Examiners' Report

Summer 2014

Pearson Edexcel GCE in Decision Mathematics D1R (6689/01R)

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Summer 2014
Publications Code UA038490

Mathematics Unit Decision Mathematics 1

Specification 6689/01R

Introduction

The paper proved accessible to the majority of students. The questions differentiated well, with most giving rise to a good spread of marks.

Report on Individual Questions

Question 1

Q01(a) and Q01(c) were well attempted with the majority of students gaining full marks. From time to time the value of 19 was misplaced in Q01(a) and occasionally the values of 12 and 10 were interchanged in Q01(c).

Many correct solutions were seen in Q01(b), but a minority produced an ascending list and failed to reverse it, leading to marks being lost later in the question. A number of students did not choose their pivots consistently, switching between middle-left and middle-right pivots during the course of the quick sort algorithm. A very small number of students lost an item or changed one, and very few cases were seen where only one pivot was chosen per iteration. Some students did not indicate that their sort was complete. This could have been achieved either by having at the end a ‘list sorted’ statement, or every item in the original list being used as a pivot or the final list being rewritten at the end. A common error was the 10 and 12 being interchanged in the 1st pass; students should be reminded that items should remain in the order from the previous pass as they move into sub-lists.

The most common explanation provided in Q01(d) was to consider a lower bound calculation which many students did correctly. A very small minority argued on the basis that there were five items which exceeded half the size of a bin although some of these arguments were not quite precise enough to gain both marks. Some students failed to relate their argument or calculation back to Q01(c) and lost a mark as a result.

Question 2

Q02(a) represented a challenge to some students. Q02(a) was worth two marks and as a result many students were able to obtained at least one mark. The vast majority provided an explanation about Hugo and tasks 1 and 3. It was common to see 'Only Hugo can do 1 and 3" although it was interesting to note that it was fairly common for students to cover every eventuality and write "only Hugo can do 1 and 3" followed by "1 and 3 can only be done by Hugo". Far less common but equally valid were the longer, more elaborate arguments involving more than one employee, for example, an argument based on employees A, C, J and P and tasks 2, 4 and 5. A minority of students did not realise what was required in this part and argued along the lines of "because A can only do 2" or similar.

In Q02(b) the majority correctly selected Janelle for training. Although most struggled to provide a fully acceptable reason or indeed in some cases any reason at all. Often students argued that Janelle should be chosen because 5 can already be done by 2 employees.

Q02(c) was answered extremely well but there was nonetheless the usual loss of marks for some students due to lack of change of status being stated or shown and/or failing to state the complete matching – in some cases students may have drawn the complete matching on a diagram which were not clear due to multiple lines being drawn from individual vertices.

Question 3

Q03(a) was usually very well done with most students applying Dijkstra's algorithm correctly. The boxes at each node in Q03(a) were usually completed correctly. When errors were made it was either an order of labelling error (some students repeated the same labelling at two different nodes) or working values were either missing, not in the correct order or simply incorrect (usually these errors occurred at D, G and/or T). The route was usually given correctly and most students realised that whatever their final value was at T this was therefore the value that they should give for their route.

Q03(b) was also well attempted with many stating the correct path from S to T via E and the correct corresponding time. However, many students neglected to correctly write down the effect on the journey. Most stated simply that "the time taken increases" without quantifying the change. As the quickest route from S to T from Q03(a) (found using a shortest path algorithm) did not include E it should not have surprised students that the time taken had increased in the second part.

Question 4

Q04(a) on the application of the Route Inspection algorithm was generally done extremely well by nearly all students. Unfortunately though there were a few students who only gave two pairings of the four odd nodes or who gave several pairings but not three distinct pairings. However, most students stated the correct three distinct pairings of the correct four odd nodes. It was relatively common though to see errors in some of the totals as students did not always find the shortest route between their pairings. Most went on to state the correct length of a shortest inspection route.

In Q04(b) most students were able to correctly calculate the time taken for the inspection although some students simply wrote down $\frac{120}{15} = 8$.

Q04(c) was challenging for most students and it was rare to see both marks awarded. The majority of students obtained no marks here due to arguments along the lines of "because that is the method that gives the shortest route" or fairly long-winded arguments to do with the order of nodes and the number of times a node can be entered/left without ever reaching the crux of the correct explanation. Of the two marks available a small minority scored a mark for conveying at least the idea of finishing at an odd vertex.

Q04(d) also proved to be fairly discriminating for students. Some students felt they needed to avoid B and D altogether and so repeat FI, others felt they should repeat BI but not because it was the least but rather because it would avoid repeating DF which was the largest pairing. There were some very thorough solutions, however, who considered the implications of starting at B and D in turn although some failed to explicitly identify that BI was repeated because it was the least pairing.

Those who correctly decided to repeat BI were usually able to write down the correct new length but there were often errors in calculating the new minimum total time; many students obtained an answer of 3272 – including a 2 second pause at the end of the test.

Question 5

Most students were able to draw the required lines correctly in Q05(a) although some were unable to draw lines sufficiently accurately (some drew lines without a ruler) or sufficiently long enough. The following general principle should always be adopted by students:

- lines should always be drawn which cover the entire graph paper supplied in the answer book and therefore,
- lines with negative gradients should always be drawn from axis to axis.

The rationale behind this is that until all the lines are drawn (and shaded accordingly) it is unclear which lines (or parts of lines) will define the boundary of the feasible region. If students only draw the line segments that they believe define the boundary of the feasible region then examiners are unaware of the order in which the lines were drawn and therefore it is unclear to examiners why some parts of the lines have been omitted. In general the lines $7x+8y=840$, $x=25$ and $y=25$ were correctly drawn and where errors occurred they tended to be with the other two lines. Furthermore, a significant number of students were unable to select the correct feasible region.

In Q05(b) most students were able to draw a correct objective line, occasionally a line of reciprocal gradient was seen although this was fairly rare. It is worth noting that some students do not make their objective line clear and when it is drawn deep into the feasible region it can sometimes be difficult to identify. Students should be reminded to ensure that their objective line is labelled or distinct from their constraint lines. The majority of students successfully labelled the optimal vertex.

In Q05(c) some students did not demonstrate any working to find the exact coordinates of vertex V. Students are possibly relying on calculators to do this for them and these students need to be reminded of the advice to students on the front cover of the question paper that ‘answers without working may not gain full credit’.

Q05(d) was found to be quite discriminating. The majority of students did not test the integer points around their optimum vertex with the correct inequalities and often those who did attempt this testing did not demonstrate that sufficient testing had been undertaken.

Question 6

Errors, where they occurred, were often due to lack of arrows or labels on arcs and sometimes extra activities or extra dummies appeared, for example, from the end of E to the sink node. Students sometimes found it difficult to have one finish and sometimes added extra activities after A and J in order to finish at one node. Only a small proportion of students attempted activity on node diagrams. The two required dummies were most often dealt with correctly.

Q05(b) was met with varied success. Some reasons for loss of marks included failing to include all relevant activities in the dependence argument stating, for example, ‘that D and G both depend on A but D depends on something else’. Students were also often too vague with regard to ‘uniqueness’ for the ‘uniqueness’ dummy (students are reminded that all activities are unique and that mention must be made to the fact that activities cannot share the same start and end events) and a significant number tried to explain in terms of dependence on D and F.

Question 7

The early and late event times were successfully completed by the vast majority of students. Errors where they arose included at the late event time at the end of C, the late event time at the end of A and/or at the end of G.

The float calculation is clearly well understood by the majority of students and very many got at least one mark in Q05(b). The lower bound in Q05(c) had more variable success; some did not do a calculation and tried to argue for a lower bound based on scheduling despite the question asking for a calculation. Others made arithmetical errors or conceptual errors (the most common being calculating the ratio of the earliest possible finish time to the number of activities) in their calculation.

In Q05(d) where students were asked to schedule the activities was often well attempted although full marks were rare. Usually students were able to plot the critical activities correctly. Common errors included: not plotting all 11 activities, drawing a cascade chart, too many workers being used, the length of activities E, I and/or J being too long, errors in precedence of activities, errors in the start times of certain activities, for example, E and/or I.

Question 8

Whilst the objective function was found correctly on many occasions, the absence of the word ‘minimise’ meant that the first mark could not be awarded. The first constraint (based on a total of at least 1000 litres of yoghurt) was usually correct. The other two constraints were either dealt with very well by students or not attempted at all. Simplified inequalities were not always seen and, on occasion, coefficients were left as fractions rather than integers.

Grade Boundaries

Grade boundaries for this, and all other papers, can be found on the website on this link:

http://www.edexcel.com/iwantto/Pages/grade-boundaries.aspx

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