

Mathematics (MEI)

Advanced Subsidiary GCE

Unit 4766: Statistics 1

Mark Scheme for January 2012

OCR (Oxford Cambridge and RSA) is a leading UK awarding body, providing a wide range of qualifications to meet the needs of candidates of all ages and abilities. OCR qualifications include AS/A Levels, Diplomas, GCSEs, OCR Nationals, Functional Skills, Key Skills, Entry Level qualifications, NVQs and vocational qualifications in areas such as IT, business, languages, teaching/training, administration and secretarial skills.

It is also responsible for developing new specifications to meet national requirements and the needs of students and teachers. OCR is a not-for-profit organisation; any surplus made is invested back into the establishment to help towards the development of qualifications and support, which keep pace with the changing needs of today's society.

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.

© OCR 2012

Any enquiries about publications should be addressed to:

OCR Publications
PO Box 5050
Annesley
NOTTINGHAM
NG15 0DL

Telephone: 0870 770 6622
Facsimile: 01223 552610
E-mail: publications@ocr.org.uk

Annotations

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

- 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 assists in marking incorrect solutions. Correct *solutions* leading to correct answers are awarded full marks but work must be marked on 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 is not usually lost for numerical errors, algebraic slips or errors in units. However, it is not usually sufficient for a candidate to state an 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 explanation than the result itself. This is usually indicated by the abbreviation 'e' on the mark scheme. This is not applicable to questions where the answer is a single value or a single expression, or where the candidate is asked to explain or justify a result. This is usually indicated by the abbreviation 'e' on the mark scheme. This is not applicable to questions where the answer is a single value or a single expression, or where the candidate is asked to explain or justify a result.

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 to questions where the 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 given 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 in a different image zone. 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, with 3 significant figures often being the expected accuracy. Variations in the degree of accuracy to which an answer is given (e.g. 2 or 4 significant figures where 3 is expected) should not be penalised, while answers which are grossly over- or under-specified should normally result in the loss of a mark. The mark scheme will detail any particular cases where the accuracy of the answer may be a marking issue should be detailed in the mark scheme rationale. If this is not the case please 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.

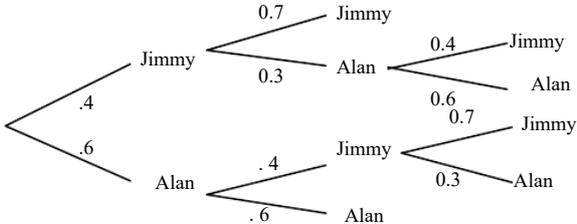
If there are two or more attempts at a question which have not been crossed out, examiners should mark what appears to be the (complete) attempt and ignore the others.

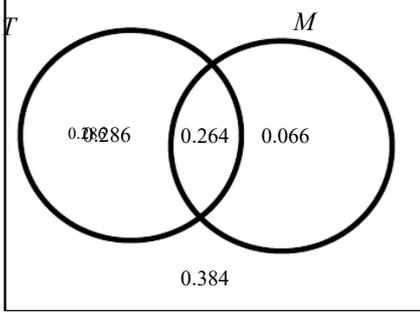
NB Follow these maths-specific instructions rather than those in the assessor handbook.

- h For a *genuine* misreading (of numbers or symbols) which is such that the object and the difficulty of the question are not changed according to the scheme but following through from the candidate's data. A penalty is then applied; 1 mark is given for this but this may differ for some units. This is achieved by withholding one A mark in the question.

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

Question	Answer	Marks	Guidance																									
1 (i)	<table style="margin-left: auto; margin-right: auto;"> <tr><td>0</td><td>8</td><td>8</td><td></td><td></td><td></td></tr> <tr><td>10</td><td>5</td><td>5</td><td></td><td></td><td></td></tr> <tr><td>20</td><td>5</td><td>6</td><td>9</td><td></td><td></td></tr> <tr><td>30</td><td>1</td><td>1</td><td>4</td><td>4</td><td>6</td></tr> </table> <p>Key 20 9 represents 29 degrees Celsius</p>	0	8	8				10	5	5				20	5	6	9			30	1	1	4	4	6	<p>G1 G1 G1 G1</p> <p>[4]</p>	<p>Stem (in either order) Leaves</p> <p>Sorted and aligned (use paper test if unsure)</p> <p>Key</p>	<p>Do not allow Ignore commas Condone 1 error Allow errors in leaf Condone missing units Allow stem 0, 1, 2,</p>
0	8	8																										
10	5	5																										
20	5	6	9																									
30	1	1	4	4	6																							
(ii)	Median = 27.5	B1 [1]		CAO																								
1 (iii)	The median since the mean is affected by the skewness of the distribution	B1 E1 [2]	For median Allow E2 for mean if supported by very convincing reason EG takes all values into account and no extreme values	Do not allow 'less outliers' unless also negative skewness Condone 'bottom half similar'																								
2 (i)	$\text{Mean} = \frac{759.00}{60} = \text{£}12.65$ $S_{xx} = 11736.59 - \frac{759^2}{60} = 2135.24$ $s = \sqrt{\frac{2135.24}{59}} = \text{£}6.02$	B1 M1 A1 [3]	Ignore units For Sxx CAO ignore units Allow more accurate answers	CAO Do not allow but allow 12 ^{13/20} M1 for 11736.59 - BUT NOTE M0 if For s ² of 36.2 (or better) or without working For RMSD of 5.97 M1A0 provided working For RMSD ² of 35.6 provided working																								
2 (ii)	<p>New mean = 12.65 × 1.02 = £12.90</p> <p>New sd = 6.02 × 1.02 = £6.14</p>	B1 B1 [2]	FT their mean Awrt 12.90 Allow 12.9 FT their sd	If candidate 'starts' for CAO Deduct at most 1 mark question for oversteps and 1 mark overall																								

Question		Answer	Marks	Guidance	
2	(iii)	New mean = $12.65 + 0.25 = \text{£}12.90$ New sd = $\text{£}6.02$	B1 B1 [2]	FT their mean Awrt 12.90 FT their sd (unless negative) Awrt 6.02	If cancelled... for CAO Allow sd un...
3	(i)		G1 G1 G1 [3]	Do a vertical scan and give: First column Second column Final column	All indep All probs must be c... Without extra bran... Ignore anything be... Allow labels 'win' Jimmy and Alan re... labels, no marks
3	(ii)	P(Alan wins) $= (0.4 \times 0.3 \times 0.6) + (0.6 \times 0.4 \times 0.3) + (0.6 \times 0.6) = 0.504$	M1 M1 A1 [3]	For any one 'correct' product For all three 'correct' products and no extras CAO	FT their tree for bo... Provided correct n... product(s) for bot...
3	(iii)	$P(\text{Ends after 4}) = (0.4 \times 0.7) + (0.6 \times 0.6) = 0.28 + 0.36 = 0.64$	M1 A1 [2]	For both products CAO	FT their tree for M... Provided two term...
4	(i)	Because $P(T M) \neq P(T)$	E1 [1]	Or $0.8 \neq 0.55$	Or $P(T \cap M) (=$ provided 0.264 in Or $0.264 \neq 0.55 \times 0.33$ Look out for comp...
4	(ii)	$P(T \cap M) = P(T M) \times P(M) = 0.80 \times 0.33 = 0.264$	M1 A1 [2]	For product CAO	A0 for 0.26

Question	Answer	Marks	Guidance	
4 (iii)		<p>G1</p> <p>G1</p> <p>G1</p> <p>[3]</p>	<p>For two labelled intersecting circles</p> <p>For at least 2 correct probabilities. FT their $P(T \cap M)$</p> <p>For remaining probabilities. FT their $P(T \cap M)$, providing probabilities between 0 and 1</p>	<p>Allow labels</p> <p>Allow other shapes</p> <p>No need for 'box'</p> <p>FT from 0.1815 in 0.1815, 0.1485, 0.3</p>
5 (i)	<p>$P(X=1) = P(g,b)+P(b,g)+P(b,b,g)+P(b,b,b,g)$</p> $= \frac{1}{4} + \frac{1}{4} + \frac{1}{8} + \frac{1}{16} = \frac{11}{16}$ <p>OR</p> <p>$P(X=1) = 1 - P(X \neq 1) = 1 - (P(bbbb)+P(ggb)+P(gggb)+P(gggg))$</p> $= 1 - \left(\frac{1}{16} + \frac{1}{8} + \frac{1}{16} + \frac{1}{16} \right) = \frac{11}{16}$	<p>M1</p> <p>M1</p> <p>A1</p> <p>[3]</p>	<p>For any two correct fractions</p> <p>For all four correct fractions</p> <p><i>NB Answer given</i></p>	<p>Must have correct fractions and girls, not just f</p> <p>With no extras</p> <p>Accept 0.6875, not</p> <p>Watch for use of B which gets MOMO</p>

Question			Answer	Marks	Guidance
6	(i)	(C)	$E(X) = np = 20 \times 0.25 = 5$	B1 [1]	CAO
6	(ii)	(A)	Let p = probability that a randomly selected student is a smoker $H_0: p = 0.25$ $H_1: p < 0.25$	B1 B1 B1 [3]	For definition of p in context For H_0 For H_1 Allow complementary probabilities. Mark as per scheme. ie $H_0: p = 0.75$ etc

Question			Answer	Marks	Guidance	
6	(ii)	(B)	H_1 has this form as the programme aims to reduce the proportion of smokers.	E1 [1]	Allow 'number' Allow 'aims for a reduction' or similar	E0 if 1
6	(iii)		$P(X \leq 1) = 0.0243 < 5\%$ $P(X \leq 2) = 0.0913 > 5\%$ So critical region is $\{0,1\}$	B1 B1 M1 A1 [4]	For $P(X \leq 1) = 0.0243$ For $P(X \leq 2) = 0.0913$ For at least one comparison with 5% CAO for critical region <i>dep</i> on M1 and at least one B1	With full correct Penalise once for Allow any form of $1, X < 2$, annotated $P(X \leq 1)$ NB USE OF POINTS B0B0M0A0 If no working but correct See additional notes for other possibilities
6	(iv)		3 does not lie in the critical region, so not significant, So there is not enough evidence to reject the null hypothesis and we conclude that there is not enough evidence to suggest that the percentage of smokers has decreased.	E1dep E1dep [2]	For 3 not in CR or for not significant or reject H_1 For conclusion in context Condone omission of 'not enough evidence' in this case	Dep on correct CR E0E0 for $P(X=3)$ not E0E0 if wrong working Alternative scheme $P(X \leq 3) = 0.2252 > 5\%$ E2 for complete mark
7	(i)		Percentage = $\frac{40}{200} \times 100 = 20$	M1 A1 [2]	For 40 seen or implied CAO	
7	(ii)		Median = 5.2 kg Q1 = 4.2 Q3 = 5.8 Inter-quartile range = $5.8 - 4.2 = 1.6$	B1 B1 B1 [3]	For Q1 or Q3 For IQR	Allow 4.2 to 4.3 for Q1 Dep on both quartiles

Question	Answer	Marks	Guidance	Additional
7 (iii)	Lower limit $4.2 - (1.5 \times 1.6) = 1.8$ Upper limit $5.8 + (1.5 \times 1.6) = 8.2$ So there are one or more outliers (if any lamb weighs more than 8.2 kg) Should not be disregarded because: 'Nothing to suggest they are not genuine items of data' Allow other convincing reasons such as very few so will not make much difference	B1 B1 E1 E1 [4]	For 1.8 ft For 8.2 ft Dep on their 1.8 and 8.2 Allow any number of outliers ≤ 5 Indep Must give reason.	Any u... E0 E0 if say so. unless lower h. If FT leads to lim... 2.0 then E0 No marks for ± 2 o... With 4.3 and 5.8 I... = 8.05 In this part FT thei... sensibly obtained b... 12.5, 37.5 No marks for use o...
7 (iv)	Median for Welsh Mountain = 3.6 IQR for Welsh Mountain = 0.8 Welsh Mountain lambs have lower average weight than crossbred Welsh Mountain lambs also have lower variation in weight than crossbred	B1 B1 E1 indep E1 indep [4]	Must imply average or CT, not just median. Allow generally lighter Must imply spread or variation, not just IQR or range Allow correct comment on consistency	FT their medians FT their IQRs Can get max B1E... range
7 (v)	Median unchanged IQR unchanged OR range or spread increased	E1 E1 [2]	even if used IQR in (iv)	E2 for 'Both com same' E1 for 'the range

Question	Answer	Marks	Guidance	
7 (vi)	$P(\text{Crossbred} > 3.9) = \frac{165}{200}$ $P(\text{Welsh Mountain} > 3.9) = \frac{1}{4}$ $P(\text{Both} > 3.9) = \frac{165}{200} \times \frac{1}{4} = \frac{165}{800} = \frac{33}{160} = 0.206$	B1 B1 M1 A1 [4]	For product of their probabilities, provided one is correct CAO	Allow Allow answers in with correct work

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 a sensible degree. In general final non probability answers should not be given to more than 4 significant figures. Allow probabilities given to 5 sig fig.

Additional notes re Q6 parts iii, iv:

Smallest critical region method for part (iii):

Smallest critical region that 1 could fall into has size 0.0243 gets B1,

Smallest critical region that 2 could fall has size 0.0913 gets B1, This is $> 5\%$ or above $< 5\%$ gets M1, A1 as per scheme

Use of k method with no probabilities quoted:

$P(X \leq k) > 5\%$ and $P(X \leq k - 1) < 5\%$ followed by $k = 2$ gets SC1
 so CR is $\{0, 1\}$ gets another SC1 dep on first SC1

Use of k method with one probability quoted:

Mark as per scheme – max B0B1M1A1

Two tailed test with $H_1: p \neq 0.25$

Gets SC2 for fully correct FT with working as follows $P(X \leq 1) = 0.0243 < 0.025$ and $P(X \geq 10) = 0.0139 > 0.025$ B1 CR is $\{0, 1, 10, 11\}$
 (iv) Final 2 marks Max M1A1.

Two tailed test done but with correct H_1 : $p < 0.25$

(ii) gets max B1B1B1E1

(iii) if compare with 5% ignore work on upper tail and mark lower tail as per scheme but if include upper tail in CR then A0 if compare with 2.5% no marks B0B0M0A0

(iv) Final 2 marks can get M1A1 if correct CR, or SC2 if they start again, provided that they compare with 5%, not 2.5%.

Lower or upper tailed test with H_1 : $p > 0.25$ and 6(ii)B wrong way around

(ii) gets max B1B1B0E0

(iii) no marks B0B0M0A0

(iv) Final 2 marks get M0A0

Lower tailed test with H_1 : $p > 0.25$ and 6(ii)B right way around

(ii) gets max B1B1B0E0, note E0, not E1

(iii) and (iv) Mark as per scheme, so full marks possible

Line diagram method for (iii)

No marks unless some 0.0243 shown on diagram, then B1 for squiggly line between 1 and 2 or on 1, B1dep for arrow pointing to left, M1 from squiggly line or from 1, A1 for CR written down in words/symbols. . **If 0.0243 and 0.0913 both seen and no other marks earned**

(iv) M1A1 as per scheme

Bar chart method for (iii)

No marks unless 0.0243 shown on diagram, then B1 for line clearly on boundary between 1 and 2 or within 1 block, B1dep for arrow pointing from boundary line or from 1, A1 for CR written down in words/ symbols. **If 0.0243 and 0.0913 both seen and no other**

B1.

(iv) M1A1 as per scheme.

OCR (Oxford Cambridge and RSA Examinations)
1 Hills Road
Cambridge
CB1 2EU

OCR Customer Contact Centre

Education and Learning

Telephone: 01223 553998

Facsimile: 01223 552627

Email: general.qualifications@ocr.org.uk

www.ocr.org.uk

For staff training purposes and as part of our quality assurance programme your call may be recorded or monitored

Oxford Cambridge and RSA Examinations
is a Company Limited by Guarantee
Registered in England
Registered Office; 1 Hills Road, Cambridge, CB1 2EU
Registered Company Number: 3484466
OCR is an exempt Charity

OCR (Oxford Cambridge and RSA Examinations)
Head office
Telephone: 01223 552552
Facsimile: 01223 552553

© OCR 2012

