(n-1)$

1.6.2 Tests concerning means of two populations

When the variances (σ_1^2 and σ_2^2) are known, the test statistic is given by:

$$Z_{cal} = \frac{(\bar{x}_1 - \bar{x}_2) - (\mu_1 - \mu_2)}{\sqrt{\left(\frac{\sigma_1^2}{n_1} + \frac{\sigma_2^2}{n_2}\right)}}$$

When variances are unknown but samples are large (both n_1 and n_2 are greater than 30), th test statistic is given by:

$$Z_{cal} = \frac{\bar{x}_1 - \bar{x}_2}{\sqrt{\left(\frac{s_1^2}{n_1} + \frac{s_2^2}{n_2}\right)}}$$

When variances are unknown and sample sizes are small, and assuming that populations a normally distributed with homogeneous variance, the test statistic is:

$$T_{cal} = \frac{\bar{x}_1 - \bar{x}_2}{\sqrt{\left(\frac{s_p^2}{n_1} + \frac{s_p^2}{n_2}\right)}}$$

1.6.3 Test concerning a population proportion

The test statistic for testing for a proportion of a single population is given by:

$$Z_{cal} = \frac{\hat{p} - p_0}{\sqrt{\frac{p_0 q_0}{n}}}$$

LIST OF FORMULAE

1.1 Measures for Describing Ungrouped Data

1.1.1 Measures of central tendency

Median

a. $y_{\frac{n+1}{2}}$ if n is odd

b. $\frac{1}{2}(y_{\frac{n}{2}} + y_{\frac{n+2}{2}})$ if n is even.

Population mean, $\mu = \frac{1}{N}\sum_{i=1}^{N} x_i$

Sample mean, $\bar{x} = \frac{1}{n}\sum_{i=1}^{n} x_i$

1.1.2 Measures of position

The position of the p^{th} percentile is given by:

$$\frac{(n+1)p}{100}$$

1.1.3 Measures of dispersion

Range = highest observed value – lowest observed value

Inter-quartile range = $Q_3 - Q_1$

Sample variance $s^2 = \frac{1}{n-1}\left(\sum_{i=1}^{n} x_i^2 - \frac{1}{n}\left(\sum_{i=1}^{n} x_i\right)^2\right)$

Population variance $\sigma^2 = \frac{1}{N}\left(\sum_{i=1}^{N} x_i^2 - \frac{1}{N}\left(\sum_{i=1}^{N} x_i\right)^2\right)$

Coefficient of variation (CV) $= \frac{s}{\bar{x}} \times 100$

Coefficient of skewness, Skp $= \frac{3(mean - median)}{standard\ deviation}$

i. Normal distribution and Poisson distribution
ii. Prediction and Forecasting
iii. Time Series and Index Numbers **[5 Marks]**

c) The roots of the equation $3x^2 + 4x - 5 = 0$ are α, β. Find the values of the following: **[5 Marks]**

i. $\frac{1}{\alpha} + \frac{1}{\beta}$

ii. $\alpha^2 + \beta^2$

SECTION B: 60 MARKS

Answer Any Three Questions of Your Choice.

Each Question Carries 20 Marks

QUESTION ONE

The commissions (in dollars) earned by a sample of 15 airtime vendors in one month were:

78	50	65	79	54	80	102	45	75
98	86	92	69	72	75	80	97	66

a) Find **[10 Marks]**
   i. Mean
   ii. Standard deviation

b) Draw a box –and –whisker plot of the above commissions earned **[5 Marks]**

c) Extrapolate any three real life business applications of the mean and standard deviation. **[5 Marks]**

QUESTION TWO

The reduction in sales of 7 randomly selected products of Goldman Group of Companies were noted before and after advertisement.

Before Advertisement	14	18	21	15	17	19	23
After Advertisement	13	15	20	15	16	16	21

Find a 95% confidence interval of the mean decline in sales of the 7 randomly selected products of Goldman Group of Companies. **[20 marks]**

QUESTION THREE

Joseph and Joyce scored the following marks from the 10 sampled end –of –semester Business Mathematics and Statistics tests they wrote during their secondary education. The tests were marked out of 50.

Joseph:	35	26	41	38	36	48	37	30	35	24
Joyce:		24	28	24	21	27	26	24	28	22	23

Calculate the Coefficient of Variation for each set of tests. Whose performance is more consistent? Justify your answer **[20 marks]**

QUESTION FOUR

a) Solve the equations simultaneously using Cramer's Rule.

$$x + 2y + 3z = 17$$
$$3x + 2y + z = 11$$
$$x - 5y + z = -5$$

b) The number of wooden chairs made by School of Vocation and Practical Skills Education per month is a randomly variable with the following probability distribution

X	19	20	21	22
P(X =x)	0.4	K	0.2	0.15

i. Calculate the value of K
ii. Find the probability that the number of chairs that will be made next month is at least 20
iii. Find the probability that the number of chairs produced per month is at most 21
iv. Find the expected number of chairs produced per month.
v. Suppose that the School of Vocation and Practical Skills Education workshop incurs fixed monthly costs of &100 and an additional construction cost of &5 per chair. Find the expected monthly cost of the operation. **[20 Marks]**

QUESTION FIVE

a) Given a random variable X which is normally distributed with mean 15 and standard deviation 10, find:
i. $P(X < 20)$
ii. $P(X > 12)$
iii. $P(12 < X < 20)$ **[7 Marks]**

b) Solve the equations simultaneously using Cramer's Rule

$$x + 2y + 3z = 17$$
$$3x + 2y + z = 11$$
$$x - 5y + z = -5$$

[5 Marks]

c) The following data give the quarterly sales figures for a retail outlet for the period 2017 to 2019.

Year	Quarter 1	Quarter 2	Quarter 3	Quarter 4
2017	14	32	33	6
2018	16	35	36	7
2019	15	38	41	8

i. Calculate four-point moving averages for the series.
ii. Plot the four-point MA series on the same graph as the original series.
[8 Marks]

THE END

SECTION A COMPULSORY: 40 Marks
ANSWER ALL QUESTIONS IN THIS SECTION

QUESTION ONE

An Economist studied the impact of external debt on economic growth using labour force growth (population size in millions), capital investment (billions of US dollars), and trade openness (ratio of imports plus exports to GDP) as control variables. The following model was estimated:

$$LnGDP_t = \beta_0 + \beta_1 LnK_t + \beta_2 LnEXD_t + \beta_3 LnTR_t + \beta_4 LnPOP_t + \varepsilon_t$$

Where, GDP = Gross domestic product; K = Capital investment; EXD = External debt; TR = Trade openness; POP = Labour force. The results of regression analysis are presented in the table below:

Results of Regression Analysis

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.050495	0.014468	3.490134	0.0017
DLK	0.094623	0.028573	3.311575	0.0026
DLNEXD	-0.525087	0.091146	-5.760943	0.0000
DLTR	-0.319642	0.135363	-2.361365	0.0257
DLPOP	11.89841	5.275785	2.255287	0.0324
R-squared	0.790432			
Adjusted R-squared	0.759385		Durbin-Watson stat	1.887577
F-statistic	25.45915			
Prob(F-statistic)	0.000000			

a) What does the term Ln and the E1 represent in the model represent?

b) Identify the dependent and independent variables used in the regression analysis.

c) Comment on the direction and significance of the relationship between the dependent variable and each of independent variables.

d) State and comment on the R-squared (adjusted) value obtained.

e) Interpret the coefficients on external debt and labour force. **[20 Marks]**

QUESTION TWO

a) Express each of the following in partial fractions:

i. $\frac{3x+5}{(x+1)(x+2)(x+3)}$

ii. $\frac{x^3}{(2x+1)(x^2+4)}$ **[6 Marks]**

b) Evaluate:

i. $\int_1^4 (x^2 - 4 + 4x^{-2})\,dx$

ii. C_4^7 or $\binom{7}{4}$ **[4 Marks]**

c) Distinguish between the following terms as used in Business Mathematics and Statistics:

CHALIMBANA UNIVERSITY

SCHOOL OF LEADERSHIP AND BUSINESS MANAGEMENT

FINAL EXAMINATION –JULY 2020

COURSE NAME:	**Business Mathematics and Statistics**
COURSE CODE:	**BMT 1100**
DATE:	**22ND July, 2020**
TIME:	**07:30 – 10:30**
DURATION:	**3 Hours**
SESSION:	**Morning**

Instructions:

1. **Answer all questions in section A**
2. **Answer any three questions from section B**
3. **Begin each question on a separate page**
4. **Write neatly and use correct business language**
5. **No phones in the examination room**
6. **Make sure you have the correct paper** before you

DO NOT TURN THIS PAGE UNTIL YOU ARE TOLD.

i. Normal distribution and Poisson distribution
ii. Prediction and Forecasting
iii. Time Series and Index Numbers **[5 Marks]**

d) The roots of the equation $3x^2 + 4x - 5 = 0$ are α, β. Find the values of the following: **[5 Marks]**

i. $\frac{1}{\alpha} + \frac{1}{\beta}$

ii. $\alpha^2 + \beta^2$

SECTION B: 60 MARKS

Answer Any Three Questions of Your Choice.

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a) Find **[10 Marks]**

i. Mean

ii. Standard deviation

b) Draw a box –and –whisker plot of the above commissions earned **[5 Marks]**

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The reduction in sales of 7 randomly selected products of Goldman Group of Companies were noted before and after advertisement.

Before Advertisement	14	18	21	15	17	19	23
After Advertisement	13	15	20	15	16	16	21

Find a 95% confidence interval of the mean decline in sales of the 7 randomly selected products of Goldman Group of Companies. **[20 marks]**

QUESTION THREE

Joseph and Joyce scored the following marks from the 10 sampled end –of –semester Business Mathematics and Statistics tests they wrote during their secondary education. The tests were marked out of 50.

Joseph:	35	26	41	38	36	48	37	30	35	24
Joyce:		24	28	24	21	27	26	24	28	22	23

Calculate the Coefficient of Variation for each set of tests. Whose performance is more consistent? Justify your answer **[20 marks]**

QUESTION FOUR

1.2 Measures for Describing Grouped Data

1.2.1 Measures of central tendency

$$\text{Mean} = \frac{\sum_{i=1}^{k} f_i x_i}{\sum_{i=1}^{k} f_i}$$

$$\text{Median} = L_m + \frac{C_m(n/2 - F_{m-1})}{f_m}$$

$$\text{Mode} = L_m + \frac{C_m(f_m - f_{m-1})}{2f_m - f_{m-1} - f_{m+1}}$$

1.2.2 Measures of position

$$\text{Lower quartile, } Q_1 = L_q + \frac{C_q(n/4 - F_{q-1})}{f_q}$$

$$\text{Upper quartile, } Q_3 = L_q + \frac{C_q(3n/4 - F_{q-1})}{f_q}$$

$$\text{P}^{\text{th}} \text{ percentile } P_k = L_p + \frac{C_p(\frac{kn}{100} - F_{p-1})}{f_p}$$

1.2.3 Measures of Dispersion

Population variance $\sigma^2 = \frac{1}{N}(\sum f_i x_i^2 - \frac{(\sum f_i x_i)^2}{N})$

Sample variance $s^2 = \frac{1}{n-1}(\sum f_i x_i^2 - \frac{(\sum f_i x_i)^2}{n})$

1.3 Discrete Probability Distributions

Expectation of a discrete random variable X

$$\mu = E(X) = \sum_{\text{all } x} xP(X = x)$$

Expectation of a function of a random variable

$$E[h(X)] = \sum_{\text{all } x} h(x)P(X = x)$$

Expected value of a linear function of a random variable

$$E(aX + b) = aE(X) + b$$

Variance of a discrete random variable

$$\sigma^2 = Var(X) = E(X^2) - [E(X)]^2$$

$$Z_{cal} = \frac{(\hat{p}_1 - \hat{p}_2) - (p_1 - p_2)}{\sqrt{\frac{pq}{n_1} + \frac{pq}{n_2}}}$$

1.7 Chi-Square Tests

$$\text{Expected frequency} = \frac{\textit{row total} \times \textit{column total}}{\textit{Grand total}}$$

$$\text{Test statistic, } \chi^2_{cal} = \sum_{i=1}^{n} \frac{(O_i - E_i)^2}{E_i}$$

1.8 Simple Linear Regression Analysis

The least squares estimates of β_0 and β_1 are a and b respectively

$$\text{where } b = \frac{n\sum xy - \sum x \sum y}{n\sum x^2 - (\sum x)^2}$$

$$\text{and } a = \frac{\sum y - b\sum x}{n}$$

1.9 Correlation Analysis

Pearson's product moment correlation coefficient is given by

$$r = \frac{n\sum xy - \sum x \sum y}{\sqrt{\left(n\sum x^2 - (\sum x)^2\right)\left(n\sum y^2 - (\sum y)^2\right)}}$$

Spearman's Rank Correlation Coefficient r_s is given by

$$r_s = 1 - \frac{6\sum d_i^2}{n(n^2 - 1)}$$

1.10 Introduction to Time Series Analysis

1.10.1 Trend Analysis

The fitted trend line is

and $$\hat{Y} = a + bX_t$$

$$b = \frac{n\sum X_t Y_t - \sum X_t \sum Y_t}{n\sum X_t^2 - (\sum X_t)^2}$$

$$a = \frac{\sum Y_t - b\sum X_t}{n}$$

1.10.2 Seasonal Analysis

$$\text{Seasonal ratio} = \frac{Y_t}{MA} = \frac{T_t \times C_t \times S_t \times I_t}{T_t \times C_t} = S_t \times I_t$$

$$\text{Actual Y}$$

$$\text{Deseasonalised Y} = \frac{\textit{Actual Y}}{\textit{Adjusted Seasonal Index S}}$$

1.11 Index Numbers

1.11.1 Simple Index Numbers

Simple Price Index

$$SPI = \frac{P_n}{P_0} \times 100$$

Simple Quantity Index

$$SQI = \frac{Q_n}{Q_0} \times 100$$

1.11.2 Weighted Index Numbers

Laspeyre Price Index, LPI $= \frac{\sum P_n Q_0}{\sum P_0 Q_0} \times 100$

Laspeyre Quantity Index, LQI $= \frac{\sum Q_n P_0}{\sum Q_0 P_0} \times 100$

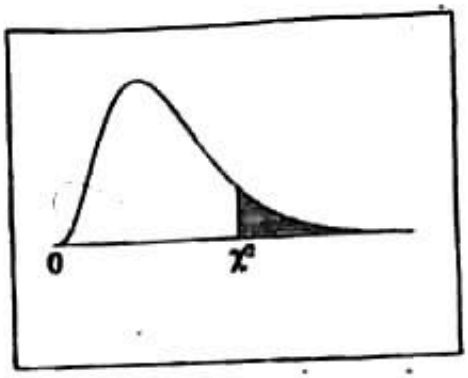
Paasche Price Index, PPI $= \frac{\sum P_n Q_n}{\sum P_0 Q_n} \times 100$

Paasche Quantity Index, PQI $= \frac{\sum Q_n P_n}{\sum Q_0 P_n} \times 100$

Fisher Price Index, FPI $= \sqrt{LPI \times PPI}$

Fisher Quantity Index, FQI $= \sqrt{LQI \times PQI}$

Chi-Square Distribution Table

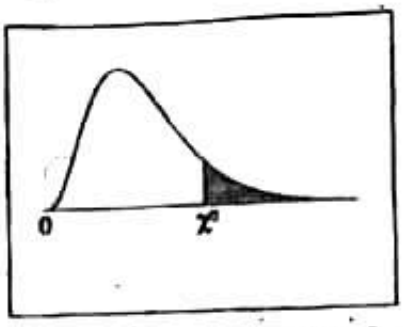


The shaded area is equal to α for $\chi^2 = \chi^2_\alpha$.

Critical Values for Chi-Square Distribution.

	Upper Tail Probability									
df	0.2	0.1	0.05	0.04	0.03	0.025	0.02	0.01	0.005	0.0005
1	1.642	2.706	3.841	4.218	4.709	5.024	5.412	6.635	7.879	12.116
2	3.219	4.605	5.991	6.438	7.013	7.378	7.824	9.210	10.597	15.202
3	4.642	6.251	7.815	8.311	8.947	9.348	9.837	11.345	12.838	17.730
4	5.989	7.779	9.488	10.026	10.712	11.143	11.668	13.277	14.860	19.997
5	7.289	9.236	11.070	11.644	12.375	12.833	13.388	15.086	16.750	22.105
6	8.558	10.645	12.592	13.198	13.968	14.449	15.033	16.812	18.548	24.103
7	9.803	12.017	14.067	14.703	15.509	16.013	16.622	18.475	20.278	26.018
8	11.030	13.362	15.507	16.171	17.010	17.535	18.168	20.090	21.955	27.868
9	12.242	14.684	16.919	17.608	18.480	19.023	19.679	21.666	23.589	29.666
10	13.442	15.987	18.307	19.021	19.922	20.483	21.161	23.209	25.188	31.420
11	14.631	17.275	19.675	20.412	21.342	21.920	22.618	24.725	26.757	33.137
12	15.812	18.549	21.026	21.785	22.742	23.337	24.054	26.217	28.300	34.821
13	16.985	19.812	22.362	23.142	24.125	24.736	25.472	27.688	29.819	36.478
14	18.151	21.064	23.685	24.485	25.493	26.119	26.873	29.141	31.319	38.109
15	19.311	22.307	24.996	25.816	26.848	27.488	28.259	30.578	32.801	39.719
16	20.465	23.542	26.296	27.136	28.191	28.845	29.633	32.000	34.267	41.308
17	21.615	24.769	27.587	28.445	29.523	30.191	30.995	33.409	35.718	42.879
18	22.760	25.989	28.869	29.745	30.845	31.526	32.346	34.805	37.156	44.434
19	23.900	27.204	30.144	31.037	32.158	32.852	33.687	36.191	38.582	45.973
20	25.038	28.412	31.410	32.321	33.462	34.170	35.020	37.566	39.997	47.498
21	26.171	29.615	32.671	33.597	34.759	35.479	36.343	38.932	41.401	49.011	
22	27.301	30.813	33.924	34.867	36.049	36.781	37.659	40.289	42.796	50.511	
23	28.429	32.007	35.172	36.131	37.332	38.076	38.968	41.638	44.181	52.000	
24	29.553	33.196	36.415	37.389	38.609	39.364	40.270	42.980	45.559	53.479	
25	30.675	34.382	37.652	38.642	39.880	40.646	41.566	44.314	46.928	54.947	
26	31.795	35.563	38.885	39.889	41.146	41.923	42.856	45.642	48.290	56.407	
27	32.912	36.741	40.113	41.132	42.407	43.195	44.140	46.963	49.645	57.858	
28	34.027	37.916	41.337	42.370	43.662	44.461	45.419	48.278	50.993	59.300	
29	35.139	39.087	42.557	43.604	44.913	45.722	46.693	49.588	52.336	60.735	
30	36.250	40.256	43.773	44.834	46.160	46.979	47.962	50.892	53.672	62.162	
31	37.359	41.422	44.985	46.059	47.402	48.232	49.226	52.191	55.003	63.582	
32	38.466	42.585	46.194	47.282	48.641	49.480	50.487	53.486	56.328	64.995	
33	39.572	43.745	47.400	48.500	49.876	50.725	51.743	54.776	57.648	66.403	
34	40.676	44.903	48.602	49.716	51.107	51.966	52.995	56.061	58.964	67.803	
35	41.778	46.059	49.802	50.928	52.335	53.203	54.244	57.342	60.275	69.199	
36	42.879	47.212	50.998	52.137	53.560	54.437	55.489	58.619	61.581	70.588	
37	43.978	48.363	52.192	53.344	54.781	55.668	56.730	59.893	62.883	71.972	
38	45.076	49.513	53.384	54.547	56.000	56.896	57.969	61.162	64.181	73.351	
39	46.173	50.660	54.572	55.748	57.215	58.120	59.204	62.428	65.476	74.725	
40	47.269	51.805	55.758	56.946	58.428	59.342	60.436	63.691	66.766	76.095	
41	48.363	52.949	56.942	58.142	59.638	60.561	61.665	64.950	68.053	77.459	
42	49.456	54.090	58.124	59.335	60.845	61.777	62.892	66.206	69.336	78.820	
43	50.548	55.230	59.304	60.526	62.050	62.990	64.116	67.459	70.616	80.176	
44	[illegible]	56. [illegible]	[illegible]	61.714	63.253	64.201	65.337	68.710	71.893	81.528	
45	[illegible]	[illegible]	[illegible]	62.901	64.453	65.410	66.555	69.957	73.166	82.876	
46	[illegible]	[illegible]	[illegible]	64.085	65.652	66.617	67.771	71.201	74.437	84.220	
47	46.608	58.774	64.001	65.268	66.847	67.821	68.986	72.443	75.704	85.560	
48	55.993	60.907	65.171	66.449	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	

Chi-Square Distribution Table



The shaded area is equal to α for $\chi^2 = \chi^2_\alpha$.

Critical Values for Chi-Square Distribution

	Upper Tail Probability									
df	0.2	0.1	0.05	0.04	0.03	0.025	0.02	0.01	0.005	0.0005
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2	3.219	4.605	5.991	6.438	7.013	7.378	7.824	9.210	10.597	15.202
3	4.642	6.251	7.815	8.311	8.947	9.348	9.837	11.345	12.838	17.730
4	5.989	7.779	9.488	10.026	10.712	11.143	11.668	13.277	14.860	19.997
5	7.289	9.236	11.070	11.644	12.375	12.833	13.388	15.086	16.750	22.105
6	8.558	10.645	12.592	13.198	13.968	14.449	15.033	16.812	18.548	24.103
7	9.803	12.017	14.067	14.703	15.509	16.013	16.622	18.475	20.278	26.018
8	11.030	13.362	15.507	16.171	17.010	17.535	18.168	20.090	21.955	27.868
9	12.242	14.684	16.919	17.608	18.480	19.023	19.679	21.666	23.589	29.666
10	13.442	15.987	18.307	19.021	19.922	20.483	21.161	23.209	25.188	31.420
11	14.631	17.275	19.675	20.412	21.342	21.920	22.618	24.725	26.757	33.137
12	15.812	18.549	21.026	21.785	22.742	23.337	24.054	26.217	28.300	34.821
13	16.985	19.812	22.362	23.142	24.125	24.736	25.472	27.688	29.819	36.478
14	18.151	21.064	23.685	24.485	25.493	26.119	26.873	29.141	31.319	38.109
15	19.311	22.307	24.996	25.816	26.848	27.488	28.259	30.578	32.801	39.719
16	20.465	23.542	26.296	27.136	28.191	28.845	29.633	32.000	34.267	41.308
17	21.615	24.769	27.587	28.445	29.523	30.191	30.995	33.409	35.718	42.879
18	22.760	25.989	28.869	29.745	30.845	31.526	32.346	34.805	37.156	44.434
19	23.900	27.204	30.144	31.037	32.158	32.852	33.687	36.191	38.583	45.973
20	25.038	28.412	31.410	32.321	33.462	34.170	35.020	37.566	39.997	47.498
21	26.171	29.615	32.671	33.597	34.759	35.479	36.343	38.932	41.401	49.011	
22	27.301	30.813	33.924	34.867	36.049	36.781	37.659	40.289	42.796	50.511	
23	28.429	32.007	35.172	36.131	37.333	38.076	38.968	41.638	44.181	52.000	
24	29.553	33.196	36.415	37.389	38.609	39.364	40.270	42.980	45.559	53.479	
25	30.675	34.382	37.652	38.643	39.880	40.646	41.566	44.314	46.928	54.947	
26	31.795	35.563	38.885	39.889	41.148	41.923	42.856	45.642	48.290	56.407	
27	32.912	36.741	40.113	41.132	42.407	43.195	44.140	46.963	49.645	57.858	
28	34.027	37.916	41.337	42.370	43.663	44.461	45.419	48.278	50.993	59.300	
29	35.139	39.087	42.557	43.604	44.913	45.722	46.693	49.588	52.336	60.735	
30	36.250	40.256	43.773	44.834	46.160	46.979	47.962	50.892	53.672	62.162	
31	37.359	41.422	44.985	46.059	47.402	48.232	49.226	52.191	55.003	63.582	
32	38.466	42.585	46.194	47.282	48.641	49.480	50.487	53.486	56.328	64.995	
33	39.572	43.745	47.400	48.500	49.876	50.725	51.743	54.776	57.648	66.403	
34	40.676	44.903	48.602	49.716	51.107	51.966	52.995	56.061	58.964	67.803	
35	41.778	46.059	49.802	50.928	52.335	53.203	54.244	57.342	60.275	69.199	
36	42.879	47.212	50.998	52.137	53.560	54.437	55.489	58.619	61.581	70.588	
37	43.978	48.363	52.192	53.344	54.781	55.668	56.730	59.893	62.883	71.972	
38	45.076	49.513	53.384	54.547	56.000	56.896	57.969	61.162	64.181	73.351	
39	46.173	50.660	54.572	55.748	57.215	58.120	59.204	62.426	65.476	74.725	
40	47.269	51.805	55.758	56.946	58.428	59.342	60.436	63.691	66.766	76.095	
41	48.363	52.949	56.942	58.142	59.638	60.561	61.666	64.950	68.053	77.459	
42	49.456	54.090	58.124	59.335	60.845	61.777	62.892	66.206	69.336	78.820	
43	50.548	55.230	59.304	60.526	62.050	62.990	64.116	67.459	70.616	80.176	
44	51.639	56.369	60.481	61.714	63.253	64.201	65.337	68.710	71.893	81.528	
45	52.729	57.505	61.656	62.901	64.453	65.410	66.555	69.957	73.166	82.876	
46	53.818	58.641	62.830	64.086	65.652	66.617	67.771	71.201	74.437	84.220	
47	54.906	59.774	64.001	65.269	66.847	67.821	68.985	72.443	75.704	85.560	
48	55.993	60.907	65.171	66.448	68.041	69.023	70.197	73.683	76.969	86.897	
49	57.079	62.038	66.339	67.627	69.233	70.222	71.406	74.919	78.231	88.231	
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	

Table entry for p and C is the critical value t^* with probability p lying to its right and probability C lying between $-t^*$ and t^*.

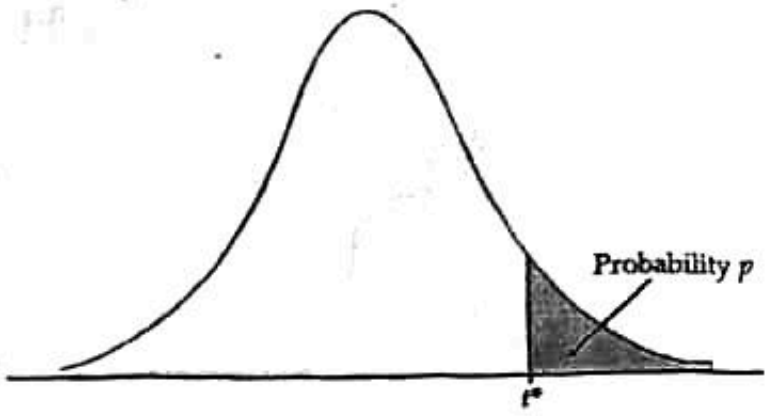

TABLE D

t distribution critical values

	Upper-tail probability p										
df	.25	.20	.15	.10	.05	.025	.02	.01	.005	.0025	.001
1	1.000	1.376	1.963	3.078	6.314	12.71	15.89	31.82	63.66	127.3	318.3
2	0.816	1.061	1.386	1.886	2.920	4.303	4.849	6.965	9.925	14.09	22.33
3	0.765	0.978	1.250	1.638	2.353	3.182	3.482	4.541	5.841	7.453	10.21
4	0.741	0.941	1.190	1.533	2.132	2.776	2.999	3.747	4.604	5.598	7.173
5	0.727	0.920	1.156	1.476	2.015	2.571	2.757	3.365	4.032	4.773	5.893
6	0.718	0.906	1.134	1.440	1.943	2.447	2.612	3.143	3.707	4.317	5.208
7	0.711	0.896	1.119	1.415	1.895	2.365	2.517	2.998	3.499	4.029	4.785
8	0.706	0.889	1.108	1.397	1.860	2.306	2.449	2.896	3.355	3.833	4.501
9	0.703	0.883	1.100	1.383	1.833	2.262	2.398	2.821	3.250	3.690	4.297
10	0.700	0.879	1.093	1.372	1.812	2.228	2.359	2.764	3.169	3.581	4.144
11	0.697	0.876	1.088	1.363	1.796	2.201	2.328	2.718	3.106	3.497	4.025
12	0.695	0.873	1.083	1.356	1.782	2.179	2.303	2.681	3.055	3.428	3.930
13	0.694	0.870	1.079	1.350	1.771	2.160	2.282	2.650	3.012	3.372	3.852
14	0.692	0.868	1.076	1.345	1.761	2.145	2.264	2.624	2.977	3.326	3.787
15	0.691	0.866	1.074	1.341	1.753	2.131	2.249	2.602	2.947	3.286	3.733
16	0.690	0.865	1.071	1.337	1.746	2.120	2.235	2.583	2.921	3.252	3.686
17	0.689	0.863	1.069	1.333	1.740	2.110	2.224	2.567	2.898	3.222	3.646
18	0.688	0.862	1.067	1.330	1.734	2.101	2.214	2.552	2.878	3.197	3.611
19	0.688	0.861	1.066	1.328	1.729	2.093	2.205	2.539	2.861	3.174	3.579
20	0.687	0.860	1.064	1.325	1.725	2.086	2.197	2.528	2.845	3.153	3.552
21	0.686	0.859	1.063	1.323	1.721	2.080	2.189	2.518	2.831	3.135	3.527
22	0.686	0.858	1.061	1.321	1.717	2.074	2.183	2.508	2.819	3.119	3.505
23	0.685	0.858	1.060	1.319	1.714	2.069	2.177	2.500	2.807	3.104	3.485
24	0.685	0.857	1.059	1.318	1.711	2.064	2.172	2.492	2.797	3.091	3.467
25	0.684	0.856	1.058	1.316	1.708	2.060	2.167	2.485	2.787	3.078	3.450
26	0.684	0.856	1.058	1.315	1.706	2.056	2.162	2.479	2.779	3.067	3.435
27	0.684	0.855	1.057	1.314	1.703	2.052	2.158	2.473	2.771	3.057	3.421
28	0.683	0.855	1.056	1.313	1.701	2.048	2.154	2.467	2.763	3.047	3.408
29	0.683	0.854	1.055	1.311	1.699	2.045	2.150	2.462	2.756	3.038	3.396
30	0.683	0.854	1.055	1.310	1.697	2.042	2.147	2.457	2.750	3.030	3.385
40	0.681	0.851	1.050	1.303	1.684	2.021	2.123	2.423	2.704	2.971	3.307
50	0.679	0.849	1.047	1.299	1.676	2.009	2.109	2.403	2.678	2.937	3.261
60	0.679	0.848	1.045	1.296	1.671	2.000	2.099	2.390	2.660	2.915	3.232
80	0.678	0.846	1.043	1.292	1.664	1.990	2.088	2.374	2.639	2.887	3.195
100	0.677	0.845	1.042	1.290	1.660	1.984	2.081	2.364	2.626	2.871	3.174
000	0.675	0.842	1.037	1.282	1.646	1.962	2.056	2.330	2.581	2.813	3.098
z^*	0.674	0.84	[illegible]	1.282	1.645	1.960	2.054	2.326	2.576	2.807	3.091
	50%	60%	[illegible]	80%	90%	95%	96%	98%	99%	99.5%	99.8%

Confidence level C

MTH1100

Assignment one

1. Evaluate the following Permutations and Combinations

(i) $5p_2$

(ii) $6p_4$

(iii) In how many ways can 7 boxes of sweets be arranged on a shelf in a grocery?

(iv) How many different committees including 3 businesswoman and 2 businessmen can be chosen from 8 businessmen and 10 businesswoman?

2. At a jewellery store , a sample of sales were classified as follows

Value of sales (kwacha)	Number of sales
15-25	10
25-35	25
35-45	40
45-55	10
55-65	8
65-75	7

(i) Plot the histogram

(ii) Calculate the sample mean

(iii) Calculate the variance

(iv) Calculate the standard deviation

(v) Calculate the mean deviation

(vi) Calculate the coefficient of variation

3. (a) Suppose that the number of accidents per week over a certain stretch of highway has a Poisson distribution with $\mu = 2$. Find the probability that on that stretch there will be the following:

(i) No accidents next week

(ii) two accidents next week

(iii) more than three accidents next week

(b) The time needed to service a car at a service station is exponential random variable with a mean of 2 minutes. Determine the probability that a newly arriving car will be serviced as follows.

(i) within 1 minute

(ii) Atleast 120 seconds

(iii) Between 1 and 2 minutes

MTH1100

Assignment one

1 Evaluate the following Permutations and Combinations

(i) $5p_3$

(ii) $6p_4$

(iii) In how many ways can 7 boxes of sweets be arranged on a shelf in a grocery?

(iv) How many different committees including 3 businesswoman and 2 businessmen can be chosen from 8 businessmen and 10 businesswoman?

2. At a jewellery store , a sample of sales were classified as follows

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Assignment one

1. Evaluate the following Permutations and Combinations

(i) $5P_3$

(ii) $6P_4$

(iii) In how many ways can 7 boxes of sweets be arranged on a shelf in a grocery?

(iv) How many different committees including 3 businesswoman and 4 businessmen can be chosen from 8 businessmen and 10 businesswoman?

2. At a jewellery store, a sample of sales were classified as follows

Value of sales (kwacha)	Number of sales
15-25	10
25-35	25
35-45	40
45-55	10
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QUESTION SIX

(a) The profit to be realised from a certain business venture to the nearest k100 are believed to follow the probability distribution shown below;

X	-200	-100	0	100	200	300
$P(X = x)$	0.2	0.25	0.1	0.15	K	0.05

(i)Calculate the value of k **[3marks]**

(ii) Find The probability that the business venture

(a) Makes a loss **[2marks]**

(b) Realises profit of at least k200 **[2marks]**

(i) Find (a) the expected earnings **[3marks]**

(b)Standard deviation **[4marks]**

(b) Upon the presidential directive for paying the retirees, one of the retirees want to invest his lump sum in a project that has the following cashflows:

Years	Cashflows (k000)
0	-200
1	80
2	90
3	100
4	120

Assuming 9% discount factor compounded annually, calculate the net present value of this project and what advise can you give to this retiree? **[11 marks]**

[Total marks 25]

b) Classify the following as either quantitative or qualitative

i) Colour of your eyes [1mark]

ii) Volume of water in a quarter tank [1mark]

iii) Gender [1mark]

iv) Marital status [1mark]

c) The following are the marks obtained BBA Students in maths test 40, 65, 35, 20, 65, 70, 80

Compute the following descriptive statistics for these data:

i) The range [2marks]

ii) Sample mean [3marks]

iii) The variance [3 marks]

iv) Sample standard deviation [3marks]

iv) The mean absolute deviation [4 marks]

[Total marks 25]

QUESTION THREE

a) Determine the area of the Z- score $P(-1.25 \leq Z \leq 1.25)$ [3marks]

b) An electrical firm supplies bulbs that have a length of life that is approximately normally distributed with a standard deviation of 20 hours. If a random sample of 40 bulbs has an average of life of 800hours.

(i)find a 95% confidence interval for the population mean life of all bulbs supplied by the firm [5marks]

(ii)find a 99% confidence interval for the population mean life of all bulbs supplied by the firm . [5marks]

(c) The time needed to service a car at the filling station is exponential random variable with a mean of 2 minutes. Determine the probability that a newly arriving car will be serviced as follows: [3marks]

(i) Within 1 minute?

QUESTION ONE

a) Find the value of $(2x)^0 + 3$ [2marks]

b) Solve the equation $5x + 7 = 2 - 3(x - 2)$ [3marks]

c) Given that $A^T = \begin{vmatrix} 2 & 11 \\ 0 & 2 \\ -3 & 5 \end{vmatrix}$, Find A [2marks]

d) For the production function $Q = 200K^{\frac{1}{4}}L^{\frac{3}{4}}$ Find the out put Q when k= 16, L = 27 [4marks]

e) During a recession the firm's revenue decline continuously so that the revenue , TR , (measured in million of kwachas) in years time is modelled by;

$TR = 10e^{-0.25t}$

i) Calculate the current revenue and the revenue in three years [4marks]

ii) After how many years will the revenue decline to k1.75 million [4marks]

f) Solve the following simultaneous equation using any method [6marks]

$$x + 2y + 2z = 7$$
$$4x + 5y + z = 11$$
$$7x - 4y - z = 1$$

QUESTION TWO [Total marks 25]

a) The cell phone industry providers in Zambia are currently dominated by MTN, Airtel and Zamtel. In a survey conducted by the BBA September intake student at Chalimbana University to determine the number of subscribers revealed the following:

Provider	Number of subscriber
MTN	50
Airtel	30
Zamtel	20

i) Use a pie chart to represent the above data [5 marks]

ii) Which provider has the largest market share [1 mark]

[4marks]

(ii) Atleast 120 seconds? [5marks]

(iii) Between 1 and 2 minutes?

[Total marks 25]

QUESTION FOUR

a)Find the value of i) 8! [2marks]

ii)10p 1 [2makrs]

b)Suppose that we two events, A and B, with P(A) = 0.5, P(B) =0.60 and P(A∩B) = 0.40

a) Find i) P(A/B) [3marks]

ii)P(B/A) [3marks]

b) Are A and B independent events? Why or why not? [2marks]

A new drug for a covid is known to be effective in 70% of the cases treated. If Six patients suffering from the disease are to be treated.

i)Find the probability that a) 4 patients will be successfully treated [3marks]

b) Atleast 2 patients will be successfully treated [4marks]

ii) Calculate a) the mean $\mu = np$ [3marks]

b)the variance $\sigma^2 = npq$ [3marks]

[Total marks 25]

QUESTION FIVE

(a) Ms eecah had k120000.00 in the Atlasmara bank after saving for 5 years at an interest rate of 12%. How much was her initial deposit? [5marks]

(b) Chalimbana complex borrows k20000 from a bank at an interest rate of 10% per annum and agrees to make equal semi-annual payments for 3years

(i) Calculate the equal semi-annual payment [6marks]

(ii) Prepare a loan amortisation schedule for this complex [14marks]

[Total Marks 25]