CPA FOUNDATION LEVEL

CIFA FOUNDATION LEVEL

QUANTITATIVE ANALYSIS

THURSDAY: 24 April 2025. Morning Paper. **Time Allowed: 3 hours.**

This paper consists of seven (7) questions. Answer any FIVE questions. ALL questions carry equal marks. Show ALL your workings. Do NOT write anything on this paper.

QUESTION ONE

(a) Discuss **THREE** emerging issues in quantitative analysis that have significantly impacted decision making in modern industries. (6 marks)

(b) A company sells a product and market research shows that the demand function for the product is linear. The price and quantity combinations observed in the market are as follows:

When price (P) is Sh.50, the quantity demanded (Q) is 200 units.
When price (P) is Sh.30, the quantity demanded (Q) is 400 units.

The total cost function (C) is given by $C(Q) = 5{,}000 + 10Q + 0.05Q^2$

Required:

(i) Determine the linear demand function. (4 marks)

(ii) Find the total revenue function. (2 marks)

(iii) Find the profit function. (2 marks)

(iv) Determine the quantity that maximises profit. (2 marks)

(v) Determine the break-even point. (4 marks)

(Total: 20 marks)

QUESTION TWO

(a) Explain the following terms as used in probability theory:

(i) Conditional probability. (2 marks)

(ii) Bayes theorem. (2 marks)

(b) A company collected data on monthly sales (in units) of a particular product over the past 100 months. The data was grouped into eight classes as shown below but two frequency values (F_3 and F_6) are missing. The mean sale is given as 48.3 units.

Sales range (units)	**Frequency**
10 – 20	8
20 – 30	12
30 – 40	**F_3**
40 – 50	20
50 – 60	18
60 – 70	**F_6**
70 – 80	10
80 – 90	7
Total	**100**

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Required:

(i) Solve for F_3 and F_6 using the given mean. (4 marks)

(ii) Compute the median sales. (2 marks)

(iii) Determine the first quartile value (Q_1). (3 marks)

(iv) Determine the third quartile value (Q_3). (3 marks)

(v) Determine the quartile deviation. (2 marks)

(vi) Determine the quartile coefficient of skewness. (2 marks)

(Total: 20 marks)

QUESTION THREE

A company tracked its quarterly sales (in millions) over the past 3 years as shown in the table below:

	Quarter			
Year	**Q_1**	**Q_2**	**Q_3**	**Q_4**
1	50	65	80	70
2	55	70	85	75
3	60	75	90	80

Required:

(a) Obtain a 4-quarter centred moving average for the data. (4 marks)

(b) Determine the typical seasonal indices for each quarter using the multiplicative model. (4 marks)

(c) Determine the deseasonalised sales for each quarter. (4 marks)

(d) Fit a trend equation to the deseasonalised data using the ordinary least squares (OLS) method. (4 marks)

(e) Forecast the seasonally adjusted sales for each quarter of the coming year using the trend equation in (d) above. (4 marks)

(Total: 20 marks)

QUESTION FOUR

(a) Outline the **SIX** steps involved in conducting a hypothesis test. (6 marks)

(b) AutoTech Solutions Ltd. is analysing the relationship between total maintenance cost (Y) and two predictor variables: Service hours (X_1) and number of replacement parts used (X_2).

Regression output from Ms Excel is as follows:

Regression statistics:

Parameter	**Output**
Multiple R	0.981542
R square	**A?**
Adjusted R square	0.955684
Standard error	24.137620
Observations	10

ANOVA Table:

Source	**d.f**	**SS**	**MS**	**F**	**Significance**
Regression	2	254,600.40	**C = ?**	**D = ?**	0.000089
Residual	7	**B = ?**	3,456.21		
Total	9	263,000			

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Regression coefficients:

Variable	Coefficient	Standard error	t-statics	P value	Lower 95%	Upper 95%
Intercept	480.32	30.1175	**E = ?**	0.000012	410.28	550.36
Service hours (X_1)	**F = ?**	4.9162	5.847	0.000095	22.32	35.18
Replacement parts (X_2)	15.60	3.2453	4.808	0.000231	10.32	20.88

Required:

(i) Determine the missing values A, B, C, D, E and F in the regression output. (6 marks)

(ii) Develop a regression equation showing the relationship between total maintenance cost and two predictor variables. (2 marks)

(iii) Determine the coefficient of determination. Interpret your results. (2 marks)

(iv) Test the adequacy of the model for prediction (F table value = 4.74). (2 marks)

(v) Explain whether service hours are adequate as predictor variable (t critical value = 2.365). (2 marks)

(Total: 20 marks)

QUESTION FIVE

(a) Highlight **SIX** qualities of a good measure of central tendency. (6 marks)

(b) Pegra Ltd. is considering launching a new electric product. However, demand for the proposed product is uncertain and the company can either launch the new product immediately or conduct market research before making a decision which could return either a favourable or unfavourable outcome. If the research outcome is favourable, Pegra Ltd. can proceed with launch. If the research outcome is unfavourable, the company has the option to abandon the launch.

Probabilities and payoffs:

Option 1: Launch immediately:
- Probability of high demand will be 60% with a projected profit of Sh.500,000
- Probability of low demand will be 40% with a projected loss of Sh.200,000

Option 2: Conduct market research at a cost of Sh.50,000
- Probability of favourable research outcome is 70%
- Probability of unfavourable research outcome is 30%

If research outcome is favourable:
- Probability of high demand will be 80% with a projected profit of Sh.500,000
- Probability of low demand will be 20% with a projected loss of Sh.200,000

If research outcome is unfavourable:

- The company can choose to abandon the launch incurring only the Sh.50,000 research cost.

Required:

(i) Construct a decision tree based on the given probabilities and outcomes. (8 marks)

(ii) Compute the expected monetary value (EMV) for each option. (4 marks)

(iii) Recommend the best investment decision for the company. (2 marks)

(Total: 20 marks)

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QUESTION SIX

(a) Explain the meaning of the following terms as used in set theory:

(i) Universal set. (2 marks)

(ii) Subset. (2 marks)

(iii) Set union. (2 marks)

(b) A simple economy consists of two sectors; Wool production and Hides tanning. Each unit of output from Wool production requires 0.6 units worth of input from Wool production and 0.3 units worth of input from Hides tanning. A unit of output from Hides tanning requires 0.2 units worth of input from Wool production and 0.5 units worth of input from Hides tanning. The final demand for the period is estimated to be 800 units for Wool production and 220 units for Hides tanning.

Required:

(i) Determine the total output required for each sector to satisfy both intermediate and final demand. (8 marks)

(ii) Account for the usage of Wool production output. (3 marks)

(iii) Account for the sources of input for Hides tanning. (3 marks)

(Total: 20 marks)

QUESTION SEVEN

(a) Explain the following terms as used in hypothesis testing:

(i) Type I error. (2 marks)

(ii) Type II error. (2 marks)

(iii) Rejection region. (2 marks)

(b) A company owns two flour mills; A and B which have different production capabilities for high, medium and low grade flour. The company has entered into a contract to supply flour to a firm every week with 120, 80 and 240 kilograms of high, medium and low grades flour respectively. It costs the company Sh.10,000 and Sh.8,000 per day to run Mill A and Mill B respectively. On a daily basis, Mill A produces 60, 20 and 40 kilograms of high, medium and low grade flour respectively while Mill B produces 20, 20 and 120 kilograms of high, medium and low grade flour respectively.

Required:

(i) Formulate the above problem as a linear programming problem in order to minimise the total cost of operation. (6 marks)

(ii) Graphically determine the number of days per week that each mill should operate to minimise the total cost of operation. (8 marks)

(Total: 20 marks)

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QUANTITATIVE ANALYSIS

WEDNESDAY: 4 December 2024. Morning Paper. **Time Allowed: 3 hours.**

This paper consists of seven (7) questions. Answer any FIVE questions. ALL questions carry equal marks. Show ALL your workings. Do NOT write anything on this paper.

QUESTION ONE

(a) Explain **TWO** applications of calculus in business management. (4 marks)

(b) Consider a company manufacturing a product with the following functions:

Marginal revenue (Sh."000") = 50 - 4q
Average costs (Sh."000") = 5 - 16/q

Required:

(i) Formulate the profit function. (4 marks)

(ii) Determine the quantity to be produced in order to maximise profit. (3 marks)

(iii) Calculate the maximum profit. (3 marks)

(c) The 2 x 2 matrices; A, X and B are given as follows:

$$A = \begin{pmatrix} 10 & 4 \\ 4 & 2 \end{pmatrix}; \quad X = \begin{pmatrix} a & b \\ c & d \end{pmatrix}; \quad B = \begin{pmatrix} 18 & 14 \\ 8 & 10 \end{pmatrix}$$

Required:

Given that AX = B, find the values of a, b, c and d. (6 marks)

(Total: 20 marks)

QUESTION TWO

(a) Outline **FOUR** characteristics of a poisson probability distribution. (4 marks)

(b) In relation to probability theory, distinguish between "subjective approach to probability" and "classical approach to probability". (4 marks)

(c) A manufacturing company is evaluating the preferences of 250 customers regarding three new products; product Exe, product Wye and product Zed. The following information was gathered from a sample survey:

- 35 customers prefer both product Exe and product Wye.
- 120 customers prefer either product Exe or product Wye but not product Zed.
- 50 customers prefer product Wye but not product Zed or product Exe.
- 140 customers prefer either product Wye or product Zed but not product Exe.
- 70 customers prefer either product Zed but not product Exe or product Wye.
- 20 customers prefer both product Exe and product Zed but not product Wye.
- 45 customers prefer product Exe but not product Wye or product Zed.

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Required:

(i) Visualise the customers' preferences using a Venn diagram. (6 marks)

(ii) Determine the probability that a customer selected at random expressed a preference for all the three products. (2 marks)

(iii) Determine the probability that a customer selected at random expressed a preference for at most two of the three products. (2 marks)

(iv) Determine the probability that a customer selected at random did not prefer any of the three products. (2 marks)

(Total: 20 marks)

QUESTION THREE

(a) Explain **THREE** methods of estimating the trend line in time series analysis. (6 marks)

(b) The manager of Glaze Ltd. has selected a random sample of 150 invoices from the company's outstanding invoices and provides the following distribution:

Sales Sh."000"	**Probability of outstanding invoice**
0 – 100	0.20
100 – 200	0.18
200 – 300	0.22
300 – 400	0.16
400 – 500	0.09
500 – 600	0.08
600 – 700	0.04
700 – 800	0.03

Required:

(i) Calculate the expected mean of the random sample. (4 marks)

(ii) Calculate the expected standard deviation of the random sample. (4 marks)

(iii) Calculate the coefficient of variation of the random sample. (2 marks)

(iv) Determine the 95% confidence interval of the mean value of the outstanding invoices. (4 marks)

(Total: 20 marks)

QUESTION FOUR

(a) Enumerate **FOUR** assumptions of linear programming model. (4 marks)

(b) Faida Ltd. is in the process of reviewing the selling price for product "Excel".

The selling prices under consideration are Sh.50, Sh.55 and Sh.60.

The following additional information is provided about the forecasted demand for product "Excel" under three different market conditions:

	Market condition (Demand in Units)		
Selling price	**Good**	**Moderate**	**Bad**
Sh.50	20,000	18,000	14,000
Sh.55	18,000	16,500	12,000
Sh.60	16,000	14,000	8,500

The fixed costs are estimated at Sh.300,000 and variable cost per unit is Sh.30.

Required:

(i) Construct the pay-off trade for product "Excel". (6 marks)

(ii) Advise Faida Ltd. on the best selling price for product "Excel" based on maximax criterion. (2 marks)

(iii) Advise Faida Ltd. on the best selling price for product "Excel" based on maximin criterion. (2 marks)

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(iv) Determine the best selling price for product "Excel" based on expected monetary value (EMV) criterion given that probability for good, moderate and bad market criterion is 0.30, 0.50 and 0.20 respectively. (3 marks)

(v) Determine the expected value of perfect information. (3 marks)

(Total: 20 marks)

QUESTION FIVE

(a) Describe **FOUR** applications of linear functions in business. (4 marks)

(b) A research assistant wishes to determine how the weight of 10 students is related to their height. He collects a random sample of 10 students and measures both height in centimetres (cm) and their weight in kilograms (kg). The results are shown in the table below:

Student Number	Height (Cm)	Weight (Kg.)
1	149	49.2
2	150	49.4
3	147	46.7
4	147	47.4
5	142	41.6
6	138	35.5
7	151	51.4
8	148	47.4
9	144	36.7
10	140	36.4

Required:

(i) The product moment correlation coefficient. (4 marks)

(ii) The ordinary least squares regression equation. (4 marks)

(iii) Predict the weight of a student with a height of 152cm. (3 marks)

(iv) The standard error of estimate. (2 marks)

(v) Determine at 95% confidence interval, the predicted weight of a student with a height of 152cm. (3 marks)

(Total: 20 marks)

QUESTION SIX

(a) Using appropriate illustrations, explain the following terms as used in matrices:

(i) Diagonal matrix. (2 marks)

(ii) Scalar matrix. (2 marks)

(b) A factory produces two products; product A and product B. The company wants to determine how many units of each product to produce in order to maximise profit. The production of each product is subject to two resource constraints; machine hours and labour hours.

The profit for each unit of product A is Sh.40 and Sh.30 for product B.

Each unit of product A requires 2 hours of machine time, while each unit of product B requires 1 hour of machine time. The company has a maximum of 100 machine hours available.

Each unit of product A requires 1 hour of labour and each unit of product B requires 2 hours of labour. The company has a maximum of 80 labour hours available.

Required:

(i) Formulate the above problem as a linear programming problem. (4 marks)

(ii) Determine the optimal solution using the simplex method. (12 marks)

(Total: 20 marks)

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QUESTION SEVEN

(a) Tangles Limited is the sole producer of three hair products; kinky, fluffy and flat that currently have a market share of 30%, 50% and 20% respectively.

Each month, some brand switching takes place as follows:

- Customers that bought kinky the previous month, 70% buy it again while equal proportion switch to fluffy and flat respectively.
- Customers that bought fluffy the previous month, 60% buy it again while 25% switch to kinky and 15% to flat.
- Customers that bought flat the previous month, 70% remain while 10% switch to kinky and 20% to fluffy.

Required:

(i) Construct a probability transition matrix of the switching probabilities. (3 marks)

(ii) Calculate the new market share a month after the current market share. (4 marks)

(iii) Calculate the steady state. (7 marks)

(b) A company operates under two departments; production and marketing department. Details relating to a sample of employees working in the two departments has been provided as follows:

	Accounting Department	**Marketing Department**
Number of employees	40	50
Average monthly salary	Sh.120,000	Sh.130,000
Standard deviation	Sh.10,000	Sh.12,000

Required:

Determine whether there is any significant difference between the average salaries of employees working in the two departments.

(Use a significance level of 5 percent). (6 marks)

(Total: 20 marks)

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QUANTITATIVE ANALYSIS

WEDNESDAY: 21 August 2024. Morning Paper. **Time Allowed: 3 hours.**

This paper has seven (7) questions. Answer any FIVE questions. ALL questions carry equal marks. Show ALL your workings. Do NOT write anything on this paper.

QUESTION ONE

(a) State **FOUR** characteristics of the mean as a measure of central tendancy. (4 marks)

(b) Describe **FOUR** assumptions of linear regression model as used in statistics. (4 marks)

(c) The total revenue function of producing product "G" is quadratic in nature. The following data shows the number of units of product G sold and the corresponding sales revenue in thousands of shillings:

Sales revenue (R) Sh."000"	2,325	2,900	3,750
Number of units sold (Q)	15	20	30

Required:

(i) Formulate the total revenue function. (6 marks)

(ii) Determine the maximum revenue of producing product "G". (4 marks)

(iii) Calculate the total revenue when the number of units sold is 80. (2 marks)

(Total: 20 marks)

QUESTION TWO

(a) In a classroom with 15 students, 4 of whom are girls, the teacher randomly selects 4 students for a group project.

Required:

Determine the probability that the group of the students selected will be composed of the following:

(i) 3 girls and 1 boy. (3 marks)

(ii) All boys. (3 marks)

(iii) At least one girl. (3 marks)

(b) The following frequency distribution table shows the amount of annual electricity bill obtained from a local utility company's annual report:

Electricity bill Sh. "000"	**Frequency**
0 – 249	3
250 – 499	10
500 – 749	8
750 – 999	3
1,000 – 1,249	4
1,250 – 1,499	1
1,500 – 1,749	0
1,750 – 1,999	1

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Required:

(i) Calculate the lower quartile and interpret your result. (3 marks)

(ii) Determine the median value of the electricity bill. (2 marks)

(iii) Compute the upper quartile value of the electricity bill. (2 marks)

(iv) Determine the quartile coefficient of skewness and interpret your result. (4 marks)

(Total: 20 marks)

QUESTION THREE

(a) An economy produces food, clothing and shelter. To produce one unit of food, it requires 0.6 units from food sector, 0.2 units from clothing sector and 0.1 units from the shelter sector. To produce one unit of clothing, it requires 0.1 units from the food sector, 0.4 units from clothing sector and 0.2 units from the shelter sector. To produce one unit of shelter it requires 0.1 units from the food sector, 0.4 units from the clothing sector and 0.4 units from the shelter sector.

Required:

(i) Determine the matrix of technical coefficient (A). (2 marks)

(ii) Compute the total output for food, clothing and shelter sectors to satisfy a final demand of 50 units of food, 400 units of clothing and 400 units of shelter.

Assume that;

$$(I - A)^{-1} = \frac{1}{0.086}\begin{pmatrix} 0.28 & 0.08 & 0.10 \\ 0.16 & 0.23 & 0.18 \\ 0.10 & 0.09 & 0.22 \end{pmatrix}$$ (4 marks)

(iii) Account for the usage of clothing sector output determined in (a) (ii) above. (3 marks)

(b) Three judges rank 8 contestants in a talent show. The rankings assigned by each judge for all contestants are displayed in the table below:

Contestant	**A**	**B**	**C**	**D**	**E**	**F**	**G**	**H**
Judge 1 Rankings	1	2	3	4	5	6	7	8
Judge 2 Rankings	2	1	3	4	6	5	7	8
Judge 3 Rankings	1	3	2	5	4	6	7	8

Required:

(i) Using the Spearman's rank correlation coefficient, determine the pair of judges that indicated the highest agreement in their rankings. (9 marks)

(ii) Describe **TWO** scenarios where one might prefer to use Spearman's rank correlation instead of other correlation models. (2 marks)

(Total: 20 marks)

QUESTION FOUR

(a) The disease monitoring centre has established that the annual number of pandemic occurrence follows a Poisson distribution with a mean of 0.30 per annum.

Required:

(i) The probability that no pandemic will occur within a year. (3 marks)

(ii) The probability that at most two pandemics will occur within a year. (3 marks)

(b) Bobino Electricals Limited manufactures electric kettle and electric cookers.

Each electric kettle is sold at Sh.1,950 and each electric cooker is sold at Sh.2,400.

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An electric kettle requires 3 kilograms of steel while an electronic cooker requires 5 kilograms of steel. Steel costs Sh.200 per kilogramme. It costs the company Sh.120 per hour to assemble each of the products.
It takes 5 hours to assemble an electric kettle and 7 hours to assemble an electronic cooker.

There are 1,500 kilograms of steel available and a total of 2,450 hours available for assembling.

Required:

(i) Formulate the linear programming equations necessary to solve the above problem. (6 marks)

(ii) Solve the linear programming equations formulated in (b) (i) above graphically. (8 marks)

(Total: 20 marks)

QUESTION FIVE

(a) Describe **TWO** laws of probability. (4 marks)

(b) A company is contemplating an investment in either of the two machines; Machine A or Machine B to enhance its production capabilities. The decision requires assessing the costs and potential returns of each machine under varying market conditions.

The following information relates to the two machines:

Machine A

- Cost: Sh.100,000,000.
- Potential returns: Sh.250,000,000, if market demand is high and Sh.60,000,000 if market demand is low.
- Probability of high market demand is 0.70.
- Probability of low market demand is 0.30.

Machine B

- Cost: Sh.150,000,000.
- Potential returns: Sh.320,000,000 if market demand is high and Sh.80,000,000 if market demand is low.
- Probability of high market demand is 0.50.
- Probability of low market demand is 0.50.

Additionally, the company can choose to conduct a survey at a cost of Sh.20,000,000 to obtain more information before making the investment decision. The survey can indicate either favourable or unfavourable results with probabilities of 0.80 and 0.20 respectively, influencing the probabilities of market conditions.

If survey is favourable for both Machine A and Machine B:

- Probability of high market demand is 0.90.
- Probability of low market demand is 0.10.

If survey is unfavourable for both Machine A and Machine B:

- Probability of high market demand is 0.20.
- Probability of low market demand is 0.80.

The potential returns of Machine A and Machine B remain unchanged regardless of the survey outcome.

Required:

(i) Draw the decision tree for the above scenario. (10 marks)

(ii) Advise the management of the company on the best decision using the Expected Monetary Value (EMV) approach. (4 marks)

(iii) Determine the Expected Monetary Value from the decision made in (b) (ii) above. (2 marks)

(Total: 20 marks)

QUESTION SIX

(a) A random variable is normally distributed with a mean of 25 and a standard deviation of 5.

Required:

Using normal distribution approach:

(i) Calculate the value that will be exceeded 10% of the time assuming an observation is randomly selected from the distribution. (2 marks)

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(ii) Compute the value that will be exceeded 85% of the time assuming an observation is randomly selected from the distribution. (2 marks)

(iii) Determine the two values of which the smaller value has 25% of the values below it and the larger value has 25% of the values above it. (2 marks)

(iv) Determine the value in which 15% of the observations will be below the distribution. (2 marks)

(b) A manufacturer claims that their packaging machine could fill a packet of sugar with an average weight of 600 grams.

A sample of 36 packets of sugar has an average weight of 500 grams with a standard deviation of 25 grams.

Required:
Test at a 5% significance level if there is sufficient evidence to reject the manufacturers claim. (6 marks)

(c) (i) Find the value of the following integral:
$\int(4x^3 + 2x + 5)$ dx for an interval between x = 1 and x = 3 (4 marks)

(ii) A function of a curve is given as:
$Y = 3x^2 - 12x + 64$

Find the integral equation of the function. (2 marks)

(Total: 20 marks)

QUESTION SEVEN

(a) The data below represents the sales made by Yatta Traders for a period of three years:

	Sales (Sh."million") Quarters			
Year	**1**	**2**	**3**	**4**
2021	4.4	10	15.8	6.4
2022	5.8	10.4	16.4	7.6
2023	6.4	11.6	18.2	8.2

Required:

(i) The 4-centered moving average trend values. (4 marks)

(ii) The seasonally adjusted additive indices. (6 marks)

(b) Highlight **SIX** assumptions of Markov analysis. (6 marks)

(c) Differentiate between "an interval estimate" and "a point estimate". (4 marks)

(Total: 20 marks)

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QUANTITATIVE ANALYSIS

WEDNESDAY: 24 April 2024. Morning Paper. **Time Allowed: 3 hours.**

This paper has seven (7) questions. Answer any FIVE questions. ALL questions carry equal marks. Show ALL your workings. Do NOT write anything on this paper.

QUESTION ONE

(a) State **FIVE** characteristics of binomial distribution. (5 marks)

(b) Isabella Koech, a businesswoman, is contemplating investing in one of two manufacturing companies namely; company A and company B. The data below shows the profits made by company A and company B over the past 150 days.

Daily profits	**Number of days**	
Sh."000"	**Company A**	**Company B**
50 – 60	12	11
60 – 70	26	14
70 – 80	38	20
80 – 90	36	23
90 – 100	18	45
100 – 110	11	23
110 – 120	9	14

Required:

(i) Calculate the standard deviation for company A and company B. (6 marks)

(ii) Calculate the coefficient of variation for company A and company B. (2 marks)

(iii) Advise Isabella Koech on the company to invest in based on the results obtained in (b) (i) and (b) (ii) above. (2 marks)

(c) Given the following sets:

A = {a, b, c, d}
B = {c, d, e, f, g}
C = {h, i, j, c, d}

Required:

Find:

(i) The universal set "∪". (2 marks)

(ii) A∩B∩C. (2 marks)

(iii) C'. (1 mark)

(Total: 20 marks)

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QUESTION TWO

(a) TOC Limited, an oil processing company purchased a machine that they intend to use in one of their production processes. The machine is expected to have a useful life of 10 years after which it can be disposed for Sh.200,000. The net book value of the machine after 8 years is estimated to be Sh.560,000.

Required:

(i) The linear depreciation equation for the value of the machine. (4 marks)

(ii) Determine the value of the machine after 6 years. (2 marks)

(iii) Determine the number of years when the value of the machine will be Sh.1,460,000. (2 marks)

(b) A production manager is convinced that a new set of plant engineers will not affect the production level in the factory. To test this hypothesis, 15 samples of the first day output is taken and average production per day is measured as 14,500 units with a standard deviation of 102. Before the new plant engineers were engaged, the average output per day was 14,650 units.

Required:

Test the manager's conviction at 5% level of significance. (8 marks)

(c) Highlight **FOUR** considerations in determining whether to employ a census or a sample in collecting primary data. (4 marks)

(Total: 20 marks)

QUESTION THREE

(a) Clekex Cleaning Limited manufactures bar soaps for a hotel industry. The company specialises in three different types of bar soaps weighing 0.5kg, 0.75kg and 1kg respectively. The three types of bar soaps are made by two machines, machine A and machine B. The number of hours required for each type of bar soap in each machine is shown below:

Type of bar soap	Time taken for bar soap production (hours)	
	Machine A	Machine B
0.5	0.40	0.25
0.75	0.60	0.12
1	0.50	0.60

Machine A has 2,800 hours available while machine B has 1,090 hours available. The management has decided that 1,000 bar soaps of 0.5kg must be produced.

Required:

The number of 0.75kg bar soaps and 1kg bar soaps that will be produced assuming machine A and B hours are fully utilised. (6 marks)

(b) The following table shows the total cost per day on production of iron sheets for the last 10 days in a manufacturing company:

Day	Number of iron sheets produced	Total cost Sh."000"
1	31	35
2	29	33
3	35	35
4	29	36
5	38	40
6	28	34
7	32	35
8	34	37
9	26	32
10	25	25

Required:

(i) Determine the total cost function using the ordinary least squares method. (6 marks)

(ii) Determine the break-even number of iron sheets produced assuming that each iron sheet is sold at Sh.2,200 each. (3 marks)

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(iii) The coefficient of determination of the data. (4 marks)

(iv) Interpret the result in (c) (iii) above. (1 mark)

(Total: 20 marks)

QUESTION FOUR

(a) Differentiate between the "multiplicative model" and "additive model" as used in time series. (4 marks)

(b) A research company has established that the occurrence of a contagious disease follows a Poisson distribution with a mean of 0.3 per week.

Required:

(i) The probability that no case of a contagious disease is reported. (3 marks)

(ii) The probability that almost one case of a contagious disease is reported. (3 marks)

(c) A solar panel production firm intends to research on a launch of a new solar panel which would increase the sales of the panels to between 2,000 units to 3,000 units per week. The weekly revenue in thousands of shillings over the range of sales could be represented by:

$$R = -3x^2 + 7x$$

Where x is the weekly solar panel units produced and sold in thousands. Past records of the solar panel production in the firm estimates its marginal costs in thousands of shillings could be represented by the function;

$$MC = 2x^2 - 3x + 5$$

The fixed costs will be Sh.1,000 per week.

Required:

(i) The average cost function of the firm. (2 marks)

(ii) The average revenue function of the firm. (1 mark)

(iii) The profit maximising output. (5 marks)

(iv) The price that should be charged to maximise profits. (2 marks)

(Total: 20 marks)

QUESTION FIVE

(a) A car hire company has provided the data below showing the number of cars hired out for the last 10 months ending 31 March 2024:

Month	**Number of cars**
June 2023	110
July 2023	115
August 2023	109
September 2023	108
October 2023	106
November 2023	111
December 2023	107
January 2024	112
February 2024	114
March 2024	110

Required:

(i) The forecast number of cars for the month of April 2024 using exponential smoothing method with a smoothing constant $\alpha = 0.3$. (3 marks)

(ii) The three months moving average forecasts for the month of April 2024. (1 mark)

(iii) Using suitable computation, advise on the best forecast method. (6 marks)

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(b) World K Tours has Sh.6 million that may be used to purchase new rental minibuses for hire during the coming holidays. The minibuses may be purchased from two different manufacturers.

Important data concerning the minibuses is summarised below:

Minibus type	Manufacturer	Cost	Maximum seating capacity	Expected daily profit per minibus (Sh.)
Weaverbird	Fastbus	80,000	11	10,000
Eaglet	Fastbus	90,000	14	12,000
Dovey	Smartbus	70,000	7	9,000
Crowlet	Smartbus	140,000	18	16,000

World K Tours wishes to purchase at least 80 minibuses and equal numbers from each of the manufacturer. World K Tours wishes to have a total sitting capacity of at least 500.

Required:

(i) Formulate the above linear programming problem. (6 marks)

(ii) Outline **FOUR** assumptions of the linear programming technique. (4 marks)

(Total: 20 marks)

QUESTION SIX

(a) A manager must select 4 employees for a job promotion. 12 employees are eligible for job promotion.

Required:

(i) Determine the number of ways in which 4 employees could be chosen. (3 marks)

(ii) Determine the number of ways in which the 4 employees could be chosen from the 12 employees in the department. (3 marks)

(b) A property developer has Sh.1,000,000 to invest in a new property. The developer has a choice of three different properties going at the same price in different towns; one in Nairobi, another in Nakuru and the other in Nanyuki. With the three properties, his ultimate profit depends on whether the economy is strong, weak or mixed.

He estimates that the pay-off matrix representing his monthly profits in thousands of shillings is as follows:

		States of nature		
		Weak	**Mixed**	**Strong**
Strategies	Nairobi	85	30	75
	Nakuru	45	45	110
	Nanyuki	60	95	85

Required:

Determine the town that the developer should invest in using:

(i) Maxi-max criterion. (2 marks)

(ii) Maxi-min criterion. (2 marks)

(iii) Mini-max regret criterion. (4 marks)

(iv) Suppose the investor reads in the newspaper that there is 50% chance of a weak economy, 20% chance of a mixed economy and a 30% chance of a strong economy.

Advise on the best strategy, given the new information. (2 marks)

(v) Compute the expected value of perfect information. (4 marks)

(Total: 20 marks)

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QUESTION SEVEN

(a) A training institution requires that all its employees participate in one of three sports clubs namely; football, rugby or chess. In each term, the training institution designates an open selection period within which employees may change from one club to another.

Prior to the last open selection period, 10% of the employees preferred football, 35% preferred rugby and the remaining chess. During the open selection period, 25% of the employees taking football switched to rugby, while 15% switched to chess. 30% of the employees taking rugby switched to football and 10% switched to chess, 20% of the employees taking chess switched to football and 10% switched to rugby.

Required:

(i) The transition matrix. (2 marks)

(ii) The percentage of employees that will be taking each sport after the last open selection period. (4 marks)

(iii) Assuming that the trend continues, determine the percentage of the employees who will be taking each sport in the long-run. (6 marks)

(b) Agritech Consultants have engaged 3 farming trainees; Jim, Ken and Lorn. After six months, the Consultancy supervisor noted that 5%, 7% and 9% of land planted by Jim, Ken and Lorn respectively had ungerminated plants. The supervisor had distributed 40%, 25% and 35% of the land respectively.

Required:

(i) Present the above information in a tree diagram. (3 marks)

(ii) The probability of land with ungerminated plants. (2 marks)

(iii) The probability that land with ungerminated plants was planted by either Ken or Lorn. (3 marks)

(Total: 20 marks)

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CPA FOUNDATION LEVEL

CIFA FOUNDATION LEVEL

QUANTITATIVE ANALYSIS

WEDNESDAY: 6 December 2023. Morning Paper. **Time Allowed: 3 hours.**

This paper has seven (7) questions. Answer any FIVE questions. ALL questions carry equal marks. Show ALL your workings. Do NOT write anything on this paper.

QUESTION ONE

(a) Highlight **FOUR** disadvantages of the mode as a measure of central tendency. (4 marks)

(b) Find the area between the curve $y = x + 2x + \frac{1}{x^2}$, the x axis and the lines x = 1 and x = 2. (4 marks)

(c) Safi Limited manufactures and sells two types of cleaning pads; Osha and Oga. The demand functions for the two products are given by:

$P_1 = 1{,}200 - 2x - 5y$
$P_2 = 1{,}700 - 3x - 2y$

Where P_1 is the unit price of Osha in shillings.
P_2 is the unit price of Oga in shillings.
x is the number of units sold of Osha.
y is the number of units sold of Oga.

The total cost of producing both products is given by the function TC = 230x + 90y.

Required:

(i) The number of units of each product required to maximise total profit. (10 marks)

(ii) The maximum total profit. (2 marks)

(Total: 20 marks)

QUESTION TWO

(a) List **SEVEN** steps of the decision making process. (7 marks)

(b) The following data shows the quarterly sales of cars for Excellent Auto Enterprises for a period of three years:

Year	Sales (Sh."million")			
	Quarter 1	**Quarter 2**	**Quarter 3**	**Quarter 4**
2020	25	20	18	30
2021	33	28	26	38
2022	41	37	34	46

Required:

(i) The 4-quarter centred moving average trend values. (4 marks)

(ii) The seasonal multiplicative indices. (5 marks)

(iii) The deseasonalised sales for each quarter. (4 marks)

(Total: 20 marks)

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QUESTION THREE

(a) Highlight **FOUR** applications of Markov chain analysis in business and finance. (4 marks)

(b) An insurance company has 2 claim assessors who must each give approval to customers who wish to lodge a claim for compensation. The manager currently has 8 such customers and has asked each assessor to independently rank the customer claims in order of merit. The rankings are shown below:

Customer	**A**	**B**	**C**	**D**	**E**	**F**	**G**	**H**
Assessor 1 Ranking	4	6	2	1	5	8	6	3
Assessor 2 Ranking	4	8	1	3	7	4	6	2

Required:

Calculate the rank correlation coefficient of the two sets of rankings and comment on the results. (8 marks)

(c) The Revenue Authority Research Department conducted a survey that revealed the number of companies that were reported as being tax compliant in the last six months of the year 2022 as recorded in the table below:

Month	**July**	**August**	**September**	**October**	**November**	**December**
Number of Companies	326	290	306	260	355	365

Required:

Test the hypothesis that the number of tax compliant companies does not depend on the month of the year at a 1% significance level. (8 marks)

(Total: 20 marks)

QUESTION FOUR

(a) An economy is based on 2 sectors; Agriculture and Manufacturing. Production of a shilling worth of Agriculture requires an input of 0.3 from the Agriculture sector and 0.1 from the Manufacturing sector.

Production of a shilling worth of manufacturing requires an input of 0.2 from the Agriculture sector and 0.4 from the Manufacturing sector.

Required:

Find the output from each sector that is needed to satisfy a final demand of Sh.12 billion for Agriculture and Sh.8 billion for Manufacturing. (8 marks)

(b) Consider the following data for 120 students of a College concerning the languages they are studying namely; French, German and Russian.

- 15 students study Russian and German.
- 58 students study German or French but not Russian.
- 28 students study French only.
- 90 students study French or German.
- 20 students study French and Russian.
- 44 students study at least two of the three languages.
- 20 students do not study any of the three languages.

Required:

(i) Present the above information in a Venn diagram. (6 marks)

(ii) Number of students who study all the three languages. (2 marks)

(iii) Proportion of students who study French. (2 marks)

(iv) Number of students who study at least one language. (2 marks)

(Total: 20 marks)

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QUESTION FIVE

(a) Explain the terms "minimax criterion" and "maximax criterion" as used in decision analysis. (4 marks)

(b) Viwanda Ltd. produces light bulbs that are packed into boxes of 100. The company's quality control department indicates that 0.5% of the light bulbs produced are defective.

Required:

(i) The percentage of boxes that will contain no defective light bulbs. (1 mark)

(ii) The percentage of boxes that will contain two or more defective light bulbs. (3 marks)

(c) An accountant wishes to undertake a cost analysis of the annual repair cost for a popular model of a machine as influenced by the age of the machine. The results obtained are shown below:

Age (years)	Repair cost (Sh."000")
1	70
3	140
5	230
8	350
7	300
12	570
8	350
4	200

Required:

(i) Pearson's coefficient of correlation between the age of the machine and the repair cost. Interpret your result. (4 marks)

(ii) Fit a least squares regression line of repair cost on age of machine to the data. (4 marks)

(iii) Interpret the meaning of regression coefficients a and b in the least squares regression line obtained in (c) (ii) above. (2 marks)

(iv) The coefficient of determination. Interpret your result. (2 marks)

(Total: 20 marks)

QUESTION SIX

(a) Explain **FOUR** limitations of quantitative analysis. (4 marks)

(b) The amount of money spent on purchases by the first 50 customers at a large department store is summarised in the following table:

Amount spent (Sh."000")	Number of customers
0 – 5	3
5 – 10	6
10 – 15	7
15 – 20	11
20 – 25	15
25 – 30	8

Required:

Compute:

(i) The mean amount spent by the 50 customers. (4 marks)

(ii) The standard deviation of the amount spent by the 50 customers. (4 marks)

(iii) The coefficient of variation of the amount spent by the 50 customers. (2 marks)

(iv) The coefficient of Kurtosis and comment on your answer. (6 marks)

(Total: 20 marks)

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QUESTION SEVEN

(a) Explain the following terms as used in statistics:

(i) Sample statistic. (2 marks)

(ii) Population parameter. (2 marks)

(iii) Sampling distribution. (2 marks)

(b) A manufacturer of dresses makes two types of dresses; Standard and Executive. Each Standard dress requires 10 labour hours from the cutting department and 30 labour hours from the sewing department. Each Executive dress requires 20 labour hours from the cutting department and 40 labour hours from the sewing department. The maximum labour hours available in the cutting department and the sewing department are 320 and 540 respectively. The company makes a profit of Sh.500 on each Standard dress and Sh.800 on each Executive dress.

Required:

(i) Formulate a mathematical model for the above linear programming problem. (4 marks)

(ii) Using the simplex method, determine the number of Standard and Executive dresses that should be produced in order to maximise profit. (10 marks)

(Total: 20 marks)

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CPA FOUNDATION LEVEL

CIFA FOUNDATION LEVEL

QUANTITATIVE ANALYSIS

WEDNESDAY: 23 August 2023. Morning Paper. **Time Allowed: 3 hours.**

Answer any FIVE questions. ALL questions carry equal marks. Show ALL your workings. Do NOT write anything on this paper.

QUESTION ONE

(a) Explain the meaning of the following terms as used in decision theory:

(i) Decision alternative. (2 marks)

(ii) State of nature. (2 marks)

(iii) Conditional payoff. (2 marks)

(iv) Opportunity cost. (2 marks)

(b) The following data relates to the ages of 100 students attending a workshop on personal branding organised by the student welfare officials of Pride Business College:

Age (in years)	**Number of students**
Below 20	2
20 – 25	4
25 – 30	10
30 – 35	20
35 – 40	32
40 – 45	18
45 – 50	10
Above 50	4

Thereafter, 15% of the youngest students and 5% of the oldest students attending the workshop were selected to attend a further training on curriculum vitae writing.

Required:

(i) Determine the youngest age of the students selected to attend the training on curriculum vitae writing. (4 marks)

(ii) Determine the highest age of the students selected to attend the training on curriculum vitae writing. (4 marks)

(iii) Calculate the median age of the students who remained after the selection of students to attend the training on curriculum vitae writing. (4 marks)

(Total: 20 marks)

QUESTION TWO

(a) State **FOUR** applications of mathematical functions in business. (4 marks)

(b) Explain the following terms as used in set theory:

(i) Disjoint set. (2 marks)

(ii) Complement of a set. (2 marks)

(iii) Union of a set. (2 marks)

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(c) The following regression equation was obtained for a class of 24 intermediate level students:

$$\hat{y} = 4.3 + 0.029X_1 + 0.029X_2 + 0.017X_3$$

Standard error 0.0074 0.013 0.007

Where:

$\hat{y}$ = Students score on a theory examination

X_1 = Students rank (from the bottom) in high school

X_2 = Students verbal aptitude score

X_3 = A measure of student character

Required:

(i) Calculate the t ratio and the 95% confidence interval for the independent variables X_1, X_2 and X_3. (6 marks)

(ii) Determine the regressor which gives the strongest evidence of being statistically discernible. (2 marks)

(iii) In writing up a final regression, explain whether one should keep the last regressor (X_3) in the equation or drop it. (2 marks)

(Total: 20 marks)

QUESTION THREE

(a) State **FOUR** characteristics of the normal distribution. (4 marks)

(b) A firm manufactures two models of bicycles; mountain bike and BMX. The firm earns profit of Sh.5,000 and Sh.6,000 on mountain bikes and BMX respectively. Both models are produced in three departments; assembly, fitting and painting. The time required per model produced and the time available per week (in hours) are given in the table below:

Departments	**Required time**		**Available time**
	Mountain bike	**BMX**	
Assembly	2	3	180
Fitting	2	1	120
Painting	3	3	240

Required:

(i) Formulate the above problem as a linear programming problem in order to maximise profits. (4 marks)

(ii) Graphically show how the manufacturer should schedule his production to maximise profits. (8 marks)

(iii) Compute and interpret the slack value for the painting department. (4 marks)

(Total: 20 marks)

QUESTION FOUR

(a) Explain the following terms as used in Markovian analysis:

(i) Transition matrix. (2 marks)

(ii) Equilibrium state. (2 marks)

(iii) Initial probability vector. (2 marks)

(b) The following pay-off matrix was developed by a company showing profits (in shillings) obtained from launching four different products P_1, P_2, P_3 and P_4 under four different states of nature:

	State of nature			
Product	**S_1**	**S_2**	**S_3**	**S_4**
P_1	5,000	9,000	7,000	8,000
P_2	7,000	4,000	6,000	12,000
P_3	10,000	8,000	9,000	7,000
P_4	14,000	5,000	7,000	6,000

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The probabilities for S_1, S_2, S_3 and S_4 are given as 0.30, 0.40, 0.20 and 0.10 respectively.

Required:

(i) Advise on the best course of action using the Mini-Max Regret Criterion. (4 marks)

(ii) Advise on the best course of action using the Expected Opportunity Loss Criterion. (4 marks)

(iii) An expert has offered to provide perfect information at a cost of Sh.2,500.

Advise the management of the company on whether or not to acquire the perfect information. (6 marks)

(Total: 20 marks)

QUESTION FIVE

(a) The output of an acre of land is assumed to be normally distributed with an average of 52 bags of maize and a standard deviation of 3.2 bags.

Required:

The probability that the output of an acre of land:

(i) Is greater than 48 bags. (2 marks)

(ii) Is greater than 60 bags. (2 marks)

(iii) Is less than 45 bags. (2 marks)

(iv) Lies between 50 bags and 60 bags. (2 marks)

(b) BMM Limited produces X number of items of product "Wonder" in a month at a cost described by the equation $C = 5x + 4{,}000$. The Management Accountant of the firm estimates that at a selling price of Sh.22 per unit, 18,000 units of "Wonder" could be sold. If the firm increases the unit price to Sh.30, only 10,000 units of "Wonder" can be sold.

Required:

(i) Determine the number of units of product "Wonder" that BMM Limited should produce and sell in order to maximise profit. (6 marks)

(ii) Determine the selling price per unit charged at the maximum profit. (2 marks)

(iii) Calculate the break-even number of units. (4 marks)

(Total: 20 marks)

QUESTION SIX

(a) Distinguish between a "two-tailed test" and a "one tailed test" as used in inferential statistics. (4 marks)

(b) The data below shows the sales made by Kuza Limited over a period of 6 years:

Year	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**
Sales (in millions of shillings)	80	78	72	68	70	82

Required:

(i) The sales forecast for the year 2023 using exponential smoothing (use a smoothing constant of 0.2). (4 marks)

(ii) The sales forecast for the year 2023 using the ordinary least squares method. (6 marks)

(iii) Using suitable computations, advise Kuza Ltd. on the preferred forecast method. (6 marks)

(Total: 20 marks)

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QUESTION SEVEN

(a) With the aid of diagrams, describe the **THREE** types of Kurtosis. (6 marks)

(b) Consider the following hypothesis:

H_O : $\mu = 400$
HI : $\mu \neq 400$

For a random sample of 12 observations, the sample mean was 407 and the sample standard deviation was 6.

Required:
Using a significance level of 0.1, advise whether the null hypothesis should be accepted or rejected. (6 marks)

(c) A mobile phone manufacturer orders for a special component called PH-2 from four different suppliers; S_1, S_2, S_3 and S_4. 20% of the components are purchased from S_1, 10% from S_2, 30% from S_3 and the remainder from S_4.

From past experience, the manufacturer knows that 2% of the components from S_1 are defective, 4% of the components from S_2 are defective, 3% of the components from S_3 are defective and 1% of the components from S_4 are defective. All components are placed directly in the store before inspection. A worker selects a component for use and finds it defective.

Required:

(i) The probability that the component was supplied by S_1. (4 marks)

(ii) The probability that the component was supplied by S_2 or S_4. (4 marks)

(Total: 20 marks)

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CPA FOUNDATION LEVEL

CIFA FOUNDATION LEVEL

QUANTITATIVE ANALYSIS

WEDNESDAY: 26 April 2023. Morning Paper. **Time Allowed: 3 hours.**

Answer any FIVE questions. ALL questions carry equal marks. Show ALL your workings. Do NOT write anything on this paper.

QUESTION ONE

(a) A survey was conducted to establish the number of faulty components from a production process. The results indicated that 0.01% of the components produced were faulty. Each machine produces 10,000 components.

Required:
The probability of there being 3 or more faulty components assuming a Poisson probability distribution. (4 marks)

(b) The Sales Manager of XYZ Ltd. estimates that the revenue function of the company is linear in nature. He has observed that at a selling price of Sh.200, the company sold 6,000 units. When the company increased the selling price per unit to Sh.700, the company sales decreased to 1,000 units.

The Cost Accountant of the company estimates that the cost function is quadratic in nature. The following data was provided:

Number of units (Q)	100	200	400
Total cost (Sh.) TC	79,000	76,000	124,000

Required:

(i) The revenue function. (4 marks)

(ii) The total cost function. (8 marks)

(iii) The profit maximising level of production. (4 marks)

(Total: 20 marks)

QUESTION TWO

(a) A survey was recently conducted to determine the preferences of 360 customers with regard to three brands of cooking oil namely; sunflower oil, coconut oil and olive oil.

The following results were obtained:

220 customers preferred sunflower oil.
160 customers preferred coconut oil.
180 customers preferred olive oil.
80 customers preferred both sunflower oil and coconut oil.
110 customers preferred both sunflower oil and olive oil.
100 customers preferred both coconut oil and olive oil.
50 customers preferred none of the brands of cooking oil.

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Required:

(i) Present the above information in the form of a Venn diagram. (4 marks)

(ii) Determine the probability that a customer picked at random prefers all the three brands of cooking oil. (2 marks)

(iii) Determine the probability that a customer picked at random prefers at least two brands of cooking oil. (2 marks)

(b) The time taken to complete a particular task was measured for 250 workers and the results were as shown below:

Time taken in minutes	**Number of workers**
0 – 5	2
5 – 10	2
10 – 15	3
15 – 20	5
20 – 25	5
25 – 30	18
30 – 40	**X**
40 – 50	100
50 – 60	**Y**
Above 60	15

Required:

(i) Determine the value of X given that the median time taken to complete the task is 40.5 minutes. (6 marks)

(ii) Determine the value of Y given that the modal time taken to complete the task is 41.5 minutes. (6 marks)

(Total: 20 marks)

QUESTION THREE

(a) Using the information given below, determine the level of output necessary from each sector to support a final demand of 500 units for sector X_1, 1,600 units for sector X_2 and 2,000 units for sector X_3:

Output	**Inputs to**			
	X_1	**X_2**	**X_3**	**Final demand (units)**
X_1	40	40	40	680
X_2	40	80	80	1,400
X_3	400	1,200	280	2,120

(12 marks)

(b) The monthly rent paid by residents of Hill View Estate is found to be normally distributed with a mean of Sh.22,150 and a standard deviation of Sh.8,900.

Required:

On the basis of a sample of 200 residents:

(i) Construct a 95% confidence interval for the monthly rent paid. (3 marks)

(ii) Test the hypothesis that the amount paid in monthly rent is Sh.20,000 at a 5% significance level. (5 marks)

(Total: 20 marks)

QUESTION FOUR

(a) Differentiate between the following terms:

(i) "Coefficient of skewness" and "coefficient of variation". (4 marks)

(ii) "Arithmetic mean" and "harmonic mean". (4 marks)

(b) Mr Rajab Omar is the Marketing Manager of Tintex Limited. He gathered data on the number of sales people engaged in a month and the sales made in the last ten months of the year 2022.

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The results were as follows:

Year 2022 Month	Number of sales people engaged	Sales Sh."000"
March	12	23
April	11	22
May	14	23
June	12	24
July	15	28
August	11	22
September	13	23
October	14	26
November	10	20
December	9	17

Required:

(i) Estimate the total sales function using the ordinary least squares method. (10 marks)

(ii) Predict the sales made in the month of January 2023 when 19 sales people were engaged. (2 marks)

(Total: 20 marks)

QUESTION FIVE

(a) Outline **FOUR** properties of a set. (4 marks)

(b) A trader purchased 7 cartons of apples and 4 cartons of bananas at a total cost of Sh.32,500 in the month of January. In the month of February, he purchased 9 cartons of apples and 6 cartons of bananas at a total cost of Sh.43,500.

Required:

Calculate the cost of a carton of apples and a carton of bananas using matrix algebra. (6 marks)

(c) Red Rose Limited has developed a new washing detergent. The company is considering whether or not to market test the detergent prior to its launch. Market testing will cost Sh.50 million which may increase the likelihood of success of the product if it passes the test. The probability of passing the test is 0.8. If the product fails the test, it is regarded as worthless.

Previous data collected was as follows:

Probability of	No testing	Market testing
High success	0.20	0.40
Moderate success	0.35	0.40
Low success	0.45	0.20

Launching the product will cost Sh.150 million and the estimated profits are as follows:

High success	Sh.900 million
Moderate success	Sh.450 million
Low success	Sh.225 million

Red Rose Limited has the option of selling the product design for Sh.250 million.

Required:

(i) A decision tree showing the pay-off and the expected monetary value (EMV) of each decision. (8 marks)

(ii) Advise the management of the company on the best course of action and the related expected monetary value (EMV). (2 marks)

(Total: 20 marks)

QUESTION SIX

(a) In the context of time series analysis, distinguish between the following terms:

(i) "Mean absolute deviation" and "mean squared error". (4 marks)

(ii) "Additive model" and "multiplicative model". (4 marks)

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(b) The quarterly profits of Nyota Limited during the years 2019, 2020, and 2021 were as tabulated below:

Year 2019	Profits in Sh."million"			
	Quarter 1	**Quarter 2**	**Quarter 3**	**Quarter 4**
2019	105	138	116	140
2020	104	122	103	146
2021	113	149	141	162

Required:

(i) The three-quarter moving averages. (4 marks)

(ii) The seasonal index for each quarter assuming the multiplicative model. (4 marks)

(iii) Derive the deseasonalised profits using the multiplicative model. (4 marks)

(Total: 20 marks)

QUESTION SEVEN

(a) Explain the meaning of the following terms in the context of probability theory:

(i) Mutually exclusive events. (2 marks)

(ii) Independent events. (2 marks)

(b) A linear programming problem has been formulated as below:

Objective function: Max $Z = 14x + 10y$

Subject to:

1. $4x + 3y \leq 240$
2. $2x + y \leq 100$
3. $y \leq 50$
4. $x, y \geq 0$

Required:

(i) Optimal production for x and y using the simplex method. (12 marks)

(ii) The slack values for each constraint. (2 marks)

(iii) The shadow price for each constraint. (2 marks)

(Total: 20 marks)

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CPA FOUNDATION LEVEL

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QUANTITATIVE ANALYSIS

WEDNESDAY: 7 December 2022. Morning Paper. **Time Allowed: 3 hours.**

Answer any FIVE questions. ALL questions carry equal marks. Show ALL your workings. Do NOT write anything on this paper.

QUESTION ONE

(a) State **FOUR** characteristics of a good measure of dispersion. (4 marks)

(b) Explain the meaning of the following terms as used in set theory:

(i) Venn diagram. (2 marks)

(ii) Complement of a set. (2 marks)

(iii) Union of a set. (2 marks)

(c) The management team of Stage Supermarket is interested in determining whether there is any relationship between the distance from customers' residences to the supermarket and the number of visits made to the supermarket in a particular period.

The following results were obtained:

Distance from customers' residences to the supermarket (in Kilometres)	**Number of visits made**
1	42
2	26
3	38
4	36
5	34
6	34
7	28
8	40
9	20
10	22

Required:

(i) Determine whether there is any relationship between the number of visits made to the supermarket and the distance from customers' residences to the supermarket. (8 marks)

(ii) Calculate the decrease in the number of visits to the supermarket with each unit increase in distance of customers' residences from the supermarket.

(2 marks)

(Total: 20 marks)

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QUESTION TWO

(a) Shoetec Ltd., a manufacturer of stylish shoes, estimates that at full scale production, it would sell between 2,000 and 3,000 pairs of shoes.

The total monthly revenue in thousands of shillings over this range is represented by the function

$TR = 3x^2 + 7x$.

The firm estimates that the marginal cost (MC) in thousands of shillings could be represented by the function

$MC = 5x^2 – 3x – 2$ and fixed cost (FC) will be Sh.1,000 per month.

Where x is the monthly output in thousands of pairs of shoes.

Required:

(i) Derive the average cost and average revenue functions of the firm. (4 marks)

(ii) Calculate the profit maximising output. (4 marks)

(iii) Calculate the price charged upon maximising profit and how much each pair of shoes would cost. (2 marks)

(b) An examination was administered to a group of students and the results were as summarised below:

Result	**% of candidates**
Passed with distinction	10%
Passed with credit	60%
Failed	30%

A candidate fails the examination if he/she obtains less than 40% in the examination. In order to pass with distinction, the candidate must obtain at least 75% in the examination.

Required:

Calculate the mean and standard deviation of the distribution of marks assuming that the marks scored are normally distributed. (10 marks)

(Total: 20 marks)

QUESTION THREE

(a) Distinguish between the following terms as used in probability:

(i) "Conditional probability" and "marginal probability". (4 marks)

(ii) "Discrete probability distributions" and "continuous probability distributions". (4 marks)

(b) The banking industry in a given country is controlled by three banks Faida Bank, Akiba Bank and Ahadi Bank. As at 31 December 2020, Faida Bank controlled 30% of the market share, Akiba Bank controlled 50% of the market share and Ahadi Bank controlled 20% of the market share.

A survey was conducted on the market shares of the three banks as at 31 December 2021 and revealed the following:

1. Faida Bank had retained 80% of its market share and lost 15% and 5% to Akiba Bank and Ahadi Bank respectively.
2. Akiba Bank had lost 10% and 20% of its market share to Faida Bank and Ahadi Bank respectively.
3. Ahadi Bank had lost 5% of its market share to Faida Bank and 5% to Akiba Bank.
4. There were no significant changes in the banking habits of the customers during the year ended 31 December 2021.

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Required:

(i) Determine the transition matrix from the above information. (2 marks)

(ii) Determine the market shares of the three banks as at 31 December 2021. (3 marks)

(iii) The steady state market shares of the three banks. (7 marks)

(Total: 20 marks)

QUESTION FOUR

(a) The Production Manager of Mechtex Ltd., a manufacturer of machines, is investigating a claim by customers about machine A and machine B that it manufactures.
The claim is that machine A has a longer useful life than machine B.
A sample of 60 machine As taken from the market reveals that the machine has a mean useful life of 28,000 hours with a standard deviation of 900 hours. A sample of 80 machine Bs has a mean useful life of 30,000 hours with a standard deviation of 1,000 hours.

Required:
Advise the Production Manager of Mechtex Ltd. if there is a significant difference in the useful lives of the machines. (8 marks)

Use a significance level of 5%.

(b) The following data relate to the number of computers sold each day over the last 240 working days by a leading computer firm.

Number of computers sold	**Number of days**
10 – 15	12
15 – 20	18
20 – 25	35
25 – 30	42
30 – 35	50
35 – 40	45
40 – 45	30
45 – 50	8

Required:

(i) The modal number of computers sold. (2 marks)

(ii) The quartile deviation of the number of computers sold. (6 marks)

(iii) The quartile coefficient of skewness of the number of computers sold. Interpret your results. (4 marks)

(Total: 20 marks)

QUESTION FIVE

(a) Highlight **FOUR** advantages of decision tree analysis as a tool for decision making. (4 marks)

(b) State **FOUR** characteristics of the binominal distribution. (4 marks)

(c) The management of a wall paint manufacturing company is faced with the problem of choosing one of three products to add to its existing product line. The potential demand for each product may turn out to be good, moderate or poor with probabilities estimated as 0.75, 0.15 and 0.10 respectively.

The estimated profit or loss under the three states of demand with respect to each product is outlined below:

	Type of demand		
Product	**Good**	**Moderate**	**Poor**
Silk	70,000	55,000	- 10,000
Matt	100,000	40,000	- 6,000
Gloss	120,000	50,000	- 40,000

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Required:

(i) Advise the management on the choice of product based on the expected monetary valve (EMV) criterion. (4 marks)

(ii) Compute the expected opportunity loss for each decision.

Which decision would you recommend based on the expected opportunity loss? (4 marks)

(iii) Compute the expected value of perfect information. (4 marks)

(Total: 20 marks)

QUESTION SIX

(a) Explain **THREE** roles of quantitative analysis in the decision making of organisations. (6 marks)

(b) The data below relate to the profits of Soko Yetu Groceries (in thousands of shillings) over a period of four years.

Year	Quarter			
	1	**2**	**3**	**4**
2019	12	9	11	14
2020	13	10	17	20
2021	15	13	20	22
2022	16	12	21	-

Required:

(i) Determine the trend equation using the least squares method. (8 marks)

(ii) Calculate the seasonal index for each quarter using the multiplicative model. (6 marks)

(Total: 20 marks)

QUESTION SEVEN

(a) Explain **THREE** decision making environments. (6 marks)

(b) Define the following terms as used in decision making:

(i) Value of perfect information. (1 mark)

(ii) Regret. . (1 mark)

(c) Majux Limited manufactures two types of fruit juices; yellow juice and red juice. 1 packet of yellow juice requires 3 minutes for cutting of fruits, 6 minutes for blending, 7 minutes for cooling and 2 minutes for packaging. 1 packet of red juice requires 5 minutes for cutting of fruits, 4 minutes for blending, 10 minutes for cooling and 5 minutes for packaging.

The company's workforce can only spend a maximum of 60 hours on cutting, $71^{1}/_{3}$ hours on blending, 105 hours on cooling and 45 hours on packaging. The profit contribution is Sh.450 for each packet of yellow juice and Sh.380 for each packet of red juice.

Required:

(i) Formulate a linear programming model from the above information. (5 marks)

(ii) Use the graphical method to solve the linear programming model formulated in (c) (i) above. (5 marks)

(iii) Calculate the slack or surplus values for cutting of fruits and interpret its meaning. (2 marks)

(Total: 20 marks)

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CPA FOUNDATION LEVEL

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QUANTITATIVE ANALYSIS

WEDNESDAY: 3 August 2022. Morning paper. **Time Allowed: 3 hours.**

Answer any FIVE questions. ALL questions carry equal marks. Show ALL your workings. Do NOT write anything on this paper.

QUESTION ONE

(a) Soundex Company has received an order to supply 900 tables, 1,200 desks and 2,000 chairs. The management of Soundex Company has decided that 500 tables, 800 desks and 1,300 chairs could be supplied from their city centre branch and the balance of the order could be filled from their industrial area branch.

Production of each table requires 3 hours in the machining department, 5 hours in the assembly department and 4 hours in the finishing department. Production of a desk requires 4 hours in the machining department, 8 hours in the assembly department and 6 hours in the finishing department. Production of a chair requires 2 hours in the machining department, 3 hours in the assembly department and 5 hours in the finishing department.

The cost of an hour in the machining, assembly and finishing department is Sh.50, Sh.100 and Sh.150 respectively.

Required:

Using matrix algebra:

(i) Calculate the total number of hours required at each branch. (6 marks)

(ii) Calculate the total cost incurred at each branch and the total cost incurred by Soundex Company to supply the order. (4 marks)

(b) The data below relates to the sales of Madi and Sons Electrical Company for the six months ending 30 June 2022:

Month	**January**	**February**	**March**	**April**	**May**	**June**
Sales (Sh."000")	80	76	78	82	72	82

Required:

Using exponential smoothing with a smoothing constant (α) of 0.25, determine the forecast sales for the month of July 2022. (4 marks)

(c) The number of employees working online during a particular week was recorded as shown below:

Day of the week	**Number of employees**
Monday	207
Tuesday	185
Wednesday	203
Thursday	180
Friday	225
Total	1,000

Required:

Test the hypothesis that the number of employees who worked online does not depend on the day of week. Use a significance level of 1%. (6 marks)

(Total: 20 marks)

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QUESTION TWO

(a) TMA Company produces three products; Standard, Deluxe and Luxury in three of its departments which are Cutting, Assembly and Finishing. The total available labour hours per week for Cutting, Assembly and Finishing departments are 180, 300 and 240 respectively.

To produce two units of Standard requires 240 minutes in the Cutting department, half the amount of time in the Assembly department and same amount of time in the Finishing department as in the Cutting department.

To produce one unit of Deluxe requires 60 minutes, 180 minutes and 60 minutes in Cutting, Assembly and Finishing departments respectively.

To produce three units of Luxury requires 180 minutes in Cutting department and twice the amount of time in both Assembly and Finishing departments.

The contribution per unit from Standard, Deluxe and Luxury is Sh.6, Sh.5 and Sh.2 per unit respectively.

Required:

(i) Formulate the above problem as a linear programming model. (6 marks)

(ii) Prepare an initial simplex tableau to solve the above model. (4 marks)

(b) The above problem was solved using a statistical software and the final simplex tableau is provided below:

	Model variables			Slack variables			
Basis	**X_1**	**X_2**	**X_3**	**S_1**	**S_2**	**S_3**	**R.H.S**
X_1	1	0	$\frac{1}{5}$	$\frac{3}{5}$	$-\frac{1}{5}$	0	48
X_2	0	1	$\frac{3}{5}$	$-\frac{1}{5}$	$\frac{2}{5}$	0	84
S_3	0	0	1	–1	0	1	60
Z	0	0	$\frac{1}{5}$	$\frac{13}{5}$	$\frac{4}{5}$	0	708

Required:

(i) Explain whether the solution is optimal. Justify your answer. (2 marks)

(ii) Determine the optimal solution for TMA Company. (2 marks)

(iii) Determine the slack or surplus value for each constraint. State which one is a slack and which one is a surplus. (4 marks)

(iv) Determine the shadow price for each constraint. (2 marks)

(Total: 20 marks)

QUESTION THREE

(a) (i) Explain the term "Markov analysis". (2 marks)

(ii) Highlight four assumptions of Markov analysis. (4 marks)

(b) Differentiate between the following sets of terms as used in hypothesis testing:

(i) "Null hypothesis" and "alternative hypothesis". (2 marks)

(ii) "Parameter" and "statistic". (2 marks)

(c) The following payoff matrix shows the potential profits in millions of shillings which are expected to arise from launching four products S_1, S_2, S_3 and S_4 for each level of demand; low, moderate or high.

Payoff matrix

	Demand		
Product	**Low**	**Moderate**	**High**
S_1	15	22	29
S_2	22	24	28
S_3	32	23	34
S_4	35	22	33

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Required:
Assuming that the products are mutually exclusive, evaluate the optimal decision using:

(i) Maximax criterion. (3 marks)

(ii) Maximin criterion. (3 marks)

(iii) Minimax regret criterion. (4 marks)

(Total: 20 marks)

QUESTION FOUR

(a) A proposal to teach longer hours on weekdays rather than have weekend classes was put forward by a subject lecturer to his students.

The following results were obtained:

	Opinion		
Students gender	**In favour**	**Opposed**	**Undecided**
Male	40	10	15
Female	20	30	20

Required:
Calculate the probability that a student selected at random will be:

(i) Female and in favour of the proposal. (2 marks)

(ii) Either male or opposed to the proposal. (2 marks)

(iii) Undecided given that the student is female. (2 marks)

(b) The Production Manager of AMIK Company has provided the following information relating to the number of units produced per day in the last 172 days:

Production per day (units)	**Frequency in days**
230 – 260	12
260 – 290	18
290 – 320	25
320 – 350	52
350 – 380	35
380 – 410	15
410 – 440	9
440 – 470	6

Required:

(i) The modal production. (2 marks)

(ii) The median production. (2 marks)

(iii) The quartile deviation of the production. (6 marks)

(c) A curve is defined by the quadratic function

$y = x^2 - 15x + 54$

Required:

(i) Determine the roots of the equation using the factorisation method. (2 marks)

(ii) By using differentiation, determine the coordinates of the turning point of the curve. (2 marks)

(Total: 20 marks)

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QUESTION FIVE

(a) ABC Ltd. has introduced a new product branded "Nilan". The Production Manager wishes to establish the relationship between the total cost of production and the number of units produced. The Production Manager also believes that the relationship between the total cost of producing "Nilan" and the number of units produced is linear in nature.

The Production Manager has gathered the following data on the production for the last 8 months:

Month	Units produced "000"	Total cost of production Sh."000"
December 2021	675	6,900
January 2022	630	6,480
February 2022	825	6,990
March 2022	645	7,200
April 2022	900	8,560
May 2022	600	6,720
June 2022	510	6,300
July 2022	550	5,250

Required:

(i) Estimate the total cost function using the ordinary least squares method. (7 marks)

(ii) The coefficient of determination between the number of units produced and the total cost of production. (2 marks)

(iii) Interpret your answer in (a) (ii) above. (1 mark)

(b) A survey of 850 residents of a certain town aimed at finding out the brand of vehicles owned, produced the following results:

316 residents owned Nissan vehicles.
160 residents owned Honda vehicles.
360 residents owned Toyota vehicles.
120 residents owned both Nissan and Toyota vehicles.
56 residents owned both Nissan and Honda vehicles.
80 residents owned both Honda and Toyota vehicles.
240 residents did not own any of the three brands of vehicles.

Required:

(i) Present the above information in the form of a Venn diagram. (5 marks)

(ii) The number of residents who own all the three brands of vehicles. (3 marks)

(iii) The number of residents who own just one of the three brands of vehicles. (2 marks)

(Total: 20 marks)

QUESTION SIX

(a) Outline four qualities of a good average. (4 marks)

(b) The weights of 1,000 items are normally distributed with a mean weight of 200 kgs and a standard deviation of 22 kgs.

Required:

(i) Determine the number of items that have weights between 210 kgs and 220 kgs. (2 marks)

(ii) Determine the number of items that have weights between 180 kgs and 230 kgs. (2 marks)

(iii) Calculate the weight below which 20% of the items fall. (2 marks)

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(c) The data below shows the probability distribution of profits earned by firms in the manufacturing industry:

Profit Sh."million"	**Probability**
10 – 20	0.05
20 – 30	0.05
30 – 40	0.10
40 – 50	0.15
50 – 60	0.30
60 – 70	0.10
70 – 80	0.20
80 – 90	0.05

Required:

(i) The expected profit. (4 marks)

(ii) The expected standard deviation. (4 marks)

(iii) The coefficient of variation. (2 marks)

(Total: 20 marks)

QUESTION SEVEN

(a) A technician at Light Industries Ltd. has established that the probability of a production process producing defective output is 0.2. A total of 60 units are produced from the process in a certain production period.

Required:

(i) The probability that exactly 10 of the units will be defective assuming a poisson distribution. (3 marks)

(ii) The probability that exactly 10 of the units will be defective assuming a binomial distribution. (2 marks)

(iii) The expected number and standard deviation of units expected to be defective assuming a binomial distribution. (2 marks)

(b) XYZ Ltd. produces and sells a product branded "Xedo". The product is produced in two departments; manufacturing and assembly.

The marginal revenue (MR) of XYZ Ltd. is given by the function

$MR = 600 - 0.12q$

Where q is the number of units produced and sold.

The total variable cost (VC) for the two departments is given as follows:

Manufacturing department

$VC = 60q + 0.06q^2$

Assembly department

$VC = 12q + 0.03q^2$

The total fixed cost for each of the departments is as follows:

	Sh.
Manufacturing department	40,000
Assembly department	120,000

Required:

(i) The total revenue, total cost and profit functions of XYZ Ltd. (6 marks)

(ii) The profit maximising level of output. (2 marks)

(iii) The maximum profit of XYZ Ltd. (1 mark)

(c) Given that $A = \begin{pmatrix} 2 & -1 & 2 \\ 1 & 0 & 3 \\ 3 & -2 & -5 \end{pmatrix}$ and

$B = \begin{pmatrix} 3 & -6 & -3 \\ 7 & -14 & -7 \\ -1 & 2 & 1 \end{pmatrix}$

Show that $AB \neq 0$ (4 marks)

(Total: 20 marks)

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PILOT PAPER

QUANTITATIVE ANALYSIS

December 2021. **Time Allowed: 3 hours.**

Answer any FIVE questions. Marks allocated to each question are shown at the end of the question. Show ALL your workings.

QUESTION ONE

(a) Mashariki Enterprises started business in January 2018 selling photo copiers in the City. The following information relates to sales and enquiries made during the year ended 31 December 2020.

Sales calls (x)	Copiers sold (y)
96	41
40	41
104	51
128	60
164	61
76	29
72	39
88	50
36	28
84	43
180	70
132	56

Required:

Derive the regression equation of y on x. (12 marks)

(b) Explain four characteristics of Karl Pearson coefficient of correlation. (8 marks)

(Total: 20 marks)

QUESTION TWO

An electronics dealer in Nakuru has labelled a certain electrical component with numbers 1 – 50. These components are normally sold to 5 specific customers who pick one each on week days only. Incidentally, the components labelled numbers 3, 18, 12, 26 and 46 are defective.

Required:

(a) The probability that one customer will have drawn five defective components by the end of 5 weeks. (15 marks)

(b) The probability that two customers will have drawn two defective components each, two none and the other components, in two weeks. (5 marks)

(Total: 20 marks)

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QUESTION THREE

(a) Explain the difference between the following terms:

(i) Type 1 and Type II errors. (4 marks)

(ii) One-tail test and two-tail test. (4 marks)

(iii) Normal distribution and t-distribution. (4 marks)

(b) The manufacturer of the TyroX radical truck tyre claims that the mean mileage the tyre can be driven before the thread wears out is 60,000 km, assuming the mileage wear follows the normal distribution and a standard deviation of 5,000 km. In a sample of 48 tyres, the mileage was found to be 59,500 km.

Required:

Test whether this observation is different from the claim by the manufacturer at 5% significance level. (8 marks)

(Total: 20 marks)

QUESTION FOUR

Agro manufacturers produce three products; Chat, Item and Wit (in thousands) whose demand and cost functions are given as follows:

Chat: AR = 16 – 3Q ; ATC = 4Q + 8
Item: P = 10 – Q – $2Q^2$; ATC = Q + 4
Wit: P = 100 – ½Q ; ATC = 300 + 2Q – $2Q^2$

Required:

(a) Output and price levels that will maximize profits. (9 marks)

(b) Maximum profit for each product. (9 marks)

(c) Total profit for the production of the three products at the optimal point. (2 marks)

(Total: 20 marks)

QUESTION FIVE

The frequency distribution of after tax earnings for Applewood Ltd. for 180 months to 31 December 2020 was as follows:

Profit after tax Sh."000" (X)	**Frequency (f)**
20,000 ≤ x < 60,000	8
60,000 ≤ x < 100,000	11
100,000 ≤ x < 140,000	23
140,000 ≤ x < 180,000	38
180,000 ≤ x < 220,000	45
220,000 ≤ x < 260,000	32
260,000 ≤ x < 300,000	19
300,000 ≤ x < 340,000	4

Required:

(a) Modify the formula given below for median to derive another one for:

(i) 25^{th} percentile of the distribution. (6 marks)

(ii) 75^{th} percentile of the distribution. (6 marks)

(Ensure to indicate what each of the symbols used stand for)

(b) Evaluate:

(i) 2^{nd} decile of the distribution. (4 marks)

(ii) 8^{th} decile of the distribution. (4 marks)

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$$L = \left(\frac{\frac{n}{2} - C}{f} \right) \epsilon$$

Where: L = Lower class boundary of the median class

n = Sample size

C = Cumulative frequency of the class below the median class

f = Frequency of the median class

ϵ + Class interval.

(Total: 20 marks)

QUESTION SIX

(a) Write short notes on the following formulas in relation to time series analysis:

(i) $Y = T \times C \times S \times I$ (4 marks)

(ii) $Y_T = b_o + b_I x$ 4 marks)

(iii) $\text{In } Y_T = \text{In bo} + \text{In } b_I$ (4 marks)

(iv) $b_I = \dfrac{\Sigma xy - n\bar{X}\bar{Y}}{\Sigma x^2 - n\bar{X}^2}$ (4 marks)

(b) Explain the process of exponential smoothing. (4 marks)

(Total: 20 marks)

QUESTION SEVEN

In the context of linear programming, explain each of the following:

(a) Constrained optimisation. (4 marks)

(b) Inequality constraints. (4 marks)

(c) Objective function. (4 marks)

(d) Constrained minimisation. (4 marks)

(e) Non-negativity constraints. (4 marks)

(Total: 20 marks)

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CPA FOUNDATION LEVEL

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QUANTITATIVE ANALYSIS

WEDNESDAY: 6 April 2022. Morning paper. **Time Allowed: 3 hours.**

Answer any FIVE questions. ALL questions carry equal marks. Show ALL your workings. Do NOT write anything on this paper.

QUESTION ONE

(a) Hexadol Limited has been in operation for the last 5 years. The Company's annual revenue function and annual cost function take the form of quadratic functions.

The following data was obtained from the records of the company for the last 3 years:

	Year		
	2019	**2020**	**2021**
Units produced and sold: "million"	4	8	12
Revenue Sh."million"	2,320	4,480	6,480
Cost Sh."million"	10,404	9,832	9,272

Required:

(i) The revenue function of the company. (4 marks)

(ii) The cost function of the company. (4 marks)

(b) Explain the following terms as used in probability:

(i) Joint probability. (2 marks)

(ii) Mutually exclusive events. (2 marks)

(iii) Conditional probability. (2 marks)

(iv) Dependent events. (2 marks)

(c) A firm has 500 employees out of whom, 2% have a minor accident in a given year. Out of the employees who have a minor accident in a given year, 30% had safety instructions. 80% of all employees had no safety instructions.

Required:

The probability of an employee being accident free given that the employee had no safety instructions. (4 marks)

(Total: 20 marks)

QUESTION TWO

(a) Explain three types of Kurtosis that a graphical representation of a frequency distribution can assume. (6 marks)

(b) The following data shows the age distribution of 350 employees of a multi-national company.

Age (years)	**Number of employees**
20 – 25	20
25 – 30	70
30 – 35	100
35 – 40	65
40 – 45	40
45 – 50	25
50 – 55	15
55 – 60	10
60 – 65	5

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Required:
Compute the following measures and give an interpretation of each:

(i) The mean age. (2 marks)

(ii) The median age. (3 marks)

(iii) The standard deviation of the employees' ages. (6 marks)

(iv) The Karl Pearson's coefficient of skewness. (3 marks)

(Total: 20 marks)

QUESTION THREE

(a) A random sample of 350 invoices issued by ARIK Ltd. revealed an average invoice value of Sh.38,780 with a standard deviation of Sh.8,750.

Required:

(i) The interval within which the population mean should fall at 95% level of confidence. (3 marks)

(ii) The sample size of invoices that would result in a 99% confidence level of the interval obtained in (a) (i) above. (3 marks)

(b) The following information relates to the operating life of two brands of mobile phones, brand A and brand B:

	Brand A	**Brand B**
Mean life (days)	1,730	1,684
Standard deviation (in days)	102	108
Sample size	200	200

Required:
Advise a potential customer on whether there is any significant difference between the quality of the two brands of mobile phones at a 5% level of significance. (6 marks)

(c) A certain new strategy K was claimed to be effective for teams playing a certain game.

In a marathon of 400 games, half of the teams used strategy K and the other half used strategy P.

The teams' performance was recorded in the following table

	Won	**Defeated**	**Drawn**
Adopted strategy K	130	20	60
Adopted strategy P	110	30	50

Required:
On the basis of the above data and using the chi-square method, advise whether there is a significant difference in the effect of the two strategies, K and P. (8 marks)

(Total: 20 marks)

QUESTION FOUR

(a) XYZ Ltd. produces three products namely A, B and C. The company presents the profit per unit of the products it produces and sells as follows:

Sh.2,000, Sh.3,000 and Sh.4,000 for products A, B and C respectively during the month of January 2022. Sh.7,000, Sh.9,000 and Sh.4,000 for products A, B and C respectively during the month of February 2022. Sh.1,000, Sh.4,000 and Sh.2,000 for products A, B and C respectively during the month of March 2022. The total profits in the months of January, February and March 2022 are Sh.17 million, Sh.45 million and Sh.16 million respectively.

Required:
The total number of each product produced and sold using matrix algebra. (8 marks)

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(b) The savings accounts in a certain microfinance bank have an average balance of Sh.240,000 and a standard deviation of Sh.60,000. The account balances are assumed to be normally distributed.

Required:

(i) The proportion of savings accounts whose balances are above Sh.275,000. (3 marks)

(ii) The proportion of savings accounts whose balances lies between Sh.190,000 and Sh.260,000. (3 marks)

(c) The average revenue function of a certain company is given by the function AR = 2,000 – 24q. The cost function is given by the function $C = 6q^2 + 1,440q + 1,280$. In both cases, q represents the quantity in units.

Required:

(i) The profit function of the company. (3 marks)

(ii) The maximum profit for the company. (3 marks)

(Total: 20 marks)

QUESTION FIVE

Ahadi Ltd. is in the process of analysing its electricity expense and its relationship with the machine hours of operation.

The following data is provided with respect to the year ended 31 December 2021:

Month	**Number of machine hours "000"**	**Electricity expense Sh."000"**
January	72	1,020
February	55	820
March	39	720
April	60	900
May	49	870
June	39	720
July	53	825
August	81	1,365
September	63	870
October	59	890
November	45	790
December	50	940

Required:

(a) The least squares regression line for the above data and interpret its meaning. (10 marks)

(b) Estimate the amount of electricity expense assuming the expected machine hours are 78,000. (2 marks)

(c) The product moment correlation coefficient between machine hours and electricity expense. Interpret your answer. (6 marks)

(d) The standard error of estimate for the regression line. Interpret your answer. (2 marks)

(Total: 20 marks)

QUESTION SIX

(a) (i) Highlight four requirements that must be met before the linear programming model can be applied. (4 marks)

(ii) A company makes two products; 1 and 2.

Each product requires time on two machines A and B. The specifications for each product are as follows:

	Product 1	**Product 2**
Processing time:		
Machine A (Hours/unit)	1.6	1.0
Machine B (Hours/unit)	2.5	1.0
Selling price (Sh./unit)	22	48
Material and labour cost (Sh./unit)	14	37
Maximum possible production and sale (units)	30	50

Maximum time available for machine A is 80 hours and for machine B is 100 hours.

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Required:
Formulate a linear programming model to determine the number of product 1 and product 2 which should be produced and sold in order to maximise total contribution for the company using the graphical method.
(12 marks)

(b) State any four assumptions of the Poisson probability distribution. (4 marks)
(Total: 20 marks)

QUESTION SEVEN

(a) The table below shows the quarterly profits of Kahawa Limited (in millions of shillings) for the years 2019, 2020 and 2021:

	Quarterly profits (Sh."million")			
Year	**Quarter 1**	**Quarter 2**	**Quarter 3**	**Quarter 4**
2019	23	32	27	21
2020	27	35	32	24
2021	31	43	40	29

Required:

(i) The three-quarter moving average of the profits. (6 marks)

(ii) The quarterly seasonal variations of the profits using the additive model. (4 marks)

(iii) Forecast the adjusted profits for the year 2022 given that the actual profits (in Sh."million") in the year 2022 are 35, 50, 47 and 33 for Quarter 1, Quarter 2, Quarter 3 and Quarter 4 respectively. (4 marks)

(b) An investment manager in an investment fund has a choice between:

1. A diversified portfolio promising Sh.15 million with a probability of 0.7 and Sh.8 million with a probability of 0.3.

2. A risky investment consisting of two contracts with independent outcomes one promising Sh.7 million with a probability of 0.7 and the other Sh.3.5 million with a probability of 0.3.

Required:

(i) Construct a decision tree depicting the above information using the expected monetary value (EMV) criterion. (3 marks)

(ii) Advise on the best decision using the EMV criterion. (3 marks)
(Total: 20 marks)

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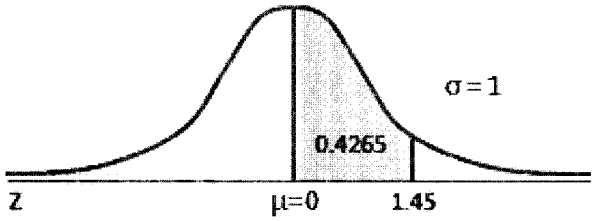
Areas Under the One-Tailed Standard Normal Curve

This table provides the area between the mean and some Z score.
For example, when Z score = 1.45 the area = 0.4265.



Z	0.00	0.01	0.02	0.03	0.04	0.05	0.06	0.07	0.08	0.09
0.0	0.0000	0.0040	0.0080	0.0120	0.0160	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	0.0910	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	0.1480	0.1517
0.4	0.1554	0.1591	0.1628	0.1664	0.1700	0.1736	0.1772	0.1808	0.1844	0.1879
0.5	0.1915	0.1950	0.1985	0.2019	0.2054	0.2088	0.2123	0.2157	0.2190	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	0.2580	0.2611	0.2642	0.2673	0.2704	0.2734	0.2764	0.2794	0.2823	0.2852
0.8	0.2881	0.2910	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	0.3340	0.3365	0.3389
1.0	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	0.3770	0.3790	0.3810	0.3830
1.2	0.3849	0.3869	0.3888	0.3907	0.3925	0.3944	0.3962	0.3980	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	0.4370	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	0.4750	0.4756	0.4761	0.4767
2.0	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	0.4830	0.4834	0.4838	0.4842	0.4846	0.4850	0.4854	0.4857
2.2	0.4861	0.4864	0.4868	0.4871	0.4875	0.4878	0.4881	0.4884	0.4887	0.4890
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	0.4920	0.4922	0.4925	0.4927	0.4929	0.4931	0.4932	0.4934	0.4936
2.5	0.4938	0.4940	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	0.4960	0.4961	0.4962	0.4963	0.4964
2.7	0.4965	0.4966	0.4967	0.4968	0.4969	0.4970	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	0.4980	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	0.4987	0.4987	0.4987	0.4988	0.4988	0.4989	0.4989	0.4989	0.4990	0.4990
3.1	0.4990	0.4991	0.4991	0.4991	0.4992	0.4992	0.4992	0.4992	0.4993	0.4993
3.2	0.4993	0.4993	0.4994	0.4994	0.4994	0.4994	0.4994	0.4995	0.4995	0.4995
3.3	0.4995	0.4995	0.4995	0.4996	0.4996	0.4996	0.4996	0.4996	0.4996	0.4997
3.4	0.4997	0.4997	0.4997	0.4997	0.4997	0.4997	0.4997	0.4997	0.4997	0.4998
3.5	0.4998	0.4998	0.4998	0.4998	0.4998	0.4998	0.4998	0.4998	0.4998	0.4998
3.6	0.4998	0.4998	0.4999	0.4999	0.4999	0.4999	0.4999	0.4999	0.4999	0.4999
3.7	0.4999	0.4999	0.4999	0.4999	0.4999	0.4999	0.4999	0.4999	0.4999	0.4999
3.8	0.4999	0.4999	0.4999	0.4999	0.4999	0.4999	0.4999	0.4999	0.4999	0.4999
3.9	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000

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Chi-square Distribution Table

d.f.	.995	.99	.975	.95	.9	.1	.05	.025	.01
1	0.00	0.00	0.00	0.00	0.02	2.71	3.84	5.02	6.63
2	0.01	0.02	0.05	0.10	0.21	4.61	5.99	7.38	9.21
3	0.07	0.11	0.22	0.35	0.58	6.25	7.81	9.35	11.34
4	0.21	0.30	0.48	0.71	1.06	7.78	9.49	11.14	13.28
5	0.41	0.55	0.83	1.15	1.61	9.24	11.07	12.83	15.09
6	0.68	0.87	1.24	1.64	2.20	10.64	12.59	14.45	16.81
7	0.99	1.24	1.69	2.17	2.83	12.02	14.07	16.01	18.48
8	1.34	1.65	2.18	2.73	3.49	13.36	15.51	17.53	20.09
9	1.73	2.09	2.70	3.33	4.17	14.68	16.92	19.02	21.67
10	2.16	2.56	3.25	3.94	4.87	15.99	18.31	20.48	23.21
11	2.60	3.05	3.82	4.57	5.58	17.28	19.68	21.92	24.72
12	3.07	3.57	4.40	5.23	6.30	18.55	21.03	23.34	26.22
13	3.57	4.11	5.01	5.89	7.04	19.81	22.36	24.74	27.69
14	4.07	4.66	5.63	6.57	7.79	21.06	23.68	26.12	29.14
15	4.60	5.23	6.26	7.26	8.55	22.31	25.00	27.49	30.58
16	5.14	5.81	6.91	7.96	9.31	23.54	26.30	28.85	32.00
17	5.70	6.41	7.56	8.67	10.09	24.77	27.59	30.19	33.41
18	6.26	7.01	8.23	9.39	10.86	25.99	28.87	31.53	34.81
19	6.84	7.63	8.91	10.12	11.65	27.20	30.14	32.85	36.19
20	7.43	8.26	9.59	10.85	12.44	28.41	31.41	34.17	37.57
22	8.64	9.54	10.98	12.34	14.04	30.81	33.92	36.78	40.29
24	9.89	10.86	12.40	13.85	15.66	33.20	36.42	39.36	42.98
26	11.16	12.20	13.84	15.38	17.29	35.56	38.89	41.92	45.64
28	12.46	13.56	15.31	16.93	18.94	37.92	41.34	44.46	48.28
30	13.79	14.95	16.79	18.49	20.60	40.26	43.77	46.98	50.89
32	15.13	16.36	18.29	20.07	22.27	42.58	46.19	49.48	53.49
34	16.50	17.79	19.81	21.66	23.95	44.90	48.60	51.97	56.06
38	19.29	20.69	22.88	24.88	27.34	49.51	53.38	56.90	61.16
42	22.14	23.65	26.00	28.14	30.77	54.09	58.12	61.78	66.21
46	25.04	26.66	29.16	31.44	34.22	58.64	62.83	66.62	71.20
50	27.99	29.71	32.36	34.76	37.69	63.17	67.50	71.42	76.15
55	31.73	33.57	36.40	38.96	42.06	68.80	73.31	77.38	82.29
60	35.53	37.48	40.48	43.19	46.46	74.40	79.08	83.30	88.38
65	39.38	41.44	44.60	47.45	50.88	79.97	84.82	89.18	94.42
70	43.28	45.44	48.76	51.74	55.33	85.53	90.53	95.02	100.43
75	47.21	49.48	52.94	56.05	59.79	91.06	96.22	100.84	106.39
80	51.17	53.54	57.15	60.39	64.28	96.58	101.88	106.63	112.33
85	55.17	57.63	61.39	64.75	68.78	102.08	107.52	112.39	118.24
90	59.20	61.75	65.65	69.13	73.29	107.57	113.15	118.14	124.12
95	63.25	65.90	69.92	73.52	77.82	113.04	118.75	123.86	129.97
100	67.33	70.06	74.22	77.93	82.36	118.50	124.34	129.56	135.81

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CPA FOUNDATION LEVEL

CIFA FOUNDATION LEVEL

QUANTITATIVE ANALYSIS

FRIDAY: 17 December 2021. **Time Allowed: 3 hours.**

Answer any FIVE questions. ALL questions carry equal marks. Show ALL your workings.

QUESTION ONE

(a) Explain the following terms as used in time series analysis:

(i) Cyclical variations. (2 marks)

(ii) Random variations. (2 marks)

(iii) Seasonal variations. (2 marks)

(iv) Trend. (2 marks)

(b) The following data relates to the profits reported by XYZ Ltd. in each of the months in the year 2020:

Month	**Profit (Sh."million")**
January	40
February	38
March	39
April	41
May	36
June	41
July	34
August	37
September	35
October	37
November	40
December	41

Required:

(i) Estimate the trend line using the ordinary least squares method. (9 marks)

(ii) Estimate the profit reported in March of the year 2021. (3 marks)

(Total: 20 marks)

QUESTION TWO

(a) State five advantages of the arithmetic mean as a measure of central tendency. (5 marks)

(b) The following data shows the distribution of profits of 150 manufacturing companies in a given year:

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Profit ("Sh."million")	Number of companies
10-20	15
20-30	13
30-40	25
40-50	30
50-60	16
60-70	10
70-80	22
80-90	12
90-100	7

Required:

(i) The arithmetic mean of the profits and interpret the results. (4 marks)

(ii) The standard deviation of the profits and interpret the results. (8 marks)

(iii) The coefficient of variation of the profits and interpret the results. (3 marks)

(Total: 20 marks)

QUESTION THREE

(a) Explain the following terms as used in Markov analysis:

(i) Markov process. (2 marks)

(ii) Equilibrium state. (2 marks)

(iii) Absorbing state. (2 marks)

(iv) Closed state. (2 marks)

(b) The marketing department of Jacuzi Ltd. estimates the daily demand function of one of its products to be linear in nature. If the price was fixed at Sh.570, the daily demand would be 400 units. If the price was increased to Sh.820, the daily sales would drop to 200 units.

The production department has indicated that the marginal cost of producing Q units of the product is given by the following equation: $MC = 2Q - 570$

Where: MC is the marginal cost and
Q is the number of units produced.

The daily fixed cost is Sh.1,100.

Required:

(i) The revenue function of Jacuzi Ltd. (4 marks)

(ii) The total cost function of Jacuzi Ltd. (3 marks)

(iii) The maximum profit that Jacuzi Ltd. could make. (5 marks)

(Total: 20 marks)

QUESTION FOUR

(a) In the context of hypothesis testing, distinguish between a "type I error" and a "type II error". (4 marks)

(b) The sales before and after a promotional campaign in ten different regions for a certain commodity were recorded as follows:

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Region	Sales before promotional campaign "Sh.million"	Sales after promotional campaign "Sh.million"
1	53	58
2	28	29
3	31	30
4	48	50
5	50	50
6	42	45
7	63	59
8	40	36
9	25	22
10	30	28

Required:
Using a 5% level of significance, determine whether the promotional campaign was a success or not. (16 marks)
(Total: 20 marks)

QUESTION FIVE
Bantu Limited makes two types of pudding: vanilla and chocolate. Each serving of vanilla pudding requires 2 teaspoons of sugar and 25 fluid measures of water, and each serving of chocolate pudding requires 3 teaspoons of sugar and 15 fluid measures of water. Bantu Limited has available each day 3,600 teaspoons of sugar and 22,500 fluid measures of water. Bantu Limited makes no more than 600 servings of vanilla pudding because that is all that it can sell each day. Bantu Limited makes a profit of Sh.10 on each serving of vanilla pudding and Sh.7 on each serving of chocolate pudding.

Required:
(a) Formulate a linear programming model to solve the above problem. (4 marks)

(b) Construct an initial simplex tableau. (4 marks)

(c) Using the simplex method, determine how many servings of each type of pudding Bantu Limited should make in order to maximise profit. (12 marks)
(Total: 20 marks)

QUESTION SIX
(a) State four applications of matrices in business. (4 marks)

(b) A global conference on "the blue economy" was recently held in Kenya and was attended by 280 delegates from America, Europe and Africa.

The following information relates to the delegates who attended the conference:

70 delegates represented Europe
96 delegates represented Africa
128 delegates represented America
20 delegates represented all the three continents.
25 delegates represented America and Africa
22 delegates represented America and Europe
26 delegates represented Europe and Africa

Required:
(i) Present the above information in the form of a Venn diagram. (4 marks)

(ii) The number of delegates who represented at least two continents. (2 marks)

(iii) The number of delegates who represented only one continent. (2 marks)

(iv) The number of delegates who represented none of the three continents. (2 marks)

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(c) During the manufacture of a product, 0.002 of the product turns out to be defective. The product is supplied in packets of 10. A consignment of 100,000 packets is produced in a certain period.

Required:
Using the Poisson distribution, calculate the approximate number of packets containing:

(i) No defectives. (2 marks)

(ii) 1 defective. (2 marks)

(iii) 2 defectives. (2 marks)

(Total: 20 marks)

QUESTION SEVEN

(a) A random sample of 15 employees of a call centre was taken and each employee took a competency test. The mean of the scores achieved by these employees was 56.3% with a standard deviation of 7.1%. The results of this test have been found to be normally distributed in the past.

Required:
Construct a 95% confidence interval for the mean of the test score of the call centre employees. (6 marks)

(b) (i) Distinguish between the "coefficient of correlation" and the "coefficient of determination". (4 marks)

(ii) The following data was obtained during a social survey conducted in a given urban area regarding the monthly income of households and their corresponding expenditure:

Household	**Monthly income Sh."000"**	**Monthly expenditure Sh."000"**
A	150	120
B	130	135
C	200	195
D	245	190
E	140	120
F	100	85
G	80	65
H	145	130
I	130	60
J	90	75

Required:
The Pearson's coefficient of correlation between monthly income and monthly expenditure and interpret the result. (10 marks)

(Total: 20 marks)

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t Table

cum. prob	$t_{.50}$	$t_{.75}$	$t_{.80}$	$t_{.85}$	$t_{.90}$	$t_{.95}$	$t_{.975}$	$t_{.99}$	$t_{.995}$	$t_{.999}$	$t_{.9995}$
one-tail	**0.50**	**0.25**	**0.20**	**0.15**	**0.10**	**0.05**	**0.025**	**0.01**	**0.005**	**0.001**	**0.0005**
two-tails	**1.00**	**0.50**	**0.40**	**0.30**	**0.20**	**0.10**	**0.05**	**0.02**	**0.01**	**0.002**	**0.001**
df											
1	0.000	1.000	1.376	1.963	3.078	6.314	12.71	31.82	63.66	318.31	636.62
2	0.000	0.816	1.061	1.386	1.886	2.920	4.303	6.965	9.925	22.327	31.599
3	0.000	0.765	0.978	1.250	1.638	2.353	3.182	4.541	5.841	10.215	12.924
4	0.000	0.741	0.941	1.190	1.533	2.132	2.776	3.747	4.604	7.173	8.610
5	0.000	0.727	0.920	1.156	1.476	2.015	2.571	3.365	4.032	5.893	6.869
6	0.000	0.718	0.906	1.134	1.440	1.943	2.447	3.143	3.707	5.208	5.959
7	0.000	0.711	0.896	1.119	1.415	1.895	2.365	2.998	3.499	4.785	5.408
8	0.000	0.706	0.889	1.108	1.397	1.860	2.306	2.896	3.355	4.501	5.041
9	0.000	0.703	0.883	1.100	1.383	1.833	2.262	2.821	3.250	4.297	4.781
10	0.000	0.700	0.879	1.093	1.372	1.812	2.228	2.764	3.169	4.144	4.587
11	0.000	0.697	0.876	1.088	1.363	1.796	2.201	2.718	3.106	4.025	4.437
12	0.000	0.695	0.873	1.083	1.356	1.782	2.179	2.681	3.055	3.930	4.318
13	0.000	0.694	0.870	1.079	1.350	1.771	2.160	2.650	3.012	3.852	4.221
14	0.000	0.692	0.868	1.076	1.345	1.761	2.145	2.624	2.977	3.787	4.140
15	0.000	0.691	0.866	1.074	1.341	1.753	2.131	2.602	2.947	3.733	4.073
16	0.000	0.690	0.865	1.071	1.337	1.746	2.120	2.583	2.921	3.686	4.015
17	0.000	0.689	0.863	1.069	1.333	1.740	2.110	2.567	2.898	3.646	3.965
18	0.000	0.688	0.862	1.067	1.330	1.734	2.101	2.552	2.878	3.610	3.922
19	0.000	0.688	0.861	1.066	1.328	1.729	2.093	2.539	2.861	3.579	3.883
20	0.000	0.687	0.860	1.064	1.325	1.725	2.086	2.528	2.845	3.552	3.850
21	0.000	0.686	0.859	1.063	1.323	1.721	2.080	2.518	2.831	3.527	3.819
22	0.000	0.686	0.858	1.061	1.321	1.717	2.074	2.508	2.819	3.505	3.792
23	0.000	0.685	0.858	1.060	1.319	1.714	2.069	2.500	2.807	3.485	3.768
24	0.000	0.685	0.857	1.059	1.318	1.711	2.064	2.492	2.797	3.467	3.745
25	0.000	0.684	0.856	1.058	1.316	1.708	2.060	2.485	2.787	3.450	3.725
26	0.000	0.684	0.856	1.058	1.315	1.706	2.056	2.479	2.779	3.435	3.707
27	0.000	0.684	0.855	1.057	1.314	1.703	2.052	2.473	2.771	3.421	3.690
28	0.000	0.683	0.855	1.056	1.313	1.701	2.048	2.467	2.763	3.408	3.674
29	0.000	0.683	0.854	1.055	1.311	1.699	2.045	2.462	2.756	3.396	3.659
30	0.000	0.683	0.854	1.055	1.310	1.697	2.042	2.457	2.750	3.385	3.646
40	0.000	0.681	0.851	1.050	1.303	1.684	2.021	2.423	2.704	3.307	3.551
60	0.000	0.679	0.848	1.045	1.296	1.671	2.000	2.390	2.660	3.232	3.460
80	0.000	0.678	0.846	1.043	1.292	1.664	1.990	2.374	2.639	3.195	3.416
100	0.000	0.677	0.845	1.042	1.290	1.660	1.984	2.364	2.626	3.174	3.390
1000	0.000	0.675	0.842	1.037	1.282	1.646	1.962	2.330	2.581	3.098	3.300
z	0.000	0.674	0.842	1.036	1.282	1.645	1.960	2.326	2.576	3.090	3.291
	0%	50%	60%	70%	80%	90%	95%	98%	99%	99.8%	99.9%
	Confidence Level										

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CPA FOUNDATION LEVEL

CIFA FOUNDATION LEVEL

QUANTITATIVE ANALYSIS

WEDNESDAY: 3 August 2022. Morning paper. **Time Allowed: 3 hours.**

Answer any FIVE questions. ALL questions carry equal marks. Show ALL your workings. Do NOT write anything on this paper.

QUESTION ONE

(a) Soundex Company has received an order to supply 900 tables, 1,200 desks and 2,000 chairs. The management of Soundex Company has decided that 500 tables, 800 desks and 1,300 chairs could be supplied from their city centre branch and the balance of the order could be filled from their industrial area branch.

Production of each table requires 3 hours in the machining department, 5 hours in the assembly department and 4 hours in the finishing department. Production of a desk requires 4 hours in the machining department, 8 hours in the assembly department and 6 hours in the finishing department. Production of a chair requires 2 hours in the machining department, 3 hours in the assembly department and 5 hours in the finishing department.

The cost of an hour in the machining, assembly and finishing department is Sh.50, Sh.100 and Sh.150 respectively.

Required:

Using matrix algebra:

(i) Calculate the total number of hours required at each branch. (6 marks)

(ii) Calculate the total cost incurred at each branch and the total cost incurred by Soundex Company to supply the order. (4 marks)

(b) The data below relates to the sales of Madi and Sons Electrical Company for the six months ending 30 June 2022:

Month	**January**	**February**	**March**	**April**	**May**	**June**
Sales (Sh."000")	80	76	78	82	72	82

Required:

Using exponential smoothing with a smoothing constant (α) of 0.25, determine the forecast sales for the month of July 2022. (4 marks)

(c) The number of employees working online during a particular week was recorded as shown below:

Day of the week	**Number of employees**
Monday	207
Tuesday	185
Wednesday	203
Thursday	180
Friday	225
Total	1,000

Required:

Test the hypothesis that the number of employees who worked online does not depend on the day of week. Use a significance level of 1%. (6 marks)

(Total: 20 marks)

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QUESTION TWO

(a) TMA Company produces three products; Standard, Deluxe and Luxury in three of its departments which are Cutting, Assembly and Finishing. The total available labour hours per week for Cutting, Assembly and Finishing departments are 180, 300 and 240 respectively.

To produce two units of Standard requires 240 minutes in the Cutting department, half the amount of time in the Assembly department and same amount of time in the Finishing department as in the Cutting department.

To produce one unit of Deluxe requires 60 minutes, 180 minutes and 60 minutes in Cutting, Assembly and Finishing departments respectively.

To produce three units of Luxury requires 180 minutes in Cutting department and twice the amount of time in both Assembly and Finishing departments.

The contribution per unit from Standard, Deluxe and Luxury is Sh.6, Sh.5 and Sh.2 per unit respectively.

Required:

(i) Formulate the above problem as a linear programming model. (6 marks)

(ii) Prepare an initial simplex tableau to solve the above model. (4 marks)

(b) The above problem was solved using a statistical software and the final simplex tableau is provided below:

	Model variables			Slack variables			
Basis	**X_1**	**X_2**	**X_3**	**S_1**	**S_2**	**S_3**	**R.H.S**
X_1	1	0	⅕	⅗	–⅕	0	48
X_2	0	1	⅗	–⅕	⅖	0	84
S_3	0	0	1	–1	0	1	60
Z	0	0	⅕	$^{13}/_{5}$	⅘	0	708

Required:

(i) Explain whether the solution is optimal. Justify your answer. (2 marks)

(ii) Determine the optimal solution for TMA Company. (2 marks)

(iii) Determine the slack or surplus value for each constraint. State which one is a slack and which one is a surplus. (4 marks)

(iv) Determine the shadow price for each constraint. (2 marks)

(Total: 20 marks)

QUESTION THREE

(a) (i) Explain the term "Markov analysis". (2 marks)

(ii) Highlight four assumptions of Markov analysis. (4 marks)

(b) Differentiate between the following sets of terms as used in hypothesis testing:

(i) "Null hypothesis" and "alternative hypothesis". (2 marks)

(ii) "Parameter" and "statistic". (2 marks)

(c) The following payoff matrix shows the potential profits in millions of shillings which are expected to arise from launching four products S_1, S_2, S_3 and S_4 for each level of demand; low, moderate or high.

Payoff matrix

	Demand		
Product	**Low**	**Moderate**	**High**
S_1	15	22	29
S_2	22	24	28
S_3	32	23	34
S_4	35	22	33

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Required:
Assuming that the products are mutually exclusive, evaluate the optimal decision using:

(i) Maximax criterion. (3 marks)

(ii) Maximin criterion. (3 marks)

(iii) Minimax regret criterion. (4 marks)

(Total: 20 marks)

QUESTION FOUR

(a) A proposal to teach longer hours on weekdays rather than have weekend classes was put forward by a subject lecturer to his students.

The following results were obtained:

	Opinion		
Students gender	**In favour**	**Opposed**	**Undecided**
Male	40	10	15
Female	20	30	20

Required:
Calculate the probability that a student selected at random will be:

(i) Female and in favour of the proposal. (2 marks)

(ii) Either male or opposed to the proposal. (2 marks)

(iii) Undecided given that the student is female. (2 marks)

(b) The Production Manager of AMIK Company has provided the following information relating to the number of units produced per day in the last 172 days:

Production per day (units)	**Frequency in days**
230 – 260	12
260 – 290	18
290 – 320	25
320 – 350	52
350 – 380	35
380 – 410	15
410 – 440	9
440 – 470	6

Required:

(i) The modal production. (2 marks)

(ii) The median production. (2 marks)

(iii) The quartile deviation of the production. (6 marks)

(c) A curve is defined by the quadratic function

$y = x^2 - 15x + 54$

Required:

(i) Determine the roots of the equation using the factorisation method. (2 marks)

(ii) By using differentiation, determine the coordinates of the turning point of the curve. (2 marks)

(Total: 20 marks)

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QUESTION FIVE

(a) ABC Ltd. has introduced a new product branded "Nilan". The Production Manager wishes to establish the relationship between the total cost of production and the number of units produced. The Production Manager also believes that the relationship between the total cost of producing "Nilan" and the number of units produced is linear in nature.

The Production Manager has gathered the following data on the production for the last 8 months:

Month	Units produced "000"	Total cost of production Sh."000"
December 2021	675	6,900
January 2022	630	6,480
February 2022	825	6,990
March 2022	645	7,200
April 2022	900	8,560
May 2022	600	6,720
June 2022	510	6,300
July 2022	550	5,250

Required:

(i) Estimate the total cost function using the ordinary least squares method. (7 marks)

(ii) The coefficient of determination between the number of units produced and the total cost of production. (2 marks)

(iii) Interpret your answer in (a) (ii) above. (1 mark)

(b) A survey of 850 residents of a certain town aimed at finding out the brand of vehicles owned, produced the following results:

316 residents owned Nissan vehicles.
160 residents owned Honda vehicles.
360 residents owned Toyota vehicles.
120 residents owned both Nissan and Toyota vehicles.
56 residents owned both Nissan and Honda vehicles.
80 residents owned both Honda and Toyota vehicles.
240 residents did not own any of the three brands of vehicles.

Required:

(i) Present the above information in the form of a Venn diagram. (5 marks)

(ii) The number of residents who own all the three brands of vehicles. (3 marks)

(iii) The number of residents who own just one of the three brands of vehicles. (2 marks)

(Total: 20 marks)

QUESTION SIX

(a) Outline four qualities of a good average. (4 marks)

(b) The weights of 1,000 items are normally distributed with a mean weight of 200 kgs and a standard deviation of 22 kgs.

Required:

(i) Determine the number of items that have weights between 210 kgs and 220 kgs. (2 marks)

(ii) Determine the number of items that have weights between 180 kgs and 230 kgs. (2 marks)

(iii) Calculate the weight below which 20% of the items fall. (2 marks)

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(c) The data below shows the probability distribution of profits earned by firms in the manufacturing industry:

Profit Sh."million"	**Probability**
10 – 20	0.05
20 – 30	0.05
30 – 40	0.10
40 – 50	0.15
50 – 60	0.30
60 – 70	0.10
70 – 80	0.20
80 – 90	0.05

Required:

(i) The expected profit. (4 marks)

(ii) The expected standard deviation. (4 marks)

(iii) The coefficient of variation. (2 marks)

(Total: 20 marks)

QUESTION SEVEN

(a) A technician at Light Industries Ltd. has established that the probability of a production process producing defective output is 0.2. A total of 60 units are produced from the process in a certain production period.

Required:

(i) The probability that exactly 10 of the units will be defective assuming a poisson distribution. (3 marks)

(ii) The probability that exactly 10 of the units will be defective assuming a binomial distribution. (2 marks)

(iii) The expected number and standard deviation of units expected to be defective assuming a binomial distribution. (2 marks)

(b) XYZ Ltd. produces and sells a product branded "Xedo". The product is produced in two departments; manufacturing and assembly.

The marginal revenue (MR) of XYZ Ltd. is given by the function

$MR = 600 - 0.12q$

Where q is the number of units produced and sold.

The total variable cost (VC) for the two departments is given as follows:

Manufacturing department

$VC = 60q + 0.06q^2$

Assembly department

$VC = 12q + 0.03q^2$

The total fixed cost for each of the departments is as follows:

	Sh.
Manufacturing department	40,000
Assembly department	120,000

Required:

(i) The total revenue, total cost and profit functions of XYZ Ltd. (6 marks)

(ii) The profit maximising level of output. (2 marks)

(iii) The maximum profit of XYZ Ltd. (1 mark)

(c) Given that $A = \begin{pmatrix} 2 & -1 & 2 \\ 1 & 0 & 3 \\ 3 & -2 & -5 \end{pmatrix}$ and

$B = \begin{pmatrix} 3 & -6 & -3 \\ 7 & -14 & -7 \\ -1 & 2 & 1 \end{pmatrix}$

Show that $AB \neq 0$ (4 marks)

(Total: 20 marks)

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CPA PART II SECTION 4

CIFA PART II SECTION 4

CCP PART II SECTION 4

QUANTITATIVE ANALYSIS

FRIDAY: 3 September 2021. **Time Allowed: 3 hours.**

Answer ALL questions. Marks allocated to each question are shown at the end of the question. Show ALL your workings.

QUESTION ONE

(a) The Aviation Perspectives Agency (APA) recently conducted a market survey to determine the air travel preferences of 170 travellers in a certain country. The air travel preferences were represented by the following airlines; Excellent Airways, Safari Connections and Tumaini Services.

The following results were obtained from the survey:

100 travellers preferred Excellent Airways.
40 travellers preferred Safari Connections.
75 travellers preferred Tumaini Services.
20 travellers preferred Excellent Airways and Safari Connections.
28 travellers preferred Excellent Airways and Tumaini Services.
18 travellers preferred Safari Connections and Tumaini Services.
9 travellers did not record any preference.

Required:

(i) Represent the above information in a Venn diagram. (4 marks)

(ii) Determine the number of travellers who preferred all the three airlines. (3 marks)

(iii) The number of travellers who preferred the Safari Connections and Tumaini Services, but not the Excellent Airways. (1 mark)

(b) The following data presents the quarterly imports of electrical products by a certain electronics company for the given four-year period:

Year	Imports in Sh."Million"			
	Quarter 1	Quarter 2	Quarter 3	Quarter 4
2017	43	71	83	59
2018	50	82	93	75
2019	62	89	101	81
2020	73	95	120	89

Required:

(i) Using 4-quarter moving averages, calculate the seasonal variations from the above data. (8 marks)

(ii) Derive the deseasonalised data for the imports using the additive model. (4 marks)

(Total: 20 marks)

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QUESTION TWO

(a) Explain any four assumptions underlying the game theory. (4 marks)

(b) Zakem Ltd. produces two products namely; "Alkon" and "Zenon". The products pass through three departments namely; Assembly, Finishing and Packaging. There is a maximum of 200 hours in each of the Assembly and Finishing departments.

In addition, a maximum of 400 hours of packaging are available for packing "Alkon" and "Zenon".

The table below shows the number of hours required per unit of each product:

Department	**Hours required per unit of product**	
	"Alkon"	**"Zenon"**
Assembly	2	3
Finishing	4	2
Packaging	5	3

Each unit of "Alkon" and "Zenon" gives a profit contribution of Sh.3,000 and Sh.2,000 respectively.

Required:

(i) Formulate a linear programming model to solve the above problem. (2 marks)

(ii) Using the simplex method, solve the linear programming model formulated in (b) (i) above. (14 marks)

(Total: 20 marks)

QUESTION THREE

(a) The demand function for a certain product is given by:

$P = 0.3Q - 5$

Where:

P is the price in shillings of the product per unit; and
Q is the quantity of the product demanded in units.

The total cost (TC) of the firm (Sh."million") is given by $TC = 1.7Q^2 - 18Q + 15$.

Required:

(i) The break-even point quantity (in units). (2 marks)

(ii) The level of output (in units) that maximises profit. (4 marks)

(b) (i) Explain the difference between "point estimate" and "confidence interval". (4 marks)

(ii) Mali Mali Supermarkets (MMS) operates two branches, one in Kisumu and the other in Mombasa. The management has received complaints that there is a significant difference between the wages paid to employees in the two branches.

A sample of 40 employees was taken from the Kisumu branch and it had a mean wage of Sh.12,000 and a standard deviation of Sh.1,000. A sample of 50 employees taken from the Mombasa branch had a mean wage of Sh.13,000 and a standard deviation of Sh.1,200.

Required:

Advise the management of MMS on whether there is a significant difference between the wages paid in Kisumu branch and Mombasa branch.

(Use a significance level of 5%). (10 marks)

(Total: 20 marks)

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QUESTION FOUR

(a) Explain the difference between "correlation coefficient" and "coefficient of determination" as used in regression analysis. (4 marks)

(b) A group of eight students were tested in "Quantitative Analysis" and "Auditing" examinations. The marks scored were as follows:

	Marks in percentage (%)	
Student	**Quantitative Analysis**	**Auditing**
A	76	82
B	43	57
C	49	75
D	84	86
E	69	68
F	69	92
G	53	43
H	36	53

Required:
Compute the Spearman's rank correlation coefficient and interpret the results. (8 marks)

(c) A medium-sized company manufactures product "Ndovu". The current variable production cost per unit of product "Ndovu" is Sh.800 while the selling price is Sh.1,150 per unit. However, the demand for product "Ndovu" is uncertain and has the following probability distribution:

Number of units of product "Ndovu"	**Probability demanded**
10	0.36
20	0.42
30	0.22

Required:
Advise the company on the optimal number of units of product "Ndovu" to produce using the:

(i) Expected monetary value (EMV) criterion. (4 marks)

(ii) Hurwicz criterion. Assume a coefficient of optimism of 0.8. (4 marks)

(Total: 20 marks)

QUESTION FIVE

(a) Summarise four practical limitations of the "queuing model". (4 marks)

(b) A recent inspection of bolts produced by a certain company revealed that 16 bolts were defective out of a total of 40 bolts inspected.

5 bolts are picked at random and inspected.

Required:

(i) Assuming that the distribution of defective bolts follows the poisson distribution, calculate the probability that at least three bolts are defective. (4 marks)

(ii) Assuming that the distribution of defective bolts follows the binomial distribution, calculate the probability that at most 3 bolts are defective. (4 marks)

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(c) ABC Limited is a construction company. An engineer identified the following activities to complete a project and their estimated expected time in weeks.

Activity	Preceding Activity	Expected estimated time (in weeks)
A	-	5
B	-	7
C	-	3
D	A	7
E	A	6
F	B	8
G	C	10
H	E, F	3
I	E, F	4
J	D, I	2
K	G, H, J	4
L	D, I	7

Required:

(i) Draw a network diagram to represent the above project. (6 marks)

(ii) Obtain the critical path and project duration. (2 marks)

(Total: 20 marks)

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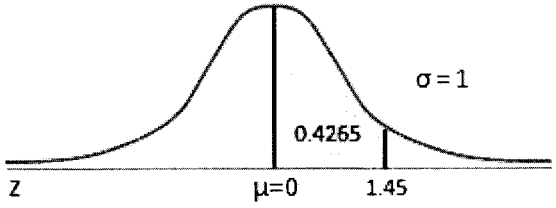
Areas Under the One-Tailed Standard Normal Curve

This table provides the area between the mean and some Z score.
For example, when Z score = 1.45 the area = 0.4265.



Z	0.00	0.01	0.02	0.03	0.04	0.05	0.06	0.07	0.08	0.09
0.0	0.0000	0.0040	0.0080	0.0120	0.0160	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	0.0910	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	0.1480	0.1517
0.4	0.1554	0.1591	0.1628	0.1664	0.1700	0.1736	0.1772	0.1808	0.1844	0.1879
0.5	0.1915	0.1950	0.1985	0.2019	0.2054	0.2088	0.2123	0.2157	0.2190	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	0.2580	0.2611	0.2642	0.2673	0.2704	0.2734	0.2764	0.2794	0.2823	0.2852
0.8	0.2881	0.2910	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	0.3340	0.3365	0.3389
1.0	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	0.3770	0.3790	0.3810	0.3830
1.2	0.3849	0.3869	0.3888	0.3907	0.3925	0.3944	0.3962	0.3980	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	0.4370	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	0.4750	0.4756	0.4761	0.4767
2.0	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	0.4830	0.4834	0.4838	0.4842	0.4846	0.4850	0.4854	0.4857
2.2	0.4861	0.4864	0.4868	0.4871	0.4875	0.4878	0.4881	0.4884	0.4887	0.4890
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	0.4920	0.4922	0.4925	0.4927	0.4929	0.4931	0.4932	0.4934	0.4936
2.5	0.4938	0.4940	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	0.4960	0.4961	0.4962	0.4963	0.4964
2.7	0.4965	0.4966	0.4967	0.4968	0.4969	0.4970	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	0.4980	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	0.4987	0.4987	0.4987	0.4988	0.4988	0.4989	0.4989	0.4989	0.4990	0.4990
3.1	0.4990	0.4991	0.4991	0.4991	0.4992	0.4992	0.4992	0.4992	0.4993	0.4993
3.2	0.4993	0.4993	0.4994	0.4994	0.4994	0.4994	0.4994	0.4995	0.4995	0.4995
3.3	0.4995	0.4995	0.4995	0.4996	0.4996	0.4996	0.4996	0.4996	0.4996	0.4997
3.4	0.4997	0.4997	0.4997	0.4997	0.4997	0.4997	0.4997	0.4997	0.4997	0.4998
3.5	0.4998	0.4998	0.4998	0.4998	0.4998	0.4998	0.4998	0.4998	0.4998	0.4998
3.6	0.4998	0.4998	0.4999	0.4999	0.4999	0.4999	0.4999	0.4999	0.4999	0.4999
3.7	0.4999	0.4999	0.4999	0.4999	0.4999	0.4999	0.4999	0.4999	0.4999	0.4999
3.8	0.4999	0.4999	0.4999	0.4999	0.4999	0.4999	0.4999	0.4999	0.4999	0.4999
3.9	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000

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CPA PART II SECTION 4

CIFA PART II SECTION 4

CCP PART II SECTION 4

QUANTITATIVE ANALYSIS

FRIDAY: 21 May 2021. **Time Allowed: 3 hours.**

Answer ALL questions. Marks allocated to each question are shown at the end of the question. Show ALL your workings.

QUESTION ONE

(a) Differentiate between "correlation analysis" and "regression analysis". (2 marks)

(b) Compu World Limited assembles and sells computers. The company estimates that if it optimally assembles computers, it could sell between 1,100 and 2,000 computers per month and the monthly revenue (in thousands of shillings) over this range of sales could be represented by the function $R = 1{,}000x - 200x^2$.

Where: R is the monthly revenue.

x is the number of computers sold per month (in thousands).

The company estimates that its marginal cost (in thousands of shillings) could be represented by the following function:

$MC = 200x^2 - 200x + 400$

Where: MC is the marginal cost

x is the number of computers assembled.

The fixed cost of the company amounts to Sh.100,000 per month. It is assumed that all the computers assembled in a given month are sold within the same month.

Required:

(i) The total cost function. (2 marks)

(ii) The profit function. (2 marks)

(iii) The optimal monthly output. (3 marks)

(iv) The maximum profit of the company. (2 marks)

(c) The Registrar of Highfliers University has observed that the grade point aggregate of the University's students is normally distributed with a mean of 2.75 and a standard deviation of 0.40.

Required:

(i) The probability that a randomly selected student from the university has a grade point aggregate of between 2.00 and 3.00. (3 marks)

(ii) The lowest grade point aggregate that should be obtained by a student for him/her to be among the top ten per cent of the students. (3 marks)

(iii) Assuming that the university has a total of 10,000 students, determine the number of students having a grade point aggregate of 3.70 or higher. (3 marks)

(Total: 20 marks)

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QUESTION TWO

(a) Highlight two properties of each of the following probability distributions:

(i) Binomial distribution. (2 marks)

(ii) Poisson distribution. (2 marks)

(b) Enumerate two advantages and two disadvantages of the ordinary least squares method of forecasting. (4 marks)

(c) An investor intends to purchase shares in one of three companies, A, B and C. The three companies have varying degrees of sensitivity to the state of the economy. There are three states of the economy classified as weak, moderate or strong. The investor has constructed the following pay off table for the profits under the three states of the economy, in millions of shillings.

	State of the economy		
Company	**Weak**	**Moderate**	**Strong**
A	-4.0	3.5	6.0
B	-2.0	2.5	4.5
C	-2.4	2.8	3.5

The probabilities for the three states of the economy are 0.2, 0.4 and 0.4 for weak, moderate and strong respectively.

Required:
Advise the investor on the best course of action based on the:

(i) Maxmin criterion. (2 marks)

(ii) Maxmax criterion. (2 marks)

(iii) Minimax regret criterion. (3 marks)

(iv) Expected value of perfect information. (5 marks)

(Total: 20 marks)

QUESTION THREE

(a) A baker makes and sells cakes to students through their cafeteria system. The distribution of cakes produced and cakes sold for the last 250 weeks is as follows:

	Number of weeks	
Number of cakes	**Cakes Produced**	**Cakes Sold**
150	20	35
250	50	50
350	80	80
450	80	65
500	20	20

Each cake costs Sh.80 to make and is sold for Sh.120 if sold during the week of production, otherwise it is sold during the second week at Sh.60. If not sold during the second week, the cake's value drops to zero and the baker suffers the total loss of production. Weekly demand is satisfied from the week's production and any demand remaining unsatisfied is satisfied from the stock of the previous week. A stock out costs the baker Sh.20 per cake.

The following random numbers are applicable:

Cakes produced	33,	86,	50,	41,	31,	78,	30,	22,	26,	88
Cakes sold	79,	03,	40,	13,	58,	61,	72,	49,	82,	86

Required:
Simulate the baker's average weekly profit over an 8-week period. (10 marks)

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(b) Kazi na Bidii Ltd. sells four types of products. The resources needed to produce one unit of each product and the sales prices are given as follows:

Cost and resources requirements for Kazi na Bidii Ltd.

Resource	Product 1	Product 2	Product 3	Product 4
Raw materials (units)	2	3	4	7
Labour hours	3	4	5	6
Sales price (Sh.)	4	6	7	8

Additional information:

1. Currently, 4,600 units of raw materials and 5,000 labour hours are available.
2. To meet customers' demand, exactly 950 total units must be produced and at least 400 units of Product 4 must be produced.
3. A computer output of the above linear programming model has been given as follows:

MAX $4x_1 + 6.5x_2 + 7x_3 + 8x_4$

SUBJECT TO:

2) $x_1 + x_2 + x_3 + x_4 = 950$
3) $x_4 >= 400$
4) $2x_1 + 3x_2 + 4x_3 + 7x_4 <= 4600$
5) $3x_1 + 4x_2 + 5x_3 + 6x_4 <= 5000$

END

LP OPTIMUM FOUND AT STEP 4

OBJECTIVE FUNCTION VALUE

1) 6650.0000

VARIABLE	VALUE	REDUCED COST
X_1	.000000	1.000000
X_2	400.000000	.000000
X_3	150.000000	.000000
X_4	400.000000	.000000

ROW	SLACK OR SURPLUS	DUAL PRICES
2)	0.000000	3.000000
3)	0.000000	-2.000000
4)	0.000000	1.000000
5)	250.000000	.000000

NO. ITERATIONS 4

RANGES IN WHICH BASIS IS UNCHANGED

		OBJECTIVE COEFFICIENT RANGES	
VARIABLE	CURRENT COEFF	ALLOWABLE INCREASE	ALLOWABLE DECREASE
X_1	4.000000	1.000000	Infinity
X_2	6.000000	0.66667	.500000
X_3	7.000000	1.000000	.500000
X_4	8.000000	2.000000	Infinity

RIGHT-HAND SIDE RANGES

ROW	CURRENT RHS	ALLOWABLE INCREASE	ALLOWABLE DECREASE
2)	950.000000	50.000000	100.000000
3)	400.000000	37.000000	125.000000
4)	4600.000000	250.000000	150.000000
5)	5000.000000	Infinity	250.000000

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Required:

(i) The optimal solution to the problem. (2 marks)

(ii) The optimal solution if the company raises the price of product 2 by Sh.0.50 per unit. (2 marks)

(iii) The optimal Z-value if a total of 980 units must be produced. (3 marks)

(iv) The optimal Z-values where 4,500 units and 4,400 units of raw materials are available. (3 marks)

(Total: 20 marks)

QUESTION FOUR

(a) Enumerate eight applications of quantitative analysis in business. (8 marks)

(b) The following is a pay-off matrix of a zero sum two person game:

		Player B strategy				
		I	II	III	IV	V
	I	−2	0	0	5	3
Player A strategy	II	4	2	1	3	2
	III	−4	−3	0	−2	6
	IV	5	3	−4	2	−6

Required:

The optimal plan for both players. (5 marks)

(c) A beauty therapist has observed that the mean arrival rate in her beauty parlour is 6 customers per hour and the mean service rate is 8 customers per hour. The beauty parlour operates a 12 hour day.

A more efficient machine for use by the therapist is available for purchase. If the machine is purchased by the therapist, it would increase the average service rate at the parlour to 12 customers per hour. The cost of each hour lost due to a customer waiting for service is Sh.875.

Required:

(i) The average waiting cost per day. (3 marks)

(ii) Evaluate the effect of purchasing the more efficient machine on the average daily waiting cost. (4 marks)

(Total: 20 marks)

QUESTION FIVE

(a) Citing an example in each case, explain the difference between a continuous function and a discrete function. (4 marks)

(b) X Ltd. is considering undertaking a project which requires the following resources:

Activity	**Preceding activity**	**Duration in days**		**Total cost normal Sh.**	**Number of persons per day**
		Normal	**Crash time**		
A	-	7	5	7,500	5
B	-	6	3	6,000	4
C	-	2	2	2,500	6
D	A	5	4	6,000	5
E	B	5	4	7,000	5
F	E	6	2	8,000	6
G	E	7	6	6,000	4
H	C	6	5	7,200	6
I	H	8	5	9,800	9
J	D	4	4	3,500	3
K	J	6	5	3,600	2
L	F	3	2	7,000	12
M	G, I	8	4	9,200	6
N	K, L, M	4	2	7,700	15

The cost of crashing an activity per day is Sh.1,000.

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Required:
Using network analysis, determine:

(i) The project's normal duration, normal cost and critical path. (8 marks)

(ii) The minimum time in which the project could be completed and the cost of the project. (8 marks)

(Total: 20 marks)

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CPA PART II SECTION 4

CIFA PART II SECTION 4

CCP PART II SECTION 4

QUANTITATIVE ANALYSIS

FRIDAY: 25 May 2018. **Time Allowed: 3 hours.**

Answer ALL questions. Marks allocated to each question are shown at the end of the question. Show ALL your workings.

QUESTION ONE

(a) Enumerate four assumptions that are implied in the application of the linear programming model. (4 marks)

(b) The unit price and total cost functions associated with the production and sale of a certain electric component are given by the following equations:

$P = 100 - 5q$

and

$TC = q^2 + 4q + 300$ (in thousands of shillings)

Where:

P is the unit price of the electric component.

q is the number of electric components produced and sold.

TC is the total cost.

Required:

(i) The number of electric components that would maximise profit. (4 marks)

(ii) The maximum profit. (2 marks)

(iii) The maximum total revenue. (2 marks)

(c) A certain firm has three main departments namely; steel, motor vehicles and construction. The three departments are interdependent. Each unit of output from the steel department requires 0.2, 0.3 and 0.4 units from steel, motor vehicles and construction departments respectively. Each unit of output from motor vehicles department requires 0.2, 0.4 and 0.2 units from steel, motor vehicles and construction departments respectively. A unit of output from the construction department requires 0.3, 0.4 and 0.1 units from steel, motor vehicles and construction departments respectively. The final demand of the firm comprises 20 million, 50 million and 30 million units of output from steel, motor vehicles and construction departments respectively.

Required:

(i) The technical coefficient matrix. (1 mark)

(ii) The total output of each department given that the Leontief's inverse matrix is as provided below:

$$\frac{1}{0.192}\begin{pmatrix} 0.46 & 0.24 & 0.26 \\ 0.43 & 0.60 & 0.41 \\ 0.30 & 0.24 & 0.42 \end{pmatrix}$$

(3 marks)

(iii) The change in the total output of the construction department, given that the final demand of steel department decreases by 2 million units and that of motor vehicles department increases by 10 million units whereas that of the construction department does not change. (4 marks)

(Total: 20 marks)

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QUESTION TWO

(a) (i) Distinguish between a "single server queuing model" and a "multiple server queuing model". (2 marks)

(ii) Highlight two assumptions of the queuing theory. (2 marks)

(b) Outline three advantages and three disadvantages of the simulation model as used in quantitative analysis. (6 marks)

(c) Mwanaisha Ali sells tree seedlings at Mavuno market. A random sample of 9 of the seedlings had the following height in centimetres:

64 62 65 63 68 69 65 63 65.

Required:
A 95 per cent confidence interval of the population mean height of the seedlings. (4 marks)

(d) BC Limited operates two factories namely; X_1 and X_2. Both factories deal in the production of a product named "Nguzo". The joint cost function for production of product "Nguzo" is given by:

$$C = f(q_1,q_2) = 2q_1^2 + q_1q_2 + q_2^2 + 500$$

Where:

C = Joint cost function of factories X_1 and X_2
q_1 = Quantity produced by factory X_1
q_2 = Quantity produced by factory X_2

BC Limited has received an order to produce 200 units of product "Nguzo".

Required:
The quantities of product "Nguzo" that should be produced by factories X_1 and X_2 respectively in order to minimise cost. (6 marks)

(Total: 20 marks)

QUESTION THREE

(a) Explain the difference between the following sets of terms as used in hypothesis testing and estimation:

(i) "Type I error" and "type II error". (2 marks)

(ii) "One tailed test" and "two tailed test". (2 marks)

(b) Faida Limited deals in the manufacture and sale of a product named "Big". The company sells the product in two of its distribution outlets, A and B.

The data below relate to a random survey of monthly mean sales of the product in the two outlets:

Outlet	Monthly mean sales (Sh."000")	Standard deviation (Sh."000")	Sample size
A	795	50	200
B	810	70	175

Required:
Test at a 5 per cent level of significance, whether there is a significant difference in the monthly mean sales of the two outlets. (6 marks)

(c) A manufacturing company is considering production of one of the three different types of pens, P_1, P_2 and P_3. The fixed and variable costs of producing the pens are as given below:

Type of pen	Fixed cost (Sh.)	Variable cost (Sh.)
P_1	2,000,000	100
P_2	3,200,000	80
P_3	6,000,000	60

The demand of the pens under three different states of demand is provided below:

State of demand	Number of pens
Low	250,000
Moderate	1,000,000
High	1,500,000

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The unit selling price of the pens is Sh.200.

Required:

(i) The payoff table of the company. (6 marks)

(ii) The type of pen to produce using the maximin criterion. (1 mark)

(iii) The type of pen to produce using the maximax criterion. (1 mark)

(iv) The type of pen to produce using the minimax regret criterion. (2 marks)

(Total: 20 marks)

QUESTION FOUR

(a) Define the following terms as used in game theory:

(i) Mixed strategy. (1 mark)

(ii) Value of the game. (1 mark)

(b) An intelligence test was undertaken by ten salesladies of a certain company.

The table below shows the intelligence test scores in percentages and the mean weekly sales in thousands of shillings made by the salesladies:

Saleslady	1	2	3	4	5	6	7	8	9	10
Intelligence test score (%)	40	70	50	60	80	50	90	40	60	60
Weekly sales (Sh. "000")	50	120	80	100	80	50	110	60	90	60

Required:

The coefficient of correlation. Interpret your result. (8 marks)

(c) A firm manufactures two products, X and Y, subject to constraints on three raw materials, RM1, RM2 and RM3. The objective of the firm is to select a product mix that will maximise weekly profit. Each unit of product X earns a profit of Sh.2 whereas each unit of product Y earns a profit of Sh.1.

Details of the raw materials required for the production of products X and Y are as given below:

Raw material	**Maximum quantity (units)**	**Quantity required per unit of production**	
		Product X	**Product Y**
RM1	27	3	0
RM2	30	0	2
RM3	20	1	1

Required:

(i) A linear programming model of the firm. (4 marks)

(ii) The optimum product mix using the simplex method. (6 marks)

(Total: 20 marks)

QUESTION FIVE

(a) An electricity company has established that the weekly number of occurrences of lightning striking transformers follows a Poisson distribution with a mean of 0.4 per week.

Required:

(i) The probability that no transformer will be struck by lightning in a week. (3 marks)

(ii) The probability that at most two transformers will be struck by lightning in a week. (5 marks)

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(b) The following information relates to a certain construction project:

Activity	Preceding activity	Time estimates (weeks)		
		Most optimistic	Most likely	Most pessimistic
A	-	2	4	12
B	-	10	12	26
C	A	8	9	10
D	A	10	15	20
E	A	7	7.5	11
F	B, C	9	9	9
G	D	3	3.5	7
H	E, F, G	5	5	5

Required:

(i) The network diagram for the project. (8 marks)

(ii) The critical path. (1 mark)

(iii) The probability of completing the project within a 30 - week duration. (3 marks)

(Total: 20 marks)

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t Table

cum. prob	$t_{.50}$	$t_{.75}$	$t_{.80}$	$t_{.85}$	$t_{.90}$	$t_{.95}$	$t_{.975}$	$t_{.99}$	$t_{.995}$	$t_{.999}$	$t_{.9995}$
one-tail	0.50	0.25	0.20	0.15	0.10	0.05	0.025	0.01	0.005	0.001	0.0005
two-tails	1.00	0.50	0.40	0.30	0.20	0.10	0.05	0.02	0.01	0.002	0.001
df											
1	0.000	1.000	1.376	1.963	3.078	6.314	12.71	31.82	63.66	318.31	636.62
2	0.000	0.816	1.061	1.386	1.886	2.920	4.303	6.965	9.925	22.327	31.599
3	0.000	0.765	0.978	1.250	1.638	2.353	3.182	4.541	5.841	10.215	12.924
4	0.000	0.741	0.941	1.190	1.533	2.132	2.776	3.747	4.604	7.173	8.610
5	0.000	0.727	0.920	1.156	1.476	2.015	2.571	3.365	4.032	5.893	6.869
6	0.000	0.718	0.906	1.134	1.440	1.943	2.447	3.143	3.707	5.208	5.959
7	0.000	0.711	0.896	1.119	1.415	1.895	2.365	2.998	3.499	4.785	5.408
8	0.000	0.706	0.889	1.108	1.397	1.860	2.306	2.896	3.355	4.501	5.041
9	0.000	0.703	0.883	1.100	1.383	1.833	2.262	2.821	3.250	4.297	4.781
10	0.000	0.700	0.879	1.093	1.372	1.812	2.228	2.764	3.169	4.144	4.587
11	0.000	0.697	0.876	1.088	1.363	1.796	2.201	2.718	3.106	4.025	4.437
12	0.000	0.695	0.873	1.083	1.356	1.782	2.179	2.681	3.055	3.930	4.318
13	0.000	0.694	0.870	1.079	1.350	1.771	2.160	2.650	3.012	3.852	4.221
14	0.000	0.692	0.868	1.076	1.345	1.761	2.145	2.624	2.977	3.787	4.140
15	0.000	0.691	0.866	1.074	1.341	1.753	2.131	2.602	2.947	3.733	4.073
16	0.000	0.690	0.865	1.071	1.337	1.746	2.120	2.583	2.921	3.686	4.015
17	0.000	0.689	0.863	1.069	1.333	1.740	2.110	2.567	2.898	3.646	3.965
18	0.000	0.688	0.862	1.067	1.330	1.734	2.101	2.552	2.878	3.610	3.922
19	0.000	0.688	0.861	1.066	1.328	1.729	2.093	2.539	2.861	3.579	3.883
20	0.000	0.687	0.860	1.064	1.325	1.725	2.086	2.528	2.845	3.552	3.850
21	0.000	0.686	0.859	1.063	1.323	1.721	2.080	2.518	2.831	3.527	3.819
22	0.000	0.686	0.858	1.061	1.321	1.717	2.074	2.508	2.819	3.505	3.792
23	0.000	0.685	0.858	1.060	1.319	1.714	2.069	2.500	2.807	3.485	3.768
24	0.000	0.685	0.857	1.059	1.318	1.711	2.064	2.492	2.797	3.467	3.745
25	0.000	0.684	0.856	1.058	1.316	1.708	2.060	2.485	2.787	3.450	3.725
26	0.000	0.684	0.856	1.058	1.315	1.706	2.056	2.479	2.779	3.435	3.707
27	0.000	0.684	0.855	1.057	1.314	1.703	2.052	2.473	2.771	3.421	3.690
28	0.000	0.683	0.855	1.056	1.313	1.701	2.048	2.467	2.763	3.408	3.674
29	0.000	0.683	0.854	1.055	1.311	1.699	2.045	2.462	2.756	3.396	3.659
30	0.000	0.683	0.854	1.055	1.310	1.697	2.042	2.457	2.750	3.385	3.646
40	0.000	0.681	0.851	1.050	1.303	1.684	2.021	2.423	2.704	3.307	3.551
60	0.000	0.679	0.848	1.045	1.296	1.671	2.000	2.390	2.660	3.232	3.460
80	0.000	0.678	0.846	1.043	1.292	1.664	1.990	2.374	2.639	3.195	3.416
100	0.000	0.677	0.845	1.042	1.290	1.660	1.984	2.364	2.626	3.174	3.390
1000	0.000	0.675	0.842	1.037	1.282	1.646	1.962	2.330	2.581	3.098	3.300
z	0.000	0.674	0.842	1.036	1.282	1.645	1.960	2.326	2.576	3.090	3.291
	0%	50%	60%	70%	80%	90%	95%	98%	99%	99.8%	99.9%
	Confidence Level										

t-table.xls 7/14/2007

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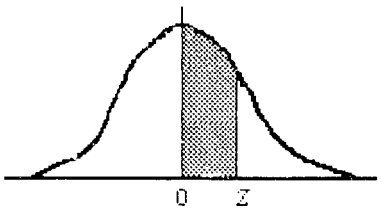
NORMAL CURVE

AREAS
under the
STANDARD
NORMAL CURVE
from 0 to z



z	0	1	2	3	4	5	6	7	8	9
0.0	.0000	.0040	.0080	.0120	.0160	.0199	.0239	.0279	.0319	.0359
0.1	.0398	.0438	.0478	.0517	.0557	.0596	.0636	.0675	.0714	.0754
0.2	.0793	.0832	.0871	.0910	.0948	.0987	.1026	.1064	.1103	.1141
0.3	.1179	.1217	.1255	.1293	.1331	.1368	.1406	.1443	.1480	.1517
0.4	.1554	.1591	.1628	.1664	.1700	.1736	.1772	.1808	.1844	.1879
0.5	.1915	.1950	.1985	.201	.2051	.2088	.2123	.2157	.2190	.2224
0.6	.2258	.2291	.2324	.2357	.2389	.2422	.2454	.2486	.2518	.2549
0.7	.2580	.2612	.2642	.2673	.2704	.2734	.2764	.2794	.2823	.2852
0.8	.2881	.2910	.2939	.2967	.2996	.3023	.3051	.3078	.3106	3133
0.9	.3159	.3186	.3212	.3238	.3264	.3289	.3315	.3340	.3365	.3389
1.0	.3413	.3438	.3461	.3485	.3508	.3531	.3554	.3577	.3599	.3621
1.1	.3643	.3665	.3686	.3708	.3729	.3749	.3770	.3790	.3810	.3830
1.2	.3849	.3869	.3888	.3907	.3925	.3944	.3962	.3980	.3997	.4015
1.3	.4032	.4049	.4066	.4082	.4099	.4115	.4131	.4147	.4162	.4177
1.4	.4192	.4207	.4222	.4236	.4251	.4265	.4279	.4292	.4306	.4319
1.5	.4332	.4345	.4357	.4370	.4382	.4394	.4406	.4418	.4429	.4441
1.6	.4452	.4463	.4474	.4484	.4495	.4505	.4515	.4525	.4535	.4545
1.7	.4554	.4564	.4573	.4582	.4591	.4599	.4608	.4616	.4625	.4633
1.8	.4641	.4649	.4656	.4664	.4671	.4678	.4686	.4693	.4699	.4706
1.9	.4713	.4719	.4726	.4732	.4738	.4744	.4750	.4756	.4761	.4767
2.0	.4772	.4778	.4783	.4788	.4793	.4798	.4803	.4808	.4812	.4817
2.1	.4821	.4826	.4830	.4834	.4838	.4842	.4846	.4850	.4854	.4857
2.2	.4861	.4864	.4868	.4871	.4875	.4878	.4881	.4884	.4887	.4890
2.3	.4893	.4896	.4898	.4901	.4904	.4906	.4909	.4911	.4913	.4916
2.4	.4918	.4920	.4922	.4925	.4927	.4929	.4931	.4932	.4934	.4936
2.5	.4938	.4940	.4941	.4943	.4945	.4946	.4948	.4949	.4951	.4952
2.6	.4953	.4955	.4956	.4957	.4959	.4960	.4961	.4962	.4963	.4964
2.7	.4965	.4966	.4967	.4968	.4969	.4970	.4971	.4972	.4973	.4974
2.8	.4974	.4975	.4976	.4977	.4977	.4978	.4979	.4979	.4980	.4981
2.9	.4981	.4982	.4982	.4983	.4984	.4984	.4985	.4985	.4986	.4986
3.0	.4987	.4987	.4987	.4988	.4988	.4989	.4989	.4989	.4990	.4990
3.1	.4990	.4991	.4991	.4991	.4992	.4992	.4992	.4992	.4993	.4993
3.2	.4993	.4993	.4994	.4994	.4994	.4994	.4994	.4995	.4995	.4995
3.3	.4995	.4995	.4995	.4996	.4996	.4996	.4996	.4996	.4996	.4997
3.4	.4997	.4997	.4997	.4997	.4997	.4997	.4997	.4997	.4997	.4998
3.5	.4998	.4998	.4998	.4998	.4998	.4998	.4998	.4998	.4998	.4998
3.6	.4998	.4998	.4999	.4999	.4999	.4999	.4999	.4999	.4999	.4999
3.7	.4999	.4999	.4999	.4999	.4999	.4999	.4999	.4999	.4999	.4999
3.8	.4999	.4999	.4999	.4999	.4999	.4999	.4999	.4999	.4999	.4999
3.9	.5000	.5000	.5000	.5000	.5000	.5000	.5000	.5000	.5000	.5000

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CPA PART II SECTION 4

CIFA PART II SECTION 4

CCP PART II SECTION 4

QUANTITATIVE ANALYSIS

FRIDAY: 1 December 2017. **Time Allowed: 3 hours.**

Answer ALL questions. Marks allocated to each question are shown at the end of the question. Show ALL your workings.

QUESTION ONE

(a) Outline four applications of mathematical functions in business. (4 marks)

(b) Highlight the four components of a time series. (4 marks)

(c) A survey was conducted on 800 households to determine their preference for three consumer goods, namely Fex, Gex and Mex. The results of the survey were as follows:

230 households preferred Fex.
245 households preferred Gex.
325 households preferred Mex.
30 households preferred all the three goods.
70 households preferred Fex and Mex.
110 households preferred Fex only
185 households preferred Mex only.

Required:

(i) Present the above information in a venn diagram. (4 marks)

(ii) The number of households that preferred Fex and Gex. (1 mark)

(iii) The probability that a household selected at random does not prefer any of the three goods. (1 mark)

(d) Soda Baridi Limited has a computerised customer billing system. Customers' accounts are classified as being paid, delinquent or bad debt. The company has a total of 1,500,000 customer accounts. A computer program was developed to display transition of accounts among the three categories. The output from the program is summarised below:

		To		
		Paid	**Delinquent**	**Bad debt**
	Paid	285,000	15,000	0
From	**Delinquent**	20,000	700,000	30,000
	Bad debt	0	0	450,000

The above transitions took place between 31 December 2015 and 31 December 2016.

Required:

The percentage of customers that will be in each of the three categories of accounts as at 31 December 2017. (6 marks)

(Total: 20 marks)

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QUESTION TWO

(a) Enumerate three circumstances under which the Poisson distribution is most applicable. (3 marks)

(b) A company produces two types of electric components whose information has been provided to you as follows:

	Component X	Component Y
Mean life in hours	1,600	1,528
Standard deviation in hours	132	149
Sample size	120	110

Required:
Determine whether the quality of the two types of electric components differ significantly. (Use a significance level of 95%). (3 marks)

(c) A survey conducted on citizens of a certain country to determine the annual per capita income indicated that the annual income of the citizens is normally distributed with a mean of Sh.980,000 and a standard deviation of Sh.160,000. One citizen was randomly selected from the country.

Required:
The probability that the annual income of the citizen:

(i) Is greater than Sh.500,000. (2 marks)

(ii) Is greater than Sh.1,220,000. (2 marks)

(iii) Lies between Sh.852,000 and Sh.1,100,000. (2 marks)

(d) Excellent Products Limited manufactures four products, A, B, C and D, using four machines, M_1, M_2, M_3 and M_4. The total outputs of the four products from the four machines are as shown below:

		Output (units "000")			
		A	B	C	D
Machines	M_1	12	12	6	13
	M_2	18	20	22	20
	M_3	16	15	12	18
	M_4	14	12	16	12

The company intends to assign the production of each output to a particular machine.

Required:
Advise the management of Excellent Products Limited on the best assignment that will maximise production. (4 marks)

(e) The demand and total cost functions (in thousands of shillings) of a certain company that deals in the manufacture of a product name "Exe" are given as follows:

$$P = 75 - 0.18Q$$

and

$$TC = 80Q + 5Q^2 - 0.03Q^3$$

Where: P is the unit selling price.
Q is the quantity demanded in units.
TC is the total cost.

Required:

(i) The profit function. (1 mark).

(ii) The output level that would maximise profit. (3 marks)

(Total: 20 marks)

QUESTION THREE

(a) Distinguish between "regression analysis" and "correlation analysis". (2 marks)

(b) Summarise two applications of rank correlation. (2 marks)

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(c) The following exponential function represents the advertising cost of a certain small enterprise:

$$y = ab^x$$

Where: y is the advertising cost in thousands of shillings
a, b are constants over a period of seven years.
x is the period under consideration.

The actual advertising cost of the enterprise over a seven year period is given as follows:

Year	1	2	3	4	5	6	7
Advertising cost (Sh. "000")	32	47	65	92	132	190	275

Required:

(i) The advertising cost function of the enterprise, using the normal equation. (7 marks)

(ii) The advertising cost of the enterprise in year 8. (1 mark)

(d) The management of New Era Computer Systems Limited is planning to launch a new product branded Zimsang. The fixed cost of Zimsang is Sh.80,000. However, the selling price, variable costs and annual sales volume of Zimsang are uncertain. The data below relate to product Zimsang:

Unit selling price (Sh.)	**Probability**	**Variable cost (Sh.)**	**Probability**	**Sales volume (units)**	**Probability**
60	0.25	20	0.25	40,000	0.30
80	0.45	40	0.55	60,000	0.35
100	0.30	60	0.20	100,000	0.35

Required:

Simulate the average profit of product Zimsang on the basis of 10 trials. Use the following random numbers:

81 32 60 04 46 31 67 25 24 10 40 02 39

68 08 59 66 90 12 64 79 31 86 68 82 89

25 11 98 16

(8 marks)
(Total: 20 marks)

QUESTION FOUR

(a) In a certain busy business facility, the mean arrival rate of clients is 800 clients per hour. The mean service rate is 820 clients per hour. The facility operates between 6.00 a.m. and 6.00 p.m. every day. The management of the facility are concerned about the average number of customers in the queuing system and wish to improve the facility in order to serve an average of 847 clients per hour. The cost of improving the facility amounts to Sh.18,500 per day. Each hour lost costs the facility Sh.125.

Required:

(i) The average waiting cost per day. (4 marks)

(ii) Advise the management on whether they should improve the facility. (4 marks)

(iii) Compare the probabilities that the total number of clients in the queue and those being served is greater than 17 in the existing and in the improved facilities. (4 marks)

(b) Two airlines, K and Q are interested in increasing their market shares. Airline K has three available strategies, advertising its special fare, advertising its unique features or advertising its safety record. On the other hand, Airline Q also has three available strategies; do nothing, advertise its special fare or advertise its special features.

The matrix below shows the gains and losses associated with the different available strategies in millions of shillings. Positive values favour Airline K and negative values favour Airline Q.

		Airline Q		
		Q_1	**Q_2**	**Q_3**
Airline K	**K_1**	– 30	0	– 90
	K_2	– 40	– 15	– 20
	K_3	80	20	– 50

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Where:

K_1 = Advertise special fare.
K_2 = Advertise unique features.
K_3 = Advertise safety record.
Q_1 = Do nothing.
Q_2 = Advertise special fare.
Q_3 = Advertise special features.

Required:

(i) The optimal strategies for each airline. (7 marks)

(ii) The value of the game. (1 mark)

(Total: 20 marks)

QUESTION FIVE

(a) Explain the following terms as used in game theory:

(i) Saddle point. (1 mark)

(ii) Dominance. (1 mark)

(b) Suggest two areas in which advanced information technology could be used to solve quantitative analysis problems. (2 marks)

(c) The data below relate to normal duration and cost along with crash duration and cost for each activity of a certain project.

Activity	Normal duration (Days)	Crash duration (Days)	Normal cost (Sh.)	Crash cost (Sh.)
1 – 2	6	4	2,800,000	3,800,000
1 – 3	8	5	4,000,000	5,600,000
2 – 3	4	2	2,200,000	3,000,000
2 – 4	3	2	1,600,000	2,800,000
3 – 4	Dummy	-	-	-
3 – 5	6	3	1,800,000	3,200,000
4 – 6	10	6	5,000,000	7,000,000
5 – 6	3	2	1,000,000	1,600,000

The indirect cost of the project is Sh.600.000 per day.

Required:

(i) The normal duration and the corresponding total cost. (6 marks)

(ii) The minimum duration and the corresponding total cost. (8 marks)

(iii) The optimum duration and the corresponding total cost. (2 marks)

(Total: 20 marks)

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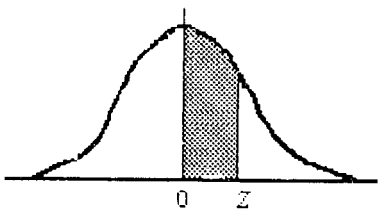
NORMAL CURVE

AREAS
under the
STANDARD
NORMAL CURVE
from 0 to z



z	0	1	2	3	4	5	6	7	8	9
0.0	.0000	.0040	.0080	.0120	.0160	.0199	.0239	.0279	.0319	.0359
0.1	.0398	.0438	.0478	.0517	.0557	.0596	.0636	.0675	.0714	.0754
0.2	.0793	.0832	.0871	.0910	.0948	.0987	.1026	.1064	.1103	.1141
0.3	.1179	.1217	.1255	.1293	.1331	.1368	.1406	.1443	.1480	.1517
0.4	.1554	.1591	.1628	.1664	.1700	.1736	.1772	.1808	.1844	.1879
0.5	.1915	.1950	.1985	.201.	.2051	.2088	.2123	.2157	.2190	.2224
0.6	.2258	.2291	.2324	.2357	.2389	.2422	.2454	.2486	.2518	.2549
0.7	.2580	.2612	.2642	.2673	.2704	.2734	.2764	.2794	.2823	.2852
0.8	.2881	.2910	.2939	.2967	.2996	.3023	.3051	.3078	.3106	3133
0.9	.3159	.3186	.3212	.3238	.3264	.3289	.3315	.3340	.3365	.3389
1.0	.3413	.3438	.3461	.3485	.3508	.3531	.3554	.3577	.3599	.3621
1.1	.3643	.3665	.3686	.3708	.3729	.3749	.3770	.3790	.3810	.3830
1.2	.3849	.3869	.3888	.3907	.3925	.3944	.3962	.3980	.3997	.4015
1.3	.4032	.4049	.4066	.4082	.4099	.4115	.4131	.4147	.4162	.4177
1.4	.4192	.4207	.4222	.4236	.4251	.4265	.4279	.4292	.4306	.4319
1.5	.4332	.4345	.4357	.4370	.4382	.4394	.4406	.4418	.4429	.4441
1.6	.4452	.4463	.4474	.4484	.4495	.4505	.4515	.4525	.4535	.4545
1.7	.4554	.4564	.4573	.4582	.4591	.4599	.4608	.4616	.4625	.4633
1.8	.4641	.4649	.4656	.4664	.4671	.4678	.4686	.4693	.4699	.4706
1.9	.4713	.4719	.4726	.4732	.4738	.4744	.4750	.4756	.4761	.4767
2.0	.4772	.4778	.4783	.4788	.4793	.4798	.4803	.4808	.4812	.4817
2.1	.4821	.4826	.4830	.4834	.4838	.4842	.4846	.4850	.4854	.4857
2.2	.4861	.4864	.4868	.4871	.4875	.4878	.4881	.4884	.4887	.4890
2.3	.4893	.4896	.4898	.4901	.4904	.4906	.4909	.4911	.4913	.4916
2.4	.4918	.4920	.4922	.4925	.4927	.4929	.4931	.4932	.4934	.4936
2.5	.4938	.4940	.4941	.4943	.4945	.4946	.4948	.4949	.4951	.4952
2.6	.4953	.4955	.4956	.4957	.4959	.4960	.4961	.4962	.4963	.4964
2.7	.4965	.4966	.4967	.4968	.4969	.4970	.4971	.4972	.4973	.4974
2.8	.4974	.4975	.4976	.4977	.4977	.4978	.4979	.4979	.4980	.4981
2.9	.4981	.4982	.4982	.4983	.4984	.4984	.4985	.4985	.4986	.4986
3.0	.4987	.4987	.4987	.4988	.4988	.4989	.4989	.4989	.4990	.4990
3.1	.4990	.4991	.4991	.4991	.4992	.4992	.4992	.4992	.4993	.4993
3.2	.4993	.4993	.4994	.4994	.4994	.4994	.4994	.4995	.4995	.4995
3.3	.4995	.4995	.4995	.4996	.4996	.4996	.4996	.4996	.4996	.4997
3.4	.4997	.4997	.4997	.4997	.4997	.4997	.4997	.4997	.4997	.4998
3.5	.4998	.4998	.4998	.4998	.4998	.4998	.4998	.4998	.4998	.4998
3.6	.4998	.4998	.4999	.4999	.4999	.4999	.4999	.4999	.4999	.4999
3.7	.4999	.4999	.4999	.4999	.4999	.4999	.4999	.4999	.4999	.4999
3.8	.4999	.4999	.4999	.4999	.4999	.4999	.4999	.4999	.4999	.4999
3.9	.5000	.5000	.5000	.5000	.5000	.5000	.5000	.5000	.5000	.5000

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CPA PART II SECTION 4

CIFA PART II SECTION 4

CCP PART II SECTION 4

QUANTITATIVE ANALYSIS

FRIDAY: 26 May 2017. **Time Allowed: 3 hours.**

Answer ALL questions. Marks allocated to each question are shown at the end of the question. Show ALL your workings.

QUESTION ONE

(a) Describe four types of sets as used in set theory. (4 marks)

(b) Explain the following terms as used in Markov analysis:

(i) Transition probability. (1 mark)

(ii) Absorbing state. (1 mark)

(c) The average revenue and marginal cost functions of a certain company are given by:

$$AR = 650 - 15x$$

and

$$MC = 9x^2 - 14x + 180$$

Where: AR is the average revenue (in Sh. million).

MC is the marginal cost (in Sh. million).

x is the level of output (in units).

The fixed cost of production is Sh. 25 million.

Required:

(i) The profit function. (3 marks)

(ii) The level of output that would maximise profit. (3 marks)

(d) Market Intelligence Research Limited carried out a study on nine households to determine the monthly income levels and the amount of expenditure incurred by the households.

The results of the study are as shown below:

Monthly Income (Sh. "000")	15	6	9	3	20	11	14	10	12
Expenditure (Sh.)	2,000	200	500	500	2,500	800	1,500	1,500	1,600

Required:

(i) The least squares regression function relating the monthly income and expenditure incurred by the households. Interpret your results. (7 marks)

(ii) The expenditure incurred by a household whose monthly income is Sh.30,000. (1 mark)

(Total: 20 marks)

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QUESTION TWO

(a) Highlight four properties of a binomial experiment. (4 marks)

(b) Viwanda Limited is a company that operates in the printing industry. The company has a total of 30 machines that operate a 24 hour cycle. The probability of a machine breaking down on any given day is 0.015.

Required:

(i) The probability that exactly four machines break down in a given day, using poisson distribution. (3 marks)

(ii) The probability that exactly four machines break down in a given day, using binomial distribution.(2 marks)

(iii) Comment on the results obtained in (b)(i) and (b)(ii) above. (2 marks)

(c) ABC Limited has recently developed a new product named "Exe". The demand for "Exe" is expected to be low, medium or high with probabilities of 0.25, 0.45 and 0.30 respectively.

The product is to be manufactured at small or large scale production with the following annual profit estimates:

		Small scale production		Large scale production	
		Profit (Sh. million)	**Probability**	**Profit (Sh. million)**	**Probability**
Demand	**Low**	40	0.25	5	0.25
	Medium	140	0.45	90	0.45
	High	180	0.30	280	0.30

Required:

Advise ABC Limited on the best course of action based on the following approaches:

(i) Expected profit. (3 marks)

(ii) Minimising risk. (6 marks)

(Total: 20 marks)

QUESTION THREE

(a) Mwangaza Limited deals in the production of electric bulbs. A random sample of 10 electric bulbs produced by the company yielded the following results on the lifetime of the bulbs:

Lifetime (hours)	4,400	4,800	3,700	3,900	5,500	4,000	3,700	4,100	4,000	5,400

The hypothetical population mean of the lifetime of the electric bulbs is given as 4,000 hours.

Required:

Test at a 5 per cent level of significance, whether there is a significant difference between the sample mean and the population mean. (8 marks)

(b) Green Furniture Limited manufactures two models of plastic chairs, C_1 and C_2 from plastic waste, using two automated machines, X and Y. The following information relates to the production of the two models of chairs for the coming year:

		C_1	C_2
Maximum sales (units)		8,000	12,000
Selling price (Sh.)		1,000	900
Machine time (hours):	X	0.5	0.3
	Y	0.4	0.45

The maximum operating hours of machines X and Y are 3,400 and 3,840 respectively. The maximum quantity of plastic waste available is 34,000 kilogrammes and each chair requires 4 kilogrammes of plastic waste. The company purchases plastic waste at Sh.50 per kilogramme. Variable machine overheads are estimated to be Sh.250 and Sh.300 per machine hour for machines X and Y respectively. All chairs produced are expected to be sold during the period. A computer generated print out of the linear programming model is as given below:

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Objective function value 4,441,250.

Variable	Value	Reduced values	Objective coefficient	All increase	All decrease
C_1	4,250	0	555	261.70	65.00
C_2	4,250	0	490	65.00	157.00

Constraints	Value	Shadow Price	Right hand side constraint	Allowable increase	Allowable decrease
Plastic waste	34,000	98.125	34,000	1,733.33	6,800
Machine X	3,400	325.000	3,400	850.00	850
Machine Y	3,612.5	0	3,800	-	227.5

Required:

(i) Formulate the mathematical model for the linear programming problem. (4 marks)

(ii) The maximum contribution of C_1 and C_2. (2 marks)

(iii) Explain the effect on contribution of the availability of additional plastic waste and machine time. (2 marks)

(iv) Explain the sensitivity of the model to changes in contribution per unit of C_1 and C_2. (2 marks)

(v) The increase in contribution of Green Furniture Limited assuming that the management overcomes the plastic waste constraint. (2 marks)

(Total: 20 marks)

QUESTION FOUR

(a) Outline five assumptions of game theory. (5 marks)

(b) The table below shows marks scored by 8 students in Mathematics and English subjects:

Student:	1	2	3	4	5	6	7	8
Marks scored in Mathematics:	31	36	44	28	56	76	36	96
Marks scored in English:	56	46	66	46	36	26	46	76

Required:

The rank coefficient of correlation. Interpret your result. (5 marks)

(c) Pure Grain Society is considering the planting of wheat on a piece of land it recently acquired.

The data below relate to the estimated selling prices, yield and cost of planting the wheat:

Selling price per tonne (Sh."000")	Probability	Yield per acre (tonne)	Probability	Cost per acre (Sh."000")	Probability
240	0.18	70	0.09	12,000	0.14
250	0.29	75	0.16	14,000	0.22
260	0.31	80	0.24	16,000	0.36
270	0.14	85	0.38	18,000	0.26
280	0.08	90	0.13	20,000	0.02

You are provided with the following random numbers:

03 91 38 55 17 46 32 43 69 72 24 22 61 96 30 32

Required:

Using eight trials, simulate the average profit of Pure Grain Society. (10 marks)

(Total: 20 marks)

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QUESTION FIVE

(a) Enumerate five characteristics of a simple queuing system. (5 marks)

(b) Two companies, A and B, are competing for business whereby one company's gain is the other company's loss. The pay-off matrix is given as follows:

		Company B's strategies		
		B_1	B_2	B_3
Company A's strategies	A_1	7	4	1
	A_2	4	2	0
	A_3	3	-1	-2
	A_4	1	5	-3

Required:
The optimal strategy for each company. (4 marks)

(c) Ujenzi Limited has been awarded a contract to build an office block. The tasks of the building project have been analysed as follows:

Activity	Preceding activity	Duration (months)	Total cost (Sh. million)
A	-	8	100
B	-	2	75
C	A	3	135
D	A	7	70
E	B	5	160
F	C, D	9	255
G	D	2	30
H	D, E	4	90
I	G, H	3	55

The overhead costs of the project amount to Sh.5 million per month.

Required:

(i) A network diagram for the project. (5 marks)

(ii) The minimum cost of the project. (2 marks)

(iii) Ujenzi Limited has been offered a bonus of Sh.25 million if they complete the project within a period of 20 months or less. The table below shows activities that would require to be crashed and their respective total costs:

Activity	Duration (months)	Total cost (Sh. million)
A	6	125
B	1	90
D	5	85
E	3	200
F	7	275
H	2	95

Determine whether or not Ujenzi Limited should accept the bonus offer. (4 marks)
(Total: 20 marks)

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t Table

cum. prob	$t_{.50}$	$t_{.75}$	$t_{.80}$	$t_{.85}$	$t_{.90}$	$t_{.95}$	$t_{.975}$	$t_{.99}$	$t_{.995}$	$t_{.999}$	$t_{.9995}$
one-tail	0.50	0.25	0.20	0.15	0.10	0.05	0.025	0.01	0.005	0.001	0.0005
two-tails	1.00	0.50	0.40	0.30	0.20	0.10	0.05	0.02	0.01	0.002	0.001
df											
1	0.000	1.000	1.376	1.963	3.078	6.314	12.71	31.82	63.66	318.31	636.62
2	0.000	0.816	1.061	1.386	1.886	2.920	4.303	6.965	9.925	22.327	31.599
3	0.000	0.765	0.978	1.250	1.638	2.353	3.182	4.541	5.841	10.215	12.924
4	0.000	0.741	0.941	1.190	1.533	2.132	2.776	3.747	4.604	7.173	8.610
5	0.000	0.727	0.920	1.156	1.476	2.015	2.571	3.365	4.032	5.893	6.869
6	0.000	0.718	0.906	1.134	1.440	1.943	2.447	3.143	3.707	5.208	5.959
7	0.000	0.711	0.896	1.119	1.415	1.895	2.365	2.998	3.499	4.785	5.408
8	0.000	0.706	0.889	1.108	1.397	1.860	2.306	2.896	3.355	4.501	5.041
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18	0.000	0.688	0.862	1.067	1.330	1.734	2.101	2.552	2.878	3.610	3.922
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26	0.000	0.684	0.856	1.058	1.315	1.706	2.056	2.479	2.779	3.435	3.707
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28	0.000	0.683	0.855	1.056	1.313	1.701	2.048	2.467	2.763	3.408	3.674
29	0.000	0.683	0.854	1.055	1.311	1.699	2.045	2.462	2.756	3.396	3.659
30	0.000	0.683	0.854	1.055	1.310	1.697	2.042	2.457	2.750	3.385	3.646
40	0.000	0.681	0.851	1.050	1.303	1.684	2.021	2.423	2.704	3.307	3.551
60	0.000	0.679	0.848	1.045	1.296	1.671	2.000	2.390	2.660	3.232	3.460
80	0.000	0.678	0.846	1.043	1.292	1.664	1.990	2.374	2.639	3.195	3.416
100	0.000	0.677	0.845	1.042	1.290	1.660	1.984	2.364	2.626	3.174	3.390
1000	0.000	0.675	0.842	1.037	1.282	1.646	1.962	2.330	2.581	3.098	3.300
z	0.000	0.674	0.842	1.036	1.282	1.645	1.960	2.326	2.576	3.090	3.291
	0%	50%	60%	70%	80%	90%	95%	98%	99%	99.8%	99.9%
	Confidence Level										

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KASNEB

CPA PART II SECTION 4

CIFA PART II SECTION 4

CCP PART II SECTION 4

QUANTITATIVE ANALYSIS

FRIDAY: 25 November 2016. **Time Allowed: 3 hours.**

Answer ALL questions. Marks allocated to each question are shown at the end of the question. Show ALL your workings.

QUESTION ONE

(a) Explain the following terms as used in linear programming:

(i) Infeasibility. (1 mark)

(ii) Unboundedness. (1 mark)

(iii) Alternate optimality. (1 mark)

(b) The following information relates to product "X" which is susceptible to three types of defects; A, B and C. The probability of product "X" containing defect C depends on whether the product contains any other defects, A or B. The probabilities of the product containing the defects are as follows:

Type of defect	**Probability**
A	0.15
B	0.14
C (if it neither contains defect A nor defect B)	0.3
C (if it contains either defect A or defect B)	0.2
C (if it contains both defects A and B)	0.1

Required:

(i) The probability that product "X" contains no defect. (5 marks)

(ii) The probability that product "X" contains only one of the three defects. (4 marks)

(c) The data below show the number of students enrolled in six colleges for a certain course, before and after the course was advertised in a certain publication:

College	**Number of students before advertisement**	**Number of students after advertisement**
1	165	170
2	140	141
3	143	142
4	160	167
5	162	168
6	154	157

Required:

Using the paired t-test, determine whether the advertisement was a success at a 5 per cent level of significance.

(8 marks)

(Total: 20 marks)

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QUESTION TWO

(a) Highlight four applications of Markov analysis in business. (4 marks)

(b) Faidika College offers three courses, namely; Accounting, Information Technology and Statistics. The marketing department of the college conducted a survey on 500 students to determine the number of students enrolled for each of the three courses. The results of the survey were as follows:

- 329 students were enrolled for Accounting.
- 186 students were enrolled for Information Technology.
- 295 students were enrolled for Statistics.
- 83 students were enrolled for Accounting and Information Technology.
- 217 students were enrolled for Accounting and Statistics.
- 63 students were enrolled for Statistics and Information Technology.

Required:

(i) Illustrate the above information in a venn diagram. (4 marks)

(ii) The probability that a student is enrolled for all the three courses. (1 mark)

(iii) The probability that a student is enrolled for Accounting or Statistics but is not enrolled for Information Technology. (1 mark)

(c) The following data show results of a regression run on the variations in labour cost as a function of labour hours worked in a certain company:

Regression statistics

R-squared	X_1
Multiple R	X_2
Standard error	0.7320
Observations	24

ANOVA	**Degrees of freedom (DF)**	**Sum of squares (SS)**	**Mean square (MS)**	**F-ratio**	**Significance F**
Regression	X_3	0.029	0.029	X_5	0
Residual or error	22	X_4	0.000455		
Total	23	0.04			

	Coefficients	**Standard error**	**t-statistic**	**P-value**
Intercept	0.077	X_6	11.328	0
Slope	0.826	0.103	X_7	0

Required:

(i) The missing values of X_1, X_2, X_3, X_4, X_5, X_6 and X_7. (7 marks)

(ii) A 95 per cent confidence level of the labour hours worked. (3 marks)

(Total: 20 marks)

QUESTION THREE

(a) TOC Limited, an oil prospecting company, intends to set up two oil refineries, refinery I and refinery II.

The following information relates to TOC Limited:

1. The company will produce two types of fuel; diesel and petrol, in each of the two refineries.
2. Three types of resources namely; crude oil, furnace time and mixer will be required to produce each litre of fuel.

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3. The resource requirements for each of the two refineries is as follows:

Fuel per litre	Crude oil (litres)	Furnace time (hours)	Mixer (litres)
Diesel (Refinery I)	3	2	8
Petrol (Refinery I)	1	1	6
Diesel (Refinery II)	3	1	7
Petrol (Refinery II)	2	1	5

4. The daily amount of crude oil available at the two refineries are 12,000 litres and 15,000 litres for refinery I and refinery II respectively.
5. The hours of furnace time available at the two refineries are 10 hours and 4 hours for refinery I and refinery II respectively.
6. The total amount of mixer available for use at the two refineries is 80,000 litres per day.
7. The fuel is expected to be sold at Sh.170 per litre of diesel and Sh.160 per litre of petrol.
8. All fuel produced is expected to be sold to a sole distributor. It will cost Sh.80 to transport each litre of fuel from refinery I and Sh.100 from refinery II to the sole distributor.
9. Assume that crude oil cannot be transported from one refinery to another.

Required:
Formulate a linear programming model to maximise TOC Limited's revenue, assuming that only transport cost is variable. (7 marks)

(b) The following data show quarterly production of oranges by a certain large scale farmer in thousands of kilogrammes:

Year	Quarter 1	Quarter 2	Quarter 3	Quarter 4
2012	250	200	180	300
2013	330	280	260	380
2014	410	370	340	460
2015	478	-	-	-

Required:
(i) The adjusted seasonal component for the four quarters using the additive model. (8 marks)

(ii) The deseasonalised production data for each quarter. (4 marks)

(iii) Explain the significance of the deseasonalised data. (1 mark)

(Total: 20 marks)

QUESTION FOUR

(a) Enumerate four limitations of linear programming models. (4 marks)

(b) Summarise four decision criteria used in decision making under uncertainty. (4 marks)

(c) An electronics company sells programmable calculators at a unit price of Sh.100. Studies indicate that the company can sell additional 100 calculators per year for Sh.5 decrease in unit price and 100 calculators per year less for Sh.5 increase in unit price. The company currently sells 3,000 calculators per year. The cost function of the company is assumed to be linear with a fixed cost of Sh.10,000 and variable cost of Sh.65 per calculator.

Required:
(i) The price and quantity that would maximise profit. (4 marks)

(ii) The maximum profit. (1 mark)

(d) A barber shop has a total of 10 available seats for customers. The inter-arrival times for customers are exponentially distributed with an average of 20 customers arriving each hour. Any prospective customer who finds all the seats occupied does not wait for service but instead leaves. The barber takes an average of 12 minutes to cut each customer's hair. Hair cut time duration is exponentially distributed.

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Required:

(i) The average number of hair cuts that will be completed by the barber each hour. (4 marks)

(ii) The average time each customer will spend at the barber shop. (3 marks)

(Total: 20 marks)

QUESTION FIVE

(a) Outline five limitations of game theory. (5 marks)

(b) The data below relate to activities of a certain project that is to be undertaken by Ujuzi Consultancy Company:

Activity	Preceding activity	Time (weeks) Optimistic	Most probable	Pessimistic
A	-	1.5	2.0	2.5
B	A	2.0	2.5	6.0
C	-	1.0	2.0	3.0
D	C	1.5	2.0	2.5
E	B,D	0.5	1.0	1.5
F	E	1.0	2.0	3.0
G	B,D	3.0	3.5	7.0
H	G	3.0	4.0	5.0
I	F,H	1.5	2.0	2.5

Required:

(i) A network diagram of the project. (8 marks)

(ii) The expected completion time of the project. (2 marks)

(iii) The probability that the project will be completed between 13 weeks and 17 weeks. (5 marks)

(Total: 20 marks)

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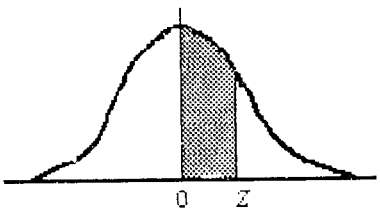
NORMAL CURVE

AREAS
under the
STANDARD
NORMAL CURVE
from 0 to z



z	0	1	2	3	4	5	6	7	8	9
0.0	.0000	.0040	.0080	.0120	.0160	.0199	.0239	.0279	.0319	.0359
0.1	.0398	.0438	.0478	.0517	.0557	.0596	.0636	.0675	.0714	.0754
0.2	.0793	.0832	.0871	.0910	.0948	.0987	.1026	.1064	.1103	.1141
0.3	.1179	.1217	.1255	.1293	.1331	.1368	.1406	.1443	.1480	.1517
0.4	.1554	.1591	.1628	.1664	.1700	.1736	.1772	.1808	.1844	.1879
0.5	.1915	.1950	.1985	.201	.2051	.2088	.2123	.2157	.2190	.2224
0.6	.2258	.2291	.2324	.2357	.2389	.2422	.2454	.2486	.2518	.2549
0.7	.2580	.2612	.2642	.2673	.2704	.2734	.2764	.2794	.2823	.2852
0.8	.2881	.2910	.2939	.2967	.2996	.3023	.3051	.3078	.3106	3133
0.9	.3159	.3186	.3212	.3238	.3264	.3289	.3315	.3340	.3365	.3389
1.0	.3413	.3438	.3461	.3485	.3508	.3531	.3554	.3577	.3599	.3621
1.1	.3643	.3665	.3686	.3708	.3729	.3749	.3770	.3790	.3810	.3830
1.2	.3849	.3869	.3888	.3907	.3925	.3944	.3962	.3980	.3997	.4015
1.3	.4032	.4049	.4066	.4082	.4099	.4115	.4131	.4147	.4162	.4177
1.4	.4192	.4207	.4222	.4236	.4251	.4265	.4279	.4292	.4306	.4319
1.5	.4332	.4345	.4357	.4370	.4382	.4394	.4406	.4418	.4429	.4441
1.6	.4452	.4463	.4474	.4484	.4495	.4505	.4515	.4525	.4535	.4545
1.7	.4554	.4564	.4573	.4582	.4591	.4599	.4608	.4616	.4625	.4633
1.8	.4641	.4649	.4656	.4664	.4671	.4678	.4686	.4693	.4699	.4706
1.9	.4713	.4719	.4726	.4732	.4738	.4744	.4750	.4756	.4761	.4767
2.0	.4772	.4778	.4783	.4788	.4793	.4798	.4803	.4808	.4812	.4817
2.1	.4821	.4826	.4830	.4834	.4838	.4842	.4846	.4850	.4854	.4857
2.2	.4861	.4864	.4868	.4871	.4875	.4878	.4881	.4884	.4887	.4890
2.3	.4893	.4896	.4898	.4901	.4904	.4906	.4909	.4911	.4913	.4916
2.4	.4918	.4920	.4922	.4925	.4927	.4929	.4931	.4932	.4934	.4936
2.5	.4938	.4940	.4941	.4943	.4945	.4946	.4948	.4949	.4951	.4952
2.6	.4953	.4955	.4956	.4957	.4959	.4960	.4961	.4962	.4963	.4964
2.7	.4965	.4966	.4967	.4968	.4969	.4970	.4971	.4972	.4973	.4974
2.8	.4974	.4975	.4976	.4977	.4977	.4978	.4979	.4979	.4980	.4981
2.9	.4981	.4982	.4982	.4983	.4984	.4984	.4985	.4985	.4986	.4986
3.0	.4987	.4987	.4987	.4988	.4988	.4989	.4989	.4989	.4990	.4990
3.1	.4990	.4991	.4991	.4991	.4992	.4992	.4992	.4992	.4993	.4993
3.2	.4993	.4993	.4994	.4994	.4994	.4994	.4994	.4995	.4995	.4995
3.3	.4995	.4995	.4995	.4996	.4996	.4996	.4996	.4996	.4996	.4997
3.4	.4997	.4997	.4997	.4997	.4997	.4997	.4997	.4997	.4997	.4998
3.5	.4998	.4998	.4998	.4998	.4998	.4998	.4998	.4998	.4998	.4998
3.6	.4998	.4998	.4999	.4999	.4999	.4999	.4999	.4999	.4999	.4999
3.7	.4999	.4999	.4999	.4999	.4999	.4999	.4999	.4999	.4999	.4999
3.8	.4999	.4999	.4999	.4999	.4999	.4999	.4999	.4999	.4999	.4999
3.9	.5000	.5000	.5000	.5000	.5000	.5000	.5000	.5000	.5000	.5000

NOT FOR SALE

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t Table

cum. prob	$t_{.50}$	$t_{.75}$	$t_{.80}$	$t_{.85}$	$t_{.90}$	$t_{.95}$	$t_{.975}$	$t_{.99}$	$t_{.995}$	$t_{.999}$	$t_{.9995}$
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30	0.000	0.683	0.854	1.055	1.310	1.697	2.042	2.457	2.750	3.385	3.646
40	0.000	0.681	0.851	1.050	1.303	1.684	2.021	2.423	2.704	3.307	3.551
60	0.000	0.679	0.848	1.045	1.296	1.671	2.000	2.390	2.660	3.232	3.460
80	0.000	0.678	0.846	1.043	1.292	1.664	1.990	2.374	2.639	3.195	3.416
100	0.000	0.677	0.845	1.042	1.290	1.660	1.984	2.364	2.626	3.174	3.390
1000	0.000	0.675	0.842	1.037	1.282	1.646	1.962	2.330	2.581	3.098	3.300
z	0.000	0.674	0.842	1.036	1.282	1.645	1.960	2.326	2.576	3.090	3.291
	0%	50%	60%	70%	80%	90%	95%	98%	99%	99.8%	99.9%
	Confidence Level										

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KASNEB

CPA PART II SECTION 4

CIFA PART II SECTION 4

CCP PART II SECTION 4

QUANTITATIVE ANALYSIS

FRIDAY: 27 May 2016. **Time Allowed: 3 hours.**

Answer ALL questions. Marks allocated to each question are shown at the end of the question. Show ALL your workings.

QUESTION ONE

(a) Explain four differences between the project evaluation and review technique (PERT) and the critical path analysis (CPA). (8 marks)

(b) A certain audit firm has two categories of employees, auditors and assistant auditors. The total monthly salary of 1 auditor and 5 assistant auditors amount to Sh.456,755 whereas the total monthly salary of 3 auditors and 9 assistant auditors amount to Sh.985,005. The firm has a total of 6 auditors and 14 assistant auditors. The employees contribute 12 per cent of their monthly salaries towards their sacco society.

Required:

(i) The monthly salary of an auditor and an assistant auditor, using matrix algebra. (4 marks)

(ii) The employees' total monthly contribution towards their sacco society. (1 mark)

(c) Shujaa Limited deals in the manufacture of a product named "Zed". The product "Zed" is produced on order and the company does not keep inventory of the product. The demand and total cost functions (in thousands of shillings) of the company are given as follows:

$P = 190 - q$

and

$TC = q^2 + 10q + 500$

Where: P is the unit selling price.
q is the quantity demanded in units.
TC is the total cost.

Required:

(i) The maximum profit of the company. (6 marks)

(ii) The output level that would maximise total revenue. (1 mark)

(Total: 20 marks)

QUESTION TWO

(a) Distinguish between a "univariate function" and a "multivariate function". (2 marks)

(b) The mean weight of 500 packaging tins from a production process are normally distributed with a mean weight of 151 grammes and a standard deviation of 15 grammes.

Required:

(i) The number of packaging tins that weigh between 120 grammes and 155 grammes. (4 marks)

(ii) The number of packaging tins that weigh more than 185 grammes. (3 marks)

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(c) The following data were obtained from the records of Kiwandani Limited for the year 2015:

Month	Total overhead cost (y) (Sh.)	Director labour hours (x)
January	16,250	1,056
February	15,000	736
March	15,000	840
April	14,500	800
May	15,250	880
June	15,750	1,008

Required:

(i) The least squares regression function relating direct labour hours and total overhead cost. (7 marks)

(ii) The coefficient of determination. Comment on your result. (4 marks)

(Total: 20 marks)

QUESTION THREE

(a) Explain the following terms as used in game theory:

(i) Pay-off. (1 mark)

(ii) Value of a game. (1 mark)

(b) Highlight eight steps followed in the simulation process. (8 marks)

(c) The table below shows the actual sales and target sales of eight sales agents for the year 2015 in millions of shillings.

Sales agent	1	2	3	4	5	6	7	8
Actual sales (y)	45	41	50	56	60	42	43	52
Target sales (x)	40	27	45	38	52	35	29	44

Required:

The Spearman's rank correlation coefficient. Interpret your result. (4 marks)

(d) A cashier at a departmental store can serve on average 24 customers per hour. The arrival rate of customers averages 20 customers per hour. The departmental store applies a single channel queuing system.

Required:

(i) The probability that the cashier is idle. (2 marks)

(ii) The average number of customers in the queuing system. (2 marks)

(iii) The average time a customer spends in the queue waiting to be served. (2 marks)

(Total: 20 marks)

QUESTION FOUR

(a) Viwanda Limited deals in the production of a product named "Nguvu". The production cost of the product is Sh.500 per unit (excluding packaging cost). The product is sold at Sh.1,000 per unit. The company is considering the purchase of one out of three different packaging systems. The cost data for the three packaging systems are as follows:

Packaging system	Purchase cost Sh. "000"	Variable cost per unit of product Sh. "000"	Scrap value Sh. "000"
A	100	1.50	10
B	200	1.00	20
C	400	0.50	40

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All the three packaging systems have a useful life of one year after which they would be sold at their estimated scrap values. The probability distribution for the demand for product "Nguvu" is as provided below:

Demand (units)	Probability
100	0.3
200	0.6
400	0.1

Required:
Recommend the packaging system that should be purchased by Viwanda Limited. (8 marks)

(b) Farm Produce Limited is a producer and distributor of maize flour. The company owns milling plants in Eldoret, Nanyuki and Narok towns. The milling plants have not been able to meet the demand orders of the company's distribution offices located in Mombasa, Kisumu, Nairobi and Isiolo towns. The company is considering the construction of a new milling plant either in Nakuru town or Meru town, in order to expand its production capacity.

The data below relate to the company's production and demand requirements.

Milling plant	Monthly output (units)	Unit production cost (Sh.)
Eldoret	30,000	96
Nanyuki	12,000	100
Narok	28,000	104

Distribution office	Monthly demand (units)
Mombasa	20,000
Kisumu	24,000
Nairobi	30,000
Isiolo	18,000

Additional information:

1. The estimated unit production costs in Nakuru and Meru towns are Sh.98 and Sh.106 respectively.
2. The unit transportation costs (in shillings) from each milling plant to each distribution office are given as follows:

		To			
		Mombasa	Kisumu	Nairobi	Isiolo
	Eldoret	64	36	52	58
From	Nanyuki	56	52	44	32
	Narok	58	42	36	50

3. The estimated unit transportation costs (in shillings) from each of the proposed milling plants to each distribution office are as follows:

		To			
		Mombasa	Kisumu	Nairobi	Isiolo
From	Nakuru	60	46	40	52
	Meru	62	56	46	28

4. Assume that the construction of one of the proposed milling plants would satisfy the demand deficiency.

Required:
Using the Vogel's approximation method (VAM), advise the management of Farm Produce Limited on the best location to construct the milling plant. (12 marks)

(Total: 20 marks)

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QUESTION FIVE

(a) Outline three differences between the normal distribution and the t-distribution. (3 marks)

(b) A certain project is expected to be completed within 18 weeks. The expected net revenue if the project is completed on time is Sh.1,120,000 but a penalty of Sh.484,000 will be imposed if the project is not completed on time. The cost of the project is Sh.459,000. The standard deviation of the project's duration is 2.08 weeks.

The table below is a summary of activities required to complete the project, the duration of the activities and their preceding activities.

Activity	Duration (weeks)	Preceding activity
A	5	-
B	2	-
C	4	-
D	2	B
E	5	B,C
F	7	C
G	6	A,D
H	3	G, D, E, F

Required:

(i) A network diagram of the project. (8 marks)

(ii) The float times of activities B and D. (2 marks)

(iii) The critical path of the project. (1 mark)

(iv) A 95 per cent confidence interval of the expected completion time of the project. (2 marks)

(v) The expected profit from the project. (4 marks)

(Total: 20 marks)

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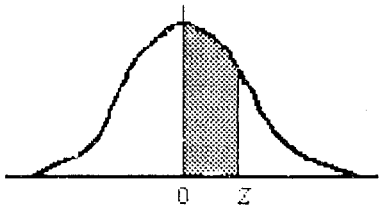
NORMAL CURVE

AREAS
under the
STANDARD
NORMAL CURVE
from 0 to z



z	0	1	2	3	4	5	6	7	8	9
0.0	.0000	.0040	.0080	.0120	.0160	.0199	.0239	.0279	.0319	.0359
0.1	.0398	.0438	.0478	.0517	.0557	.0596	.0636	.0675	.0714	.0754
0.2	.0793	.0832	.0871	.0910	.0948	.0987	.1026	.1064	.1103	.1141
0.3	.1179	.1217	.1255	.1293	.1331	.1368	.1406	.1443	.1480	.1517
0.4	.1554	.1591	.1628	.1664	.1700	.1736	.1772	.1808	.1844	.1879
0.5	.1915	.1950	.1985	.201	.2051	.2088	.2123	.2157	.2190	.2224
0.6	.2258	.2291	.2324	.2357	.2389	.2422	.2454	.2486	.2518	.2549
0.7	.2580	.2612	.2642	.2673	.2704	.2734	.2764	.2794	.2823	.2852
0.8	.2881	.2910	.2939	.2967	.2996	.3023	.3051	.3078	.3106	3133
0.9	.3159	.3186	.3212	.3238	.3264	.3289	.3315	.3340	.3365	.3389
1.0	.3413	.3438	.3461	.3485	.3508	.3531	.3554	.3577	.3599	.3621
1.1	.3643	.3665	.3686	.3708	.3729	.3749	.3770	.3790	.3810	.3830
1.2	.3849	.3869	.3888	.3907	.3925	.3944	.3962	.3980	.3997	.4015
1.3	.4032	.4049	.4066	.4082	.4099	.4115	.4131	.4147	.4162	.4177
1.4	.4192	.4207	.4222	.4236	.4251	.4265	.4279	.4292	.4306	.4319
1.5	.4332	.4345	.4357	.4370	.4382	.4394	.4406	.4418	.4429	.4441
1.6	.4452	.4463	.4474	.4484	.4495	.4505	.4515	.4525	.4535	.4545
1.7	.4554	.4564	.4573	.4582	.4591	.4599	.4608	.4616	.4625	.4633
1.8	.4641	.4649	.4656	.4664	.4671	.4678	.4686	.4693	.4699	.4706
1.9	.4713	.4719	.4726	.4732	.4738	.4744	.4750	.4756	.4761	.4767
2.0	.4772	.4778	.4783	.4788	.4793	.4798	.4803	.4808	.4812	.4817
2.1	.4821	.4826	.4830	.4834	.4838	.4842	.4846	.4850	.4854	.4857
2.2	.4861	.4864	.4868	.4871	.4875	.4878	.4881	.4884	.4887	.4890
2.3	.4893	.4896	.4898	.4901	.4904	.4906	.4909	.4911	.4913	.4916
2.4	.4918	.4920	.4922	.4925	.4927	.4929	.4931	.4932	.4934	.4936
2.5	.4938	.4940	.4941	.4943	.4945	.4946	.4948	.4949	.4951	.4952
2.6	.4953	.4955	.4956	.4957	.4959	.4960	.4961	.4962	.4963	.4964
2.7	.4965	.4966	.4967	.4968	.4969	.4970	.4971	.4972	.4973	.4974
2.8	.4974	.4975	.4976	.4977	.4977	.4978	.4979	.4979	.4980	.4981
2.9	.4981	.4982	.4982	.4983	.4984	.4984	.4985	.4985	.4986	.4986
3.0	.4987	.4987	.4987	.4988	.4988	.4989	.4989	.4989	.4990	.4990
3.1	.4990	.4991	.4991	.4991	.4992	.4992	.4992	.4992	.4993	.4993
3.2	.4993	.4993	.4994	.4994	.4994	.4994	.4994	.4995	.4995	.4995
3.3	.4995	.4995	.4995	.4996	.4996	.4996	.4996	.4996	.4996	.4997
3.4	.4997	.4997	.4997	.4997	.4997	.4997	.4997	.4997	.4997	.4998
3.5	.4998	.4998	.4998	.4998	.4998	.4998	.4998	.4998	.4998	.4998
3.6	.4998	.4998	.4999	.4999	.4999	.4999	.4999	.4999	.4999	.4999
3.7	.4999	.4999	.4999	.4999	.4999	.4999	.4999	.4999	.4999	.4999
3.8	.4999	.4999	.4999	.4999	.4999	.4999	.4999	.4999	.4999	.4999
3.9	.5000	.5000	.5000	.5000	.5000	.5000	.5000	.5000	.5000	.5000

NOT FOR SALE

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t Table

cum. prob	$t_{.50}$	$t_{.75}$	$t_{.80}$	$t_{.85}$	$t_{.90}$	$t_{.95}$	$t_{.975}$	$t_{.99}$	$t_{.995}$	$t_{.999}$	$t_{.9995}$
one-tail	0.50	0.25	0.20	0.15	0.10	0.05	0.025	0.01	0.005	0.001	0.0005
two-tails	1.00	0.50	0.40	0.30	0.20	0.10	0.05	0.02	0.01	0.002	0.001
df											
1	0.000	1.000	1.376	1.963	3.078	6.314	12.71	31.82	63.66	318.31	636.62
2	0.000	0.816	1.061	1.386	1.886	2.920	4.303	6.965	9.925	22.327	31.599
3	0.000	0.765	0.978	1.250	1.638	2.353	3.182	4.541	5.841	10.215	12.924
4	0.000	0.741	0.941	1.190	1.533	2.132	2.776	3.747	4.604	7.173	8.610
5	0.000	0.727	0.920	1.156	1.476	2.015	2.571	3.365	4.032	5.893	6.869
6	0.000	0.718	0.906	1.134	1.440	1.943	2.447	3.143	3.707	5.208	5.959
7	0.000	0.711	0.896	1.119	1.415	1.895	2.365	2.998	3.499	4.785	5.408
8	0.000	0.706	0.889	1.108	1.397	1.860	2.306	2.896	3.355	4.501	5.041
9	0.000	0.703	0.883	1.100	1.383	1.833	2.262	2.821	3.250	4.297	4.781
10	0.000	0.700	0.879	1.093	1.372	1.812	2.228	2.764	3.169	4.144	4.587
11	0.000	0.697	0.876	1.088	1.363	1.796	2.201	2.718	3.106	4.025	4.437
12	0.000	0.695	0.873	1.083	1.356	1.782	2.179	2.681	3.055	3.930	4.318
13	0.000	0.694	0.870	1.079	1.350	1.771	2.160	2.650	3.012	3.852	4.221
14	0.000	0.692	0.868	1.076	1.345	1.761	2.145	2.624	2.977	3.787	4.140
15	0.000	0.691	0.866	1.074	1.341	1.753	2.131	2.602	2.947	3.733	4.073
16	0.000	0.690	0.865	1.071	1.337	1.746	2.120	2.583	2.921	3.686	4.015
17	0.000	0.689	0.863	1.069	1.333	1.740	2.110	2.567	2.898	3.646	3.965
18	0.000	0.688	0.862	1.067	1.330	1.734	2.101	2.552	2.878	3.610	3.922
19	0.000	0.688	0.861	1.066	1.328	1.729	2.093	2.539	2.861	3.579	3.883
20	0.000	0.687	0.860	1.064	1.325	1.725	2.086	2.528	2.845	3.552	3.850
21	0.000	0.686	0.859	1.063	1.323	1.721	2.080	2.518	2.831	3.527	3.819
22	0.000	0.686	0.858	1.061	1.321	1.717	2.074	2.508	2.819	3.505	3.792
23	0.000	0.685	0.858	1.060	1.319	1.714	2.069	2.500	2.807	3.485	3.768
24	0.000	0.685	0.857	1.059	1.318	1.711	2.064	2.492	2.797	3.467	3.745
25	0.000	0.684	0.856	1.058	1.316	1.708	2.060	2.485	2.787	3.450	3.725
26	0.000	0.684	0.856	1.058	1.315	1.706	2.056	2.479	2.779	3.435	3.707
27	0.000	0.684	0.855	1.057	1.314	1.703	2.052	2.473	2.771	3.421	3.690
28	0.000	0.683	0.855	1.056	1.313	1.701	2.048	2.467	2.763	3.408	3.674
29	0.000	0.683	0.854	1.055	1.311	1.699	2.045	2.462	2.756	3.396	3.659
30	0.000	0.683	0.854	1.055	1.310	1.697	2.042	2.457	2.750	3.385	3.646
40	0.000	0.681	0.851	1.050	1.303	1.684	2.021	2.423	2.704	3.307	3.551
60	0.000	0.679	0.848	1.045	1.296	1.671	2.000	2.390	2.660	3.232	3.460
80	0.000	0.678	0.846	1.043	1.292	1.664	1.990	2.374	2.639	3.195	3.416
100	0.000	0.677	0.845	1.042	1.290	1.660	1.984	2.364	2.626	3.174	3.390
1000	0.000	0.675	0.842	1.037	1.282	1.646	1.962	2.330	2.581	3.098	3.300
z	0.000	0.674	0.842	1.036	1.282	1.645	1.960	2.326	2.576	3.090	3.291
	0%	50%	60%	70%	80%	90%	95%	98%	99%	99.8%	99.9%
	Confidence Level										

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CPA PART II SECTION 4

CIFA PART II SECTION 4

CCP PART II SECTION 4

QUANTITATIVE ANALYSIS

PILOT PAPER

September 2015. **Time Allowed: 3 hours.**

Answer ALL questions. Marks allocated to each question are shown at the end of the question. Show ALL your workings.

QUESTION ONE

(a) Highlight any four assumptions of Markov Analysis. (4 marks)

(b) The research industry in your country has three market research firms namely X, Y and Z which provide research services. The following data has been collected in relation to the flow of clients among the three firms:

	Number of clients	Market share	Flow of Clients						Number of clients	Market share
			Gains from			Losses to				
	31.12.2013		X	Y	Z	X	Y	Z	31.12.2014	
X	408	0.177	-	24	40	-	30	18	424	0.184
Y	832	0.361	30	-	10	24	-	14	834	0.362
Z	1062	0.461	18	14	-	40	10	-	1044	0.454

Required:

(i) Convert the above data into a matrix of transition probabilities. (4 marks)

(ii) Estimate each firm's market share for 2015. (4 marks)

(c) A firm has a linear demand function for its product. When the price of the product is Sh. 220, the quantity demanded is 40 units. When the price increases to Sh. 240 the quantity demanded becomes 30 units. In addition, the firm's marginal cost function is given by:

$MC = 40q - 2q^2 + 2$
Fixed cost = Sh. 5million

where q = quantity demanded, MC = marginal cost (in Sh. million)

Required:

(i) The level of output that maximises profits. (3 marks)

(ii) The maximum profit. (1mark)

(iii) The price of the product at the maximum profit. (1mark)

(iv) The price elasticity of demand when the profit is at the maximum (interpret your result). (3 marks)

(Total: 20 marks)

QUESTION TWO

(a) The City Theatre has four auditoriums namely C1, C2, C3 and C4. Each auditorium performs a different play at any given time. The performances start at different times to avoid long queues that would occur if all the auditoriums were to start performance at the same time. The theatre has a single ticket booth and a cashier who can maintain an average service rate of 280 patrons per hour. Arrivals are poisson distributed at an average of 210 patrons per hour. The services are assumed to follow an exponential distribution.

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Required:

(i) The average number of patrons waiting in line to purchase the tickets. (2 marks)

(ii) The average time spent waiting in line to get to the ticket window. (2 marks)

(iii) The average time a patron spends in the system. (2 marks)

(iv) The percentage of time the cashier is busy. (2 marks)

(v) The probability that there are more than two people in the system. (2 marks)

(b) A marketing firm employs part-time marketers. The hours worked and the earnings of ten such marketers are as shown below:

Marketer	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
Hours worked (x)	20	30	48	39	28	14	60	50	62	43
Earnings (Sh. "000") (y)	5.5	7.4	11.0	9.3	7.2	4.3	13.5	12.0	14.0	10.0

Required:

(i) The least squares regression function relating the hours worked and earnings. Interpret your results. (6 marks)

(ii) The Spearman's rank correlation coefficient. Comment on your result. (4 marks)

(Total: 20 marks)

QUESTION THREE

(a) Lanex Company specialises in the production of an industrial dye. The firm manufacturers two types of dyes; light and dark. The selling price and the unit variable costs for the dyes are shown below:

Production	**Selling price (Sh.) per litre**	**Unit variable cost (Sh.) per litre**
Light	13.00	9.00
Dark	16.00	10.00

Each litre of light dye requires 6 minutes of skilled labour and each litre of dark dye requires 12 minutes of skilled labour.

In a given day, there are 400 man hours of skilled labour available. There are also 100 grammes of an important blending chemical available each day, where each litre of light dye requires 0.05 grammes of the blending chemical and each litre of dark dye requires 0.02 grammes of the chemical.

The processing capacity at the plant is limited to 3,000 litres of dye per day.

The company is committed to supply a leading retailer with 5,000 litres of light dye and 2,500 litres of dark dye each working week (consisting of five days). In addition, there is an agreement with the unions that at least 2,000 litres should be produced each day.

Lanex company's management would like to determine the daily production volume for each of the two dyes that will maximise total contribution.

Required:

(i) A linear programming model of the production problem facing Lanex company. (2 marks)

(ii) Using the graphical approach, determine the optimum daily production plan and consequent contribution. (8 marks)

(b) Brightshine Limited based in Nairobi manufactures a detergent. The firm is considering opening a new plant in Nakuru. The opening of a new plant will, however, depend on the demand for the detergent in Nakuru.

Information concerning the demand for the detergent is shown below:

H - High demand and leads to a profit of Sh.6,000,000 per year.
M - Moderate demand and leads to a profit of Sh.1,500,000 per year.
L - Low demand and leads to a loss of Sh.2,500,000 per year.

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The chances of having high, moderate and low demand are assessed at 30%, 30% and 40% respectively by the firm's management.

A market research group could be employed to provide information on which market demand would be realised. Past experience with work in the same market with this group shows its information cannot be relied upon to be absolutely accurate.

The market research group classifies its results as either being good prospects (G) or poor prospects (P). The table below gives the extent of reliability of this market research group:

Market survey	**Actual state of nature**		
Result	**H**	**M**	**L**
G	0.7	0.6	0.2
P	0.3	0.4	0.8

The market research group would charge a fee of Sh.60,000 if it was hired.

Required:

(i) The best course of action on the basis of prior information. (2 marks)

(ii) The expected value of perfect information. (2 marks)

(iii) Advise Brightshine Limited whether the market research should be conducted. Show your workings using a decision tree. (6 marks)

(Total: 20 marks)

QUESTION FOUR

(a) Distinguish between the following sets of terms:

(i) Zero-sum game and non-zero sum game. (2 marks)

(ii) Pure strategy game and Mixed strategy game. (2 marks)

(b) An engineering firm is tendering for a contract to supply a steel fabrication. The tasks have been analysed as follows:

Activity	**Predecessor activity**	**Time (Days)**
A	-	10
B	-	12
C	A	10
D	A	9
E	A	13
F	A, B	17
G	C	12
H	C, D	14
I	E	13
J	G, H	12
K	H	10
L	H, I	14
M	H, I, F	13

Required:

(i) A network diagram for the project. (8 marks)

(ii) The critical path and the expected project duration. (4 marks)

(iii) The time schedules for activities F, G and H. (4 marks)

(Total: 20 marks)

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QUESTION FIVE

(a) A machine is composed of three components X, Y and Z. The probability that component X is in good working condition is $^{7}/_{10}$. If component X is in good working condition, the probability that component Y is in good working condition is $^{3}/_{5}$. If component X is not in good working condition, the probability that component Y is in good working condition is $^{1}/_{3}$. If components X and Y are in good working condition, the probability that component C is in good working condition is $^{5}/_{6}$, otherwise, it is $^{1}/_{10}$.

The machine can only be effective when component Z is in good working condition.

Required:

(i) The probability that the machine is effective. (2 marks)

(ii) The probability that only one component Y or Z is in good working condition. (2 marks)

(iii) The probability that component Y is in good working condition given that component Z is in good working condition. (2 marks)

(b) The data below represent the sales made by Pengo Traders for a period of three years:

	Sales (Sh. "000,000") Quarter			
Year	**1**	**2**	**3**	**4**
2012	2.2	5	7.9	3.2
2013	2.9	5.2	8.2	3.8
2014	3.2	5.8	9.1	4.1

Required:

(i) The centred moving average trend values. (4 marks)

(ii) The seasonal additive indices. (4 marks)

(iii) The deseasonalised time series. (2 marks)

(c) Highlight the four components of a time series. (4 marks)

(Total: 20 marks)

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CPA PART II SECTION 4

CIFA PART II SECTION 4

CCP PART II SECTION 4

QUANTITATIVE ANALYSIS

FRIDAY: 27 November 2015. **Time Allowed: 3 hours.**

Answer ALL questions. Marks allocated to each question are shown at the end of the question. Show ALL your workings.

QUESTION ONE

(a) Star Manufacturers Limited specialises in the production of two products, A and B. The manufacturer sells the products at a fixed selling price to its customers. The following table shows the requirements for production of products A and B:

	Product		
	A	**B**	**Available resources**
Materials (Kilogrammes)	5	7	13,400
Labour (Hours)	3	4	7,800

Product A is sold for Sh.2,080 per unit whereas product B is sold for Sh.7,939 per unit. The variable costs of production are uncertain with the following margins of error:

	Product		
	A	**B**	**Error**
Labour/Hour (Sh.)	140	265	± 10%
Material/Kilogramme (Sh.)	236	710	± 5%

Star Manufacturers Limited utilises all the available resources.

Required:
Using matrix algebra, determine:

(i) The total expected revenue. (3 marks)

(ii) The expected maximum profit. (3 marks)

(iii) The expected minimum profit. (3 marks)

(b) Apex Limited is planning to launch a new product in the market. It has undertaken a survey on the product's colour, brand name and packaging. The company sent questionnaires to 200 potential customers to obtain their views on the three attributes of the product. The results were as follows:

- 24 persons liked the packaging and the brand name.
- 77 persons liked the brand name or the colour but did not like the packaging.
- 40 persons liked the colour only.
- 120 persons liked the colour or the brand name.
- 23 persons liked the colour and the packaging.
- 43 persons liked at least two of the three attributes.
- 5 persons did not like any of the three attributes.
- The questionnaires of 25 persons were not received back.

The company's policy is to incorporate an attribute in the product if at least 50 per cent of the respondents liked the attribute.

Required:

(i) Present the above information in a venn diagram. (6 marks)

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(ii) Number of persons that liked all the three attributes. (1 mark)

(iii) Proportion of persons that liked the colour. (1 mark)

(iv) Proportion of persons that liked the brand name. (1 mark)

(v) Proportion of persons that liked the packaging. (1 mark)

(vi) Attribute(s) to be incorporated in the product. (1 mark)

(Total: 20 marks)

QUESTION TWO

(a) Explain how differential calculus could be used in solving optimisation problems. (2 marks)

(b) The marginal cost and demand functions for Ujenzi Limited are given as follows:

$MC = 2x + 16$ (in Sh.million)
and
$P = x^2 - 24x + 117$ (in Sh.million)

Where:
MC is the marginal cost function
P is the price of a building constructed
x is the number of buildings constructed in a year.

The total annual fixed costs of the company amount to Sh.39 million.

Required:

(i) The profit function. (2 marks)

(ii) The selling price per building constructed that will maximise profit. (3 marks)

(c) The data below show the number of cars imported by a certain car dealer over a four-year period:

Year	Quarter 1	Quarter 2	Quarter 3	Quarter 4
2011	20	32	62	29
2012	21	42	75	31
2013	23	39	77	48
2014	27	39	92	53

Required:

(i) The trend equation, using the least squares method. (5 marks)

(ii) Average seasonal index for each quarter using the multiplicative model. (4 marks)

(iii) Year 2015 seasonally adjusted import forecasts for each quarter. (4 marks)

(Total: 20 marks)

QUESTION THREE

(a) Outline four applications of the programme evaluation and review technique (PERT) in the planning and management of projects. (4 marks)

(b) The table below relates to the number of units packaged by nine casual employees of Bidii Limited and the packaging time taken by each of the employees:

Number of units packaged	14	8	9	12	6	11	10	5	10
Time (seconds)	230	110	130	190	109	181	154	79	144

Required:

(i) The regression line of packaging time against the number of units packaged. (6 marks)

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(ii) The product moment correlation coefficient. (3 marks)

(iii) The standard error of estimate. (3 marks)

(iv) A 95 per cent interval estimate of the regression line. (2 marks)

(v) The packaging time interval for 7 units. (2 marks)

(Total: 20 marks)

QUESTION FOUR

(a) Explain the following terms as used in game theory:

(i) Pure strategy. (1 mark)

(ii) Saddle point. (1 mark)

(b) Highlight four applications of linear programming in business. (4 marks)

(c) Quick Works Limited deals in the provision of typing services. On average, a typist at the company receives 22 letters per day for typing. The typist works for 8 hours a day and it takes an average of 20 minutes to type a letter. The company has determined that the cost of a letter waiting to be typed is Sh.8 per hour and the typing equipment operating cost plus the salary of the typist amount to Sh.400 per day. In an attempt to improve on the letter typing service, the company is planning to lease one of the two models of automated typewriters to be used together with the existing typing equipment. The additional cost per day and the increase in typist's efficiency of the two models is as given below:

Model	Additional cost per day (Sh.)	Increase in typist's efficiency (%)
I	370	50
II	390	75

Required:

Advise the company on the action that it should take in order to minimise the total daily cost. (5 marks)

(d) Jane Cherop was employed by Golden Houses Limited as a sales agent last year. During the year, she was able to sell up to a maximum of 6 houses in a month. Due to good performance in the past year, the company has offered Jane Cherop one of the following three salary plans for the next year:

Plan A: A 25 per cent salary increament to Sh.50,000 per month.

Plan B: A fixed monthly salary of Sh.20,000 per month plus a commission of Sh.12,000 per house sold.

Plan C: No monthly salary but a commission of Sh.20,000 per house sold.

Required:

(i) The optimal salary plan for Jane Cherop based on the maximin criterion. (3 marks)

(ii) The optimal salary plan for Jane Cherop based on the minimax regret criterion. (3 marks)

(iii) Assume that during the past year, the distribution of the houses sold by Jane Cherop for the twelve months was as follows:

Number of houses sold	0	1	2	3	4	5	6
Number of months	1	2	1	2	1	3	2

Advise Jane Cherop on the optimal salary plan based on the expected value criterion. (3 marks)

(Total: 20 marks)

QUESTION FIVE

(a) A simulation model attempts to describe a business system using a number of equations. These equations are characterised by four types of variables.

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Required:
With reference to the above statement, explain the four types of variables in a simulation equation. (8 marks)

(b) The table below shows the probability distribution of the number of digital boxes sold by an electronics store on a daily basis:

Digital boxes sold (units)	0	1	2	3	4	5	6	7	8
Probability	0.05	0.05	0.10	0.15	0.20	0.15	0.15	0.10	0.05

Required:

(i) The probability that the number of digital boxes sold in a given day is at least 3 but less than 7. (2 marks)

(ii) The mean daily sales of digital boxes. (2 marks)

(iii) The standard deviation of digital boxes daily sales. (2 marks)

(c) The sales manager of Uza Limited has obtained the following data on the values of a random sample of 100 outstanding sales invoices of the company:

Value Sh."000"	**Number of outstanding sales invoices**
0 < 100	20
100 < 200	18
200 < 300	22
300 < 400	15
400 < 500	9
500 < 600	8
600 < 700	4
700 < 800	2
800 < 900	2
	100

Required:

(i) The standard deviation of the random sample. (4 marks)

(ii) A 95 per cent confidence level of the mean value of outstanding sales invoices. (2 marks)

(Total: 20 marks)

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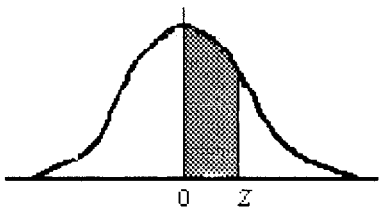
NORMAL CURVE

AREAS
under the
STANDARD
NORMAL CURVE
from 0 to z



z	0	1	2	3	4	5	6	7	8	9
0.0	.0000	.0040	.0080	.0120	.0160	.0199	.0239	.0279	.0319	.0359
0.1	.0398	.0438	.0478	.0517	.0557	.0596	.0636	.0675	.0714	.0754
0.2	.0793	.0832	.0871	.0910	.0948	.0987	.1026	.1064	.1103	.1141
0.3	.1179	.1217	.1255	.1293	.1331	.1368	.1406	.1443	.1480	.1517
0.4	.1554	.1591	.1628	.1664	.1700	.1736	.1772	.1808	.1844	.1879
0.5	.1915	.1950	.1985	.201	.2051	.2088	.2123	.2157	.2190	.2224
0.6	.2258	.2291	.2324	.2357	.2389	.2422	.2454	.2486	.2518	.2549
0.7	.2580	.2612	.2642	.2673	.2704	.2734	.2764	.2794	.2823	.2852
0.8	.2881	.2910	.2939	.2967	.2996	.3023	.3051	.3078	.3106	3133
0.9	.3159	.3186	.3212	.3238	.3264	.3289	.3315	.3340	.3365	.3389
1.0	.3413	.3438	.3461	.3485	.3508	.3531	.3554	.3577	.3599	.3621
1.1	.3643	.3665	.3686	.3708	.3729	.3749	.3770	.3790	.3810	.3830
1.2	.3849	.3869	.3888	.3907	.3925	.3944	.3962	.3980	.3997	.4015
1.3	.4032	.4049	.4066	.4082	.4099	.4115	.4131	.4147	.4162	.4177
1.4	.4192	.4207	.4222	.4236	.4251	.4265	.4279	.4292	.4306	.4319
1.5	.4332	.4345	.4357	.4370	.4382	.4394	.4406	.4418	.4429	.4441
1.6	.4452	.4463	.4474	.4484	.4495	.4505	.4515	.4525	.4535	.4545
1.7	.4554	.4564	.4573	.4582	.4591	.4599	.4608	.4616	.4625	.4633
1.8	.4641	.4649	.4656	.4664	.4671	.4678	.4686	.4693	.4699	.4706
1.9	.4713	.4719	.4726	.4732	.4738	.4744	.4750	.4756	.4761	.4767
2.0	.4772	.4778	.4783	.4788	.4793	.4798	.4803	.4808	.4812	.4817
2.1	.4821	.4826	.4830	.4834	.4838	.4842	.4846	.4850	.4854	.4857
2.2	.4861	.4864	.4868	.4871	.4875	.4878	.4881	.4884	.4887	.4890
2.3	.4893	.4896	.4898	.4901	.4904	.4906	.4909	.4911	.4913	.4916
2.4	.4918	.4920	.4922	.4925	.4927	.4929	.4931	.4932	.4934	.4936
2.5	.4938	.4940	.4941	.4943	.4945	.4946	.4948	.4949	.4951	.4952
2.6	.4953	.4955	.4956	.4957	.4959	.4960	.4961	.4962	.4963	.4964
2.7	.4965	.4966	.4967	.4968	.4969	.4970	.4971	.4972	.4973	.4974
2.8	.4974	.4975	.4976	.4977	.4977	.4978	.4979	.4979	.4980	.4981
2.9	.4981	.4982	.4982	.4983	.4984	.4984	.4985	.4985	.4986	.4986
3.0	.4987	.4987	.4987	.4988	.4988	.4989	.4989	.4989	.4990	.4990
3.1	.4990	.4991	.4991	.4991	.4992	.4992	.4992	.4992	.4993	.4993
3.2	.4993	.4993	.4994	.4994	.4994	.4994	.4994	.4995	.4995	.4995
3.3	.4995	.4995	.4995	.4996	.4996	.4996	.4996	.4996	.4996	.4997
3.4	.4997	.4997	.4997	.4997	.4997	.4997	.4997	.4997	.4997	.4998
3.5	.4998	.4998	.4998	.4998	.4998	.4998	.4998	.4998	.4998	.4998
3.6	.4998	.4998	.4999	.4999	.4999	.4999	.4999	.4999	.4999	.4999
3.7	.4999	.4999	.4999	.4999	.4999	.4999	.4999	.4999	.4999	.4999
3.8	.4999	.4999	.4999	.4999	.4999	.4999	.4999	.4999	.4999	.4999
3.9	.5000	.5000	.5000	.5000	.5000	.5000	.5000	.5000	.5000	.5000

NOT FOR SALE

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CPA PART II SECTION 4

CIFA PART II SECTION 4

CCP PART II SECTION 4

QUANTITATIVE ANALYSIS

MONDAY: 30 November 2020. **Time Allowed: 3 hours.**

Answer ALL questions. Marks allocated to each question are shown at the end of the question. Show ALL your workings.

QUESTION ONE

(a) A potential investor in the production of a new type of organic fertilizer estimated the demand function of the product to be AR = 150 – Q.

Where:

AR is the average revenue in thousands of shillings.
Q is the output in tonnes.

The investor estimated the variable cost (VC) per unit tonne associated with the production to be:

VC/tonne = Q – 285 in thousands of shillings.

The firm's cost when not producing any output is estimated at Sh.8,750,000.

Required:

(i) The profit function. (2 marks)

(ii) The level of output that maximises profit. (2 marks)

(iii) The breakeven output. (2 marks)

(b) A game between two players, A and B has the following pay off matrix:

		Player A strategies				
		A_1	A_2	A_3	A_4	A_5
Player B Strategies	B_1	0	–4	1	2	4
	B_2	–4	5	–1	1	9
	B_3	13	5	3	11	9
	B_4	–2	8	–7	–1	–2

Required:

(i) The optimum strategy for each player. (4 marks)

(ii) The saddle point. (1 mark)

(iii) The value of the game. (1 mark)

(c) An accounting college has two classes, day class and evening class. From a survey conducted by the head of academics in the college, the following results were obtained:

	Classes	
	Day	**Evening**
Number of students	13	15
Average test mark (%)	45	55
Standard deviation (%)	4	5

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Required:
Determine whether there is any significant difference in the average test mark between the two classes at 5% level of significance. (8 marks)

(Total: 20 marks)

QUESTION TWO

(a) A baker must decide whether to bake brown bread or white bread for a new market. Demand at the market can either be small or large with probability estimated to be 0.3 and 0.7 for brown bread and white bread respectively.

Additional information:

1. If brown bread is baked and demand proves to be high, the baker may choose not to expand (pay off = Sh.350,000) or to expand (pay off = Sh.420,000).
2. If brown bread is baked and demand is low, there is no reason to expand and the payoff is Sh.310,000.
3. If white bread is baked and demand proves to be low, the choice is to do nothing (Sh.90,000) or to stimulate demand through local advertising. The response to advertising may be either modest or sizeable, with their probabilities estimated to be 0.4 and 0.6 respectively. If it is modest, the pay off is estimated to be Sh.50,000; the pay off grows to Sh.340,000 if the response is sizeable.
4. If white bread is baked and the demand turns out to be high, the payoff is Sh.1,400,000.

Required:

(i) A decision tree showing the payoff and expected monetary value of each alternative decision. (6 marks)

(ii) Advise the management of the bakery on the best product to introduce into the market. (2 marks)

(b) In a choral music competition, 9 contestants were awarded marks in percentage using a music scoring grid by two assessors. The results obtained were given as shown in the table below:

	Marks in % by:	
Contestant	**1st Assessor**	**2nd Assessor**
A	72	76
B	82	80
C	79	78
D	70	73
E	67	70
F	81	85
G	78	69
H	75	83
I	65	68

Required:

(i) The rank correlation coefficient. Interpret your results. (4 marks)

(ii) Coefficient of determination. (1 mark)

(c) In a certain hospital, the arrival rate of patients into the outpatient department is 3 patients per hour and 4 patients are normally attended per hour.

Required:

(i) Service rate. (1 mark)

(ii) Length of queue. (1 mark)

(iii) Length of the system. (1 mark)

(iv) The time a patient takes being actually attended. (2 marks)

(v) The probability that there are more than six patients in the outpatient hospital department. (2 marks)

(Total: 20 marks)

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QUESTION THREE

(a) Dolce Ltd. is in the process of launching a new product into the market. Three variables are uncertain; selling price, variable cost and sales volume.

The following information is provided:

Selling price (Sh)	**Probability**
600	0.30
700	0.50
800	0.20
Variable cost (Sh.)	**Probability**
300	0.40
400	0.50
500	0.10
Sales volume (units)	**Probability**
40,000	0.30
50,000	0.50
60,000	0.20

The following random numbers have been provided:

44, 84, 82, 50, 85, 40, 96, 88, 16, 16, 97, 92, 44, 82, 39, 33, 83, 42, 16, 07, 77, 66, 50, 20, 50, 95, 83, 39, 58, 44, 77, 11, 08, 38, 89, 45, 09, 99, 81, 97, 50, 83.

Required:

The average contribution of Dolce Ltd. using Monte Carlo simulation with 10 simulations. (10 marks)

(b) The production manager of Sweet Ltd. is concerned with the fluctuating indirect labour cost in relation to the labour hours worked by the employees.

The following data was collected for the past 12 months.

Month	**Labour hours "000"**	**Indirect labour cost Sh."000"**
January	48	963
February	68	752
March	94	1,032
April	82	1,316
May	46	710
June	78	1,180
July	96	1,456
August	60	770
September	72	1,004
October	62	1,211
November	88	917
December	68	1,190

Required:

Using the ordinary least squares method:

(i) Formulate the indirect cost function. (5 marks)

(ii) Compute the indirect labour cost for 120 labour hours. (2 marks)

(iii) Calculate the coefficient of determination. (3 marks)

(Total: 20 marks)

QUESTION FOUR

(a) Explain the following terms as used in linear programming:

(i) Infeasibility. (2 marks)

(ii) Unboundedness. (2 marks)

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(b) A training institution has four lecturers represented as L1, L2, L3 and L4. The Head of department wishes to assign them to handle three topics in quantitative analysis; T1, T2 and T3. This will be done based on competency which is measured in terms of mastery of subject matter and personal preference on the time schedule while satisfying policies and provisions of the institution.

All of the lecturers have taught the topics in the past and have been evaluated with the following scores in the three different topics as follows:

		Topics		
		T1	**T2**	**T3**
Lecturers	**L1**	42	16	27
	L2	48	40	25
	L3	50	18	36
	L4	58	38	60

Required:

(i) The optimal assignment for these three topics. (4 marks)

(ii) The maximum score. (2 marks)

(iii) The lecturer that will not be assigned any topic. (1 mark)

(c) The data given below shows the profits in shillings million made by an economic sector in your country during the various quarters of the given years.

	Profits in quarters			
Year	**Q1**	**Q2**	**Q3**	**Q4**
2016	83	260	215	293
2017	105	383	248	553
2018	140	430	323	588
2019	168	503	340	755

Required:

(i) 3 quarter moving average of the series. (5 marks)

(ii) The deseasonalised profit of the economic sector using the additive model. (4 marks)

(Total: 20 marks)

QUESTION FIVE

(a) With reference to analysis of variances (ANOVA) tests:

(i) Distinguish between one-way and two-way ANOVA tests. (2 marks)

(ii) Outline four assumptions of two-way ANOVA tests. (4 marks)

(iii) Explain the difference between ANOVA tests and T-tests. (4 marks)

(b) In the context of critical path analysis (CPA) method:

(i) Discuss two strengths and two weaknesses of CPA method. (4 marks)

(ii) Explain three practical applications of CPA method. (6 marks)

(Total: 20 marks)

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t Table

cum. prob	$t_{.50}$	$t_{.75}$	$t_{.80}$	$t_{.85}$	$t_{.90}$	$t_{.95}$	$t_{.975}$	$t_{.99}$	$t_{.995}$	$t_{.999}$	$t_{.9995}$
one-tail	0.50	0.25	0.20	0.15	0.10	0.05	0.025	0.01	0.005	0.001	0.0005
two-tails	1.00	0.50	0.40	0.30	0.20	0.10	0.05	0.02	0.01	0.002	0.001
df											
1	0.000	1.000	1.376	1.963	3.078	6.314	12.71	31.82	63.66	318.31	636.62
2	0.000	0.816	1.061	1.386	1.886	2.920	4.303	6.965	9.925	22.327	31.599
3	0.000	0.765	0.978	1.250	1.638	2.353	3.182	4.541	5.841	10.215	12.924
4	0.000	0.741	0.941	1.190	1.533	2.132	2.776	3.747	4.604	7.173	8.610
5	0.000	0.727	0.920	1.156	1.476	2.015	2.571	3.365	4.032	5.893	6.869
6	0.000	0.718	0.906	1.134	1.440	1.943	2.447	3.143	3.707	5.208	5.959
7	0.000	0.711	0.896	1.119	1.415	1.895	2.365	2.998	3.499	4.785	5.408
8	0.000	0.706	0.889	1.108	1.397	1.860	2.306	2.896	3.355	4.501	5.041
9	0.000	0.703	0.883	1.100	1.383	1.833	2.262	2.821	3.250	4.297	4.781
10	0.000	0.700	0.879	1.093	1.372	1.812	2.228	2.764	3.169	4.144	4.587
11	0.000	0.697	0.876	1.088	1.363	1.796	2.201	2.718	3.106	4.025	4.437
12	0.000	0.695	0.873	1.083	1.356	1.782	2.179	2.681	3.055	3.930	4.318
13	0.000	0.694	0.870	1.079	1.350	1.771	2.160	2.650	3.012	3.852	4.221
14	0.000	0.692	0.868	1.076	1.345	1.761	2.145	2.624	2.977	3.787	4.140
15	0.000	0.691	0.866	1.074	1.341	1.753	2.131	2.602	2.947	3.733	4.073
16	0.000	0.690	0.865	1.071	1.337	1.746	2.120	2.583	2.921	3.686	4.015
17	0.000	0.689	0.863	1.069	1.333	1.740	2.110	2.567	2.898	3.646	3.965
18	0.000	0.688	0.862	1.067	1.330	1.734	2.101	2.552	2.878	3.610	3.922
19	0.000	0.688	0.861	1.066	1.328	1.729	2.093	2.539	2.861	3.579	3.883
20	0.000	0.687	0.860	1.064	1.325	1.725	2.086	2.528	2.845	3.552	3.850
21	0.000	0.686	0.859	1.063	1.323	1.721	2.080	2.518	2.831	3.527	3.819
22	0.000	0.686	0.858	1.061	1.321	1.717	2.074	2.508	2.819	3.505	3.792
23	0.000	0.685	0.858	1.060	1.319	1.714	2.069	2.500	2.807	3.485	3.768
24	0.000	0.685	0.857	1.059	1.318	1.711	2.064	2.492	2.797	3.467	3.745
25	0.000	0.684	0.856	1.058	1.316	1.708	2.060	2.485	2.787	3.450	3.725
26	0.000	0.684	0.856	1.058	1.315	1.706	2.056	2.479	2.779	3.435	3.707
27	0.000	0.684	0.855	1.057	1.314	1.703	2.052	2.473	2.771	3.421	3.690
28	0.000	0.683	0.855	1.056	1.313	1.701	2.048	2.467	2.763	3.408	3.674
29	0.000	0.683	0.854	1.055	1.311	1.699	2.045	2.462	2.756	3.396	3.659
30	0.000	0.683	0.854	1.055	1.310	1.697	2.042	2.457	2.750	3.385	3.646
40	0.000	0.681	0.851	1.050	1.303	1.684	2.021	2.423	2.704	3.307	3.551
60	0.000	0.679	0.848	1.045	1.296	1.671	2.000	2.390	2.660	3.232	3.460
80	0.000	0.678	0.846	1.043	1.292	1.664	1.990	2.374	2.639	3.195	3.416
100	0.000	0.677	0.845	1.042	1.290	1.660	1.984	2.364	2.626	3.174	3.390
1000	0.000	0.675	0.842	1.037	1.282	1.646	1.962	2.330	2.581	3.098	3.300
z	0.000	0.674	0.842	1.036	1.282	1.645	1.960	2.326	2.576	3.090	3.291
	0%	50%	60%	70%	80%	90%	95%	98%	99%	99.8%	99.9%
	Confidence Level										

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CPA PART II SECTION 4

CIFA PART II SECTION 4

CCP PART II SECTION 4

QUANTITATIVE ANALYSIS

THURSDAY: 28 November 2019. **Time Allowed: 3 hours.**

Answer ALL questions. Marks allocated to each question are shown at the end of the question. Show ALL your workings.

QUESTION ONE

(a) Business analytics is today emerging as a critical component of driving and sustaining business growth, particularly in the face of rising competition and other market dynamics.

Required:
In the context of the above statement, describe what "business analytics" entails. (6 marks)

(b) Six consultants work for XYZ Ltd. A consultant has a 20% chance of being absent from work in a given day. The company needs to establish the probability of more than two consultants being absent from work.

Required:
Compute the above probability of absence assuming:

(i) A binomial distribution. (4 marks)

(ii) A Poisson distribution. (4 marks)

(c) A small economy has two sectors, X_1 and X_2 producing a single product for their internal and external demand (in units), as summarised in the following transaction matrix.

Production sector	Purchase sector		Consumer demand
	X_1	X_2	
X_1	500	800	200
X_2	600	1,400	400

The projected consumer demand changes to 400 units and 800 units for sector X_1 and X_2 respectively.

Required:
The required gross output of each sector in order to meet the new demand. (6 marks)

(Total: 20 marks)

QUESTION TWO

(a) The profit function (in Sh. "000") for a given company is given as:

Profit = $10x - x^2 - 5$
Where x represents time in months.

Required:

(i) Cumulative profit in the break-even time interval. (4 marks)

(ii) The best time to end the production. (2 marks)

(iii) The total profit based on your result in (a) (ii) above. (1 mark)

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(b) A manufacturing company is testing a plant for acceptance. For the plant to be accepted, the mean reflectometer reading should be 19.5 and above.

A random sample of 25 readings is taken and found to have a mean of 19.7 with a standard deviation of 1.5

Required:
Test at 95% level of confidence whether the company should accept the new plant. (3 marks)

(c) Explain two advantages and two disadvantages of decision trees as used in decision theory. (4 marks)

(d) A bank teller can open new accounts at an average rate of 3 accounts per hour. Customers requiring to open an account arrive at an average rate of 2 customers per hour.

The management of the bank has established a single channel single phase queuing system.

Required:
(i) The average number of customers in the system. (2 marks)

(ii) The average time spent by a customer in the system. (2 marks)

(iii) The average number of customers in the queue. (1 mark)

(iv) The utilisation factor of the service utility. (1 mark)
(Total: 20 marks)

QUESTION THREE
(a) In the context of time series analysis, describe three differences between "additive" and "multiplicative" models. (6 marks)

(b) A small business is interested in establishing the relationship between the number of hits on its website (measured by number of visitors that have used the main menu) and the amount spent in website promotion (in Sh. "000").

The table below gives the figures for the last six months:

Month	Website hits	Website promotion (Ksh. "000")
1	25	1.0
2	24	1.2
3	56	1.6
4	54	1.4
5	55	1.2
6	58	1.8

Required:
(i) Illustrate, using a graph, the number of website hits against the amount spent in website promotion.

Comment on any relationship between website hits and the extent of promotion. (4 marks)

(ii) Calculate the correlation coefficient and give an interpretation to its value. (5 marks)

(iii) Determine the regression line. (5 marks)
(Total: 20 marks)

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QUESTION FOUR

(a) (i) Explain the meaning of a "transition matrix". (2 marks)

(ii) Outline two features of a transition matrix. (2 marks)

(b) A chemical reaction in a processing plant is given by:

$K = T^2 P^{-1}$, where:

T is an input matrix.

P^{-1} is an inverse of matrix P.

K is an output matrix.

Given that $T = \begin{pmatrix} 2 & 4 \\ 2 & 0 \end{pmatrix}$ and

$P = \begin{pmatrix} 1 & 7 \\ 0 & 4 \end{pmatrix}$

Required:
Calculate the output matrix K. (4 marks)

(c) Kikwetu Company Ltd. is the sole producer of 3 cosmetic products; Meta, Nzuri and Safi which currently have a market share of 40% , 40% and 20% respectively. Each week, some brand switching takes place. Of those who bought Meta the previous week, 60% buy it again while 20% switch to Nzuri and 20% to Safi. Of those who bought Nzuri the previous week, 50% buy it again while 40% switch to Meta and 10% to Safi. Of those who bought Safi, 80% remain loyal while 10% switch to Meta and 10% to Nzuri.

Required:

(i) Construct a probability transition matrix of the switching probabilities. (2 marks)

(ii) Construct a vector to represent the initial market share in percentages. (1 marks)

(iii) Calculate a new market share a week after the current market share. (3 marks)

(d) Simulation models have various applications in business.

Required:
Discuss how simulation models can be applied in:

(i) Predicting business outcome. (3 marks)

(ii) Managing business risks. (3 marks)

(Total: 20 marks)

QUESTION FIVE

(a) A businessman has three alternatives open to him, each of which can be followed by any of the five payoff conditional possible events (in millions of shillings) as given below.

	Pay off conditional on events				
Alternative	**E_1**	**E_2**	**E_3**	**E_4**	**E_5**
A	6	2	-2	-12	4
B	-6	-3	10	16	0
C	12	8	4	0	6

Required:
Advise the businessman on the best alternative under:

(i) Maximin criterion. (1 mark)

(ii) Maximax criterion. (1 mark)

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(iii) The Hurwitz criterion, assuming a degree of optimism of 0.6. (1 mark)

(iv) Laplace criterion. (1 mark)

(b) A manufacturing firm produces two products, X and Y. The standard revenues and costs per unit of the products are as follows:

	Product X		Product Y	
	Sh.	Sh.	Sh.	Sh.
Selling price		400		360
Variable costs:				
Material B (Sh.20 per kg)	80		80	
Direct labour (Sh.16 per hour)	64		32	
Packing (Sh.24 per hour)	24		48	
Other variables	152	(320)	140	(300)
Fixed overhead (Sh.14 per hour direct labour)		(56)		(28)
Standard profit		24		32

Additional information:

1. Packaging is a separate automated task and the cost relates to materials and electricity.
2. The maximum available inputs per week are limited as follows:

Material B	240 kg
Direct labour	200 hours
Packaging time	100 hours

3. The profit of the company could be increased by increasing the selling price of product Y.

Required:

(i) Formulate and solve the above Linear programming model graphically. (6 marks)

(ii) Determine the maximum selling price of Product Y at which the solution in (b) (i) above would still remain optimal. (2 marks)

(c) John Wekesa is the manager at Mikate Bakers Ltd. He intends to establish the cost of each bread. He gathers the following data on the total cost of each day's production for the last 10 days as shown in the table below:

Day	Number of units of bread (in hundreds)	Total cost (Sh."000")
1	45	46
2	42	43.2
3	55	46.6
4	43	48
5	60	56.4
6	40	44.8
7	48	46.2
8	53	50.6
9	36.6	40.2
10	34	33

Required:

(i) The total cost function using the least squares method. (6 marks)

(ii) If each bread is sold at Sh.50, predict the break-even number of units of bread. (2 marks)

(Total: 20 marks)

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t Table

cum. prob	$t_{.50}$	$t_{.75}$	$t_{.80}$	$t_{.85}$	$t_{.90}$	$t_{.95}$	$t_{.975}$	$t_{.99}$	$t_{.995}$	$t_{.999}$	$t_{.9995}$
one-tail	0.50	0.25	0.20	0.15	0.10	0.05	0.025	0.01	0.005	0.001	0.0005
two-tails	1.00	0.50	0.40	0.30	0.20	0.10	0.05	0.02	0.01	0.002	0.001
df											
1	0.000	1.000	1.376	1.963	3.078	6.314	12.71	31.82	63.66	318.31	636.62
2	0.000	0.816	1.061	1.386	1.886	2.920	4.303	6.965	9.925	22.327	31.599
3	0.000	0.765	0.978	1.250	1.638	2.353	3.182	4.541	5.841	10.215	12.924
4	0.000	0.741	0.941	1.190	1.533	2.132	2.776	3.747	4.604	7.173	8.610
5	0.000	0.727	0.920	1.156	1.476	2.015	2.571	3.365	4.032	5.893	6.869
[illegible]											
11	0.000	0.697	0.876	1.088	1.363	1.796	2.201	2.718	3.106	4.025	4.437
12	0.000	0.695	0.873	1.083	1.356	1.782	2.179	2.681	3.055	3.930	4.318
13	0.000	0.694	0.870	1.079	1.350	1.771	2.160	2.650	3.012	3.852	4.221
14	0.000	0.692	0.868	1.076	1.345	1.761	2.145	2.624	2.977	3.787	4.140
15	0.000	0.691	0.866	1.074	1.341	1.753	2.131	2.602	2.947	3.733	4.073
[illegible]											
21	0.000	0.686	0.859	1.063	1.323	1.721	2.080	2.518	2.831	3.527	3.819
22	0.000	0.686	0.858	1.061	1.321	1.717	2.074	2.508	2.819	3.505	3.792
23	0.000	0.685	0.858	1.060	1.319	1.714	2.069	2.500	2.807	3.485	3.768
24	0.000	0.685	0.857	1.059	1.318	1.711	2.064	2.492	2.797	3.467	3.745
25	0.000	0.684	0.856	1.058	1.316	1.708	2.060	2.485	2.787	3.450	3.725
[illegible]											
40	0.000	0.681	0.851	1.050	1.303	1.684	2.021	2.423	2.704	3.307	3.551
60	0.000	0.679	0.848	1.045	1.296	1.671	2.000	2.390	2.660	3.232	3.460
80	0.000	0.678	0.846	1.043	1.292	1.664	1.990	2.374	2.639	3.195	3.416
100	0.000	0.677	0.845	1.042	1.290	1.660	1.984	2.364	2.626	3.174	3.390
1000	0.000	0.675	0.842	1.037	1.282	1.646	1.962	2.330	2.581	3.098	3.300
[illegible]											
	0%	50%	60%	70%	80%	90%	95%	98%	99%	99.8%	99.9%
	Confidence Level										

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CPA PART II SECTION 4

CIFA PART II SECTION 4

CCP PART II SECTION 4

QUANTITATIVE ANALYSIS

FRIDAY: 24 May 2019. **Time Allowed: 3 hours.**

Answer ALL questions. Marks allocated to each question are shown at the end of the question. Show ALL your workings.

QUESTION ONE

(a) The marginal revenue and average cost functions of Biashara Limited are given as follows:

$MR = 40q - 3q^2$ (in Sh. million)

and

$AC = 2q - 10 + 25/q$ (in Sh. million)

Where: MR is the marginal revenue function.
q is the quantity of units produced and sold.
AC is the average cost function.

Required:

(i) The profit function. (2 marks)

(ii) The maximum profit. (4 marks)

(b) A salesman earns a fixed monthly basic salary and a commission that is directly proportional to the number of units sold in the month. During the months of February 2019 and March 2019, the salesman's total earnings were Sh.60,000 and Sh.70,000 respectively. The number of units sold by the salesman in the months of February 2019 and March 2019 were 100 and 250 respectively. During the month of April 2019, the salesman sold 400 units.

Required:

Using matrix algebra, determine:

(i) The fixed monthly basic salary of the salesman. (2 marks)

(ii) Commission earned per unit sold. (2 marks)

(iii) Total earnings of the salesman in the month of April 2019. (2 marks)

(c) A medium sized commercial bank has a clientele of 200 active customers. The bank operates three different types of accounts namely; current account, savings account and fixed deposit account. Information obtained from the bank indicates that:

- 84 customers operate savings accounts.
- 109 customers operate current accounts.
- 106 customers operate fixed deposit accounts.
- 45 customers operate both savings and current accounts.
- 36 customers operate both savings and fixed deposit accounts.
- 43 customers operate both fixed deposit and current accounts.

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Required:

(i) Present the above information in a venn diagram. (3 marks)

(ii) The probability that a customer selected at random operates all the three types of accounts. (4 marks)

(iii) The probability that a customer selected at random operates only two types of accounts. (1 mark)

(Total: 20 marks)

QUESTION TWO

(a) Enumerate four assumptions of:

(i) A normal distribution. (4 marks)

(ii) A binomial distribution. (4 marks)

(b) A certain store has three cashiers serving customers at any given point in time. Each of the cashiers can serve on average 5 customers per hour. The arrival rate of customers averages 12 customers per hour.

Required:

The probability that there are no customers in the queuing system at a given point in time. (4 marks)

(c) A manufacturing company intends to introduce a new product into the market. Three products have been proposed namely; P_1, P_2 and P_3. The company can only introduce one of the three products. The following are the estimates of the probabilities and annual profits of the three products at three given states of demand, namely; high, moderate and low.

		Annual profit (Sh."000")		
State of demand	**Probability**	**P_1**	**P_2**	**P_3**
High	0.35	15,000	34,000	22,000
Moderate	0.40	25,000	30,000	15,000
Low	0.25	(5,000)	(3,000)	8,000

Required:

(i) A decision tree showing the payoff and expected monetary value of each alternative action. (6 marks)

(ii) Advise the management of the company on the best product to introduce into the market. (2 marks)

(Total: 20 marks)

QUESTION THREE

(a) Explain the following terms as used in network planning and analysis:

(i) Free float. (1 mark)

(ii) Total float. (1 mark)

(iii) Project crashing. (1 mark)

(b) (i) In relation to hypothesis testing and estimation, distinguish between "null hypothesis" and "alternative hypothesis". (2 marks)

(ii) Beta Limited deals in the manufacture of a detergent named "safi". A recent survey undertaken to determine the percentage of residents who use "safi" revealed that out of 500 residents selected at random, only 10% used "safi". In order to increase the usage of "safi" amongst the residents, the company undertook an advertising campaign that cost Sh.2.5 million. A survey undertaken after the campaign revealed that out of 600 residents selected at random, 15% used "safi".

Required:

Determine whether the advertising campaign increased the usage of "safi" amongst the residents. (Use a significance level of 5%). (5 marks)

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(c) Two competing companies, A and B, that deal in the sale of computers, have an equal share of the market. Both companies intend to increase their market share through adoption of three different media of advertisement, namely: newspaper, radio and television. The payoff table for the two companies, showing the gain or loss of customers from adoption of the different media of advertisement is as shown below:

		Company B	
Company A	**Newspaper**	**Radio**	**Television**
Newspaper	40	50	-17
Radio	10	25	-10
Television	100	30	60

Required:

(i) The optimal strategies for companies A and B. (8 marks)

(ii) The value of the game. (2 marks)

(Total: 20 marks)

QUESTION FOUR

(a) Highlight two differences between "transportation" and "assignment" models of linear programming. (4 marks)

(b) Summarise three applications of shadow prices in decision making. (3 marks)

(c) The table below shows the number of years of experience of ten salespersons and the respective mean monthly sales realised by the salespersons.

Salesperson	**Years of experience**	**Mean monthly sales (Sh.)**
1	6	180,000
2	4	150,000
3	2	80,000
4	10	500,000
5	7	190,000
6	4	100,000
7	6	200,000
8	7	220,000
9	12	600,000
10	8	200,000

Required:

(i) The coefficient of correlation. Interpret your result. (7 marks)

(ii) Using ordinary least squares method, predict the mean monthly sales that would be realised by a salesperson having 15 years of experience. (6 marks)

(Total: 20 marks)

QUESTION FIVE

(a) Outline four merits of using the project evaluation and review technique (PERT) to plan and analyse a project in an organisation. (4 marks)

(b) A food processing company intends to install a computerised order processing system. The activities to be carried out during the installation of the system and their time estimates are given below:

	Time estimates (days)		
Activity	**Optimistic time**	**Most likely time**	**Pessimistic time**
A	7	17	27
B	5	11	23
C	3	8	19
D	23	31	45
E	9	21	39
F	9	11	25
G	2	5	14
H	9	10	17

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The above time estimates were analysed using a computer and the results of the analysis were as follows:

Activity	Earliest start time (days)	Latest start time (days)	Earliest finish time (days)	Latest finish time (days)
A	0	0	17	17
B	17	17	29	29
C	29	43	38	52
D	29	29	61	61
E	38	52	60	74
F	61	61	74	74
G	61	79	67	85
H	74	74	85	85

Required:

(i) The expected completion time and variance of each of the activities. (8 marks)

(ii) The total float of each activity. (4 marks)

(iii) The expected completion time and variance of the project. (2 marks)

(iv) The 95% confidence interval for the project's completion time. (2 marks)

(Total: 20 marks)

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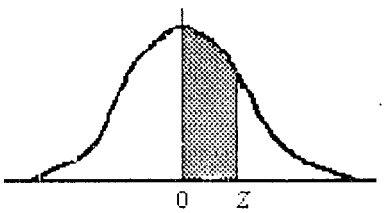
NORMAL CURVE

AREAS
under the
STANDARD
NORMAL CURVE
from 0 to z



z	0	1	2	3	4	5	6	7	8	9
0.0	.0000	.0040	.0080	.0120	.0160	.0199	.0239	.0279	.0319	.0359
0.1	.0398	.0438	.0478	.0517	.0557	.0596	.0636	.0675	.0714	.0754
0.2	.0793	.0832	.0871	.0910	.0948	.0987	.1026	.1064	.1103	.1141
0.3	.1179	.1217	.1255	.1293	.1331	.1368	.1406	.1443	.1480	.1517
0.4	.1554	.1591	.1628	.1664	.1700	.1736	.1772	.1808	.1844	.1879
0.5	.1915	.1950	.1985	.201	.2051	.2088	.2123	.2157	.2190	.2224
0.6	.2258	.2291	.2324	.2357	.2389	.2422	.2454	.2486	.2518	.2549
0.7	.2580	.2612	.2642	.2673	.2704	.2734	.2764	.2794	.2823	.2852
0.8	.2881	.2910	.2939	.2967	.2996	.3023	.3051	.3078	.3106	3133
0.9	.3159	.3186	.3212	.3238	.3264	.3289	.3315	.3340	.3365	.3389
1.0	.3413	.3438	.3461	.3485	.3508	.3531	.3554	.3577	.3599	.3621
1.1	.3643	.3665	.3686	.3708	.3729	.3749	.3770	.3790	.3810	.3830
1.2	.3849	.3869	.3888	.3907	.3925	.3944	.3962	.3980	.3997	.4015
1.3	.4032	.4049	.4066	.4082	.4099	.4115	.4131	.4147	.4162	.4177
1.4	.4192	.4207	.4222	.4236	.4251	.4265	.4279	.4292	.4306	.4319
1.5	.4332	.4345	.4357	.4370	.4382	.4394	.4406	.4418	.4429	.4441
1.6	.4452	.4463	.4474	.4484	.4495	.4505	.4515	.4525	.4535	.4545
1.7	.4554	.4564	.4573	.4582	.4591	.4599	.4608	.4616	.4625	.4633
1.8	.4641	.4649	.4656	.4664	.4671	.4678	.4686	.4693	.4699	.4706
1.9	.4713	.4719	.4726	.4732	.4738	.4744	.4750	.4756	.4761	.4767
2.0	.4772	.4778	.4783	.4788	.4793	.4798	.4803	.4808	.4812	.4817
2.1	.4821	.4826	.4830	.4834	.4838	.4842	.4846	.4850	.4854	.4857
2.2	.4861	.4864	.4868	.4871	.4875	.4878	.4881	.4884	.4887	.4890
2.3	.4893	.4896	.4898	.4901	.4904	.4906	.4909	.4911	.4913	.4916
2.4	.4918	.4920	.4922	.4925	.4927	.4929	.4931	.4932	.4934	.4936
2.5	.4938	.4940	.4941	.4943	.4945	.4946	.4948	.4949	.4951	.4952
2.6	.4953	.4955	.4956	.4957	.4959	.4960	.4961	.4962	.4963	.4964
2.7	.4965	.4966	.4967	.4968	.4969	.4970	.4971	.4972	.4973	.4974
2.8	.4974	.4975	.4976	.4977	.4977	.4978	.4979	.4979	.4980	.4981
2.9	.4981	.4982	.4982	.4983	.4984	.4984	.4985	.4985	.4986	.4986
3.0	.4987	.4987	.4987	.4988	.4988	.4989	.4989	.4989	.4990	.4990
3.1	.4990	.4991	.4991	.4991	.4992	.4992	.4992	.4992	.4993	.4993
3.2	.4993	.4993	.4994	.4994	.4994	.4994	.4994	.4995	.4995	.4995
3.3	.4995	.4995	.4995	.4996	.4996	.4996	.4996	.4996	.4996	.4997
3.4	.4997	.4997	.4997	.4997	.4997	.4997	.4997	.4997	.4997	.4998
3.5	.4998	.4998	.4998	.4998	.4998	.4998	.4998	.4998	.4998	.4998
3.6	.4998	.4998	.4999	.4999	.4999	.4999	.4999	.4999	.4999	.4999
3.7	.4999	.4999	.4999	.4999	.4999	.4999	.4999	.4999	.4999	.4999
3.8	.4999	.4999	.4999	.4999	.4999	.4999	.4999	.4999	.4999	.4999
3.9	.5000	.5000	.5000	.5000	.5000	.5000	.5000	.5000	.5000	.5000

NOT FOR SALE

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t Table

cum. prob	$t_{.50}$	$t_{.75}$	$t_{.80}$	$t_{.85}$	$t_{.90}$	$t_{.95}$	$t_{.975}$	$t_{.99}$	$t_{.995}$	$t_{.999}$	$t_{.9995}$
one-tail	0.50	0.25	0.20	0.15	0.10	0.05	0.025	0.01	0.005	0.001	0.0005
two-tails	1.00	0.50	0.40	0.30	0.20	0.10	0.05	0.02	0.01	0.002	0.001
df											
1	0.000	1.000	1.376	1.963	3.078	6.314	12.71	31.82	63.66	318.31	636.62
2	0.000	0.816	1.061	1.386	1.886	2.920	4.303	6.965	9.925	22.327	31.599
3	0.000	0.765	0.978	1.250	1.638	2.353	3.182	4.541	5.841	10.215	12.924
4	0.000	0.741	0.941	1.190	1.533	2.132	2.776	3.747	4.604	7.173	8.610
5	0.000	0.727	0.920	1.156	1.476	2.015	2.571	3.365	4.032	5.893	6.869
6	0.000	0.718	0.906	1.134	1.440	1.943	2.447	3.143	3.707	5.208	5.959
7	0.000	0.711	0.896	1.119	1.415	1.895	2.365	2.998	3.499	4.785	5.408
8	0.000	0.706	0.889	1.108	1.397	1.860	2.306	2.896	3.355	4.501	5.041
9	0.000	0.703	0.883	1.100	1.383	1.833	2.262	2.821	3.250	4.297	4.781
10	0.000	0.700	0.879	1.093	1.372	1.812	2.228	2.764	3.169	4.144	4.587
11	0.000	0.697	0.876	1.088	1.363	1.796	2.201	2.718	3.106	4.025	4.437
12	0.000	0.695	0.873	1.083	1.356	1.782	2.179	2.681	3.055	3.930	4.318
13	0.000	0.694	0.870	1.079	1.350	1.771	2.160	2.650	3.012	3.852	4.221
14	0.000	0.692	0.868	1.076	1.345	1.761	2.145	2.624	2.977	3.787	4.140
15	0.000	0.691	0.866	1.074	1.341	1.753	2.131	2.602	2.947	3.733	4.073
16	0.000	0.690	0.865	1.071	1.337	1.746	2.120	2.583	2.921	3.686	4.015
17	0.000	0.689	0.863	1.069	1.333	1.740	2.110	2.567	2.898	3.646	3.965
18	0.000	0.688	0.862	1.067	1.330	1.734	2.101	2.552	2.878	3.610	3.922
19	0.000	0.688	0.861	1.066	1.328	1.729	2.093	2.539	2.861	3.579	3.883
20	0.000	0.687	0.860	1.064	1.325	1.725	2.086	2.528	2.845	3.552	3.850
21	0.000	0.686	0.859	1.063	1.323	1.721	2.080	2.518	2.831	3.527	3.819
22	0.000	0.686	0.858	1.061	1.321	1.717	2.074	2.508	2.819	3.505	3.792
23	0.000	0.685	0.858	1.060	1.319	1.714	2.069	2.500	2.807	3.485	3.768
24	0.000	0.685	0.857	1.059	1.318	1.711	2.064	2.492	2.797	3.467	3.745
25	0.000	0.684	0.856	1.058	1.316	1.708	2.060	2.485	2.787	3.450	3.725
26	0.000	0.684	0.856	1.058	1.315	1.706	2.056	2.479	2.779	3.435	3.707
27	0.000	0.684	0.855	1.057	1.314	1.703	2.052	2.473	2.771	3.421	3.690
28	0.000	0.683	0.855	1.056	1.313	1.701	2.048	2.467	2.763	3.408	3.674
29	0.000	0.683	0.854	1.055	1.311	1.699	2.045	2.462	2.756	3.396	3.659
30	0.000	0.683	0.854	1.055	1.310	1.697	2.042	2.457	2.750	3.385	3.646
40	0.000	0.681	0.851	1.050	1.303	1.684	2.021	2.423	2.704	3.307	3.551
60	0.000	0.679	0.848	1.045	1.296	1.671	2.000	2.390	2.660	3.232	3.460
80	0.000	0.678	0.846	1.043	1.292	1.664	1.990	2.374	2.639	3.195	3.416
100	0.000	0.677	0.845	1.042	1.290	1.660	1.984	2.364	2.626	3.174	3.390
1000	0.000	0.675	0.842	1.037	1.282	1.646	1.962	2.330	2.581	3.098	3.300
Z	0.000	0.674	0.842	1.036	1.282	1.645	1.960	2.326	2.576	3.090	3.291
	0%	50%	60%	70%	80%	90%	95%	98%	99%	99.8%	99.9%
	Confidence Level										

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CPA PART II SECTION 4

CIFA PART II SECTION 4

CCP PART II SECTION 4

QUANTITATIVE ANALYSIS

FRIDAY: 30 November 2018. **Time Allowed: 3 hours.**

Answer ALL questions. Marks allocated to each question are shown at the end of the question. Show ALL your workings.

QUESTION ONE

(a) Explain the following terms as used in decision theory:

(i) Opportunity loss. (1 mark)

(ii) Expected value of perfect information. (1 mark)

(b) Outline three assumptions of the transportation model. (3 marks)

(c) A company operates under two departments, P and Q. Details relating to a sample of employees working in the two departments has been provided as follows:

	Department P	**Department Q**
Number of employees	29	24
Average monthly salary	Sh.260,000	Sh.310,000
Standard deviation	Sh.25,000	Sh.30,000

Required:

Determine whether there is any significant difference between the average monthly salaries of employees working in the two departments. (Use a significance level of 5 per cent). (6 marks)

(d) Bidii College offers three courses namely; Accounting, Computing and Driving. The college has a total population of 500 students. Data obtained from the college revealed the following:

329 Students were undertaking Accounting course.
186 Students were undertaking Computing course.
295 Students were undertaking Driving course.
83 Students were undertaking both Accounting and Computing courses.
217 Students were undertaking both Accounting and Driving courses.
63 Students were undertaking both Computing and Driving courses.

Required:

(i) Present the above information in a Venn diagram. (3 marks)

(ii) The number of students undertaking all the three courses. (4 marks)

(iii) The number of students undertaking only one course. (2 marks)

(Total: 20 marks)

QUESTION TWO

(a) ABC Limited manufactures and sells electronic calculators whose marginal cost function is given by:

$$MC = x - 100 \text{ (in thousands of shillings)}$$

Where: MC is the marginal cost function.
x is the number of electronic calculators produced and sold.

The fixed cost of production amounts to Sh.250,000. The total revenue function is estimated to be quadratic in nature.

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The table below shows the sales revenue realised by the company at three different production levels:

Number of electronic calculators produced and sold (x)	Sales revenue (Sh."000")
20	1,600
40	3,200
60	4,800

Required:

(i) The total profit function. (6 marks)

(ii) The maximum profit. (2 marks)

(b) X Limited, Y Limited and Z Limited deal in the production of detergents. On 1 January 2017, the three companies introduced a similar new detergent in the market. Prior to introduction of the new detergent, the three companies had an equal share of the market. A survey conducted on the market shares of the three companies as at 31 December 2017 revealed the following:

1. X Limited had retained 90 per cent of its customers but had lost 3 per cent and 7 per cent of its customers to Y Limited and Z Limited respectively.
2. Y Limited had retained 75 per cent of its customers but had lost 10 per cent and 15 per cent of its customers to X Limited and Z limited respectively.
3. Z Limited had retained 80 per cent of its customers but had lost 5 per cent and 15 per cent of its customers to X Limited and Y Limited respectively.
4. There were no significant changes in the buying habits of the customers during the year.

Required:

(i) The market shares of the three companies as at 31 December 2018. (3 marks)

(ii) The long run market shares of the three companies. (9 marks)

(Total: 20 marks)

QUESTION THREE

(a) Explain the following terms as used in hypothesis testing:

(i) Level of significance. (1 mark)

(ii) Region of rejection. (1 mark)

(b) Summarise three factors that determine the size of the Pearson product moment correlation coefficient. (6 marks)

(c) The following data were obtained from the records of a certain company, relating to the year 2018:

Month	Total overhead costs – Y (Sh.)	Direct labour hours – X
January	14,250	856
February	13,000	536
March	13,000	640
April	12,500	600
May	13,250	680
June	13,750	808

Required:

(i) The least squares regression function relating the direct labour hours to the total overhead cost. (7 marks)

(ii) The coefficient of determination. (4 marks)

(iii) Comment on the results obtained in (c) (ii) above. (1 mark)

(Total: 20 marks)

QUESTION FOUR

The data below represent the number of students enrolled in a certain college over a four year period:

	Number of students enrolled			
	Quarter			
Year	1	2	3	4
2015	70	100	80	60
2016	50	40	120	80
2017	90	70	70	40
2018	60	100	130	-

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Required:

(a) The adjusted seasonal component for each of the four quarters, using the multiplicative model. (12 marks)

(b) Estimate the enrollment of students in each of the four quarters of year 2019 using the simple least squares method. (8 marks)

(Total: 20 marks)

QUESTION FIVE

(a) Explain the following terms as used in probability theory:

(i) Mutually exclusive events. (1 mark)

(ii) Independent events. (1 mark)

(iii) Joint probability. (1 mark)

(iv) Conditional probability. (1 mark)

(b) The manager of a certain project has identified the following information relating to the project:

Activity	Immediate predecessor (s)	Duration (weeks)	Probability
A	-	3	0.25
		4	0.50
		5	0.25
B	-	4	0.15
		5	0.30
		6	0.20
		7	0.20
		8	0.15
C	A	1	0.20
		3	0.65
		5	0.15
D	B, C	4	0.80
		5	0.20
E	D	3	0.15
		4	0.25
		5	0.25
		6	0.35
F	D	5	0.20
		7	0.80
G	E, F	2	0.50
		3	0.50

Required:

(i) A network diagram for the project. (6 marks)

(ii) The expected duration of the project. (2 marks)

(iii) Simulate the durations of the project on the basis of two runs. (8 marks)

(Total: 20 marks)

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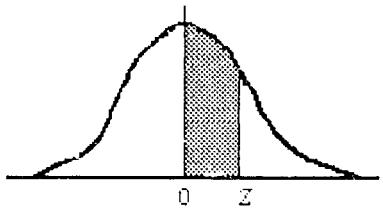
NORMAL CURVE

AREAS
under the
STANDARD
NORMAL CURVE
from 0 to z



z	0	1	2	3	4	5	6	7	8	9
0.0	.0000	.0040	.0080	.0120	.0160	.0199	.0239	.0279	.0319	.0359
0.1	.0398	.0438	.0478	.0517	.0557	.0596	.0636	.0675	.0714	.0754
0.2	.0793	.0832	.0871	.0910	.0948	.0987	.1026	.1064	.1103	.1141
0.3	.1179	.1217	.1255	.1293	.1331	.1368	.1406	.1443	.1480	.1517
0.4	.1554	.1591	.1628	.1664	.1700	.1736	.1772	.1808	.1844	.1879
0.5	.1915	.1950	.1985	.201	.2051	.2088	.2123	.2157	.2190	.2224
0.6	.2258	.2291	.2324	.2357	.2389	.2422	.2454	.2486	.2518	.2549
0.7	.2580	.2612	.2642	.2673	.2704	.2734	.2764	.2794	.2823	.2852
0.8	.2881	.2910	.2939	.2967	.2996	.3023	.3051	.3078	.3106	3133
0.9	.3159	.3186	.3212	.3238	.3264	.3289	.3315	.3340	.3365	.3389
1.0	.3413	.3438	.3461	.3485	.3508	.3531	.3554	.3577	.3599	.3621
1.1	.3643	.3665	.3686	.3708	.3729	.3749	.3770	.3790	.3810	.3830
1.2	.3849	.3869	.3888	.3907	.3925	.3944	.3962	.3980	.3997	.4015
1.3	.4032	.4049	.4066	.4082	.4099	.4115	.4131	.4147	.4162	.4177
1.4	.4192	.4207	.4222	.4236	.4251	.4265	.4279	.4292	.4306	.4319
1.5	.4332	.4345	.4357	.4370	.4382	.4394	.4406	.4418	.4429	.4441
1.6	.4452	.4463	.4474	.4484	.4495	.4505	.4515	.4525	.4535	.4545
1.7	.4554	.4564	.4573	.4582	.4591	.4599	.4608	.4616	.4625	.4633
1.8	.4641	.4649	.4656	.4664	.4671	.4678	.4686	.4693	.4699	.4706
1.9	.4713	.4719	.4726	.4732	.4738	.4744	.4750	.4756	.4761	.4767
2.0	.4772	.4778	.4783	.4788	.4793	.4798	.4803	.4808	.4812	.4817
2.1	.4821	.4826	.4830	.4834	.4838	.4842	.4846	.4850	.4854	.4857
2.2	.4861	.4864	.4868	.4871	.4875	.4878	.4881	.4884	.4887	.4890
2.3	.4893	.4896	.4898	.4901	.4904	.4906	.4909	.4911	.4913	.4916
2.4	.4918	.4920	.4922	.4925	.4927	.4929	.4931	.4932	.4934	.4936
2.5	.4938	.4940	.4941	.4943	.4945	.4946	.4948	.4949	.4951	.4952
2.6	.4953	.4955	.4956	.4957	.4959	.4960	.4961	.4962	.4963	.4964
2.7	.4965	.4966	.4967	.4968	.4969	.4970	.4971	.4972	.4973	.4974
2.8	.4974	.4975	.4976	.4977	.4977	.4978	.4979	.4979	.4980	.4981
2.9	.4981	.4982	.4982	.4983	.4984	.4984	.4985	.4985	.4986	.4986
3.0	.4987	.4987	.4987	.4988	.4988	.4989	.4989	.4989	.4990	.4990
3.1	.4990	.4991	.4991	.4991	.4992	.4992	.4992	.4992	.4993	.4993
3.2	.4993	.4993	.4994	.4994	.4994	.4994	.4994	.4995	.4995	.4995
3.3	.4995	.4995	.4995	.4996	.4996	.4996	.4996	.4996	.4996	.4997
3.4	.4997	.4997	.4997	.4997	.4997	.4997	.4997	.4997	.4997	.4998
3.5	.4998	.4998	.4998	.4998	.4998	.4998	.4998	.4998	.4998	.4998
3.6	.4998	.4998	.4999	.4999	.4999	.4999	.4999	.4999	.4999	.4999
3.7	.4999	.4999	.4999	.4999	.4999	.4999	.4999	.4999	.4999	.4999
3.8	.4999	.4999	.4999	.4999	.4999	.4999	.4999	.4999	.4999	.4999
3.9	.5000	.5000	.5000	.5000	.5000	.5000	.5000	.5000	.5000	.5000

NOT FOR SALE

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3	0.000	0.765	0.978	1.250	1.638	2.353	3.182	4.541	5.841	10.215	12.924
4	0.000	0.741	0.941	1.190	1.533	2.132	2.776	3.747	4.604	7.173	8.610
5	0.000	0.727	0.920	1.156	1.476	2.015	2.571	3.365	4.032	5.893	6.869
6	0.000	0.718	0.906	1.134	1.440	1.943	2.447	3.143	3.707	5.208	5.959
7	0.000	0.711	0.896	1.119	1.415	1.895	2.365	2.998	3.499	4.785	5.408
8	0.000	0.706	0.889	1.108	1.397	1.860	2.306	2.896	3.355	4.501	5.041
9	0.000	0.703	0.883	1.100	1.383	1.833	2.262	2.821	3.250	4.297	4.781
10	0.000	0.700	0.879	1.093	1.372	1.812	2.228	2.764	3.169	4.144	4.587
11	0.000	0.697	0.876	1.088	1.363	1.796	2.201	2.718	3.106	4.025	4.437
12	0.000	0.695	0.873	1.083	1.356	1.782	2.179	2.681	3.055	3.930	4.318
13	0.000	0.694	0.870	1.079	1.350	1.771	2.160	2.650	3.012	3.852	4.221
14	0.000	0.692	0.868	1.076	1.345	1.761	2.145	2.624	2.977	3.787	4.140
15	0.000	0.691	0.866	1.074	1.341	1.753	2.131	2.602	2.947	3.733	4.073
16	0.000	0.690	0.865	1.071	1.337	1.746	2.120	2.583	2.921	3.686	4.015
17	0.000	0.689	0.863	1.069	1.333	1.740	2.110	2.567	2.898	3.646	3.965
18	0.000	0.688	0.862	1.067	1.330	1.734	2.101	2.552	2.878	3.610	3.922
19	0.000	0.688	0.861	1.066	1.328	1.729	2.093	2.539	2.861	3.579	3.883
20	0.000	0.687	0.860	1.064	1.325	1.725	2.086	2.528	2.845	3.552	3.850
21	0.000	0.686	0.859	1.063	1.323	1.721	2.080	2.518	2.831	3.527	3.819
22	0.000	0.686	0.858	1.061	1.321	1.717	2.074	2.508	2.819	3.505	3.792
23	0.000	0.685	0.858	1.060	1.319	1.714	2.069	2.500	2.807	3.485	3.768
24	0.000	0.685	0.857	1.059	1.318	1.711	2.064	2.492	2.797	3.467	3.745
25	0.000	0.684	0.856	1.058	1.316	1.708	2.060	2.485	2.787	3.450	3.725
26	0.000	0.684	0.856	1.058	1.315	1.706	2.056	2.479	2.779	3.435	3.707
27	0.000	0.684	0.855	1.057	1.314	1.703	2.052	2.473	2.771	3.421	3.690
28	0.000	0.683	0.855	1.056	1.313	1.701	2.048	2.467	2.763	3.408	3.674
29	0.000	0.683	0.854	1.055	1.311	1.699	2.045	2.462	2.756	3.396	3.659
30	0.000	0.683	0.854	1.055	1.310	1.697	2.042	2.457	2.750	3.385	3.646
40	0.000	0.681	0.851	1.050	1.303	1.684	2.021	2.423	2.704	3.307	3.551
60	0.000	0.679	0.848	1.045	1.296	1.671	2.000	2.390	2.660	3.232	3.460
80	0.000	0.678	0.846	1.043	1.292	1.664	1.990	2.374	2.639	3.195	3.416
100	0.000	0.677	0.845	1.042	1.290	1.660	1.984	2.364	2.626	3.174	3.390
1000	0.000	0.675	0.842	1.037	1.282	1.646	1.962	2.330	2.581	3.098	3.300
z	0.000	0.674	0.842	1.036	1.282	1.645	1.960	2.326	2.576	3.090	3.291
	0%	50%	60%	70%	80%	90%	95%	98%	99%	99.8%	99.9%
	Confidence Level										

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