RECOGNISING ACHIEVEMENT

GCE

Statistics (MEI)

Advanced Subsidiary GCE **AS H132**

Report on the Units

June 2007

H132/MS/R/07

Oxford Cambridge and RSA Examinations

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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 syllabus 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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G241 (Z1) and 4766 Statistics 1

General Comments

The paper attracted a fairly wide range of responses, although there were relatively few scripts with very low scores. There was no evidence to suggest that candidates had insufficient time to attempt all questions. As in recent sessions, answers were often well presented but once again many candidates did not appear to appreciate the implications of using rounded answers in subsequent calculations.

Good answers were seen from many candidates in questions 1, 2, 3(i),(ii), 4(i),(ii), 5(i), 6, 7(i)-(iii) and 8(i),(ii). Candidates' work on Venn diagrams was much better than in recent papers, although in this paper candidates had to use a given diagram, rather than complete their own and perhaps this assisted them to perform well.

Candidates' responses to Q3(iii) suggest that more attention should be given to finding mean and standard deviation of transformed data. Calculation and interpretation of conditional probability as in Q7 continues to cause difficulties. In hypothesis testing, the work generally continues to improve; the use of point probabilities rather than tail probabilities seems to be declining, although many candidates are still not meeting the requirement to define p in words. There were a number of centres where candidates who scored well on the rest of the paper appeared to have minimal knowledge of hypothesis testing, possibly suggesting that this topic has only been covered superficially.

Comments on Individual Questions

Section A

1 Album tracks; combinations and arrangements

(i) Many totally correct answers were seen although candidates occasionally evaluated $^8P_4$.

(ii) Again very many correct answers were seen with the most frequent error being an answer of 16, often from 4^2.

2 Customer spending; frequency table and total from histogram.

(i) Most candidates correctly stated the group limits, although occasionally boundaries such as 19 or 21 instead of 20 were seen. Answers to the frequencies were less successful with a significant number of candidates giving the frequency density in place of frequency or doubling or halving each frequency.

(ii) Most candidates realised the necessity for finding the sum of the frequencies multiplied by the interval mid-point, although a few simply gave the sum of the frequencies as their answer. Others multiplied the mid-points by the frequency density. A few decided that the question required an estimation of the mean amount of money spent.

3 Exam marks; mean, standard deviation, outliers, linear transformation.

(i) Virtually all candidates obtained the mean correctly although some were less successful with the standard deviation. Errors here included use of an incorrect formula for S_{xx} but only occasionally division by *n* rather than (*n*-1).

(ii) There were many fully correct answers although there was occasionally use of 1.5*s* rather than 2*s*.

(iii) Many candidates were totally successful with the mean and standard deviation of the scaled data. The most frequent error was to calculate $s_y = 1.2s_x – 10$ instead of $s_y = 1.2s_x$. Some candidates decided to calculate the transformed summary statistics and then use these to find the new mean and standard deviation. Quite often this did lead to a correct new mean but almost without exception they were unable to adapt this approach to find the new standard deviation. The fact that only 2 marks were available should have alerted candidates that this did not warrant a further 2 pages of calculations.

4 Recycling; Venn diagram, conditional probability.

(i) Most candidates answered both parts entirely correctly, demonstrating their abilities to correctly read and interpret a Venn diagram.

(ii) A pleasing number of correct answers were seen to a question on a topic which candidates often struggle with. The idea was to use the Venn diagram to write down the probability without any calculation, but some chose to use the conditional probability formula which was of course equally acceptable. There was nonetheless a variety of errors leading to answers such as 13/50, 11/50 and 24/50, effectively missing the conditional nature of the question.

(iii) Correct answers to this part were conspicuous by their absence. Invariably answers such as 2 × 18/50 × 32/50 or 18/50 × 32/50 were given, with candidates not realizing that the second selection was from 49. Indeed sight of a second fraction with a denominator of 49 was a rarity, even from very high scoring candidates. This type of decreasing probability question has been set many times in the past and candidates should ask themselves a simple question – are the events independent or dependent?

5 Rainfall and global warming, median and interquartile range, discussion.

(i) A considerable proportion of candidates stated that the 11^{th} value was the median rather than the average of the 11^{th} and 12^{th}. They were more successful with the interquartile range although the use of (7+1)/2 for the lower quartile was not unusual. A very few candidates treated the data as continuous and constructed a cumulative frequency curve, gaining no credit.

(ii) Full marks in this part were very rare. Many candidates, even those who overall scored highly, answered this as a question about summer rainfall, ignoring all reference to global warming being the cause. Such candidates thought that the conclusion was valid based on the median falling by 1 day and the IQR staying the same. This gained no credit.

6 Telephone competition; probability, calculation of E(*X*) and Var(*X*).

(i) Most candidates answered correctly, either by using a probability argument or by considering combinations. A few tried to justify the given value by using the other probabilities given in the table.

(ii) Most candidates calculated both expectation and variance correctly, although some inaccuracy was seen when candidates used decimal probabilities. Some candidates correctly found $E(X^2)$ thus scoring some credit, but then omitted the subtraction of $[E(X)]^2$ or used $[E(X)]$ only in calculating $Var(X)$. There are still some candidates who insist in dividing either $E(X)$ or $Var(X)$ or both by divisors n or (n-1). Such actions are penalised. Overall this question was a rich source of marks for many candidates.

Section B

7 Screening test; tree diagram, probability, conditional probability, interpretation.

(i) Almost all candidates gained all 4 marks here.

(ii) Again the vast majority of candidates were successful here.

(iii) Most candidates were again successful although a few multiplied instead of added the relevant products.

(iv) Many candidates were successful here although some candidates were unable to find this conditional probability. Common errors included answers of 0.0091, 0.0436/0.91, 0.0436/0.0091 and (0.0436 × 0.0091)/0.0436.

(v) The attempts at commenting on the answer to part iv) were very mixed with some candidates thinking that the larger the value of their answer, the more effective the test. A significant number of answers referred to a proportion of negative results rather than a proportion of those with the disease.

(vi) There were a few excellent answers but, without a complete tree diagram to assist them, most candidates failed to identify all the required possibilities. Common errors included partially correct answers such as 0.91 + 0.06 × 0.9 = 0.964, as well as entirely incorrect answers such as 0.91 × 0.99 + 0.06 × 0.9 = 0.9549.

8 Job applications; binomial distribution, expected frequency, highest probability, hypothesis test, critical region.

(i) Relatively few candidates were able to find this relatively straightforward upper tail probability correctly. Most failed to realise what was required by "at least". Answers of $P(X = 4) = 0.2093$, $P(X \geq 4) = 0.5489$ or 0.7582, $P(X \geq 4) = 1 - 0.2093$ or $= 1 - 0.7582$ appeared with regularity.

(ii) Most answers to part ii) were correct although few candidates resisted the urge to round their answer of 3.4 to an integer. Others insisted erroneously that $E(X) = 3$ or that $E(X) = 17 \times 0.4511$ (or their probability in part (i))

(iii) Answers to this part were disappointing, with many candidates stating that 3 was the most likely number of applicants as that value was closest to the expectation. Although the value with highest probability in the binomial distribution is close to the expectation, it is necessary to calculate probabilities both sides of the expectation to confirm the maximum. With 3 marks available, candidates should realise that more than this is required. Full credit could only be given when candidates had found both $P(X = 3)$ and $P(X = 4)$, (and also preferably $P(X=2)$) but some were content to make their judgement based on $P(X=3)$ alone. Those who did not calculate any probabilities earned no marks at all. Again this type of question has been set in the past and the required methodology has been commented on in previous reports.

(iv) Many candidates correctly stated their hypotheses in symbolic form. However, many incorrect notations were also seen. The required notation is clearly given in the mark scheme and candidates should be trained to use this, leading to a straightforward two marks. As in previous papers, still very few candidates realise the need to define the parameter '*p*' and thus most lose a third mark, even if they have stated their hypotheses correctly. Previous reports have referred to the importance of this. However the reason for the form of the alternative hypothesis was explained well by many candidates

(v) There was also an improvement here on earlier papers, with fewer candidates using point probabilities. However, a common error was to evaluate lower tail probabilities, despite having the correct upper tail hypothesis. Amongst candidates who did find an upper tail probability, a very common error was to state correctly that $P(X \geq 6) = 0.1057 > 5\%$ and $P(X \geq 7) = 0.0377 < 5\%$ before giving a wrong critical region of $X \geq 6$. Other answers obviously along the right lines failed to include any probabilities as justification, for example $P(X \geq k) < 0.05$, $P(X \leq k\text{-}1) > 0.95$, $k - 1 = 6$, $k = 7$, critical region is 7 and above. Candidates are expected to give numerical probabilistic justification for their answers. A further frequent omission was the failure to provide an explicit numerical comparison of the tail probabilities with the significance level of 5%, which again is always a requirement in hypothesis tests.

(vi) This was usually answered correctly by those candidates who had already shown an understanding of hypothesis testing in part (v).

G242 (Z2) Statistics 2

General Comments

This was the second sitting of this module and the second occasion on which the new award of AS Statistics was available. Again, a very small entry means that making general comments about the paper is difficult without the likelihood of identifying individual candidates. Hence, this report is brief and provides minimal detail.

The specification and the question papers and mark schemes are of course published separately. Teachers are warmly invited to study these and consider using this qualification as a support for the very many subjects where statistics is used as a tool. This does not exclude using the qualification alongside A-level mathematics (though the first module, which is common to this specification and to the MEI A/AS mathematics suite, naturally cannot be counted towards an award in both).

It is encouraging to see that, on the whole, the work submitted this year was noticeably better than last year. Candidates showed familiarity with the variety of statistical techniques required in this specification.

When preparing for this paper and other statistical examinations, candidates should familiarise themselves with the conditions under which specific distributions apply; they should also be prepared to support their explanations using the context in which the problems are set. When carrying out hypothesis tests, candidates should be able to provide appropriate hypotheses and define any symbols used – for example, if μ is used to represent a population mean then this should be stated. In hypothesis tests, candidates are expected to give conclusions using the context in which the problem is set. Conclusions should not be too definite; candidates should use phrases such as “the evidence suggests that” rather than “this proves that”.

Comments on Individual Questions

For the reason set out above, of avoiding the possibility of accidental identification of individual candidates, detailed comments on the candidates' work in the questions are not provided in this Report. Attention is again drawn to the published question paper and mark scheme. These will give a good indication of the nature of the questions that are asked and the sorts of answers that are expected.

G243 (Z3) Statistics 3

General Comments

This was the second sitting of this module and the second occasion on which the new award of AS Statistics was available. The entry was again extremely small; it is to be earnestly hoped that there will be a considerable increase. By the time this report is published, the MEI textbook supporting the AS Statistics specification should be available, and this will no doubt be helpful.

The small entry again presents difficulties in respect of this Report because of the paramount necessity to avoid the accidental possibility of identification of individual candidates. Therefore the Report is brief and couched only in general terms.

The specification and the question papers and mark schemes are of course published separately. Teachers are warmly invited to study these and consider using this qualification as a support for the very many subjects where statistics is used as a tool. This does not exclude using the qualification alongside A-level mathematics (though the first module, which is common to this specification and to the MEI A/AS mathematics suite, naturally cannot be counted towards an award in both).

The question paper consisted of four questions, all of which were to be attempted. Question 4 was longer than the others, following through a more extended line of enquiry with way-stages along the route. All this was in accordance with the specification.

It is pleasing that, on the whole, the work was, at the least, of a respectable standard – certainly better than last year. Two general criticisms that can be made are as follows. First, many candidates were too assertive in stating conclusions of statistical tests. No statistical test can prove that any hypothesis is right or wrong, no matter what level of significance is attained. It is correct to state that "the result is significant [or not significant, as the case may be] at [say] the 5% level", and candidates are indeed normally expected to say that. But a subsequent verbal conclusion in the context of the problem is usually expected, and this should contain phrases such as "there is evidence that ..." or "it seems that ..."; it is not correct to simply state, assertively, "and therefore the means are not equal" [or whatever the context is]. Secondly, many candidates were not sufficiently careful in distinguishing populations and samples; this is a key distinction, and recognising the importance of it is one of the central tenets of the specification.

Comments on Individual Questions

For the reason set out above, of avoiding the possibility of accidental identification of individual candidates, detailed comments on the candidates' work in the questions are not provided in this Report. Attention is again drawn to the published question paper and mark scheme. These will give a good indication of the nature of the questions that are asked and the sorts of answers that are expected.

Advanced Subsidiary GCE (MEI Statistics) (H132)
June 2007 Assessment Session

Unit Threshold Marks

Unit		Maximum Mark	a	b	c	d	e	u
G241	Raw	72	55	48	41	35	29	0
	UMS	100	80	70	60	50	40	0
G242	Raw	72	58	50	43	36	29	0
	UMS	100	80	70	60	50	40	0
G243	Raw	72	58	50	43	36	29	0
	UMS	100	80	70	60	50	40	0

Specification Aggregation Results

Overall threshold marks in UMS (i.e. after conversion of raw marks to uniform marks)

	Maximum Mark	A	B	C	D	E	U
H132	300	240	210	180	150	120	0

The cumulative percentage of candidates awarded each grade was as follows:

	A	B	C	D	E	U	Total Number of Candidates
H132	14.3	42.9	71.4	85.7	100	100	7

For a description of how UMS marks are calculated see;
www.ocr.org.uk/OCR/WebSite/docroot/understand/ums.jsp

Statistics are correct at the time of publication

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