Pearson Edexcel

Principal Examiner Feedback

Summer 2018

Pearson Edexcel GCE A Level Mathematics

Statistics & Mechanics (9MA0/03)

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Summer 2018
Publications Code 9MA0_03_1806_ER

SECTION A: STATISTICS

Introduction

This was the first paper in the new specification and sadly there did seem to be some students who were not that well prepared for the change in content and question style. In the statistics section the responses to questions 1 and 5 were particularly poor, with over 50% failing to score any of the marks in question 1

Comments on individual questions

Question 1

This question was supposed to be a gentle starter, making use of the student's knowledge of the large data set. Unfortunately many did not seem to be familiar with this and certainly were not aware that cloud cover was measure in oktas and subsequently there were a number who left the question blank. Those who did know about the cloud cover variable were able to give a discrete uniform distribution but many forgot to include 0. Those who did try and engage with the question could often score in part (c) but responses to part (d) were poor. This question required students to suggest a refinement to Helen's model and most answers lacked the detail required for the mark.

Question 2

This question was answered quite well by most students. In part (a), some failed to give their hypotheses in terms of a population parameter but most quoted the correct critical value from the tables. We would always expect a conclusion to a hypothesis test to be given in context and many students failed to do this.

In part (b) some students identified that as the temperature increased more people would be outside visiting the beach perhaps rather than going shopping. There were several other less convincing suggestions made and some that would have suggested a positive correlation between weekly sales and temperature. Part (c) was answered very well, but in part (d) some students seemed unfamiliar with the term, all that was required was the identification of temperature as the required variable and an explanation that, in this model, sales depend on or are affected by temperature. Part (e) was answered well again with most mentioning the idea of rate and the relevant values.

Question 3

In part (a), we would expect answers to use the context and although many stated that Peta assumes that the probability of hitting the target is constant most did not mention that the throws of the dart had to be independent too, many simply referring to just "trials".

Part (b) was answered fairly well, but in part (c) many carried on using the B(10, 0.1) model finding P(H = 5) rather than P(F = 5). Part (d) proved more challenging; those who carefully started to list the probabilities were often able to add these manually (few identified the arithmetic series as intended) and those who realised that the sum of the probabilities was equal to 1 usually went on to score all the marks and the mark in part (e). However, many thought that P(F = 10) = 1 or even that P(F = 5) had to equal their answer to part (c) and made little progress in (d) but could often collect the mark in (e). Part (f) was not answered well; the question clearly steered students to comment on the probability of a dart hitting the target using these two models. There were some good descriptions of what was happening with Thomas' model but often these were not compared to Peta's model.

Question 4

This question was answered fairly well. Most students gave a correct response in part (a) and many mentioned quota sampling in part (b). The question required a brief description of the method and although some mentioned "strata" few gave a suggestion as to what these strata might be and a question like this does require the answer to be related to the context of the question. Some mentioned stratified sampling in (b) and gained no credit as this is not a "non-random" method of sampling.

Most answered part (c) correctly and parts (d) and (e) were probably the best answered parts on the whole of section A. Part (f) was a familiar type of question from the legacy S1 specification but, although many identified the median and interquartile range as being the preferred statistics to use far fewer gave a reason to support this based on the presence of the outliers.

In part (g) most students identified that the median and upper quartile would change but few could give an adequate and accurate description to explain why. Many explained that the two values have moved to below 40 but failed to go on to explain that this would mean that there were more than 50% of the values below 40 and so the median of 40 would need to be lower. There were a number of students referring to changes in the mean and standard deviation despite these values not appearing in a box plot. It is hoped that over time students will get better at giving the level of detail in explanation that the new specification requires.

Question 5

Whilst parts (a) and (d) were often answered well, parts (b) and (c) proved much more challenging and only the strongest 10% made significant progress here. Part (a) was answered well and most students knew they needed to use their calculators to answer it and did so correctly. Those who identified that a conditional probability was required in part (b) were often able to make progress, often obtaining the probability of 0.4462 and using that correctly to complete part (b) and make progress in (c).

In part (c), some simply squared their probability of 0.4462 without realising the need to consider the two new batteries as well. Part (d) was often answered quite well with many stating the hypotheses correctly and identifying the correct model. Most calculated the appropriate probability correctly and many gave their solution in context too.

SECTION B: MECHANICS

Introduction

Overall the quality of the scripts seemed very mixed with some clear and entirely correct solutions but a substantial number were well below standard, particularly for Question 9 and Question 10. There may have been some evidence of time being a limiting factor as some Question 10 answers seemed rushed or unfinished, although it is difficult to be sure whether time or ability was the main issue here.

Question 7 was the best answered with 54% of the students scoring full marks, closely followed by question 6 where 55% of students scored full marks. Question 9 was by far the most challenging where the modal mark was zero and just under half the students scored 6, or fewer, out of 13.

In calculations the numerical value of g which should be used is 9.8 unless otherwise stated. Final answers should then be given to 2 (or 3) significant figures – more accurate answers will be penalised, including fractions but exact multiples of g are usually accepted.

If there is a printed answer to show then students need to ensure that they show sufficient detail in their working to warrant being awarded all of the marks available.

In all cases, as stated on the front of the question paper, students should show sufficient working to make their methods clear to the examiner and correct answers without working may not score all, or indeed, any of the marks available.

If a student runs out of space in which to give his/her answer than he/she is advised to use a supplementary sheet.

Question 6

The vast majority of students recognised the requirement to integrate to find the position vector and subsequently to substitute the given values of t. Occasionally, these were substituted straight into the velocity vector but such instances were rare and much correct working was seen. Most proceeded to find the magnitude of the vector joining the two points to give the exact distance as a surd as required; only a very small minority went straight to a rounded decimal value.

Question 7

Part (a) was well done by the majority of students. Virtually all attempted to resolve vertically and then use '$F = ma$' horizontally to find the acceleration. A few omitted the vertical component of the tension when finding the reaction which simplified the problem and resulted in the loss of 3 of the available 6 marks. '$F = 0.14R$' was almost invariably used to deduce the value of the acceleration. Full marks were often achieved for this part of the question.

In the second part, many clear and concise explanations were seen for why the acceleration would be less if the brush were pushed rather than pulled. To achieve both marks it was necessary to comment on the pushing down increasing the normal reaction, which in turn causes an increase in the available friction and a consequent decrease in acceleration. Those who failed to refer explicitly to the reaction or, more commonly, failed to draw the final conclusion about the acceleration achieved one of the two available marks. Occasionally, there was some confusion between the 'reaction' force and the 'resultant' force. Further calculations were not required here although some included them in their explanations.

Question 8

The first part was generally well done with most students using a constant acceleration formula in vectors ($\mathbf{r} = \mathbf{u}t + \frac{1}{2}\mathbf{a}t^2$) to find **a,** using the given velocity and position vectors. The few who chose to integrate a constant acceleration vector, and then use the given information to identify the constants of integration, mostly did so successfully. The magnitude of **a** was almost invariably calculated correctly but, since the answer was given, it was important that there was some working shown. Those who had no valid method for finding **a** tended to achieve the method mark for calculating the magnitude of their vector. A small minority of students attempted to apply *suvat* equations to the magnitudes of the given vectors; by chance this led to an answer which rounded to the given 2.5 m s^{-2}. However, such attempts achieved no credit.

Part (b) provided a greater challenge. Here it was necessary to find **v** after 2 seconds and then use this as the initial velocity for the second part of the motion. The given direction of motion meant that the coefficients of the i and j components of velocity were equal which in turn led to an equation in *t*. The main errors were in either trying to equate coefficients for a position rather than a velocity vector or in using 7**i** -10**j** (a position vector) as the initial velocity. Some students made no valid progress at all with this part of the question. There were, nevertheless, a fair number of entirely correct solutions seen

Question 9

In part (a), most students used a 'moments about *A*' equation to deduce the given expression for the tension in the rope. Since the answer was given it was important that the preceding working was sufficient and accurate but generally this was well done. In part (b), most used a horizontal resolution and the given expression for *T* to calculate a value of *x*. Errors in the straightforward algebraic manipulation were surprisingly common, sometimes leading to a dimensionally incorrect value. The most popular approach to part (c) was to resolve vertically to find the vertical component of the reaction. Occasionally a weight was omitted or the tension was not resolved, but there were a fair number of valid attempts. Again, slips in simplifying the expression were fairly prevalent and sometimes an incorrect value of *x* was being carried forward. Those who reached an answer which was a multiple of *Mg* generally gained the final method mark for dividing the components of reaction to find tanβ. Although there were some entirely correct solutions seen, there was evidence of confusion and lack of a systematic approach in other attempts.

Part (d) required a calculation of the maximum value of *x* which was possible for the rope not to break. This required a comparison of the given expression for *T* with the maximum possible (5*Mg*). Following correct algebra some students concluded that the weight had to be less than (rather than 'not more than' or 'less than or equal to') 5*a*/3 from *A* and achieved 2 out of the 3 available marks. Those who wrote in general terms about why there was a limit to how far the weight could be placed relative to *A* could achieve no credit without an attempt to calculate a value of *x*.

Question 10

In the first part, the majority of candidates used '$v^2 = u^2 + 2as$' with a correct distance to derive the given expression for U^2. A few attempted equations involving *t* but not always successfully. In part (b), most started with the valid strategy of using horizontal and vertical equations ($s = ut + 1/2at^2$). Not all included the appropriate correct distance (-1.25) and there were occasional sign errors. By substituting for *t* and then for *U* (using the expression from (a)) it was possible to obtain a quadratic equation in tanα. Not all attempts were successful, with errors in simplification leading to equations with a variety of trig functions or else not quadratics. Alternatively, rather than substituting for *t* and *U* in the original equation, a quadratic in *t* could be found by an initial substitution for *U*sinα. The resulting value of *t* could then be used in '20 = *Ut*cosα' to find α. This method was seen successfully employed on occasion. Similarly, the motion could be split into two stages and the times to and from the highest points found. This approach was only very rarely seen. Some candidates made several attempts at this part of the question; it is worth remembering that if none are crossed out only the last most complete solution will be credited.

Reference to air resistance was by far the most common correct response about the limitations of the model in part (c). Other valid comments relating to spin, dimensions of the ball and wind effects were all seen on occasion. Most candidates who offered an answer managed to score the mark with comments such as 'the ball might hit something' or 'it is difficult to throw at exactly that angle' being only very rarely seen.

Those who attempted part (d) generally used a correct method to find the time, most commonly using their value of α to find *U* and then to find *t* (from 20 = *Ut*cosα). An incorrect value of α carried forward meant 2 out of a possible 3 marks could be achieved. Some reverted to the vertical motion equation and calculated t from the quadratic. Others made no attempt at this part having presumably run out of time or having not found a value for α previously.

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