OCR
Oxford Cambridge and RSA

GCE

Mathematics (MEI)

Unit **4766**: Statistics 1

Advanced Subsidiary GCE

Mark Scheme for June 2016

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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 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 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. NB See note below scheme

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.

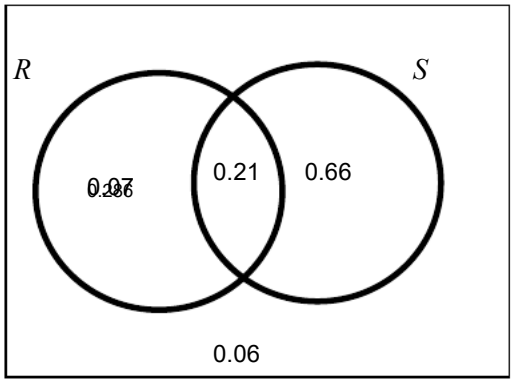
The situation regarding any particular cases that arise while you are marking for which you feel you need detailed guidance should be discussed with your Team Leader.

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

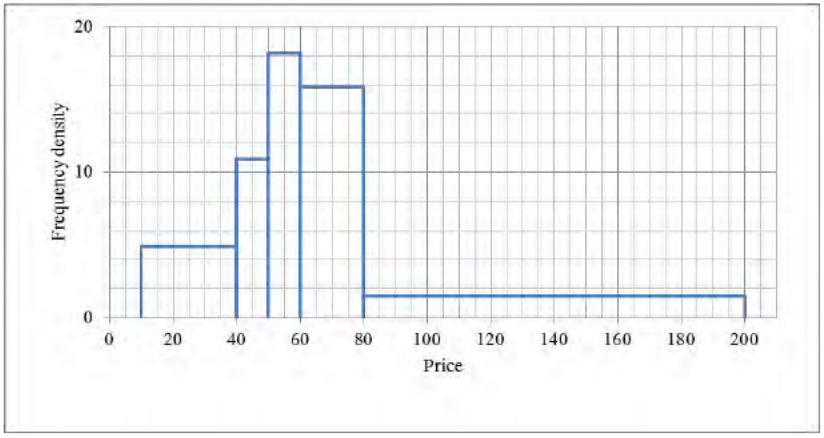
Question			Answer	Marks	Guidance	
1	(i)		Median = 29.0 IQR = 31.8 – 27.8 = 4.0	B1 M1 A1 **[3]**	 For either quartile – allow alternative definitions of quartiles	Condone wrong method Allow 27.75 and 31.9 leading to 4.15 Do not allow 27.7, 27.9, 31.6,32.0
1	(ii)		Lower limit = 27.8 - 1.5 × 4.0 = 21.8 27.75, 31.9 lead to 21.525 and 38.125 27.7, 31.6 lead to 21.85 and 37.45 Upper limit = 31.8 + 1.5 × 4.0 = 37.8 So there are no outliers (at either end of the distribution)	M1 A1 A1 B1 **[4]**	Method for either FT sensible quartiles and IQR FT sensible quartiles and IQR Dep on at least one A1 Use of median scores 0/4	For use of mean (29.44) and SD (2.516765…) 29.44 ± 2×2.516765 M1 Lower Limit = 24.4 A1 Upper limit = 34.5 A1 So no outliers B1
2	(i)		P(Does not lose any match) = $0.8^3 = 0.512 = {}^{64}/_{125}$	B1 **[1]**		
2	(ii)		P(Wins all 3 or draws all 3 or loses all 3) = $0.5^3 + 0.3^3 + 0.2^3$ $= 0.16 = {}^{4}/_{25}$	M1 A1 **[2]**	Including addition	
2	(iii)		P(all three outcomes occur) = 3! × 0.5 × 0.3 × 0.2 = 0.18 Required probability = 1 – '0.18' – 0.16 $= 0.66 = {}^{33}/_{50}$	M1* A1 *M1 dep A1 **[4]**	 CAO	Allow M1 for k × 0.5 × 0.3 × 0.2 even if k = 1 Even if cubed Not if cubed
			OR:			
			P(WWW') + P(DDD') + P(LLL')	M1	For any one product (no need for '3 ×')	Even if cubed
			$3 \times 0.5^2 \times 0.5 + 3 \times 0.3^2 \times 0.7 + 3 \times 0.2^2 \times 0.8$	M1	For '3 ×'	Dep on at least 1 correct term
			0.375 + 0.189 + 0.096	M1	For sum of three correct terms (no need for '3 ×') And no incorrect terms	NB common wrong answer of 0.22 from omitting '3 ×' or 0.44 from '2×' scores M1M0M1A0 Not if cubed
			0.66	A1	CAO	

Question			Answer	Marks	Guidance	
			OR:			
			P(WWD) + P(WWL) + P(DDW) + P(DDL) + P(LLW) + P(LLD)	M1	For any one product (no need for '3 ×')	Even if cubed
			$3\times0.5^2\times0.3+3\times0.5^2\times0.2+3\times0.3^2\times0.5+3\times0.3^2\times0.2+3\times0.2^2\times0.5+3\times0.2^2\times0.3$	M1	For '3 ×'	Dep on at least 1 correct term
			0.225 + 0.15 + 0.135 + 0.054 + 0.06 + 0.036	M1	For sum of six correct terms (no need for '3 ×') And no incorrect terms	Not if cubed
			0.66	A1	CAO	
3	**(i)**		Number of ways = 5! = 120	B1 **[1]**		
3	**(ii)**		Probability = 2/120 = 1/60 or 0.0167 or $0.01\dot{6}$	M1 A1 **[2]**	For division by their 120 CAO	M1 for $^{k}/_{120}$ Condone final answer of 2/120 Do not allow 0.016
3	**(iii)**		$\frac{1}{5}\times\frac{1}{4}\times\frac{1}{3}=\frac{1}{60}$ or 0.0167 or $0.01\dot{6}$	B1 **[1]**	Condone 2/120 for B1	Do not allow 0.016
3	**(iv)**		$\frac{3}{5}\times\frac{2}{4}\times\frac{1}{3}=\frac{1}{10}$ or $1/{}^5C_3 = 1/10$	M1 A1 M1 A1 **[2]**	For 3/5 × CAO For division by ${}^5C_3$	Listing options gives 12/120 Or (3! / 120) × 2 Or $({}^3P_3\times{}^2P_2)/120)$ SC2 for 3! × their part (iii) or 6 × their part (iii)

Question			Answer	Marks	Guidance	
4	(i)		$k/2 + k/6 + k/12 + k/20 + k/30 = 1$ $(30 + 10 + 5 + 3 + 2)k/60 = 1$ $50k = 60$ $k = 1.2$	M1 A1	For correct equation including = 1 Need one further intermediate step after equation NB **Answer Given**	Allow substitution of $k = 1.2$ to show probabilities add to 1 with convincing working which must be more than just 1.2/2+1.2/6+1.2/12+1.2/20+1.2/30 = 1 This latter gets M1A0
			r: 2, 3, 4, 5, 6 $P(X = r)$: 0.6 $= {}^{3}/_{5}$, 0.2 $= {}^{1}/_{5}$, 0.1 $= {}^{1}/_{10}$, 0.06 $= {}^{3}/_{50}$, 0.04 $= {}^{1}/_{25}$	B1 **[3]**	Complete correct table in fraction or decimal form NOT in terms of k	Must tabulate probabilities, though may be seen in part(ii) If fractions any denominator is ok provided numerators are integers
4	(ii)		$E(X) = (2\times0.6)+(3\times0.2)+(4\times0.1)+(5\times0.06)+(6\times0.04)$ $E(X) = 2.74$ or ${}^{137}/_{50}$	M1 A1	For Σrp (at least 3 terms correct) Provided 5 reasonable probabilities seen. CAO If probs wrong but sum = 1 allow max M1A0M1M1A1. If sum ≠ 1 allow max M1A0M1M1A0 (provided all probabilities ≥ 0 and <1)	Use of $E(X-\mu)^2$ gets M1 for attempt at $(x-\mu)^2$ should see $(-0.74)^2$, 0.26^2, 1.26^2, 2.26^2, 3.26^2, (if E(X) wrong FT their E(X)) (all 5 correct for M1), then M1 for $\Sigma p(x-\mu)^2$ (at least 3 terms correct with their probabilities)
			$E(X^2) = (4\times0.6)+(9\times0.2)+(16\times0.1)+(25\times0.06)+(36\times0.04)$ $= 8.74$ or ${}^{437}/_{50}$ $Var(X) = 8.74 - 2.74^2 = 1.23$ or 1.232 or ${}^{3081}/_{2500}$	M1* M1* dep A1 **[5]**	For Σr^2p (at least 3 terms correct) for – their $E(X)^2$ FT their E(X) provided $Var(X) > 0$	Division by 5 or other spurious value at end and/or rooting final answer gives max M1A1M1M1A0, or M1A0M1M1A0 if E(X) also divided by 5. Unsupported correct answers get 5 marks (Probably from calculator) Condone 1.2324 despite the fact that this is over-specified since it is the exact answer

Question			Answer	Marks	Guidance	
5		(i)	$P(R \cap S) = P(R) + P(S) - P(R \cup S)$ $= 0.28 + 0.87 - 0.94$ $= 0.21$	M1 A1 **[2]**	For correct use of formula	Or $0.28 - x + 0.87 - x + x = 0.94$
5		(ii)		G1 G1 G1 **[3]**	For two labelled intersecting circles For at least 2 correct probabilities. FT their $P(R \cap S)$ For remaining probabilities. FT their $P(R \cap S)$	Allow labels such as $P(R)$ and $P(S)$ Allow other sensible shapes in place of circles Allow their $P(R \cap S)$ rounded to 2dp For both G1 marks FT their 0.21 **provided < 0.28** For FT if $P(R \cap S) = x$ then others are $0.28 - x$, $0.87 - x$, $x - 0.15$ 0.2436 leads to 0.0364, 0.6264, 0.0936
5		(iii)	$P(R \mid S) = \frac{P(R \cap S)}{P(S)} = \frac{0.21}{0.87} = \frac{21}{87} = 0.241$ Exact answer 0.241379… This is the probability that (on a randomly selected day) there is at least 1 mm of rain, given that there is at least 1 hour of sun.	M1 A1 E1 **[3]**	for fraction CAO FT their part (i) (for M1 only) but M0 if their answer to part (i) is $P(R) \times P(S)$ Need more than just probability of rain given sun Must include 'probability' or 'chance' oe Do not allow just P(at least 1 mm of rain, given that there is at least 1 hour of sun)	Allow $\frac{7}{29}$ or $\frac{21}{87}$ as final answer Allow 0.24 with working Condone 'if' or 'when' for 'given that' but not the words 'and' or 'because' or 'due to' for E1. E1 (independent of M1): the order/structure must be correct i.e. no reverse statement Allow 'The probability that on a randomly selected day when there is at least 1 hour of sun there is at least 1 mm of rain.' oe

Question			Answer	Marks	Guidance	
6	(i)		Mean = $\dfrac{(25\times147)+(45\times109)+(55\times182)+(70\times317)+(140\times175)}{930}$	M1	For midpoints (at least 3 correct) (allow 25.005, 45.005 etc leading to answer 70.20)	M0A0M0A0 unless using midpoints Answer must NOT be left as improper fraction as this is an estimate
			$\dfrac{750\times7+1250\times22+1750\times26+2500\times18+4000\times7}{80}=\dfrac{151250}{80}$ = (£)70.19 or (£)70.2	A1	CAO (exact answer 70.19355…) Correct answers obtained from use of calculator statistical functions gain full marks Condone answer of (£)70.20	Accept correct answers for mean and sd from calculator even if eg wrong *Sxx* given
			$\Sigma x^2 f =$ $(25^2\times147)+(45^2\times109)+(55^2\times182)+(70^2\times317)+(140^2\times175)$ = 91875 + 220725 + 550550 + 1553300 + 3430000 = 5846450		For attempt at S_{xx} Should include sum of at least 3 correct multiples $fx^2 - \Sigma x^2/n$ Do not FT their incorrect mean for A1	For use of midpoints 25.5, 45.5, 55.5, 70.5, 140.5 allow SC1 for £70.69 and SC1 for 36.89
			$S_{xx}=5846450-\dfrac{65280^2}{930}=1264215.161$ or $5846450-930\times70.19^2$	M1	(exact answer 36.88949…) Condone answer of (£)36.90	If using $(x-\bar{x})^2$ method, B2 if 36.9 or better, otherwise B0 Allow use of 70.2 in calculation of S_{xx} = 1263372.8 leading to 36.87719…
			$s=\sqrt{\dfrac{1264215}{929}}=\sqrt{1360.83}=36.89$ or (£)36.9 Allow any answer between 36.87 and 36.90 without checking working	A1 **[4]**	If both mean and sd over-specified, just deduct one mark	Condone RMSD of 36.87 (36.86985…) since *n* is so large
6	(ii)		100/120 × 175 = 145.83 145.83/930 = 0.1568 So 15.7%	M1* *M1dep A1 **[3]**	For 175/120	Or 20/120 × 175 = 29.166 oe (175 – 29.166)/930 Accept 16% with working

Question			Answer	Marks	Guidance	
6	(iii)			M1 A1	For fds - at least 3 correct Accept any suitable unit for fd such as eg freq per cm. Allow 15.9 and 1.5 and condone 1.45	M1 can be also be gained from freq per 10 – 4.9, 10.9, 18.2, 15.35, 0.146 (at least 3 correct) or similar. 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)
			 NB If not using fd's only mark available is B1 for width of bars Heights must be within ≤ 1 square of overlay (only for scales 2cm = 4 units (blue) or 5 units (red)) – otherwise check heights. Note that you must make sure that the overlay is aligned correctly with the vertical axis.	B1 B1 B1 **[5]**	linear scales on both axes and label on both axes (Allow horizontal axis labelled x) Vertical scale starting from zero (not broken - but can get final mark for heights if broken) width of bars (within half a square) (NO GAPS ALLOWED) height of bars	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 have linear scale. Condone starting at 10 rather than 0. For inequality labels see additional notes below. Height of bars – must be linear vertical scale. FT of heights dep on at least 3 heights correct and all must agree with their fds If fds not given and 3 or 4 heights correct then max M1A0G1G1G0

Price	Frequency	Group width	Frequency density
$10 \le x \le 40$	147	30	4.90
$40 < x \le 50$	109	10	10.90
$50 < x \le 60$	182	10	18.20
$60 < x \le 80$	317	20	15.85
$80 < x \le 200$	175	120	1.46

Question			Answer	Marks	Guidance	
6	(iv)		Positive skewness	B1 [1]	Allow +ve	
6	(v)		Area for men from 100 to 200 = 100 × 2 = 200 200/990 = 0.202 So 20.2% Cannot be certain as both figures are estimates	M1 A1 E1 [3]	 Independent	Or $^{100}/_{120} \times 240$ 20% with working Allow comments such as 'grouped data so cannot be certain' or 'Values are not exact so cannot be certain' oe or 'midpoints have been used so cannot be certain' oe
6	(vi)		Men's running shoes have a lower average price than women's (as their mean is only £68.83 compared to £70.19). Or equivalent for women Men's running shoes have a more variation in price than women's (as their sd is £42.93 compared to £36.89). Or equivalent for women	E1 E1 [2]	FT their mean Do NOT condone lower central tendency or lower mean FT their SD	Allow 'on the whole' or similar in place of 'average'. Allow 'more spread' or similar but not 'higher range' or 'higher variance' or 'less distributed' Condone less consistent
7	(i)	(*A*)	$X \sim B(16, 0.1)$ $P(X = 3) = 0.25^4 \times 0.75^{16}\binom{20}{4} \times 0.25^4 \times 0.75^{16} = 0.1423$ Or: From tables $P(X \le 3) - P(X \le 2) = 0.9316 - 0.7892 = 0.1424$	M1 M1 A1 M2 A1 [3]	For $0.1^3 \times 0.9^{13}$ For $\binom{16}{3} \times p^3 \times q^{13}$ CAO For 0.9316 – 0.7892 CAO	With $p + q = 1$ Also for 560 × 0.000254.. Allow 0.14 or better
7	(i)	(*B*)	$P(X \ge 3) = 1 - P(X \le 2) = 1 - 0.7892 = 0.2108$	M1 A1 [2]	For 0.7892 CAO	If calculating $P(X = 0) + P(X = 1) + P(X = 2)$ allow M1 for 0.79 or better and A1 for 0.21 or better.

Question			Answer	Marks	Guidance	
7	(i)	(*C*)	Expected number = 16 × 0.1 = 1.6	B1 **[1]**		Do not allow final answer of 1 or 2 even if correct 1.6 given earlier
7	(ii)		Let p = probability of a randomly chosen person using 1234 as their PIN (in the population) H_0: $p = 0.1$ H_1: $p < 0.1$ The alternative hypothesis has this form as the advertising campaign aims to reduce the proportion of the population who use 1234 as their PIN.	B1 B1 B1 B1 **[4]**	For definition of p (in context) For H_0 For H_1 Dep on < 0.1 used in H_1 Do Not allow just 'proportion will be lower' or similar.	Do NOT allow <u>number</u> in place of probability. See below for additional notes For use of 0.9 as P(do not use 1234), contact team leader. E0 for simply stating H_1 in words Condone number instead of proportion.
7	(iii)	(*A*)	For $n = 20$, $P(X \leq 0) = 0.1216$ 0.1216 > 0.10 So no point in carrying out the test as H_0 could not be rejected (even if nobody in the sample uses 1234 as their PIN). oe	M1* *M1dep A1 **[3]**	For sight of 0.1216 For > 0.10 or > 10% Do NOT FT wrong H_1 or state 'There is no critical region' oe For A1 need $P(X \leq 0)$ or $P(X = 0)$ somewhere oe	Condone $P(X = 0)$ in place of $P(X \leq 0)$ Need to see a comparison with 0.1 or 10% explicitly, not just mentioning significance level. Allow SC2 for clearly indicating use of B(20, 0.1) but with no mention of 0.1216 with convincing reasoning and final answer correct Allow CR is empty but NOT CR is zero
		(*B*)	Lowest value of k is 13	B1 **[1]**	Or 13%	
7	(iv)		$P(X \leq 2) = 0.0530$ 0.0530 > 0.05 So not significant. Do not reject H_0 Conclude that there is not enough evidence to support the suggestion that the advertising campaign has been successful. Reminder: When you mark this question part, if you 'fit to height' you can check the last page for working or mark it BP if there none	B1 M1 A1* *E1 dep **[4]**	For **<u>use</u>** of $P(X \leq 2)$ only For comparison of 0.0530 with 5% Also allow $P(X \leq 2) > 0.05$, $(P(X \leq 1) < 0.05)$ so CR is {0, 1} for first two marks then A1E1 as usual Condone 'number of people' in conclusion	No marks unless H_1 correct If B0 then no further marks Allow 'accept H_0' or 'reject H_1' Must include 'insufficient evidence to suggest that' or something similar i.e. an element of doubt either in the A or E mark.

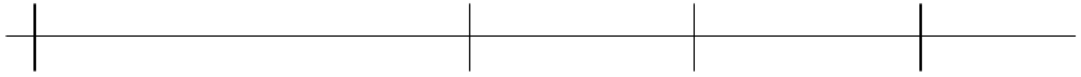
NOTE RE OVER-SPECIFICATION OF ANSWERS

If answers are grossly over-specified, deduct the final answer mark. Note in Q6i only deduct 1 mark even if both mean and sd over-specified. 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.

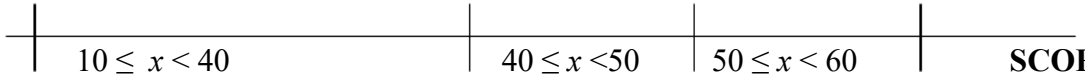
ANNOTATION RULES

See note 12 above and particularly 12a. Remember to put full annotation on all practice and standardisation scripts unless the candidate has scored full marks or zero. In addition for all marking in Q6(iii), if the candidate has not scored full marks then show which B marks have been awarded in the right hand margin, in the same order as they are given in the mark scheme. You should indicate any errors made.

Additional notes re Q6 part iii G mark

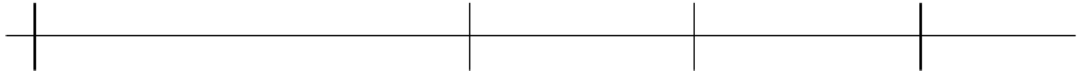


SCORES G1



SCORES G0

BUT



SCORES G1

Additional notes re Q7 part ii

Minimum needed for B1 is p = probability of using 1234.
Allow p = P(using 1234)
Definition of p must include word probability (or chance or proportion or percentage or likelihood but NOT possibility, number or amount).
Preferably given 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 1234.'
Do NOT allow 'p = the probability of using 1234 is different'
Allow p=10%, allow only p or θ or π or ρ. However allow any single symbol <u>if defined</u> (including x)
Allow $H_0 = p=0.1$, Allow $H_0 : p={}^1/_{10}$
Allow NH and AH in place of H_0 and H_1
Do not allow $H_0 : P(X=x) = 0.1$
Do not allow H_0: =0.1, =10%, P(0.1), p(x)=0.1, x=0.1 (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 0.1 oe
Thus eg H_0 : P(using 1234) = 0.1, H_1 : P(using 1234) < 0.1 gets B0B1B1

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