OCR
RECOGNISING ACHIEVEMENT

GCE

Mathematics (MEI)

Advanced Subsidiary GCE

Unit **4766:** Statistics 1

Mark Scheme for January 2013

Oxford Cambridge and RSA Examinations

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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.

Annotations and abbreviations

Annotation	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 either 0 or full 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 is designed to assist in marking incorrect solutions. Correct *solutions* leading to correct answers are awarded full marks but work must not be judged on the answer alone, and answers that are given in the question, especially, must be validly obtained; key steps in the working must always 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 work must be carefully assessed. When a candidate adopts a method which does not correspond to the mark scheme, award marks according to the spirit of the basic scheme; if you are in any doubt whatsoever (especially if several marks or candidates are involved) you should contact 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. Method marks are not usually lost for numerical errors, algebraic slips or errors in units. However, it is not usually sufficient for a candidate just to indicate an intention of using some method or just to quote a formula; the formula or idea must be applied to the specific problem in hand, eg by substituting the relevant quantities into the formula. In some cases the nature of the errors allowed for the award of an M mark may be 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 establishment of an unknown result.

Unless otherwise indicated, marks once gained cannot subsequently be lost, eg wrong working following a correct form of answer is ignored. Sometimes this is reinforced in the mark scheme by the abbreviation isw. However, this would not apply to a case where 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 specifically says otherwise; and similarly where there are several B marks allocated. (The notation 'dep *' is used to indicate that a particular mark is dependent on an earlier, asterisked, mark in the scheme.) Of course, in practice it may happen that when a candidate has once gone 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, when 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 incorrect results. Otherwise, A and B marks are given for correct work only — differences in notation are of course permitted. A (accuracy) marks are not given for answers obtained from incorrect working. When A or B marks are awarded for work at an intermediate stage of a solution, 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 often be '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 shown within the 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. 3 significant figures may often be the norm for this, but this always needs to be considered in the context of the problem in hand. For example, in quoting probabilities from Normal tables, we generally expect *some* evidence of interpolation and so quotation to 4 decimal places will often be appropriate. But even this does not always apply – quotations of the standard critical points for significance tests such as 1.96, 1.645, 2.576 (maybe even 2.58 – but not 2.57) will commonly suffice, especially if the calculated value of a test statistic is nowhere near any of these values. Sensible discretion *must* 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. For example, if 3 significant figures are expected (either because of an explicit instruction or because the general context of a problem demands it) but only 2 are given, loss of an accuracy ("A") mark is likely to be appropriate; but if 4 significant figures are given, this should not normally be penalised. Likewise, answers which are slightly deviant from what is expected in a very minor manner (for example a Normal probability given, after an attempt at interpolation, as 0.6418 whereas 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, insistence that the value of a test statistic is (say) 2.128888446667 merely because that is the value that happened to come off the candidate's calculator.

Note that this applies to answers that are given as final stages of calculations; intermediate working should usually be carried out, and quoted, 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 mark 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 do as 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 last (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, misreads are often such that 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 some accuracy ("A") marks do not. It is difficult to legislate in an overall sense beyond this global statement because misreads, even when the object and/or difficulty remains unchanged, can vary greatly in their effects. For example, a misread of 1.02 as 10.2 (perhaps as a quoted value of 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 almost unnoticeable in the candidate's work.

A misread should normally attract *some* penalty, though this would often be only 1 mark and should rarely if ever be more than 2. Commonly in sections of questions where there is a numerical answer either at the end of the section or to be obtained and commented on (eg the value of a test statistic), this answer will have an "A" mark that may actually be designated as "cao" [correct answer only]. This should be interpreted *strictly* – if the misread has led to failure to obtain this value, then this "A" mark must be withheld even if all method 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 of the candidate's value of a test statistic is generally allowed (and often explicitly stated as such within the marking scheme), so that the candidate may exhibit knowledge of how to compare it with a critical value and draw conclusions. Such "fresh starts" are not affected by any earlier misreads.

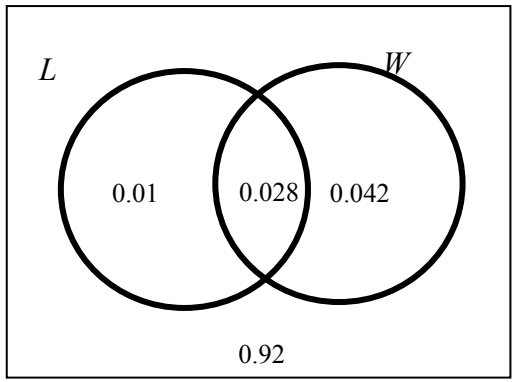
A misread may be of a symbol rather than a number – for example, an algebraic symbol in a mathematical expression. Such misreads are more likely to bring about a considerable change in the object and/or difficulty of the question; but, if they do not, they should be treated as far as possible in the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

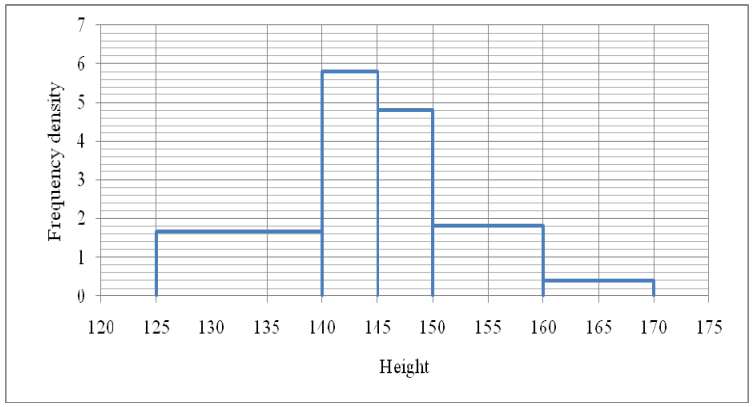
Question			Answer	Marks	Guidance	
1	(i)		Positive	B1 **[1]**	CAO	
1	(ii)		Mean = 5.064 allow 5.1 with working 126.6/25 or 5.06 without SD = 1.324 allow 1.3 with working or 1.32 without	B1 B2 **[3]**	Allow B1 for RMSD = 1.297 or var =1.753 or MSD = 1.683	Also allow B1 for Sxx = 42.08 or for $\Sigma x^2 = 683$ SC1 for both mean = 50.64 and SD = 13.24 (even if over-specified)
1	(iii)		$\bar{x} - 2s = 5.064 - 2\times1.324 = 2.416$ $\bar{x} + 2s = 5.064 + 2\times1.324 = 7.712$ So there is an outlier.	B1FT M1 A1FT E1 **[4]**	FT their mean and sd for $\bar{x} + 2s$ but withhold final E mark if their limits mean that there are no outliers. For upper limit Incorrect statement such as 7.6 and 8.1 are outliers gets E0 Do not award E1 if calculation error in upper limit	For use of quartiles and IQR $Q_1 = 3.95$; $Q_3 = 6.0$; IQR = 2.05 3.95 – 1.5(2.05) gets M1 Allow other sensible definitions of quartiles 6.0 + 1.5(2.05) gets M1 Limits 0.875 and 9.075 So there are no outliers NB do not penalise over-specification here as not the final answer but just used for comparison. FT from SC1
2	(i)		<table><tr><td>r</td><td>2</td><td>3</td><td>4</td><td>5</td></tr><tr><td>P($X = r$)</td><td>3k</td><td>8k</td><td>15k</td><td>24k</td></tr></table> $3k + 8k + 15k + 24k = 1$ $k = 0.02$	B1 M1 A1 **[3]**	For correct table (ito k or correct probabilities 0.06, 0.16, 0.30, 0.48) or $k = 1/50$ (with or without working)	 For their four multiples of k added and =1. Allow M1A1 even if done in part **(ii)** – link part **(ii)** to part **(i)**

Question			Answer	Marks	Guidance	
2	(ii)		$E(X) = (2\times0.06)+(3\times0.16)+(4\times0.30)+(5\times0.48) = 4.2$ or 21/5	M1 A1	For Σrp (at least 3 terms correct Provided 4 reasonable probabilities seen. cao	If probs wrong but sum = 1 allow full marks here. If sum ≠ 1 allow max M1A0M1 M0A0 (provided all probabilities between 0 and 1) Or ito k NB $E(X) = 210k$, $E(X^2) = 924k$ gets M1A0M1M0A0. $E(X) = 210k$, $\text{Var}(X) = 924k - (210k)^2$ gets M1A0M1M1A0.
			$E(X^2) = (4\times0.06)+(9\times0.16)+(16\times0.30)+(25\times0.48) = 18.48$ $\text{Var}(X) = 18.48 - 4.2^2$ $= 0.84 = 21/25$	M1 M1 A1	For Σr^2p (at least 3 terms correct) dep for – their $E(X)^2$ FT their $E(X)$ provided $\text{Var}(X) > 0$ (and of course $E(X^2)$ is correct)	Use of $E(X-\mu)^2$ gets M1 for attempt at $(x-\mu)^2$ should see $(-2.2)^2$, $(-1.2)^2$, $(-0.2)^2$, 0.8^2, (if $E(X)$ wrong FT their $E(X)$) (all 4 correct for M1), then M1 for $\Sigma p(x-\mu)^2$ (at least 3 terms correct with their probabilities) Division by 4 or other spurious value at end gives max M1A1M1M1A0, or M1A0M1M1A0 if $E(X)$ also divided by 4. Unsupported correct answers get 5 marks
				[5]		
3	(i)		$P(L\cap W) = P(L\mid W)\times P(W) = 0.4\times0.07 = 0.028$	M1 A1 **[2]**	For $P(L\mid W)\times P(W)$ cao	

Question			Answer	Marks	Guidance	
3	(ii)			B1 B1 B1 **[3]**	For two labelled intersecting circles For at least 2 correct probabilities. For remaining probabilities	FT their 0.028 provided < 0.038
3	(iii)		$P(L \cap W) = 0.028, P(L) \times P(W) = 0.038 \times 0.07 = 0.00266$ Not equal so not independent	M1 A1 E1* dep on M1 **[3]**	For correct use of $P(L) \times P(W)$ If P(L) wrong, max M1A0E0. No marks if P(W) wrong For 0.00266 Allow 'they are dependent' Do not award E1 if P($L \cap W$)wrong	Or EG $P(L \mid W) = 0.4, P(L) = 0.038$ Not equal so not independent M1 is for comparing with some attempt at numbers P($L \mid W$) with P(L) , A1 for 0.038 If P(L) wrong, max M1A0E0
4	(i)		$\binom{11}{3}$ = 165	M1 A1 **[2]**	Seen Cao	

Question			Answer	Marks	Guidance	
4	(ii)		$\frac{\binom{5}{2}\times\binom{6}{1}}{\binom{11}{3}}+\frac{\binom{5}{3}\times\binom{6}{0}}{\binom{11}{3}}=\frac{60}{165}+\frac{10}{165}=\frac{70}{165}=\frac{14}{33}=0.424$	M1	For intention to add correct two fractional terms	**Or** For attempt at correct two terms
				M1	For numerator of first term	For prod of 3 correct fractions =4/33
			Alternative	M1	For numerator of sec term Do not penalise omission of $\binom{6}{0}$	For whole expression ie $3\times\frac{5}{11}\times\frac{4}{10}\times\frac{6}{9}\left(=\frac{4}{11}\right)$ (= 3 × 0.1212…)
			$1-\text{P(1 or 0)}=1-3\times\frac{5}{11}\times\frac{6}{10}\times\frac{5}{9}-\frac{6}{11}\times\frac{5}{10}\times\frac{4}{9}$ $=1-\frac{5}{11}-\frac{4}{33}=\frac{14}{33}$			
			M1 for 1 – P(1 or 0) , M1 for first product, M1 for ×3, M1 for second product, A1	M1	For correct denominator	For attempt at $\frac{5}{11}\times\frac{4}{10}\times\frac{3}{9}\left(=\frac{2}{33}\right)$
				A1 **[5]**	cao	cao Use of binomial can get max first M1
5	(i)		$\left(\frac{5}{6}\right)^2\times\frac{1}{6}=\frac{25}{216}$ (= 0.116)	M1	For 5/6 (or 1 – 1/6) seen	If extra term or whole number factor present give M1M0A0
				M1	For whole product	
				A1 **[3]**	cao	Allow 0.12 with working
5	(ii)		$1-\left(\frac{5}{6}\right)^{10}=1-0.1615=0.8385$	M1	For $(5/6)^{10}$ (without extra terms)	Allow 0.838 or 0.839 without working and 0.84 with working. For addition $P(X=1)+\ldots+P(X=10)$ give M1A1 for 0.84 or better, otherwise M0A0
				A1 **[2]**	cao	

Question			Answer	Marks	Guidance	
6	(i)		4 + ½ of 18 = 4 + 9 =13	M1 A1 **[2]**	For ½ of 18 cao	13/100 gets M1A0
6	(ii)		(Median) = 50.5th value	M1	For 50.5 seen	SC2 for use of 50th value leading to Est = 140 + (25 /29 × 5) = 144.3 (SC1 if over-specified)
			Est = $140 + \left(\frac{25.5}{29}\right)\times 5$ or = $140 + \left(\frac{50.5-25}{54-25}\right)\times 5$	M1	For attempt to find this value	or Est = $145 - \left(\frac{3.5}{29}\right)\times 5$ = 144.4
			= 144.4	A1 **[3]**		NB no marks for mean = 144.35 NB Watch for over-specification

Question	Answer	Marks	Guidance	
6 (iii)	<table><tr><th>Height</th><th>Frequency</th><th>Group width</th><th>Frequency density</th></tr><tr><td>$125 \leq x \leq 140$</td><td>25</td><td>15</td><td>1.67</td></tr><tr><td>$140 < x \leq 145$</td><td>29</td><td>5</td><td>5.80</td></tr><tr><td>$145 < x \leq 150$</td><td>24</td><td>5</td><td>4.80</td></tr><tr><td>$150 < x \leq 160$</td><td>18</td><td>10</td><td>1.80</td></tr><tr><td>$160 < x \leq 170$</td><td>4</td><td>10</td><td>0.40</td></tr></table> 	M1 A1 G1 W1 H1	For fd's - at least 3 correct Accept any suitable unit for fd such as eg freq per cm. correct to at least one dp allow 1.66 but not 1.6 for first fd linear scales on both axes and label on vertical axis width of bars height of bars	M1 can be also be gained from freq per 10 – 16.7, 58, 48, 18, 4 (at least 3 correct) or freq per 5 – 8.35, 29, 24, 9, 2 for all correct. If fd not explicitly given, M1 A1 can be gained from all heights correct (within one square) on histogram (and M1A0 if at least 3 correct) Linear scale and label on vertical axis IN RELATION to first M1 mark ie fd or frequency density or if relevant freq/10, etc (NOT eg fd/10). However allow scale given as fd×10, or similar Accept f/w or f/cw (freq/width or freq/class width) Can also be gained from an accurate key G0 if correct label but not fd's. Must be drawn at 125, 140 etc NOT 124.5 or 125.5 etc NO GAPS ALLOWED Must have linear scale. No inequality labels on their own such as 125≤S<140, etc but allow if a clear horizontal linear scale is also given. Ignore horizontal label. Height of bars – must be linear vertical scale. FT of heights dep on at least 3 heights correct and all must agree with their

Question			Answer	Marks	Guidance	
				[5]		fds If fds not given and at least 3 heights correct then max M1A0G1W1H0 Allow restart with correct heights if given fd wrong (for last three marks only)
6	(iv)		4 boys 0.6 × 15 = 9 girls So 5 more girls	M1 A1 A1 [3]	For 0.6 × 15 For 9 girls cao	Or 45 × 0.2 = 9 (number of squares and 0.2 per square)
6	(v)		Frequencies and midpoints for girls are Height: 132.5, 142.5, 147.5, 155, 167.5 Frequency: 18, 23, 31, 19, 9 So mean = $\frac{(132.5\times18)+(142.5\times23)+(147.5\times31)+(155\times19)+(167.5\times9)}{100}$ $=\frac{(2385)+(3277.5)+(4572.5)+(2945)+(1507.5)}{100}$ = 146.9 (Exact answer 146.875)	B1 B1 M1 M1* Dep on M1 A1 [5]	For at least three frequencies correct At least three midpoints correct For attempt at $\sum xf$ For division by 100 Cao NB Watch for over-specification	 No further marks if not using midpoints For sight of at least 3 xf pairs Allow answer 146.9 or 147 but not 150 NB Accept answers seen without working (from calculator) Use of 'not quite right' midpoints such as 132.49 or 132.51 etc can get B1B0M1M1A0

Question			Answer	Marks	Guidance	
7	(i)	(*A*)	$X \sim \text{B}(10, 0.35)$ $\text{P}(5 \text{ accessing internet}) = \binom{10}{5} \times 0.35^5 \times 0.65^5$ $= 0.1536$ **OR** from tables $= 0.9051 - 0.7515 = 0.1536$	M1 M1 A1 **OR** M2 A1 **[3]**	or $0.35^5 \times 0.65^5$ For $\binom{10}{5} \times p^5 \times q^5$ cao For $0.9051 - 0.7515$ cao	With p + $\boldsymbol{q}$ = **1** Also for 252×0.0006094 Allow 0.15 or better NB 0.153 gets A0 See tables at the website http://www.mei.org.uk/files/pdf/formula_book_mf2.pdf
7	(i)	(*B*)	$\text{P}(X \geq 5) = 1 - \text{P}(X \leq 4)$ $=1 - 0.7515$ $= 0.2485$	M1 A1 **[2]**	For 0.7515 cao	Accept 0.25 or better – allow 0.248 or 0.249 Calculation of individual probabilities gets B2 if fully correct 0.25 or better, otherwise B0.
7	(i)	(*C*)	$\text{E}(X) = np = 10 \times 0.35$ $= 3.5$	M1 A1 **[2]**	For 10×0.35 cao	If any indication of rounding to 3 or 4 allow M1A0

Question			Answer	Marks	Guidance	
7	(ii)		Let $X \sim B(20, 0.35)$ Let p = probability of a customer using the internet (for population)	B1	For definition of p in context	Minimum needed for B1 is p = probability of using internet. Allow p = P(using internet) Definition of p must include word probability (or chance or proportion or percentage or likelihood but NOT possibility). Preferably as a separate comment. However can be at end of H_0 as long as it is a clear definition 'p = the probability of using internet', Do NOT allow 'p = the probability of using internet is different'
			H_0: $p = 0.35$	B1	For H_0	Allow p=35%, allow only p or θ or π or ρ. However allow any single symbol <u>if defined</u> (including x) Allow $H_0 = p=0.35$, Allow H_0 : $p={}^{7}/_{20}$or $p={}^{35}/_{100}$ Allow NH and AH in place of H_0 and H_1 Do not allow H_0 : P(X=x) = 0.35 Do not allow H_0: =0.35, =35%, P(0.35), p(x)=0.35, x=0.35 (unless x correctly defined as a probability) Do not allow H_0 and H_1 reversed For hypotheses given in words allow Maximum B0B1B1 Hypotheses in words must include probability (or chance or proportion or percentage) and the figure 0.35 oe Thus eg H_0 : p(using internet) = 0.35, H_1 : p(using internet) ≠ 0.35 gets B0B1B1

Question	Answer	Marks	Guidance	
	H_1: $p \neq 0.35$	B1	For H_1	Allow '$p < 0.35$ or $p > 0.35$' in place of $p \neq 0.35$
	H_1 has this form because the test is to investigate whether the proportion is different, (rather than lower or higher).	E1		Do not allow if H_1 wrong.
	$P(X \geq 10)$	B1	For notation $P(X \geq 10)$ or $P(X > 9)$ or $1 - P(X \leq 9)$ (as long as no incorrect notation)	This mark may be implied by 0.1218 as long as no incorrect notation. No further marks if point probs used - $P(X = 10) = 0.0686$ (do not even give the notation mark for correct notation) DO NOT FT wrong H_1, but see extra notes
	$= 1 - 0.8782 = 0.1218$	B1*	For 0.1218 Allow 0.12	Or for $1 - 0.8782$ Indep of previous mark
	$> 2.5\%$	M1* dep	For comparison with 2.5%	
	So not significant.	A1*		Allow 'accept H_0' or 'reject H_1'
	Conclude that there is not enough evidence to indicate that the probability is different. (Must state 'probability', not just 'p')	E1* dep on A1		Must include 'sufficient evidence' or something similar such as 'to suggest that' ie an element of doubt either in the A or E mark.
	ALTERNATIVE METHOD FOR FINAL 5 MARKS			
	Critical region method			Do not insist on correct notation as candidates have to work out two probabilities for full marks. If only upper tail of CR given (or only upper tail justified), allow max 4/5 for final 5 marks.
	LOWER TAIL $P(X \leq 2) = 0.0121 < 2.5\%$ $P(X \leq 3) = 0.0444 > 2.5\%$	B1	For either probability	
	UPPER TAIL $P(X \geq 11) = 1 - P(X \leq 10) = 1 - 0.9468 = 0.0532 > 2.5\%$ $P(X \geq 12) = 1 - P(X \leq 11) = 1 - 0.9804 = 0.0196 < 2.5\%$	B1	For either probability	

Question			Answer	Marks	Guidance	
			So critical region is {0,1,2,12,13,14,15,16,17,18,19,20}	M1* dep	cao dep on at least one correct comparison with 2.5%	No marks if CR not justified Condone {0,1,2, 12, … 20}, $X \leq 2$, $X \geq 12$, oe but not P($X \leq 2$) etc
			So not significant Conclude that there is not enough evidence to indicate that the probability is different.	A1* E1* dep on A1 **[9]**		NB If CR found correctly then P($X = 10$) subsequently found but cand says '10 not in CR' then allow up to all last five marks. If do not say '10 not in CR' allow none of last five marks
7	**(iii)**		0.0022 < 2.5% So reject H_o, Significant. Conclude that there is enough evidence to indicate that the probability is different.	B1 E1* dep **[2]**	For either reject H_o or significant, dep on correct comparison Dep on good attempt at correct hypotheses in part (ii)	If they have H_1: p>0.35, allow SC1 if all correct including comparison with 5%.

APPENDIX

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 of accuracy. 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 Q7 part ii

Comparison with 97.5% method
If 97.5% seen anywhere then
B1 for P($X \leq 9$)
B1 for 0.8782
M1* for comparison with 97.5% dep on second B1
A1* for not significant oe
E1*

Smallest critical region method:
Smallest critical region that 10 could fall into is {10,11,12,13,14,15, 16, 17, 18,19,20} **gets B1 and has size 0.1218 gets B1, This is > 2.5% gets M1*, A1*, E1* as per scheme**
NB These marks only awarded if 10 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.

Upper tailed test done with H_1: $p>0.35$
Hyp gets max B1B1B0E0
If compare with 5% give SC2 for $P(X \geq 10) = 1 - 0.8782 = 0.1218 > 5\%$ and SC1 for final conclusion (must be 'larger than' not 'different from')
If compare with 2.5% no further marks B0B0M0A0E0

Lower tailed test done with H_1: $p<0.35$
No marks out of last 5.

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