THE INSTITUTE OF CHARTERED ACCOUNTANTS, GHANA

NOVEMBER 2015 PROFESSIONAL EXAMINATIONS

QUANTITATIVE TOOLS IN BUSINESS (1.4)

EXAMINERS GENERAL COMMENTS

GENERAL PERFORMANCE

The general performance of candidates can be described as below average. Majority of the candidates who wrote their exams at centers outside Accra and Kumasi performed extremely poor with a few scoring above 40%. Few high performers recorded are found in Accra and Kumasi. A couple of candidates scored 0%. There were no traceable copying by candidates except that those who could not answer the questions decided to copy the questions, table of formulae, the normal distribution table into their booklets for marking. Per the scripts submitted for marking this year, one will conclude that candidates were extremely ill-prepared for the paper and this has reflected in their performance.

STANDARD OF THE PAPER

The paper on quantitative tools in business taken in November, was generally well written and the standard of the questions were very adequate for the Level One.

In fact, the standard is comparable to the May 2015 paper but a little different from the previous administered papers. There were little or no ambiguities and typing errors in the paper. The only identifiable error or misprint was **Question Two** where in the wording of the first Sub-Question (i), the word VARIES was used instead of VARIOUS. This error, however had limited effect on the understanding of the question. In general most candidates who tackled this question understood the sub-question. I suggest that the moderator/moderators are given little more time to proof read every paper before they are packaged for the question bank. The mark allocation was well done. Indeed, every sub-question had marks duly allocated and the marks were appropriate for each question (i.e. it followed the weighting in the revised syllabus). Finally, I will like to say that the questions were evenly spread over the topics in the syllabus. The only limitations of the paper are inadequate graph plotting related questions and some of the questions being a bit technical , example Question Three.

STRENGTH OF CANDIDATES

Candidates notable strengths in the performance were on the normal distribution question, **Question Two** and Forecasting questions, **Question One** & **Question Three** (Time Series analysis and regression analysis) . Majority could read the normal distribution table easily

and use the calculator very well in the Questions, One & Three. This strengths were demonstrated mostly by candidates who took their paper in Accra and Kumasi. This might be due to the availability of teaching and learning materials in these centers, and qualified instructors for teaching the quantitative tools in business. I suggest ICAG open teaching centers in every regional capital and also find qualified lecturers to teach at the centers.

WEAKNESSES OF CANDIDATES

Candidates main weaknesses were; lack of basic knowledge of algebra and inadequate preparation for the exams. This is reflected in their inability to explain basic terms like EMV, Expected Value of Perfect Information, Payoff table, Maxima rule, Maximin rule and many more simple concepts. This weakness is widespread and included candidates from Accra and Kumasi centers.

Refer to detailed question-by-question analysis of performance below for more on this other weaknesses:

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QUESTION ONE

(a) State the **Four** (4) Factors which may be present in a Time Series Data. (4 Marks)

(b) Quarterly Sales of a Golden Tree Chocolate Bar at a Popular Mall in KoKoLand City are given as follows:

YEAR	QUARTER 1	QUARTER 2	QUARTER 3	QUARTER 4
1	1260	756	588	1596
2	1352	966	579	2028
3	1786	920	865	2273

Required:

(i) Calculate the trend in the series using a 4-point centered moving average method. (4 Marks)

(ii) Using (i) calculate the Average Seasonal Variation based on the Additive Model of Time Series analysis (4 Marks)

(iii) Using the values in (ii), determine the Adjusted Average Seasonal Variation for the Time Series Data. (4 Marks)

(iv) Prepare Seasonal Adjusted Forecast for Year 4 using the Additive Model. (4 Marks)

(**Total=20Marks**)

QUESTION TWO

Jodoo Company Ltd had a new, large order for its product and thinks that this may herald an expansion of the market, and therefore its sales and profits. The Jodoo Ltd could move the factory to a new and larger site which would ensure any future expansion needs were met, and this would cost GHS 1 Million. The existing factory could be expanded at a cost of GHS 0.25 Million, but this would limit the potential to meet particularly high increases in future market growth. Finally the new order could be met by overtime working at a cost of GHS 0.08 Million. Future increases in potential sales could only be partially met by this method. Consultants suggest that there are three likely scenarios, a 40 per cent increase in sales, a 10 per cent increase in sales and a 0 per cent increase in sales, with probabilities of 0.2, 0.6 and 0.2 respectively. A new factory would easily cope with increased sales and the likely extra profit from the 40 per cent sales increase would be GHS 6 Millions, whereas the expanded factory would have more problems in such a large expansion and would only yield extra profits of GHS 3.5 Millions, whilst overtime working would be able to make only modest increase in production, thus restricting extra profit to GHS 1.5 Million. If potential sales grew by 10 per cent, then a new factory would yield GHS 2.5 Million extra profit, and an expanded factory GHS 2.5 Million extra profit and overtime working GHS 1.5 Million Profit. A 0 per cent increase in potential sales would lead to a zero increase in profit under any of the options.

Required:

(i) Construct a decision tree to represent the varies scenarios of expansion. (6 Marks)

(ii) Calculate the expected monetary value of each node of your tree in (i). (8 Marks)

(iii) Advise the company on how to react to this opportunity. (6 Marks)

(Total =20Marks)

QUESTION THREE

The monthly demand for Maize (00s of bags) for the last year in Bosua Market is as shown below:

Month	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**
Demand	**42**	**43**	**40**	**44**	**50**	**47**	**53**	**49**	**54**	**57**	**63**	**60**

Required:

(a) Calculate, the regression line $y = a + bx$ for the Data. (9 Marks)

(b) Using the regression line in (a) above, determine forecast for next year

(i) January, (1 Mark)

(ii) February, (1 Mark)

(iii) March. (1 Marks)

(c) Determine, the Standard Error in forecasting demand in (b) above.

(8 Marks)

(**Total=20Marks**)

QUESTION FOUR

(a) State the relationships between the **mean**, **median** and **mode** in a Non-Symmetric Distribution. (5 Marks)

(b) A large departmental store, BOBO, has analyzed the monthly amount spent by its credit card customers and found that it is normally distributed with a mean of GHC 100 and a standard deviation of GHC 15.

Required:

Determine, the percentage of people who will spend:

(i) Over GHC 130. (2 Marks)

(ii) Over GHC 120. (2 Marks)

(iii) Below GHC 70. (2 Marks)

(iv) Between GHC 100 and GHC 130. (2 Marks)

(v) Between GHC 115 and GHC 130. (2 Marks)

Calculate, the minimum amount spent of:

(vi) The top 10%. (2.5 Marks)

(vii) The top 3% of customers. (2.5 Marks)

(Total = 20 Marks)

QUESTION FIVE

(a) Calculate the sum of the infinite geometric progressions

(i) $3, 0.3, 0.03, 0.003, \ldots, 3\times10^{-(n-1)}$ (2 Marks)

(ii) $100,\ 100(1.01)^{-1}, 100(1.01)^{-2}, 100(1.01)^{-3}, ..., 100(1.01)^{-(n-1)}$ (2 Marks)

(b) KuKu invested GHS 2000.00 into a Deluxe Equity Fund.

Required:

(i) Determine, how long it will take the GHS 2000.00 investment to accumulate GHS 800.00 interest at 10% compounded quarterly,if the interest is allowed for the fractional part of a conversion period. (1 month= 30 days). (4 Marks)

(ii) Determine, how long it will take the GHS 2000.00 investment to triple in value, if it doubled in value in 6 years at a certain rate of interest compounded monthly.(1 month = 30 days) (4 Marks)

(iii) Determine, the interest rate in b(ii) above. (2 Marks)

(c) Calculate, the accumulated value of GHS 2000.00 for 5 years at 16% compounded

(i) Quarterly (1 Mark)

(ii) Monthly (1 Mark)

(iii) Annually (1 Mark)

(iv) Semiannually (1 Mark)

(v) Continuously. (2 Marks)

(**Total=20Marks**)

QUESTION SIX

(a) Calculate the geometric mean of the following rates of returns for an Investment on the Ghana Stock Exchange:

0.50 0.30 -0.50 -0.25 (4 Marks)

(b) You have been given the responses of 18 ICAG students to a question on how much they have spent on textbooks in the last month:

0	0	19.99	32.98	19.99	19.99
48.20	32.98	0	19.99	0	32.98
19.99	0	24.50	0	32.98	100.00

Required:

(i) Compute, the mean, median and mode. Comment on the distribution of the responses. (8 Marks)

(ii) Compute, the inter-quartile deviation, mean deviation and the standard deviation. Comment on your results. (8 Marks)

(**Total=20 Marks**)

QUESTION SEVEN

(a) Explain the following terms in decision making:

(i) Maximax Rule. (1 Mark)

(ii) Maximin Rule. (1 Mark)

(iii) Expected Monetary Value. (1 Mark)

(iv) Payoff table. (1 Mark)

(v) Expected value of perfect information. (1 Mark)

(b) A TV manufacturer finds that he can sell x units per week at a price $p = 250 - 0.5x$ each. His cost of production of x TV sets per week is $C = 240 + x^2$.

Required:

(i) Determine, how many sets per week should he produce to maximize his profit. (5 Marks)

(ii) Determine, the maximize profit. (2 Marks)

(c) The price p and quantity x of a product, Kaako are related by the relation:

$$x = 16 - 4p - p^2 .$$

Required:

(i) Determine the elasticity of demand at $p = 3$. (4 Marks)

(ii) Determine, marginal revenue at $p = 3$. (4 Marks)

(**Total=20Marks)**

SUGGESTED SOLUTIONS

QUESTION ONE

(a) The FOUR main factors are

(i) Trend Factors

(ii) Seasonal Factors

(iii) Cyclical Factors

(iv) Random Factors/ Irregular Factors

(b) (i)

TIME	SALES (A)	4-POINT MOVING TOTAL	4-POINT MOVING AVERAGE	CENTRED MOVING AVERAGE(T)	SEASONAL EFFECT (A-T)
1	1260				
2	756	4200	1050.00		
3	588	4292	1073.00	1062	-474
4	1596	4502	1125.50	1099	497
5	1352	4495	1123.25	1124	228
6	966	4925	1231.25	1177	-211
7	579	5359	1339.75	1286	-707
8	2028	5513	1328.75	1334	694
9	1786	5599	1399.75	1364	422
10	920	5844	1461.00	1430	-510
11	865				
12	2273				

(ii)

YEAR	QUARTER 1	QUARTER 2	QUARTER 3	QUARTER 4
1			-474	497
2	228	-211	-707	694
3	422	-510		
TOTAL	650	-721	-1181	1191
AVERAGE	325	-360.5	-590.5	595.5

(iii) Total of average values = 325+(-360.5)+(-590.5)+595.5=-30.5

Adjustment factor = 30.5/4=7.625

QUARTER	AVERAGE	ADJUSTMENT	ADJUSTED AVERAGE	SEASONAL EFFECT
1	325.00	+ 7.625	332.625	333
2	-360.50	+7.625	-352.875	-353
3	-590.50	+7.625	-582.875	-583
4	599.50	+7.625	603.125	603

YEAR	QUARTER	PERIOD	TREND	SEASONAL EFFECT	FORECAST
4	1	13	1590	+333	1923
	2	14	1645	-353	1292
	3	15	1700	-583	1117
	4	16	1755	+603	2358

The trend column above was obtain by computing the gradient using the first value of the centered moving average , 1062 and the last centered moving average ,1430.

Thus the gradient = $\frac{1430-1062}{10-3}=52.57$.

Forecasting from the last centered moving average we evaluate the equation $y=1430+52.57x$, where $x=3,4,5,6$.

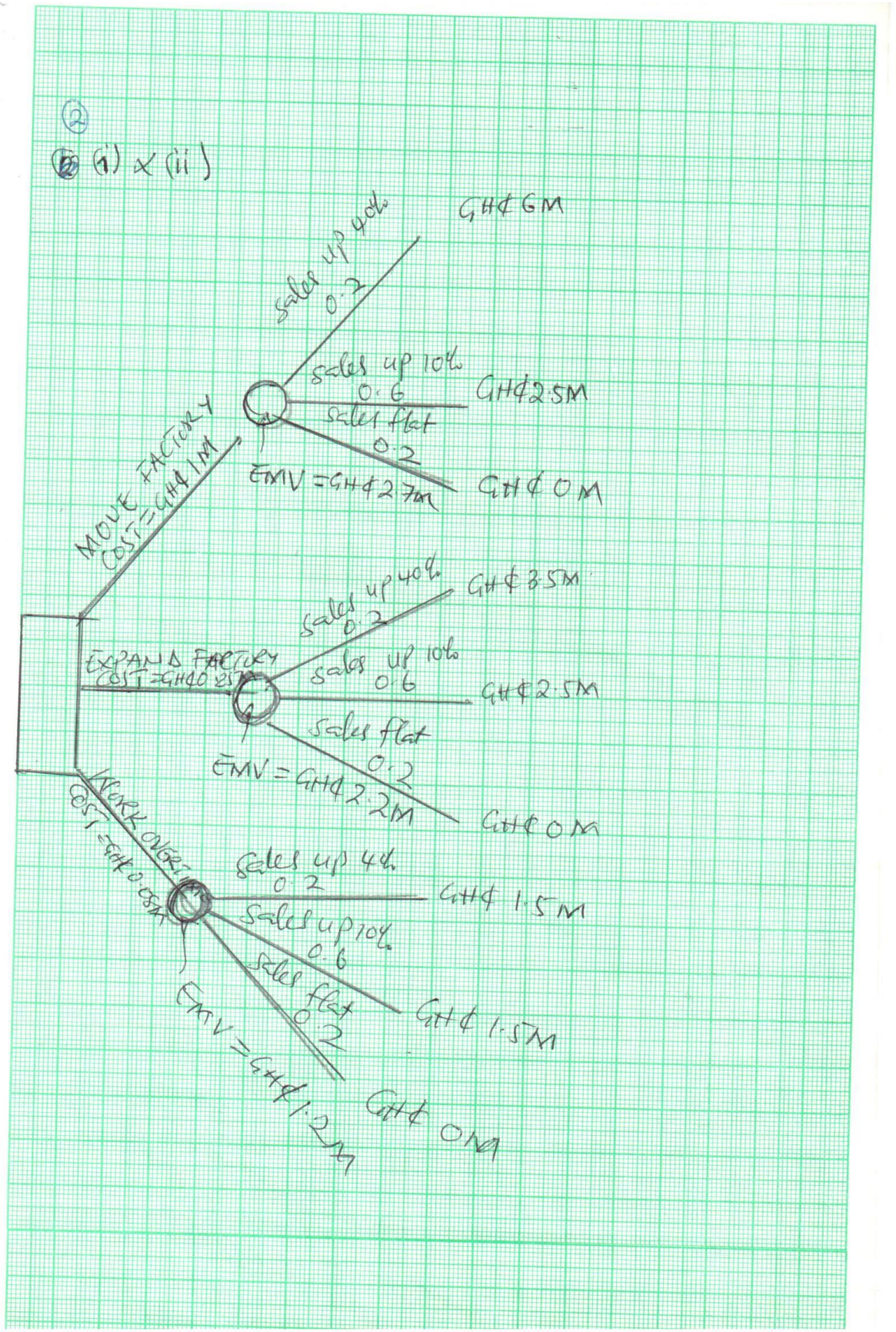
Example trend value of first quarter of year 4 is given by

$$y=1430+52.57(3)=1587.71\approx 1590$$

EXAMINER'S COMMENT

It was the most popular question among candidates and many candidates who answered it scored high marks with one person scoring 20/20. However, only a handful of candidates could answer correctly sub-question (iv) and those who tried to answer it used a very long procedure of least square regression. Given the mark allocated for this sub-question, it was a waste of their limited time. Please refer to the marking scheme for the best approach to answer it.

QUESTION TWO



(ii)

EMV(Move)= $0.2\times6+0.6\times2.5+0.2\times0=2.7$ **M**

EMV(Expand)= $0.2\times3.5+0.6\times2.5+0.2\times0=2.2$ **M**

EMV(Work)= $0.2\times1.5+0.6\times1.5+0.2\times0=1.2$ **M**

(iii)

EXPANSION	EMV	COST	PROFIT
MOVED FACT.	2.7M	1M	1.7 M
EXPAND FACT.	2.2M	0.25M	1.95M
WORK OVERTIME	1.2M	0.08M	1.12M

The best reaction to this opportunity is form the company to expand factory and they would earn profit of GHC 1.95 M.

EXAMINER'S COMMENT

This question was the least answered question by candidates, and those who answered it could not even draw the decision tree for 6 marks. Candidates who were able to draw the tree could not calculated the profit, and so could not answer sub-question (iii). Standard of candidates' understanding of the English Language might be the reason for the unpopular nature of this question.

QUESTION THREE

(a) ,(b) and (c) $y_e = 37.69 + 1.92x$

MONTH (x)	DEMAND (y)	xy	x^2	y_e	$y - y_e$	$(y - y_e)^2$
1	42	42	1	39.61	2.39	5.71
2	43	86	4	41.53	1.47	2.16
3	40	120	9	43.45	-3.45	11.90
4	44	176	16	45.37	-1.37	1.88
5	50	250	25	47.29	2.71	7.34
6	47	282	36	49.21	-2.21	4.88
7	53	371	49	51.13	1.87	3.49
8	49	392	64	53.05	-4.05	16.40
9	54	486	81	54.97	-0.97	0.94
10	57	570	100	56.87	0.13	0.07
11	63	693	121	58.81	4.19	17.56
12	60	720	144	60.73	-0.73	0.53
$\sum x = 78$	$\sum y = 602$	$\sum xy = 4188$	$\sum x^2 = 650$			$\sum (y - y_e)^2 = 72.86$

$$b = \frac{12 \times 4188 - (78)(602)}{12 \times 650 - (78)^2} = \frac{50256 - 46956}{7800 - 6084} = 1.92$$

$$a = \frac{602}{12} - (1.92)\left(\frac{78}{12}\right) = 37.69$$

(b)

(i) $y = 37.67 + 1.92(13) = 62.63$

(ii) $y = 37.67 + 1.92(14) = 64.55$

(iii) $y = 37.67 + 1.92(15) = 66.47$

(c) Standard Error= $\sqrt{\frac{72.86}{12-2}} = \sqrt{7.286} = 2.699$

EXAMINER'S COMMENT

Question Three was the second most popular question among candidates after Question One. However, few candidates could manage 15 marks and above. Some could not code the months serially as 1,2,3,…, 12 and so did not know how to carry out the regression analysis. Moreover, those candidates who could code were not able to answer sub-section (c) , which was meant to test them on how to assess estimates from the regression line.

QUESTION FOUR

(a) Positively Skewed: $\text{mode} \le \textit{median} \le \textit{mean}$

Negatively Skewed: $\text{mod}\, e \ge \textit{median} \ge \textit{mean}$

(b) Let X be amount spent on credit cards. Then $X \sim N(100, 225)$

(i) $$P(X \ge 130) = P\left(\frac{X-100}{15} \ge \frac{130-100}{15}\right) = P(Z \ge 2)$$
$$= 0.5 - P(0 \le Z \le 2)$$
$$= 0.5 - 0.4772$$
$$= 0.0228$$

2.3% of the people spent over GHC 130.00

(ii) $$P(X \ge 120) = P\left(\frac{X-100}{15} \ge \frac{120-100}{15}\right)$$
$$= P(Z \ge 1.33) = 0.5 - 0.4082 = 0.0918$$

9.2% of the people spent over GHC 120

(iii) $P(X \le 70) = P\left(\frac{X-100}{15} \le \frac{70-100}{15}\right)$

$= P(Z \le -2)$

$= 0.5 - 0.4772$

$= 0.023$

2.3% of the people spent below GHC 70

(iv) $P(100 \le X \le 130) = P\left(0 \le \frac{X-100}{15} \le \frac{130-100}{15}\right)$

$= P(0 \le Z \le 2)$

$= 0.4772$

47.7% of the people spent between GHC 100 and GHC 130

(v) $P(115 \le X \le 130) = P\left(\frac{115-100}{15} \le \frac{X-100}{15} \le \frac{130-100}{15}\right)$

$= P(1 \le Z \le 2)$

$= 0.4772 - 0.3413$

$=0.1359$

13.6% of the people spent between GHC 115 and GHC 130.

(vi) $P(X \ge k) = 0.1$

$P(Z \ge t) = 0.1$

$t = 1.28$

$\frac{k-100}{15} = 1.28$

$k = 100 + 1.28 \times 15 = 119.2$

(vii) $P(X \ge k) = 0.03$

$$P\left(\frac{X-100}{15} \geq \frac{k-100}{15}\right) = 0.03$$

$$t = 1.88$$

$$\frac{k-100}{15} = 1.88$$

$$k = 100 + 1.88 \times 15$$

$$= 128.2$$

EXAMINER'S COMMENT

Candidates who answered this question did extremely well. In fact, they could easily read from the normal distribution table probabilities, hence questions (b) (I)-(vii) were well-answered. However, some candidates could not do the inverse reading of probabilities from the normal distribution table.

QUESTION FIVE

(a)

(i) $3, 0.3, 0.03, 0.003, \ldots, 3 \times 10^{-(n-1)}$

Sum to Infinity $S = \frac{3}{1-\frac{1}{10}} = 3 \times \frac{10}{9} = 3.33$

(ii) $S = \frac{100}{1-\frac{1}{1.01}} = 100 \times \frac{1.01}{0.01} = 10100$

(b)

(i) Let n represent the number of quarter- years

$$2800 = 2000\left(1 + \frac{0.1}{4}\right)^n$$

$$(1.025)^n = 1.4$$

$$n = \frac{\log(1.4)}{\log(1.025)} = 13.62643323$$

$n \approx 3$ years 4 months 26 days.

(ii) Let i be the interest rate . Then

$$2 \times 2000 = 2000(1+i)^{6\times 12}$$

$$(1+i)^{72} = 2$$

$$(1+i) = 2^{\frac{1}{72}}$$

Therefore, the time to triple is given by

$$3 \times 2000 = 2000\left(2^{\frac{1}{72}}\right)^{n}$$

$$\frac{n}{72} = \frac{\log 3}{\log 2}$$

$$n = 72 \times \frac{\log 3}{\log 2} = 114.1173001$$

$n \approx 9$ years 6 months 4 days

(iii) $i = 2^{\frac{1}{72}} - 1 = 1.0096 - 1 = 0.0096$

Therefore, the interest rate is 0.96 percent.

(c) Let A represent the accumulated amount .

(i) $A = 2000\left(1+\frac{0.16}{4}\right)^{4\times 5} = 2000(1.04)^{20} = 4382.25$

(ii) $A = 2000\left(1+\frac{0.16}{12}\right)^{12\times 5} = 4427.614$

(iii) $A = 2000(1+0.16)^{1\times 5} = 4200.68$

(iv) $A = 2000\left(1+\frac{0.16}{2}\right)^{2\times 5} = 4317.85$

(v) $A = 2000e^{(0.16\times 5)} = 4451.08$

EXAMINER'S COMMENT

This question was also unpopular among candidates. Candidates were ill-prepared for business mathematics/ mathematical finance questions. They did not understand the concept of compounding and progression in finance. Most candidates used the 16% compound interest rate without taking into account the frequency of compounding in a year.

QUESTION SIX

(a) $\left(1+R_g\right)^4=\left(1+R_1\right)\left(1+R_2\right)\left(1+R_3\right)\left(1+R_4\right),\ R_1=0.5, R_2=0.3, R_3=-0.5, R_4=-0.25$

$$R_g=\sqrt[4]{(1+0.5)(1+0.3)(1-0.5)(1-0.25)}-1$$

$$=\sqrt[4]{1.5\times1.3\times0.5\times0.75}-1$$

$$=0.9247332-1$$

$$=-0.0752$$

The geometric mean of the rates of returns on the investment is -7.5%.

(b)

x	Freq. f	fx	$x-22.48$	$(x-22.48)^2$ d	fd^2	$\lvert x-22.48\rvert$ u	fu
0	6	0	-22.48	505.35	3032.10	22.48	134.9
19.99	5	99.95	-2.49	6.20	31.00	2.49	12.45
24.50	1	24.50	2.02	4.08	4.08	2.02	2.02
32.98	4	131.92	10.50	110.25	441.00	10.50	42.0
48.20	1	48.20	25.72	661.52	661.52	25.72	25.7
100.00	1	100.00	77.52	6009.35	6009.35	77.52	77.5
$\sum$	18	404.57			10179.1		294.57

(i) $\text{Mean}=\frac{404.57}{18}=22.48$, Mode $=0$ and Median= 19.99

As $0<19.99<22.48$ we say the distribution is positively skewed.

(ii) Mean deviation $=\frac{294.57}{18-1}=17.33$

$$\text{Standard Deviation} = \sqrt{\frac{10179.0}{18-1}}$$

$$= \sqrt{598.77}$$

$$= 24.46$$

First quartile = 0

Third quartile=32.98

Inter-quartile Deviation =32.98-0=32.98

These measures of variability are not zero, so we say there exists some variations in the responses.

EXAMINER'S COMMENT

Question Six was the third most popular question among candidates and most candidates who attempted this question did extremely well. However, some candidates did not understand the requirement of the question and as a result they tried to group the data into classes using the Sturge's formula. Those who managed to compute the necessary statistics for the data could not interpret or comment on the figures they have obtained

QUESTION SEVEN

(a)

(i) Maximax Rule

It chooses the "best of the the best" and is a rule favoured by decision-makers who are risk-seekers.

(ii) Maximin Rule

It chooses the "the best of the worst" and is a rule favoured by decision-makers who are risk-averse.

(iii) Expected Monetary Value

It is an expected value in monetary terms. It is found by multiplying each pay off by the probability that this pay off will occur.

(iv) Pay off table

It is simply a table that gives the outcome (e.g, profits) of a decision under different conditions or states of nature.

(v) Expected Value of Perfect Information

It is the difference between the expected value with perfect information and the best EMV.

(b) Demand function : $p = 250 - 0.5x$

Cost function: $c = 240 + x^2$

(i) Profit is given by

$$\pi(x) = px - c = (250 - 0.5x)x - (240 + x^2) = 250x - 1.5x^2 - 240$$

The profit maximizing quantity is given by $\frac{d\pi}{dx} = 250 - 3x = 0$

Therefore we have $x = 83.33$

(ii) Maximum Profit

$$\pi(83.33) = 250(83.33) - 1.5(83.33)^2 - 240 = 20,832.5 - 10,415.83 - 240 = 10,176.67$$

(c) Demand function: $x = 16 - 4p - p^2$

(i) $\frac{dx}{dp} = -4 - 2p$

$$Elasticity = \frac{p}{x} \times \frac{dx}{dp} = \frac{3}{16 - 4(3) - 3^2} \times \left[-4 - 2(3)\right] = \frac{30}{5} = 6$$

(ii) Marginal Revenue = $\frac{dR}{dx}$

$$R = p(x)x \Rightarrow \frac{dR}{dx} = p\frac{dx}{dx} + x\frac{dp}{dx} = p + (16 - 4p - p^2).\frac{1}{(-4 - 2p)}$$

Therefore , Marginal Revenue is given by

$$MR = 3 + (16 - 4(3) - 3^2).\frac{1}{(-4 - 2(3))} = 3 + (-5)\frac{1}{-10} = 3 + 0.5 = 3.5\,.$$

EXAMINER'S COMMENT

Answers provided by candidates for Question Seven (a) were not understandable . Candidates could not construct good sentences in English and when they are able to do so, the sentences constructed deviate greatly from the marking scheme. Candidates could hardly apply some basic rules of differentiation , which was the main test in question Seven (c) (i)-(ii).