RECOGNISING ACHIEVEMENT

GCE

Statistics (MEI)

Advanced Subsidiary GCE **AS H132**

OCR Report to Centres

June 2012

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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.

OCR will not enter into any discussion or correspondence in connection with this report.

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OCR REPORT TO CENTRES

G241 Statistics 1

General Comments

The level of difficulty of the paper appeared to be appropriate and there was no evidence of candidates being unable to complete the paper in the allocated time. Many candidates were well prepared but a number struggled to handle even the more standard parts of questions. Most candidates supported their numerical answers with appropriate explanations and working.

It is pleasing to report that the hypothesis test question was generally answered very well, with most candidates not only giving their hypotheses in terms of *p* but also defining *p* as the probability of a bike frame being faulty. Most candidates also included an element of doubt in their conclusion saying eg. 'There is sufficient evidence to suggest that the proportion of faulty frames has increased'. Unfortunately most candidates lost marks due to over specification of some of their answers, despite recent examiners' reports warning against this. Particular examples are given in the comments on 6(iii) and 6(v) below.

The comments below on individual questions are based on candidate responses to both 4766 and G241.

Comments on Individual Questions

1) (i) The majority of candidates gained full marks in this part. However a significant number completed this question as if the bulbs were replaced before each choice. This was given 1 mark out of the 3 available.

1) (ii) Once again the majority of candidates gained at least 2 marks out of 3. Those who answered by finding the P(2 blue and one red) and adding it to P(2 red and one blue) were in the majority, but were less successful than those who found 1 – (P(3 red) + P(3 blue)). This was due to the omission of the 3 possible arrangements of each probability.

2) (i) Again the majority of candidates gained full marks. A fairly common error was to add rather than multiply ${}^9C_3$ and ${}^5C_3$. A small number of candidates tried to use permutations rather than combinations.

2) (ii) Many candidates gained full credit for dividing their answer to part (i), correct or not, by 3003. Those who did not see the connection with part (i) did not fare so well, and even if they found the correct product of fractions they rarely multiplied this by ${}^6C_3$.

3) (i) This question was very well answered, with most candidates scoring all 3 marks.

3) (ii) Many fully correct responses were seen, although a number of candidates calculated P(X<29) or P(X≤29) rather than P(X≥29).

3) (iii) Many candidates gained full credit here, even if as a follow through from their answer to part (ii). A common error was to multiply their answer to part (ii) by 30 or 300 instead of by 10. A number of candidates also rounded their answer to a whole number, thereby losing the second mark.

4) (i)(*A*) Most candidates scored full marks, but a significant number scored zero. Candidates needed to multiply 0.92^2 by 0.08, but a significant number simply worked out 0.08^3, which gained no credit.

4) (i)(*B*) In this part candidates needed to multiply 0.92 by 0.08 then add this product to their answer to part (i). This was often achieved successfully, but a number of candidates gave their answer to 6 significant figures, thus losing the second mark.

4) (ii) Many fully correct responses were seen. Most other candidates gained no credit as they had no real idea of what was required.

5) Many candidates were awarded at least 7 out of the 8 marks available. The hypotheses were generally correct and well defined but a minority of candidates still omitted a definition of p. Only a small number of candidates incorrectly used point probabilities. Many candidates used the first method in the scheme, usually successfully. A smaller number used the critical region method, again fairly successfully, but a number thought that the critical region started at 3. Some candidates who used the critical region method, failed to justify their critical region. In this case they were only eligible for the first 3 marks for the hypotheses.

6) (i) On the whole, this question was answered well, with a very high proportion of candidates calculating the frequency densities correctly. Of those candidates who did not calculate the FD correctly, most achieved 1 mark for the correct widths. There were very few inequality labels on the x axis. However, candidates should be reminded that they need to label the vertical axis. Drawing of the bars was done well although a few candidates struggled to draw a bar of height 0.0035.

6) (ii) Many candidates thought that the calculation involved subtraction rather than addition and even when the calculation was correct, there was often no element of doubt to their conclusion.

6) (iii) On the whole this question was very well answered. It was extremely common to award 4 marks in total, due to the over specification of answers. Many candidates gave the exact answer 1890.625, but an element of sensible rounding, to say 1891 or even 1890, was looked for. A significant number did not find the standard deviation correctly, sometimes giving the root mean square deviation or calculating $(fx)^2$ rather than fx^2. The explanation mark was very well answered.

6) (iv) Again this was also very well answered. Even candidates who had made errors in the previous part usually gained follow through marks. Most candidates knew that the limits for outliers were mean $\pm$ 2 standard deviations. A number of candidates did not include an element of doubt in their conclusion about the number of outliers and thus were not awarded the final mark.

6) (v) The modal mark in this question was 2 out of 3, scored by approximately 2/3 of the candidature. This was due to candidates over specifying their answer, giving it as 781250000 rather than for example 780000000. Candidates who were unsure how to do this part nevertheless usually gained a method mark for multiplying by 1000.

6) (vi) Where candidates achieved this mark, they often realised that the duty would reduce the sales of larger cars. They also achieved this mark where they stated that the sample may not be representative, although this needed to be very clearly stated for the mark to be awarded. A number of candidates erroneously stated that people would refuse to pay the duty.

7) (i) This part was very well answered.

7) (ii) Again many fully correct responses were seen. Many other candidates scored 1 mark out of 4 for finding $0.6 \times 0.5^4 = 0.0375$. Some candidates multiplied 0.6×0.5^4 or 0.4×0.5^4 or indeed both by ${}^5C_1$ rather than by ${}^4C_1$.

7) (iii) Approximately half of candidates scored full marks in this part. However many lost one or both marks for a number of errors – a non linear vertical scale, one or both labels missing, heights incorrect (particularly the final height), or less often a frequency polygon or a point plot. Candidates should be advised to use a ruler in questions such as this.

7) (iv) Again approximately half of candidates scored the mark here. The most popular answer was 'slightly negative', but some said positive skew or symmetrical and/or unimodal.

7) (v) There were very many correct answers, with even the weakest candidates often scoring full marks. Arithmetic errors were common often because of writing the probabilities incorrectly as eg 0.375 rather than 0.0375. Only a few candidates left the variance as 8 or did not square E(X). Very few incorrectly divided by 5, unlike in previous sessions.

7) (vi) Candidates needed to have a very good understanding of probability to gain marks in this part. However, some got 1, 2 or 3 products of probabilities correct but very few had the coefficients correct.

G242 Statistics 2

General Comments

Many candidates showed good ability to apply their statistical knowledge and performed particularly well on the hypothesis tests, though the goodness of fit test was not completed as successfully as the Wilcoxon test or the chi-squared test for association. Many candidates lacked the knowledge of different modelling assumptions and properties of probability distributions needed to be able to tackle the questions requiring explanation. Some candidates did not read questions carefully enough to take advantage of the instructions given.

Comments on Individual Questions

1) (i) Few candidates supplied adequate justification for the use of a binomial model.

1) (ii) Many candidates identified the correct parameter but did not provide a correct reason for the appropriateness of the Poisson model.

1) (iii) Many followed the instructions to use the Poisson approximating distribution. Others opted to attempt to use a binomial distribution. Of those using the correct distribution, many scored 2/2 but some evaluated $P(X = 3)$ or $1 – P(X \leq 3)$ for $P(X \geq 3)$.

1) (iv) Many fully correct answers were seen. Most candidates knew what was required.

1) (v) Many candidates tackled this question well. For those familiar with the chi-squared goodness of fit test, the main source of lost marks was through providing incorrect or overly assertive conclusions.

2) (i) This was well answered by most candidates.

2) (ii) This question was, on the whole, well answered with many gaining full marks. Some candidates did not standardise correctly, using variance in place of standard deviation.

2) (iii) Few correct answers were seen. Many candidates realised that the sample, being a subset of the population, would likely produce a different mean to the population mean.

2) (iv) Few candidates were familiar with the term ‘standard error’.

2) (v) Many candidates attempted a Normal probability calculation here. Few fully correct responses were seen. Many of those attempting the calculation standardised incorrectly. Some did not use the Normal table with sufficient accuracy.

2) (vi) Very few candidates could give the correct reason as to why it was not necessary to apply the Central Limit Theorem.

3) (i) This question proved to be a rich source of marks for many candidates. Many candidates managed to identify at least one of the necessary assumptions. Most provided appropriate hypotheses involving a median, but few referred to 'population median'. The majority of those who managed to rank their differences between sample values and population median went on to secure most of the remaining marks, though mistakes were seen in some scripts and some final conclusions were either incorrect, overly assertive or did not refer back to the context of the question.

3) (ii) Few candidates provided a correct response.

3) (iii) Few correct responses were seen. Many provided general comments relating to sample size rather than focussing on necessary assumptions.

4) (i) Most candidates answered this well. Some lost a mark through providing the standard deviation correct to 5 or more significant figures. Some missed the instruction to 'show that the sample mean is 239' and simply quoted the figure given.

4) (ii) Some candidates were able to explain, with reference to the data, whether or not they thought the sample could have an underlying Normal distribution.

4) (iii) Many candidates were familiar with the structure of a confidence interval. Of these, many based their interval on the Normal distribution rather than the *t* distribution despite this being indicated in the question. Some of those using the *t* distribution over-specified their answers, giving 6 or more significant figures. Some candidates interpreted the instruction 'obtain a 95% confidence interval' to mean 'carry out a hypothesis test'.

4) (iv) Few candidates scored 3/3 in this question. Many of those who obtained a confidence interval in part (iii) used it appropriately to gain credit.

4) (v) Most recognised that the small sample was reason to support the use of a *t* distribution. Many also recognised that the population variance being unknown provided further support.

5) (i) This question was well answered and a rich source of marks for most candidates. Many scored at least 10/11. Other than making mistakes in calculations, reasons for losing marks commonly included use of incorrect hypotheses, over-assertive conclusions and stating the wrong value for the number of degrees of freedom.

5) (ii) Some candidates correctly explained the relevance of the indicated contribution to the outcome of the hypothesis. Many provided comments based only on the context of the question. In such questions, candidates should aim to provide statistically based comments.

5) (iii) Most candidates connected medium pesticide use as showing least association with change in population. Many provided a correct reason to support their decision.

G243 Statistics 3

General Comments

The level of difficulty of the paper appeared to be appropriate for the candidates and there was no evidence of candidates being unable to complete the paper in the allocated time. Although many candidates did well, a significant number gained relatively few marks. In general, candidates supported their numerical answers with appropriate explanations and working, although in questions requiring discussion it was sometimes difficult to work out what the candidate meant.

Many candidates lost marks because they gave their hypotheses in words and failed to mention 'population'. In tests for the mean or for Pearson's product moment correlation coefficient candidates should use parameters μ and ρ and of course define these as population mean or population product moment correlation coefficient. Rather fewer candidates than last year lost marks because their answers were too assertive. Questions 1 and 2 were found to be more difficult than questions 3 and 4 with many candidates scoring most of the marks in question 3.

Comments on Individual Questions

1) (i) Although some candidates gained full credit, most omitted one or two of the three essentials specified in the mark scheme. A number of candidates described random rather than systematic sampling.

1) (ii) Few candidates scored marks for correct hypotheses as most either gave them in words without mentioning population or referred to μ_1 and μ_2 rather than μ_D. However most candidates did actually carry out a paired comparison *t* test. The majority of candidates then found the test statistic correctly, but a few made an error in finding the critical value.

1) (iii) Many correct answers were seen, but some candidates just mentioned a Wilcoxon test without specifying whether signed rank or rank sum, losing a mark. Some weaker candidates mentioned random and/or independent.

2) (i) A number of candidates incorrectly thought that the two samples were paired. Others discussed spurious factors such as variance or whether the populations were Normally distributed. However, a good number of fully correct answers were seen.

2) (ii) Although some fully correct responses were seen, many candidates performed a Wilcoxon signed rank test, presumably mistakenly thinking that the data were paired.

2) (iii) This was mostly answered correctly.

2) (iv) Some fully correct answers were seen, but many candidates thought that the variances needed to be known.

3) (i) This again was mostly answered correctly although a number of candidates lost a mark for over specifying their answer.

3) (ii) Although a good number of essentially correct responses were seen, most candidates did not define rho as the population correlation coefficient and thus lost a mark. Some candidates lost marks by giving their hypotheses in words without mentioning population. A number did not give their conclusion in context, thus losing the final mark.

3) (iii) This was answered reasonably well although some candidates clearly did not know the requirement for the test, or how to check its validity, often mentioning a line of best fit.

3) (iv) Many candidates were able to gain the mark here for explaining why a hypothesis test was unnecessary. A few incorrectly tried to compare 0.291 with the critical value from part (ii).

3) (v) Approximately half of the candidature gave a response similar to that in the mark scheme, some suggesting a third variable and others not. Some omitted 'Correlation does not imply causation', but if they suggested a third variable, they could still gain full credit.

4) (i) A good number of fully correct responses were seen, although some just described Treatment D as a Control, without describing its purpose. Others did not mention 'Control' but if they clearly explained the purpose, they were able to gain full credit.

4) (ii) Most candidates gained a mark for stating that the sample is too small and many also gained a mark for stating that some of the people may have a worse cold than others (or equivalent). Very few mentioned that the experiment is not replicated so one cannot gain any knowledge of variability.

4) (iii) Many candidates gained one mark by stating that this is a distinct improvement on the suggestion in part (ii) (or equivalent) but rather less gained the second mark.

4) (iv) Although very few candidates gained both marks, a very common response was 'to avoid any bias' (or equivalent) which gained one mark.

4) (v) This was generally well answered.

4) (vi) Many correct responses were seen, with candidates often discussing 'psychological effects'.

4) (vii) This was generally fairly well answered with candidates often gaining most of the marks available. A few failed to define the parameter μ, thus losing a mark. However a number of candidates tried to find a pooled estimate for sample variance and thus failed to gain any credit other than possibly for the hypotheses.

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