

Mathematics (MEI)

Advanced Subsidiary GCE

Unit 4766: Statistics 1

Mark Scheme for June 2013

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This mark scheme is published as an aid to teachers and students, to indicate the requirements of the examination. It shows the basis on which marks were awarded by Examiners. It does not indicate the details of the discussions which took place at an Examiners' meeting before marking commenced.

All Examiners are instructed that alternative correct answers and unexpected approaches in candidates' scripts must be given marks that fairly reflect the relevant knowledge and skills demonstrated.

Mark schemes should be read in conjunction with the published question papers and the Report on the Examination.

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

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Annotations and abbreviations

| Annotation in scoris | Meaning |
|----------------------|-------------------------------|
| ✓ and ✗ | |
| BOD | Benefit of doubt |
| FT | Follow through |
| ISW | Ignore subsequent working |
| M0, M1 | Method mark awarded 0, 1 |
| A0, A1 | Accuracy mark awarded 0, 1 |
| B0, B1 | Independent mark awarded 0, 1 |
| SC | Special case |
| ^ | Omission sign |
| MR | Misread |
| Highlighting | |

| Other abbreviations in mark scheme | Meaning |
|------------------------------------|--|
| E1 | Mark for explaining |
| U1 | Mark for correct units |
| G1 | Mark for a correct feature on a graph |
| M1 dep* | Method mark dependent on a previous mark, indicated by * |
| cao | Correct answer only |
| oe | Or equivalent |
| rot | Rounded or truncated |
| soi | Seen or implied |
| www | Without wrong working |

Subject-specific Marking Instructions for GCE Mathematics (MEI) Statistics strand

- a. Annotations should be used whenever appropriate during your marking.

The A, M and B annotations must be used on your standardisation scripts for responses that are not awarded marks. It is vital that you annotate standardisation scripts fully to show how the marks have been awarded.

For subsequent marking you must make it clear how you have arrived at the mark you have awarded.

- b. An element of professional judgement is required in the marking of any written paper. Remember that the mark scheme assist in marking incorrect solutions. Correct *solutions* leading to correct answers are awarded full marks but work must be the answer alone, and answers that are given in the question, especially, must be validly obtained; key steps in the work must be looked at and anything unfamiliar must be investigated thoroughly.

Correct but unfamiliar or unexpected methods are often signalled by a correct result following an *apparently* incorrect method. Such methods must be carefully assessed. When a candidate adopts a method which does not correspond to the mark scheme, award marks in the spirit of the basic scheme; if you are in any doubt whatsoever (especially if several marks or candidates are involved) consult your Team Leader.

- c. The following types of marks are available.

M

A suitable method has been selected and *applied* in a manner which shows that the method is essentially understood and not usually lost for numerical errors, algebraic slips or errors in units. However, it is not usually sufficient for a candidate to show the intention of using some method or just to quote a formula; the formula or idea must be applied to the specific problem by substituting the relevant quantities into the formula. In some cases the nature of the errors allowed for the award of a mark is specified.

A

Accuracy mark, awarded for a correct answer or intermediate step correctly obtained. Accuracy marks cannot be given unless the associated Method mark is earned (or implied). Therefore M0 A1 cannot ever be awarded.

B

Mark for a correct result or statement independent of Method marks.

E

A given result is to be established or a result has to be explained. This usually requires more working or evidence than the result itself. Marks are awarded for the process of reaching a result, not just for the result itself. If a candidate reaches the correct result without showing any working, marks are usually awarded for the result only. If a candidate shows working but does not reach the correct result, marks are awarded for the working shown. If a candidate shows working and reaches the correct result, marks are awarded for both the working and the result. If a candidate shows working and reaches the correct result, but the working is incorrect, marks are awarded for the result only. If a candidate shows working and reaches the correct result, but the working is incorrect, marks are awarded for the result only. If a candidate shows working and reaches the correct result, but the working is incorrect, marks are awarded for the result only.

Unless otherwise indicated, marks once gained cannot subsequently be lost, eg wrong working following a correct answer is ignored. Sometimes this is reinforced in the mark scheme by the abbreviation isw. However, this would not apply if a candidate passes through the correct answer as part of a wrong argument.

- d. When a part of a question has two or more 'method' steps, the M marks are in principle independent unless the scheme indicates otherwise; and similarly where there are several B marks allocated. (The notation 'dep *' is used to indicate that a mark is dependent on an earlier, asterisked, mark in the scheme.) Of course, in practice it may happen that when a candidate is wrong in a part of a question, the work from there on is worthless so that no more marks can sensibly be given. On the other hand, if two or more steps are successfully run together by the candidate, the earlier marks are implied and full credit must be given.
- e. The abbreviation ft implies that the A or B mark indicated is allowed for work correctly following on from previously indicated correct work. Otherwise, A and B marks are given for correct work only — differences in notation are of course permitted. A (accuracy) mark is given for answers obtained from incorrect working. When A or B marks are awarded for work at an intermediate stage, there may be various alternatives that are equally acceptable. In such cases, exactly what is acceptable will be detailed in the mark scheme rationale. If this is not the case please consult your Team Leader.

Sometimes the answer to one part of a question is used in a later part of the same question. In this case, A marks will be awarded for 'follow through'. In such cases you must ensure that you refer back to the answer of the previous part question even if this is not the case. You may find it easier to mark follow through questions candidate-by-candidate rather than question-by-question.

- f. Wrong or missing units in an answer should not lead to the loss of a mark unless the scheme specifically indicates otherwise.

Candidates are expected to give numerical answers to an appropriate degree of accuracy. 3 significant figures may often be appropriate, but this always needs to be considered in the context of the problem in hand. For example, in quoting probabilities we generally expect *some* evidence of interpolation and so quotation to 4 decimal places will often be appropriate. But in other cases, 3 significant figures will always apply – quotations of the standard critical points for significance tests such as 1.96, 1.645, 2.576 (maybe even 1.96, 1.645, 2.576) will commonly suffice, especially if the calculated value of a test statistic is nowhere near any of these values. Sensible judgement should be exercised in such cases.

Discretion must also be exercised in the case of small variations in the degree of accuracy to which an answer is given. If 3 significant figures are expected (either because of an explicit instruction or because the general context of the question requires it) and 4 are given, loss of an accuracy ("A") mark is likely to be appropriate; but if 4 significant figures are given, this is not penalised. Likewise, answers which are slightly deviant from what is expected in a very minor manner (for example, 0.6418 given, after an attempt at interpolation, as 0.6417 was expected) should not be penalised. However, answers which are *grossly* over- or under-specified should normally result in the loss of a mark. This includes cases such as, for example, a value of a test statistic is (say) 2.128888446667 merely because that is the value that happened to come off the calculator. This rule, that this applies to answers that are given as final stages of calculations; intermediate working should usually be carried out to a greater degree of accuracy to avoid the danger of premature approximation.

The situation regarding any particular cases where the accuracy of the answer may be a marking issue should be detailed in the scheme rationale. If in doubt, contact your Team Leader.

g. Rules for replaced work

If a candidate attempts a question more than once, and indicates which attempt he/she wishes to be marked, then examiners should mark the candidate requests.

If there are two or more attempts at a question which have not been crossed out, examiners should mark what appears to be the (complete) attempt and ignore the others.

NB Follow these maths-specific instructions rather than those in the assessor handbook.

h. Genuine misreading (of numbers or symbols, occasionally even of text) occurs. If this results in the object and/or difficulty of the question being considerably changed, it is likely that all the marks for that question, or section of the question, will be lost. However, if the object and/or difficulty remain substantially unaltered; these cases are considered below.

The simple rule is that *all* method ("M") marks [and of course all independent ("B") marks] remain accessible but at least one accuracy ("A") mark does not. It is difficult to legislate in an overall sense beyond this global statement because misreads, even if the object and/or difficulty remains unchanged, can vary greatly in their effects. For example, a misread of 1.02 as 10.2 (perhaps a sample mean) may well be catastrophic; whereas a misread of 1.6748 as 1.6746 may have so slight an effect as to be unnoticeable in the candidate's work.

A misread should normally attract *some* penalty, though this would often be only 1 mark and should rarely be more. Commonly in sections of questions where there is a numerical answer either at the end of the section or at the end of a question (eg the value of a test statistic), this answer will have an "A" mark that may actually be designated as "cao" (correct answer only) and should be interpreted *strictly* – if the misread has led to failure to obtain this value, then this "A" mark must be withheld, even if marks have been earned. It will also often be the case that such a mark is implicitly "cao" even if not explicitly designated as such.

On the other hand, we commonly allow "fresh starts" within a question or part of question. For example, a follow-through value of a test statistic is generally allowed (and often explicitly stated as such within the marking scheme), so that the candidate can exhibit knowledge of how to compare it with a critical value and draw conclusions. Such "fresh starts" are not affected by misreads.

A misread may be of a symbol rather than a number – for example, an algebraic symbol in a mathematical expression or formula is more likely to bring about a considerable change in the object and/or difficulty of the question; but, if they do not, they should be treated as far as possible in the same way as numerical misreads, *mutatis mutandis*. This also applies to misreads of text, which can cause major problems in fair marking.

The situation regarding any particular cases that arise while you are marking for which you feel you need detailed guidance should be discussed with your Team Leader.

Note that a miscopy of the candidate's own working is not a misread but an accuracy error.

| Question | Answer | Marks | | |
|----------|---|--|--|--|
| 1 (i) | $\text{Mean} = \frac{24940}{100} = 249.4\text{g or } 249\text{g}$ $S_{xx} = 6240780 - \frac{24940^2}{100} = 20744$ $s = \sqrt{\frac{20744}{99}} = \sqrt{209.53} = 14.4751 = 14.5\text{g}$ | B1 M1 A1 [3] | Ignore units For S_{xx} CAO ignore units | CA NB 24 specifica M1 for 6240 BUT NOTE M For s^2 of 210 (o with or witho For RMSD of 1 M1A0 provide For RMSD ² of 2 M1A0 provide Allow 14.48 bu |
| 1 (ii) | $\text{New mean} = (0.9 \times 249.4) - 15 = 209.5\text{g}$ $\text{New sd} = 0.9 \times 14.48 = 13.03\text{g}$ | B1 M1 A1 [3] | FT their mean provided answer is positive FT their sd FT Allow 13.0 to 13.1 | If candidate 'sta marks for CAO Allow 209 Or for $0.9^2 \times 14.5$ Deduct at most question for ove and 1 mark ove |

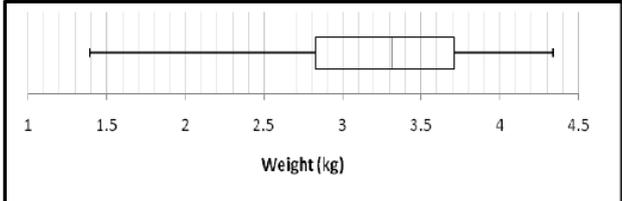
| Question | Answer | Marks | | |
|----------|--|--|---|--|
| 2 (i) | $3 \times \frac{5}{10} \times \frac{4}{9} \times \frac{5}{8} = \frac{300}{720} = \frac{5}{12} = (0.4167)$ <p>Or</p> $\frac{\binom{5}{2} \times \binom{5}{1}}{\binom{10}{3}} = \frac{10 \times 5}{120} = \frac{5}{12}$ | M1 M1 M1 A1 [4] M1* M1* M1* dep A1 | For $5/10 \times 4/9$ For $\times 5/8$ For $3 \times$ triple product CAO (Fully simplified) For $\binom{5}{2} \times \binom{5}{1}$ For $\binom{10}{3}$ For whole fraction CAO (Fully simplified) | Correct working divided by some M1M1M1 Zero for bin Allow M2 for $\frac{5}{10} \times \frac{5}{9} \times \frac{4}{8}$ Or 3 separate ec Answer must be Seen Seen Correct working divided by some M1M1M0A0 |
| 2 (ii) | $4 \times \frac{7}{12} \times \left(\frac{5}{12}\right)^3 + \left(\frac{5}{12}\right)^4$ $= 0.169 + 0.030 = 0.199$ <p>Or = $\frac{875}{5184} + \frac{625}{20736} = \frac{1375}{6912}$</p> | M1FT M1FT M1FT A1 [4] | For first probability For $(5/12)^4$ For sum of both correct probabilities CAO Do not allow 0.2, unless fuller answer seen first | Allow 4C_3 Provided sum < Alternative for allow M1FT for for sum of three answer, A1 CAO |

| Question | | Answer | Marks | |
|----------|-------|---|------------------------------|---|
| 3 | (i) | $X \sim B(50, 0.1)$ $P(5 \text{ underweight}) = \binom{50}{5} \times 0.1^5 \times 0.9^{45} = 0.1849$ | M1 M1 A1 [3] | For $0.1^5 \times 0.9^{45}$ For $\binom{50}{5} \times p^5 \times q^{45}$ CAO With $p = 0.1$ Also for 2. Allow 0.185 or NB 0.18 gets A1 |
| 3 | (ii) | $X \sim B(20, 0.1)$ $P(X \geq 1) = 1 - P(X = 0)$ $= 1 - 0.1216 = 0.8784$ | M1 A1 [2] | For 0.1216 CAO Allow M1 for 0 Allow 0.878 or See tables at the http://www.mei.gov.uk/resources/files/2013/04/book_mf2.pdf |
| 3 | (iii) | $E(X) = 48 \times 0.8784 = 42.16 (= 42.2)$ | M1 A1 [2] | FT their probability from part (ii) If any indication or to another int SC1 for $48 \times$ th answer. NB 0.6083 in (i) |

| Question | | Answer | Marks | |
|----------|------|---|--|--|
| 4 | (i) | $P(X=15) = \frac{3}{6} \times \frac{2}{5} \times \frac{1}{4}$ $= \frac{6}{120} = \frac{1}{20} = 0.05$ <p>Or $\frac{1}{{}_6C_3} = \frac{1}{20} = 0.05$</p> <p>Or $\frac{3! \times 3!}{6!} = \frac{1}{20} = 0.05$</p> | M1 A1 [2] | For product of three correct fractions NB ANSWER GIVEN NB $1 - (0.45 + 0.45 + 0.05) = 0.05$ scores M0A0 Full marks $3! \times \frac{1}{6} \times \frac{1}{5} \times \frac{1}{4} =$ Allow 3×2 in SC1 for $6 \times \frac{1}{6} \times \frac{1}{5} \times \frac{1}{4} =$ |
| 4 | (ii) | $E(X) = (15 \times 0.05) + (1010 \times 0.45) + (2005 \times 0.45) + (3000 \times 0.05)$ $= 1507.5 \text{ so } 1508 \text{ (4sf)}$ | M1 A1 | For Σrp (at least 3 terms correct) CAO Allow 1507, 153015/2 |
| | | $E(X^2) = (15^2 \times 0.05) + (1010^2 \times 0.45) + (2005^2 \times 0.45) + (3000^2 \times 0.05)$ $= 2718067.5$ | M1 | For $\Sigma r^2 p$ (at least 3 terms correct) Use of $E(X-\mu)^2$ $(x-\mu)^2$ should see $497.5^2, 1492.5^2,$ $E(X)$ (all 4 correct) for $\Sigma p(x-\mu)^2$ (at least 3 terms) with their probability Division by 4 or end gives max M M1A0M1M1A0 4. Unsupported correct marks |
| | | $\text{Var}(X) = 2718067.5 - (1507.5)^2$ $= 445511.25 \text{ so } 445500 \text{ (4sf)}$ | M1 A1 | dep for – their $E(X)^2$ FT their $E(X)$ provided $\text{Var}(X) > 0$ (and of course $E(X^2)$ is correct) Allow 446000 |
| | | | [5] | |

| Question | | Answer | Marks | |
|----------|-------|---|---|--|
| 5 | (i) | <p>Because if people cannot make a correct identification, then the probability that they guess correctly will be 0.5</p> <p>For 'equally likely to guess right or wrong' or 'two outcomes with equal probability' or '50:50 chance of success' or 'right one in two occasions on average' or 'two (equally likely) outcomes' etc</p> | <p>E1</p> <p>E1</p> <p>[2]</p> | <p>For idea of a guess or 'chosen at random'</p> <p>For idea of two outcomes</p> <p>NB 'She s... than they... on its own a... idea of a guess</p> |
| 5 | (ii) | 'Because people may do better than they would by guessing' or similar | <p>B1</p> <p>[1]</p> | <p>For idea of selecting correctly /identifying /knowing</p> <p>No marks if ans... because there ar... who make a cor...</p> |
| 5 | (iii) | <p>$P(X \geq 13) = 1 - P(X \leq 12) = 1 - 0.8684 = 0.1316$</p> <p>NB PLEASE ANNOTATE THE TOP AND BOTTOM OF THE EXTRA PAGE IF NOT USED</p> <p>$0.1316 > 0.05$</p> <p>So not significant</p> <p>There is insufficient evidence to suggest that people can make a correct identification.</p> | <p>M1</p> <p>B1*</p> <p>M1*</p> <p>dep</p> <p>A1*</p> <p>E1*</p> <p>dep</p> | <p>For notation $P(X \geq 13)$ or $P(X > 12)$ or $1 - P(X \leq 12)$</p> <p>For 0.1316</p> <p>For comparison with 5%</p> <p>NB Point probabilities score zero.</p> <p>Notation $P(X = ...$ If they have the... give M1 and ign... notation. Or for $1 - 0.8684$ mark</p> <p>Allow 'accept F...</p> <p>Must include 'in... something simil... that' ie an elem... A or E mark. M... E1 mark. Do not allow 'st... suggest proporti... identification is</p> |

| Question | Answer | Marks | | |
|----------|---|--|--|---|
| | <p>ALTERNATIVE METHOD – follow method above unless some mention of CR seen</p> <p>Critical region method UPPER TAIL $P(X \geq 14) = 1 - P(X \leq 13) = 1 - 0.9423 = 0.0577 > 5\%$ $P(X \geq 15) = 1 - P(X \leq 14) = 1 - 0.9793 = 0.0207 < 5\%$</p> <p>So critical region is $\{15,16,17,18,19,20\}$</p> <p>13 not in CR so not significant</p> <p>There is insufficient evidence to indicate that people can make a correct identification.</p> | <p>B1</p> <p>M1*</p> <p>M1* dep</p> <p>A1*</p> <p>E1* dep on A1</p> <p>[5]</p> | <p>Must see some reference to CR to gain any marks</p> <p>For either probability</p> <p>For a correct comparison with 5% cao dep on the two correct probabilities</p> <p>Must include '13 not in CR'</p> <p>Ignore any work on lower critical region</p> | <p>Do not insist candidates have probabilities for 'critical region'</p> <p>Allow comparison of 'critical region'</p> <p>No marks if CR Condone $\{15, \dots\}$ not $P(X \geq 15)$ Allow 'accept F</p> <p>NB If CR found P(X=13) subse says '13 not in C five marks. If d allow no marks</p> |

| Question | | Answer | Marks | |
|----------|-------|--|---|--|
| 6 | (i) | Median = 3.32 kg Q1 (= 6.5th value) = 2.83 Q3 (= 19.5th value) = 3.71 Inter-quartile range = $3.71 - 2.83 = 0.88$ | B1 B1 B1 [3] | For Q1 or Q3 For IQR dep on both quartiles correct For Q1 For Q3 and If no quartile IQR in range 0. |
| | (ii) |  | G1 G1 G1 FT their median and quartiles if sensible – guidance above is only for correct values | Dep on attempt with at least a b Condone lack of Do not award un significantly sho Allow LH whisk outlier marked a |
| 6 | (iii) | Lower limit $2.83 - (1.5 \times 0.88) = 1.51$ Upper limit $3.71 + (1.5 \times 0.88) = 5.03$ Exactly one baby weighs less than 1.51 kg and none weigh over 5.03 kg so there is exactly one outlier. | [3] B1 B1 E1* | For 1.51 FT For 5.03 FT Dep on their 1.51 and 5.03 Any use of med B0 B0 E0 No marks for ± In this part FT t if sensibly obtai location ie 6.5, Do not penalise not the final ans Do not allow un limit above 4.34 between 1.39 ar |

| Question | | Answer | Marks | |
|----------|------|--|-------------------------------------|---|
| | | 'Nothing to suggest that this baby is not a genuine data value so she should not be excluded' or 'This baby is premature and therefore should be excluded'. | E1* Dep [4] | Any sensible comment in context For ... B1 For ... B1 For 3.2... Then E1E1 a... |
| 6 | (iv) | Median = 3.5 kg Q1 = 50th value = 3.12 Q3 = 150th value = 3.84 Inter-quartile range = 3.84 – 3.12 = 0.72 | B1 B1 B1 [3] | For Q1 or Q3 For IQR FT their quartiles For Q1 allow 3. For Q3 allow 3. Dep on both qua If no quartiles g IQR in range 0. |
| 6 | (v) | Female babies have lower weight than male babies on the whole Female babies have higher weight variation than male babies | E1 FT E1 FT [2] | Allow 'on average' or similar in place of 'on the whole' Allow 'more spread' or similar but not 'higher range' Condone less consistent Do not allow low Do not allow hi both lower med making clear wh |
| 6 | (vi) | Male babies must weigh more than 4.34 kg Approx 10 male babies weigh more than this. | M1* | For 10 or 9 or 8 Or 200 – 190, 2 |
| | | Probability = $\frac{10}{200} \times \frac{9}{199} = \frac{90}{39800} = \frac{9}{3980} = 0.00226$ or $\frac{9}{200} \times \frac{8}{199} = \frac{72}{39800} = 0.00181$ or $\frac{8}{200} \times \frac{7}{199} = \frac{56}{39800} = \frac{7}{4975} = 0.00141$ | M1* dep A1 [3] | For first fraction multiplied by any other different fraction (Not a binomial probability) CAO Allow their answer to min of 2 sf Allow any of th For spurious fac answer allow M SC1 for $n/200 \times$ |

| Question | | Answer | Marks | | |
|----------|------|--|---|---|--|
| 7 | (i) | | <p>G1</p> <p>G1</p> <p>G1</p> <p>G1</p> <p>[4]</p> | <p>For first set of branches</p> <p>For second set of branches (indep)</p> <p>For third set of branches (indep)</p> <p>For labels</p> | <p>All probabilities</p> <p>All probabilities</p> <p>All probabilities</p> <p>All correct labels 'H' and 'M' etc. First, Second, T. Do not allow m</p> |
| 7 | (ii) | <p>A</p> <p>$P(\text{Hits with at least one}) = 1 - P(\text{misses with all})$ $= 1 - (0.9 \times 0.95 \times 0.95) = 1 - 0.81225 = 0.18775$</p> <p>ALTERNATIVE METHOD only if there is an attempt to add 7 probabilities At least three correct triple products Attempt to add 7 triple products</p> <p>FURTHER ALTERNATIVE METHOD $0.1 + 0.9 \times 0.05$ Above probability + $0.9 \times 0.95 \times 0.05$</p> | <p>M1*</p> <p>M1*</p> <p>dep</p> <p>A1</p> <p>M1</p> <p>M1</p> <p>A1</p> <p>M1</p> <p>M1</p> <p>A1</p> <p>[3]</p> | <p>For $0.9 \times 0.95 \times 0.95$</p> <p>For $1 - \text{ans}$</p> <p>CAO</p> <p>CAO</p> <p>CAO</p> | <p>FT their tree for provided three t</p> <p>0.188 or better. Allow 751/4000</p> <p>(not necessarily</p> |

| Question | | Answer | Marks | |
|----------|--------|---|--|---|
| 7 | (ii) B | $\begin{aligned} &P(\text{Hits with exactly one}) \\ &= (0.1 \times 0.8 \times 0.95) + (0.9 \times 0.05 \times 0.8) + (0.9 \times 0.95 \times 0.05) \\ &= 0.076 + 0.036 + 0.04275 = \frac{19}{250} + \frac{9}{250} + \frac{171}{4000} \\ &= \frac{619}{4000} = 0.15475 \end{aligned}$ | M1 M1 M1 A1 [4] | For two correct products For all three correct products For sum of all three correct products CAO Allow 0.155 or |
| 7 | (iii) | $\begin{aligned} &P(\text{Hits with exactly one given hits with at least one}) \\ &= \frac{P(\text{Hits with exactly one and hits with at least one})}{P(\text{Hits with at least one})} \\ &= \frac{0.15475}{0.18775} \\ &= 0.8242 \end{aligned}$ | M1 M1 A1 [3] | If answer to (B) then max M1M1 Both must be p Allow 0.824 or |
| 7 | (iv) | $\begin{aligned} &P(\text{Hits three times overall}) = \\ &(0.1 \times 0.2 \times 0.2) + (0.9 \times 0.95 \times 0.95 \times 0.05 \times 0.2 \times 0.2) \\ &= 0.004 + 0.0016245 \\ &= 0.0056245 \end{aligned}$ | M1 M1 M1* Dep on both prev M1's A1 [4] | For $0.1 \times 0.2 \times 0.2$ or 0.004 or 1/250 For $0.9 \times 0.95 \times 0.95 \times 0.05 \times 0.2 \times 0.2$ For sum of both CAO Allow 0.00562 |

NOTE RE OVER-SPECIFICATION OF ANSWERS

If answers are grossly over-specified, deduct the final answer mark in every case. Probabilities should also be rounded to the correct accuracy. In general final non probability answers should not be given to more than 4 significant figures. Allow probabilities to be given to 3 significant figures.

PLEASE HIGHLIGHT ANY OVER-SPECIFICATION

Please note that there are no G or E marks in scoris, so use B instead

**NB PLEASE ANNOTATE EVERY ADDITIONAL ANSWER SHEET
FULL MARKS AWARDED OR THE PAGE IS BLANK**

Additional notes re Q5 part iii

Comparison with 95% method

If 95% seen anywhere then

M1 for $P(X \leq 12)$

B1 for 0.8684

M1* for comparison with 95% dep on second B1

A1* for not significant oe

E1*

Comparison with 95% CR method

If 95% seen anywhere then

B1 for 0.9423 or 0.9793

M1 for correct comparison with 95%

M1dep for correct CR provided both probs correct
then follow mark scheme for CR method

Smallest critical region method:

Smallest critical region that 13 could fall into is $\{13, 14, 15, 16, 17, 18, 19, 20\}$ gets B1 and has size 0.1316 gets B1, This is $> 5\%$ as per scheme

NB These marks only awarded if 13 used, not other values.

Use of k method with no probabilities quoted:

This gets zero marks.

Use of k method with one probability quoted:

Mark as per scheme

Line diagram method and Bar chart method

No marks unless correct probabilities shown on diagram, then mark as per scheme..

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