Level 3 Certificate

Quantitative Problem Solving (MEI)

OCR Level 3 Certificate Quantitative Problem Solving **H867**

OCR Report to Centres June 2017

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This report on the examination provides information on the performance of candidates which it is hoped will be useful to teachers in their preparation of candidates for future examinations. It is intended to be constructive and informative and to promote better understanding of the specification content, of the operation of the scheme of assessment and of the application of assessment criteria.

Reports should be read in conjunction with the published question papers and mark schemes for the examination.

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OCR REPORT TO CENTRES

01 Introduction to Quantitative Reasoning

General Comments:

This is the second time that this qualification was examined, and candidates seemed better prepared to tackle the questions. Candidates generally scored well with percentages, drawing and interpreting charts and tables and estimating calculations. Conversion of metric units and working with numbers in standard form continue to cause difficulties as did distinguishing between situations involving repeated percentage change and those that were more straightforward. Candidates seemed better prepared to interpret their answers in the context of the question. Many candidates could have done better if brief comments indicating or clarifying their thinking were included with their calculations and if better use was made of $\approx$ in problems involving numerical estimation. Some candidates used the blank spaces rather than the answer boxes for their answer and Examiners had to search for their work.

Comments on Individual Questions:

Question No.

Q1(i) and (ii). Many good answers were seen to parts (i) and (ii). Some candidates did not recall that there are 52 weeks in a year, with many using $4 \times 12 = 48$ weeks which lost the final A mark. A number of candidates divided the percentage by 52 and changed the situation into one involving compound interest, losing most of the marks.

Q1(iii) The answer was given in this question and some candidates who had an understanding of the problem did not include "1 in …" and lost the final mark. Marks could have been improved for some by indicating that $500\,000^2 \approx 253$ billion. Some good answers were seen using a tree diagram but many used 1 in 253 billion as the probability on the second branch. Others had clearly prepared for a question which asked them to calculate the probability of winning the lottery and included this even though it did not relate to the question.

Q2(i) Most candidates were able to interpret the correlation between deprivation scores and smoking prevalence but many phrased their answer in such a way that a causality was stated or implied.

Q2 (ii), (iii) and (iv). Candidates mostly understood what was required of them and the ranges of acceptable values gave credit to candidates who understood the question but did not read the scale accurately. Some lost method marks by not indicating that they were attempting to subtract the lower quartile from the upper quartile, and some candidates performed the order of operations incorrectly in (iv).

Q2(v) Candidates were not always clear that they were looking for evidence of variability and some just repeated their answer to (i).

Q3(i), (ii) and (iii) Almost all candidates could read the information from the tables and most had a correct graph. Some lost a mark for not joining their points.

Q3(iv) The intention here was that candidates work with integers throughout and the mark scheme reflected this. Marks were often lost by candidates who assumed that the instruction not to use a calculator meant that long multiplication was being tested, and they were awarded only 2 marks out of 5.

Q4(i) Many candidates did not grasp that they were asked to comment on house prices which were falling until Feb09 and then increasing. Much detail was given about the variations in percentage changes which received no credit.

Q4(ii) This was quite well answered even by candidates who did not score well in (i).

Q4(iii) This question can neatly be answered using the multiplier method and many good answers were seen. Some candidates only used one percentage change scoring 1 of 4 marks. There were many candidates who used "$\times$ 1.7" , "÷ 0.017", and "÷ 0.983" showing that the multiplier method is not always well understood. Candidates did not always notice that their answers were not sensible values in the context.

Q4(iv) Most gained at least partial credit; common errors involved re-stating a correct reason they had already given. A noticeable number, quite correctly thought that Hanna might have damaged her house resulting in a fall in value or improved it resulting in a rise in value. Responses involving errors in the chart etc. did not gain credit.

Q5(i) and (ii) Usually well answered although some gave the reason in (ii) as "that's too much for a sandwich" which is the answer to a different question. Some lost marks by giving two age ranges, not picking up on the singular wording of the question.

Q5(iii) and (iv) Not many candidates picked up that this was a standard question of calculating the mean from a grouped frequency. Many got 1 mark for the total frequency but then used it inappropriately to try to obtain a sensible value. Many gave the modal class as their answer.

Q5(v) Most candidates were able to get 3 of 5 marks here, but many failed to see the pattern in the values and so had a line of incorrect answers.

Q5(vi) Many candidates did not notice that there was an error in the question, and gave the formula for cell C2. Some gave the formula for the number sold per day (cell B2) which also gained full credit. Where a candidate indicated that there was an error in the question, they automatically were given full marks as a special case. Overall, candidates scored slightly better in (vi) than in (vii) which suggests that not many candidates were disadvantaged by the error.

Q5(vii) Most candidates gave a formula containing A2*B2 for 1 mark but many lost the second mark either by omitting the = or by having D2 = at the start of the formula. Any formula that could be dragged down successfully was awarded full credit, typically with the inclusion of $ or brackets.

Q5(viii) and (ix) Follow through was allowed from an incorrect table in part (v) so most students were awarded a mark in (viii). The expected method (880 $\times$ 20) – 8000 = £9600 profit per month was often not seen and candidates began again calculating the profit, often including the cost of making the sandwiches twice, or omitting it altogether. The final mark was allowed from an incorrect value of profit providing there was a calculation involving income and costs.

Q6(i) This question caused a good deal of difficulty as most candidates did not seem to know the conversion factor from cm^3 to m^3. Further difficulties were caused as there was a lack of clarity in the working where a few words to explain their working may have helped. Candidates had not anticipated this question from the pre-release material so were unprepared for it.

Q6(ii) This was the most difficult question on the paper and was omitted altogether by many candidates. Candidates who worked throughout in cm^3 were the most successful. One mark was given for finding the surface area of the lake in any unit, and the first method mark for dividing the volume by the surface area in any unit. Candidates were required to be very clear how the given answer in cm had been obtained, so some candidates who claimed the given answer did not get full marks.

Q6(iii) This was intended to be answered using multipliers, and was done quite simply by many candidates. Those who worked with the volume of the lake and reduced the volume three times often made errors with the large numbers involved. Quite a large number of candidates simply added the values, showing a flawed understanding of percentage change.

Q6(iv) Only half the candidates chose the correct graph here, many choosing the linear graph instead.

Q6(v) Many instances of a correct trial and improvement method gained full credit, but some did not write down enough evidence that n = 9 was not enough and only that n = 10 was the solution. Some credit was given to candidates who had an incorrect indicial equation but had a valid method to try and solve it. Many candidates who had chosen the linear graph in (iv) simply divided 50 by 7.

Q6(vi) Most sensible comments were credited but we did not allow “same glacier” nor “same units”.

02 Statistical Problem Solving

General Comments:

Most candidates attempted all the questions on the paper and it was pleasing to see that a vast majority had benefitted from doing the course. They engaged with the questions well and were able to show what they could do; there were very few answers left blank. Calculations were generally done well. There were many very good attempts to interpret and comment on the results; however, many candidates still lack the technical language skills to express their comments clearly.

A few of the questions proved a good challenge for the strong candidates. Overall the paper seemed to be approachable, but quite demanding at the top end. Areas that seemed particularly challenging were interpretation of normal probability plots, and making a clear distinction between a population and a sample.

Future candidates should be encouraged to use technical terms with their correct, precise meaning, rather than simply as a replacement for informal terms. In this paper we often saw imprecise use of terms ‘correlation’, ‘line of best fit’, ‘skew’ and ‘outlier’. They should also be careful to answer exactly the question asked; for example, if they are asked for a conclusion based on a graph, they should not attempt to produce an explanation based on a different source of information, or on their everyday experience. Having said that, Examiners prefer to see an attempt at an answer rather than blank answer spaces, even if it proves to be incorrect.

Comments on Individual Questions:

Question No. 1

Almost all candidates scored marks in this question about the proposed closure of a tourist information centre. In part i(*A*) they were required to find numbers for a stratified sample of local businesses and many scored full marks for this; a common mistake was to assign equal numbers to each stratum. The majority of candidates were able to correctly name stratified sample in part (i)(*B*), although there was still a variety of incorrect answers. In part (ii) almost all candidates obtained the answer £77 000 for the cost to those in the sample, but very few realised that the question was asking for the total cost to all businesses.

The final part asked for reasons why the cost might be overestimated; there were some very good answers to this but also many that explained why it might be inaccurate (for example, due to rounding) rather than too great (because of deliberate exaggeration in order to discourage the closing of the tourist information centre).

Question No. 2

The first two parts of this question involved a test for positive association between systolic and diastolic blood pressures using Spearman's rank correlation coefficient. There were many good answers to this; the most common mistake was to use a 2-tail test. Candidates need to be careful when stating the hypotheses: the null hypothesis is that there is no association, not that there is *no positive* association. The question was structured so that part (i) asked for the calculation of the correlation coefficient and part (ii) for the hypothesis test. Many candidates worked “on automatic” and did not split their answer correctly over the two parts of the answer space. This was not penalised, but indicates that they should think more carefully about the different steps of a hypothesis test.

Part (iii) asked for comments on a graph showing an individual's systolic pressure over time and this was very well answered. Part (iv) required them to infer what could be said about the diastolic pressure; the expected answer was that it will follow a similar pattern to the systolic pressure, because of the positive association established in part (i). Although many candidates understood this point, a significant minority did not give a reason for their answer. Furthermore, some did not make it clear whether they were talking about the diastolic or the systolic pressure, referring simply to "the blood pressure".

In both parts (iii) and (iv) candidates should note that the questions explicitly asked for an inference about the pressure from the graph; many tried to speculate about the effect of diet and exercise on Simon's blood pressure, which can clearly not be seen from the graph alone.

Question No. 3

This question involved a chi squared test on a contingency table. The context was birds dying from ingesting poison from dead rats. Most candidates were able to obtain the correct numbers in parts (i) and (ii). Answers to part (iii), which asked for the conclusion from the test, were less complete; many seemed to use a critical value for a Spearman's or Pearson's table, or referred to 'correlation' in their answer. (The correct answer was that the test was significant, or that there was evidence to reject H_0.)

The interpretation of the test result was required in part (iv). This proved to be one of the most challenging questions on the paper. The correct interpretation was that the poison does not affect all birds to the same extent; it is possible that many more candidates realised this than were able to express clearly. Many referred to an association between the rat poison and the number of dead birds, or the number of birds and the area. The data also shows that owls are most affected by the poison; a large number of answers stated that crows were most affected because they give the largest contribution to the chi squared statistic; however, this contribution was in the 'low' column.

As in Q.2, many did not distinguish clearly between the chi squared calculation and the test; again, this was not penalised.

Questions 4, 5 and 6 were based on the pre-release data set.

Question No. 4

In part (a) candidates were asked to find the total GDP of the Cayman Islands to the nearest million US$. Most found the relevant data and used the figures correctly but many of them then failed to round the answer or rounded it incorrectly.

In part (b) candidates were given the death rate for Iceland and asked to find the change in population over one year. This required them to find the population from the data set and also the birth rate; a common mistake was to ignore the births. In the last part, candidates were asked about their assumptions. The expected answer was that there had been no emigration or immigration but only a few gave this; some attempted to justify their earlier work by saying there had been no births in Iceland that year. Some also mentioned assumptions about the death rate being constant or not changing from year to year; they did not realise that this data is from the past and therefore can be taken as correct.

Question No. 5

This question started with interpretation of a Normal probability plot for the life expectancies of countries in mainland Sub-Saharan Africa. In the first part they had to identify two particular countries on the given graph and most candidates did this successfully.

In the second part they were asked to comment on the suitability of a normal distribution model based on the graph; this made it clear that many candidates think that the line on a normal probability plot is a "line of best fit". Moreover, the term 'outlier' was often seen in relation to the points which do not lie on the line; this is incorrect in this context. The examiners marked this part on the basis of what candidates were trying to say.

In part (iii) candidates were asked to show that none of the countries had a life expectancy that was more than 2 standard deviations from the mean, and to work out how many would be expected if the distribution was truly Normal. Here most candidates showed that they did understand that the vertical axis on the normal probability plot represents the number of standard deviations from the mean, resulting in many sensible attempts at the first request. In order to score the mark they needed to write an explanation in words, rather than just doing a calculation. There were fewer correct answers to the second request, which relied on the knowledge that, in a normal distribution, 95% of data is expected to lie within two standard deviations of the mean.

The next two parts, (iv) and (v), involved comparing the distribution of life expectancies in Europe with those in Africa and these parts were quite well answered. In the final part, (vi), candidates were asked to consider the effect of the different life expectancies for Eastern and Western Europe on the distribution for Europe as a whole; stronger candidates recognised that this was the cause of the bimodality of the distribution. It was common to see 'skew' – another technical word – used imprecisely here.

This whole question involved a lot of interpretation and it was pleasing to see that most candidates followed it through, making plausible attempts at all the parts.

Question No. 6

This question looked at the ratio of countries' physician density to their GDP per capita. Some of the interpretation required was quite challenging, but it was pleasing to see so many candidates engage with the question and try to draw on their general knowledge in order to produce sensible comments.

Part (i) involved setting up the ratio for the OPEC countries which were taken as a sample; most candidates were successful on it. In part (ii), Nigeria was taken as an example. It has the lowest GDP per capita of the OPEC countries and one of the lower absolute physician densities, but actually scores quite highly on the physician density relative to the GDP. Most candidates realised the first two points but struggled with the third. Similarly, very few were able to answer part (iii), which asked them to explain what the measure '*M*' showed.

In part (iv) they were presented with a scatter diagram on which they had to identify one particular country, draw a line of best fit and relate it to the measure they had been working with earlier in the question. Many did not attempt the last of these demands, possibly not even realising that they were supposed to estimate the gradient of the line.

In the final part candidates were given the value of the PMCC for all countries for the two variables they had been working with (physician density and GDP per capita) and asked to interpret it; this proved rather challenging but also produced some very good answers.

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