2014 Further Mathematics GA 2: Examination 1

GENERAL COMMENTS

The majority of students were generally well prepared for the 2014 Further Mathematics examination 1.

SPECIFIC INFORMATION

The tables below indicate the percentage of students who chose each option. The correct answer is shaded.

The statistics in this report may be subject to rounding errors resulting in a total less than 100 per cent.

Section A

Core: Data analysis

Question	% A	% B	% C	% D	% E	% No Answer
1	3	85	4	1	7	0
2	1	8	10	76	4	1
3	2	9	86	2	1	0
4	1	12	52	29	5	0
5	1	95	2	1	1	0
6	37	30	4	4	25	0
7	7	6	77	5	5	0
8	8	1	24	39	28	0
9	12	58	10	11	8	1
10	6	6	5	6	77	0
11	6	13	4	3	73	0
12	26	9	30	32	3	0
13	7	11	37	30	14	0

The Core section was generally well answered. Students performed well on questions that required a routine application of a skill in a familiar circumstance; however, they struggled with the graphical location of medians (Question 13).

Students performed less well on questions that required deeper conceptual understanding to obtain an answer. This was clear in Questions 4 and 8, both of which required more than a superficial understanding of the differences between categorical and numerical variables.

Question 4

In Question 4 students were asked to identify the number of categorical variables in a data set. There were three: *sex*, *type of car* and *postcode* (option D); however, the majority of students did not choose this option. Most students decided that there were only two categorical variables (option C), possibly rejecting *postcode* because its data values were numbers. Postcodes are numbers, as are phone numbers. However, in both cases, these numbers only serve as identifiers. They have no other numerical properties. If students are in doubt about classifying a variable as categorical or numerical, they should ask, 'Does it make sense to calculate the mean of this variable?' If the answer is 'No', the variable is categorical. For postcodes, the answer is 'No'.

Question 6

In Question 6, students were asked to match a box plot to a given dot plot. An initial inspection of the dot plot indicated that there might be up to three outliers. However, by using the information in the plots to locate the upper fence ($Q3 + 1.5 \times IQR = 50 + 1.5 \times 20 = 80$), it was clear that only two of these points could be regarded as outliers, making option A the correct answer. The majority of students chose one of the two options showing three outliers, options that could have been eliminated by making a quick estimation of the location of the outer fence.

Question 8

An understanding of types of variables was also required to answer Question 8. The key to answering this question was to recognise that the type of variable plays a role in choosing an appropriate statistical plot when displaying data. Of the plots listed in this question, only a back-to-back stem plot was suitable for displaying the association between a car's speed (a numerical variable) and the sex of the driver (a categorical variable with two categories). A parallel box plot would also have been appropriate, but was not given as an option.

Question 12

In Question 12 students were asked to determine the percentage by which an actual sales figure would change when the seasonal index is 1.25. Few students answered this question correctly. The majority of students chose one of the two options with a 25% in the answer. This was not a question that could be answered by inspection and a calculation was required.

From the formula sheet:

$$\text{seasonal index} = \frac{\text{actual figure}}{\text{deseasonalised figure}}$$

Making the deseasonalised sales the subject of the formula:

$$\text{deseasonalised figure } \frac{\text{actual figure}}{\text{seasonal index}}$$

Here, SI = 1.25, so

$$\text{deseasonalised figure} = \frac{\text{actual figure}}{1.25} = 0.80 \times \text{actual figure}$$

Thus, to obtain the deseasonalised sales for summer, the actual sales figure must be decreased by 20%.

Module 1: Number patterns

Question	% A	% B	% C	% D	% E	% No Answer
1	99	1	0	0	0	0
2	9	2	85	2	1	0
3	5	19	5	67	5	0
4	8	2	9	6	75	0
5	6	63	10	16	4	1
6	2	2	15	6	74	0
7	6	11	42	19	21	0
8	23	40	11	11	13	0
9	10	17	17	44	12	1

The questions in Module 1: Number patterns were very well answered. Students performed well on questions that required a routine application of arithmetic and geometric sequences in familiar circumstances. Students demonstrated a general competence with difference equations and their applications.

Question 7

The question stated that the first two terms in a Fibonacci-related sequence were p and q. The question required students to find the difference in value between the fourth and fifth terms in terms of p and q.

A straightforward way to answer this question was to form a table and use the basic property of a Fibonacci-related sequence to generate the first five terms of this sequence. For example:

term number	1	2	3	4	5
value	p	q	$p + q$	$p + 2q$	$2p + 3q$

Thus, the difference between the fourth and fifth terms is $2p + 3q – (p + 2q) = p + q$, which corresponded to option C.

Module 2: Geometry and trigonometry

Question	% A	% B	% C	% D	% E	% No Answer
1	5	83	8	1	2	0
2	2	2	90	4	1	0
3	6	4	5	82	2	0
4	15	17	49	15	3	1
5	10	11	6	67	4	1
6	16	14	14	12	43	1
7	57	8	4	14	17	1
8	8	69	8	12	1	1
9	9	25	26	33	6	1

The questions in Module 2: Geometry and trigonometry were very well answered. Students were generally correct in answering questions that required a routine application of geometric and trigonometric techniques in a range of contexts including the use of bearings.

Question 9

Many students struggled to correctly answer Question 9, which involved the scaling of surface areas. The task in Question 9 was to determine the surface area of the middle section of a cone, given that the surface area of the top section was 180 cm^2.

One solution strategy was to use scaling to first find the total surface area of the middle and top sections combined. The surface area of the top section could then be subtracted to find the shaded area.

$SA_{\text{middle + top}} = 180\ (15/9)^2 = 500\ \text{cm}^2$

$SA_{\text{middle}} = SA_{\text{middle + top}} - SA_{\text{middle}}$

$= (500 - 180)\ \text{cm}^2 = 320\ \text{cm}^2$ (option D)

Module 3: Graphs and relations

Question	% A	% B	% C	% D	% E	% No Answer
1	4	81	12	2	1	0
2	19	5	18	7	50	0
3	3	14	7	74	1	0
4	9	68	7	7	9	0
5	65	8	11	11	5	0
6	2	4	7	75	11	1
7	3	64	15	11	6	0
8	11	55	13	13	7	1
9	17	12	45	7	19	1

The majority of questions in Module 3 were very well answered.

Module 4: Business-related mathematics

Question	% A	% B	% C	% D	% E	% No Answer
1	1	9	4	85	1	0
2	20	10	59	4	7	0
3	8	16	57	13	5	1
4	3	2	6	7	83	0
5	8	9	76	5	2	1
6	23	18	17	36	5	1
7	10	55	20	5	9	1
8	6	13	12	57	10	1
9	5	13	10	53	18	1

Student performance on Module 4: Business-related mathematics was similar to the performance of students in other modules. Students generally performed well on questions that required the routine application of percentage change, the principles of simple and compound interest, and straight line/flat rate and reducing balance depreciation. Questions that required the routine application of a financial solver for solution were also well answered.

Students struggled with the calculation of effective interest and showed a poor understanding of how interest is calculated at each stage in a reducing balance loan.

Question 6

The majority of students did not correctly answer this question on determining an effective interest rate.

Calculating an effective interest problem is a two-step process.

Step 1 involved calculating the flat rate of interest.

interest paid = total amount repaid – amount owed = 61 × 80 – 1000 = \$1080 = \$80

flat rate of interest (r_f) = $\left(\dfrac{\text{interest paid}}{\text{amount owed} \times \text{time in years}}\right) \times 100 = \left(\dfrac{80}{1000 \times 0.5}\right) \times 100 = 16\%$

Step 2 involved converting this flat rate of interest into an effective rate of interest.

For *n* payments,

effective interest = $\left(\dfrac{2n}{n+1}\right) \times r_f = \left(\dfrac{2 \times 6}{6+1}\right) \times 16 = 27.42\ ...\%$ (option D)

Question 9

Question 9 asked students to calculate the amount of the final payment for a reducing balance loan.

Again, this was a two-step problem.

Step 1 involved calculating the future value of the loan after 47 payments.

Using a financial solver, this amount is found to be \$802.39...

Step 2 required adding a month's interest to this amount to find the final payment.

final payment = 802.3911... + 802.3911... × $\left(\dfrac{4.75}{12 \times 100}\right)$ = \$805.57 to the nearest cent (option E)

While most students could correctly use their financial solver to find the amount still owed after the second last payment had been made (\$802.39), they apparently failed to realise that this amount would attract interest during the last month of the loan.

Module 5: Networks and decision mathematics

Question	% A	% B	% C	% D	% E	% No Answer
1	1	10	1	87	1	0
2	11	0	0	88	0	0
3	2	2	75	19	2	0
4	59	3	22	10	6	0
5	84	5	3	3	5	0
6	3	69	15	10	4	0
7	58	10	15	10	7	0
8	12	12	17	18	40	0
9	4	39	9	23	24	0

Questions in the Networks and decision mathematics module were generally very well answered, with the notable exceptions of Questions 7 and 9.

Students generally performed well on questions that required knowledge of the general properties of graphs, and eulerian and hamiltonian paths and circuits. They were also generally able to solve problems involving the application of Prim's algorithm and determining the shortest path by inspection.

Students struggled with recognising a planar graph when drawn in non-planar form (Question 7) and correctly identifying the minimum cut in a practical flow problem with more than one source (Question 9).

Question 7
In this question, students were given four graphs and asked how many were planar; however, few students answered correctly (option E, 4). The majority of students chose option A, 0. This suggests that most students were unaware that intersecting edges in a graph do not automatically preclude the graph from being planar.

Question 9
This question assessed the implicit assumption made about the properties of minimum cut when applying the minimum cut/maximum flow theorem, but many students did not answer correctly.

A flow network with two sources (two car parks) and a single sink (the exit) was provided. While Cut C had the minimum capacity, neither it nor Cut A separated both sources (car parks) from the sink. Thus, neither of these cuts could be used to determine the minimum flow. Of the three cuts that did separate both sources from the sink, Cut D had the minimum capacity and hence determined the maximum flow.

Module 6: Matrices

Question	% A	% B	% C	% D	% E	% No Answer
1	92	1	0	1	5	0
2	2	80	12	5	1	0
3	11	68	7	8	5	1
4	10	2	77	2	9	0
5	10	5	69	8	8	0
6	16	17	7	16	42	2
7	15	6	3	64	12	1
8	11	9	10	8	60	1
9	14	17	40	19	11	1

The majority of questions in Module 6: Matrices were generally very well answered.