OCR
Oxford Cambridge and RSA

Wednesday 25 May 2016 – Morning

AS GCE MATHEMATICS (MEI)

4766/01 Statistics 1

QUESTION PAPER

Candidates answer on the Printed Answer Book.

OCR supplied materials:
- Printed Answer Book 4766/01
- MEI Examination Formulae and Tables (MF2)

Other materials required:
- Scientific or graphical calculator

Duration: 1 hour 30 minutes

INSTRUCTIONS TO CANDIDATES

These instructions are the same on the Printed Answer Book and the Question Paper.

- The Question Paper will be found inside the Printed Answer Book.
- Write your name, centre number and candidate number in the spaces provided on the Printed Answer Book. Please write clearly and in capital letters.
- **Write your answer to each question in the space provided in the Printed Answer Book**. If additional space is required, you should use the lined page(s) at the end of this booklet. The question number(s) must be clearly shown.
- Use black ink. HB pencil may be used for graphs and diagrams only.
- Read each question carefully. Make sure you know what you have to do before starting your answer.
- Answer **all** the questions.
- Do **not** write in the bar codes.
- You are permitted to use a scientific or graphical calculator in this paper.
- Final answers should be given to a degree of accuracy appropriate to the context.

INFORMATION FOR CANDIDATES

This information is the same on the Printed Answer Book and the Question Paper.

- The number of marks is given in brackets **[ ]** at the end of each question or part question on the Question Paper.
- You are advised that an answer may receive **no marks** unless you show sufficient detail of the working to indicate that a correct method is being used.
- The total number of marks for this paper is **72**.
- The Printed Answer Book consists of **12** pages. The Question Paper consists of **8** pages. Any blank pages are indicated.

INSTRUCTION TO EXAMS OFFICER / INVIGILATOR

- Do not send this Question Paper for marking; it should be retained in the centre or recycled. Please contact OCR Copyright should you wish to re-use this document.

Section A (36 marks)

1 The stem and leaf diagram illustrates the weights in grams of 20 house sparrows.

25	0		
26	0	5	8
27	7	9	
28	1	4	5
29	0	0	2
30	7	7	
31	6		
32	0	4	7
33	3	3	

Key: 27 | 7 represents 27.7 grams

(i) Find the median and interquartile range of the data. **[3]**

(ii) Determine whether there are any outliers. **[4]**

2 In a hockey league, each team plays every other team 3 times. The probabilities that Team A wins, draws and loses to Team B are given below.

- P(Wins) = 0.5
- P(Draws) = 0.3
- P(Loses) = 0.2

The outcomes of the 3 matches are independent.

(i) Find the probability that Team A does not lose in any of the 3 matches. **[1]**

(ii) Find the probability that Team A either wins all 3 matches or draws all 3 matches or loses all 3 matches. **[2]**

(iii) Find the probability that, in the 3 matches, exactly two of the outcomes, 'Wins', 'Draws' and 'Loses' occur for Team A. **[4]**

3 **(i)** There are 5 runners in a race. How many different finishing orders are possible? [You should assume that there are no 'dead heats', where two runners are given the same position.] **[1]**

For the remainder of this question you should assume that all finishing orders are equally likely.

(ii) The runners are denoted by A, B, C, D, E. Find the probability that they either finish in the order ABCDE or in the order EDCBA. **[2]**

(iii) Find the probability that the first 3 runners to finish are A, B and C, in that order. **[1]**

(iv) Find the probability that the first 3 runners to finish are A, B and C, in any order. **[2]**

4 The probability distribution of the random variable X is given by the formula

$$P(X = r) = \frac{k}{r(r-1)} \text{ for } r = 2, 3, 4, 5, 6.$$

(i) Show that the value of k is 1.2. Using this value of k, show the probability distribution of X in a table. **[3]**

(ii) Find E(X) and Var(X). **[5]**

5 Measurements of sunshine and rainfall are made each day at a particular weather station. For a randomly chosen day,

- R is the event that at least 1 mm of rainfall is recorded,
- S is the event that at least 1 hour of sunshine is recorded.

You are given that P(R) = 0.28, P(S) = 0.87 and P($R \cup S$) = 0.94.

(i) Find P($R \cap S$). **[2]**

(ii) Draw a Venn diagram showing the events R and S, and fill in the probability corresponding to each of the four regions of your diagram. **[3]**

(iii) Find P($R \mid S$) and state what this probability represents in this context. **[3]**

Section B (36 marks)

6 An online store has a total of 930 different types of women's running shoe on sale. The prices in pounds of the types of women's running shoe are summarised in the table below.

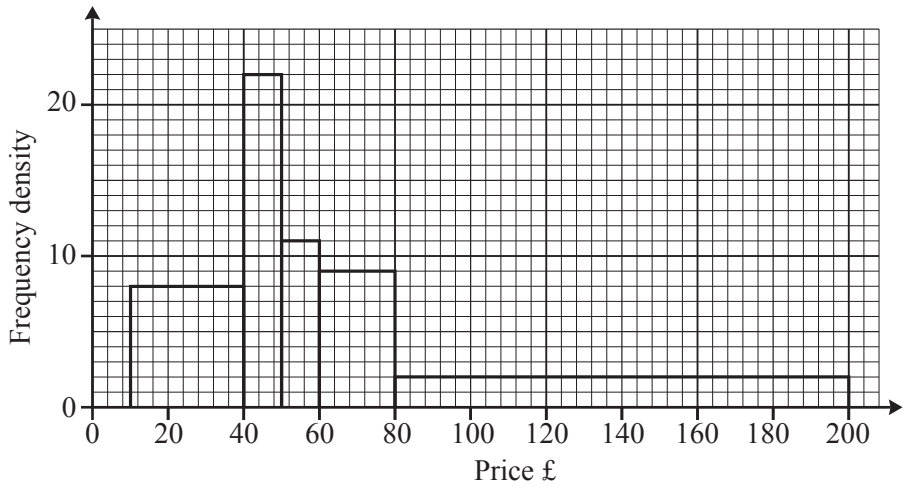
Price (£x)	$10 \leqslant x \leqslant 40$	$40 < x \leqslant 50$	$50 < x \leqslant 60$	$60 < x \leqslant 80$	$80 < x \leqslant 200$
Frequency	147	109	182	317	175

(i) Calculate estimates of the mean and standard deviation of the shoe prices. **[4]**

(ii) Calculate an estimate of the percentage of types of shoe that cost at least £100. **[3]**

(iii) Draw a histogram to illustrate the data. **[5]**

The corresponding histogram below shows the prices in pounds of the 990 types of men's running shoe on sale at the same online store.



(iv) State the type of skewness shown by the histogram for men's running shoes. **[1]**

(v) Martin is investigating the percentage of types of shoe on sale at the store that cost more than £100. He believes that this percentage is greater for men's shoes than for women's shoes. Estimate the percentage for men's shoes and comment on whether you can be certain which percentage is higher. **[3]**

(vi) You are given that the mean and standard deviation of the prices of men's running shoes are £68.83 and £42.93 respectively. Compare the central tendency and variation of the prices of men's and women's running shoes at the store. **[2]**

7 To withdraw money from a cash machine, the user has to enter a 4-digit PIN (personal identification number). There are several thousand possible 4-digit PINs, but a survey found that 10% of cash machine users use the PIN '1234'.

(i) 16 cash machine users are selected at random.

(*A*) Find the probability that exactly 3 of them use 1234 as their PIN. **[3]**

(*B*) Find the probability that at least 3 of them use 1234 as their PIN. **[2]**

(*C*) Find the expected number of them who use 1234 as their PIN. **[1]**

An advertising campaign aims to reduce the number of people who use 1234 as their PIN. A hypothesis test is to be carried out to investigate whether the advertising campaign has been successful.

(ii) Write down suitable null and alternative hypotheses for the test. Give a reason for your choice of alternative hypothesis. **[4]**

(iii) A random sample of 20 cash machine users is selected.

(*A*) Explain why the test could not be carried out at the 10% significance level. **[3]**

(*B*) The test is to be carried out at the k% significance level. State the lowest integer value of k for which the test could result in the rejection of the null hypothesis. **[1]**

(iv) A new random sample of 60 cash machine users is selected. It is found that 2 of them use 1234 as their PIN. You are given that, if $X \sim \mathrm{B}(60, 0.1)$, then (to 4 decimal places)

$$\mathrm{P}(X = 2) = 0.0393, \qquad \mathrm{P}(X < 2) = 0.0138, \qquad \mathrm{P}(X \leqslant 2) = 0.0530.$$

Using the same hypotheses as in part **(ii)**, carry out the test at the 5% significance level. **[4]**

END OF QUESTION PAPER

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OCR
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Wednesday 25 May 2016 – Morning

AS GCE MATHEMATICS (MEI)

4766/01 Statistics 1

PRINTED ANSWER BOOK

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OCR supplied materials:
- Question Paper 4766/01 (inserted)
- MEI Examination Formulae and Tables (MF2)

Other materials required:
- Scientific or graphical calculator

Duration: 1 hour 30 minutes

* 4 7 6 6 0 1 *

* 5 9 9 6 0 7 1 2 6 3 *

Candidate forename		Candidate surname	

Centre number						Candidate number				

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Section A (36 marks)

1 (i)	
1 (ii)	

2 (i)	
2 (ii)	
2 (iii)	
3 (i)	
3 (ii)	

3 (iii)	
3 (iv)	
4 (i)	

4 (ii)	

5 (i)

5 (ii)

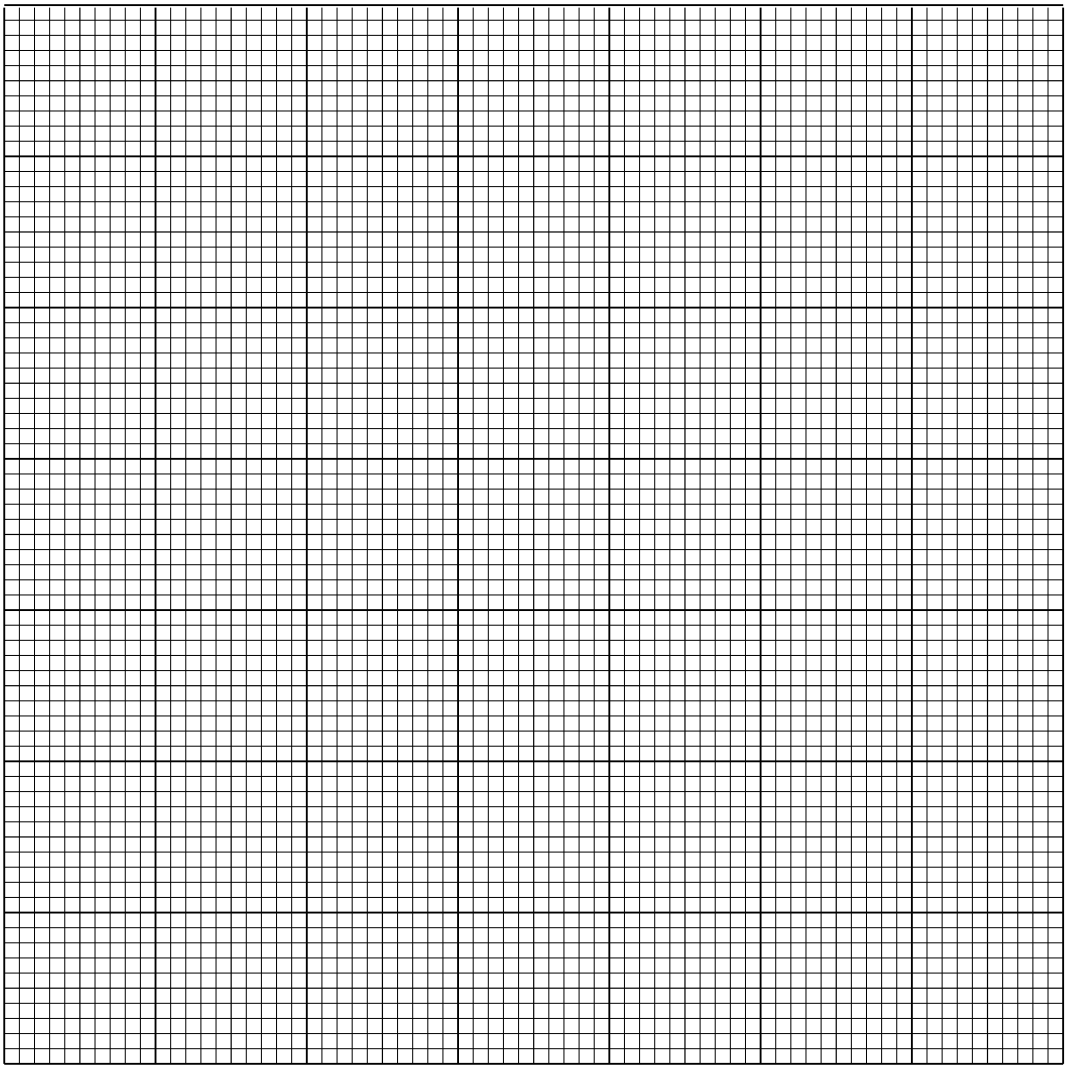
5 (iii)

Section B (36 marks)

6 (i)

6 (ii)

6 (iii)



6 (iv)	
6 (v)	
6 (vi)	

PLEASE DO NOT WRITE IN THIS SPACE

7 (i) (*A*)

7 (i) (*B*)

7 (i) (*C*)

7 (ii)

7 (iii) (*A*)	
7 (iii) (*B*)	
7 (iv)	

ADDITIONAL ANSWER SPACE

If additional space is required, you should use the following lined page(s). The question number(s) must be clearly shown in the margin(s).

OCR
Oxford Cambridge and RSA

GCE

Mathematics (MEI)

Unit **4766**: Statistics 1

Advanced Subsidiary GCE

Mark Scheme for June 2016

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, Cambridge Nationals, Cambridge Technicals, 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.

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.

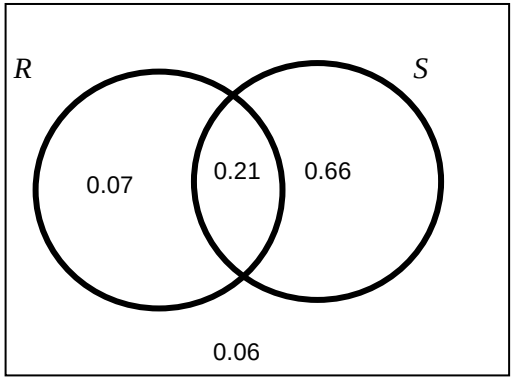
The situation regarding any particular cases that arise while you are marking for which you feel you need detailed guidance should be discussed with your Team Leader.

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	B1		Condone wrong method
			IQR = 31.8 – 27.8	M1	For either quartile – allow alternative definitions of quartiles	Allow 27.75 and 31.9 leading to 4.15
			= 4.0	A1		Do not allow 27.7, 27.9, 31.6,32.0
				[3]		
1	(ii)		Lower limit = 27.8 - 1.5 × 4.0 = 21.8	M1	Method for either	For use of mean (29.44) and SD (2.516765…)
			27.75, 31.9 lead to 21.525 and 38.125	A1	FT sensible quartiles and IQR	29.44 ± 2×2.516765 M1
			27.7, 31.6 lead to 21.85 and 37.45			Lower Limit = 24.4 A1
			Upper limit = 31.8 + 1.5 × 4.0 = 37.8	A1	FT sensible quartiles and IQR	Upper limit = 34.5 A1
						So no outliers B1
			So there are no outliers (at either end of the distribution)	B1	Dep on at least one A1	
				[4]	Use of median scores 0/4	
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) = $0.5^3 + 0.3^3 + 0.2^3$	M1	Including addition	
			$= 0.16 = {}^{4}/_{25}$	A1		
				[2]		
2	(iii)		P(all three outcomes occur) = 3! × 0.5 × 0.3 × 0.2	M1*		Allow M1 for $k \times 0.5 \times 0.3 \times 0.2$ even if k = 1 Even if cubed
			= 0.18	A1		
			Required probability = 1 – '0.18' – 0.16	*M1 dep		Not if cubed
			$= 0.66 = {}^{33}/_{50}$	A1	CAO	
				[4]		
			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	

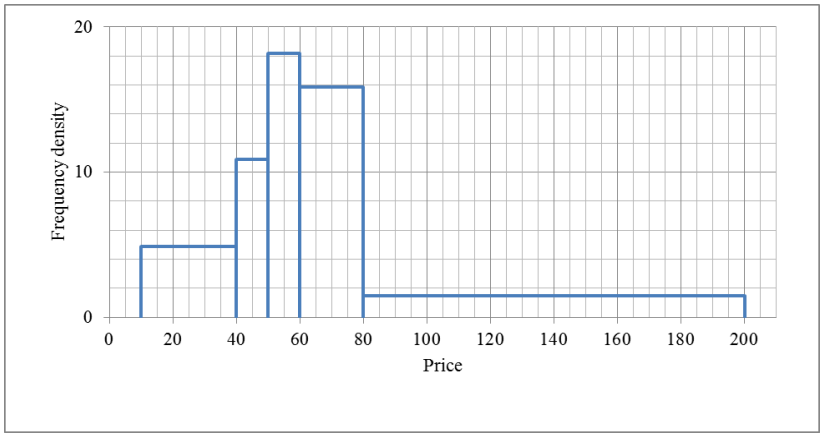
Question			Answer	Marks	Guidance	
			OR:			
			P(WWD) + P(WWL) + P(DDW) + P(DDL) + P(LLW) + P(LLD)	M1	For any one product (no need for '3 ×')	Even if cubed
			$3\times0.5^2\times0.3+3\times0.5^2\times0.2+3\times0.3^2\times0.5+3\times0.3^2\times0.2+3\times0.2^2\times0.5+3\times0.2^2\times0.3$	M1	For '3 ×'	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
			<table><tr><td>r</td><td>2</td><td>3</td><td>4</td><td>5</td><td>6</td></tr><tr><td>P($X = r$)</td><td>0.6 $= {}^{3}/_{5}$</td><td>0.2 $= {}^{1}/_{5}$</td><td>0.1 $= {}^{1}/_{10}$</td><td>0.06 $= {}^{3}/_{50}$</td><td>0.04 $= {}^{1}/_{25}$</td></tr></table>	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)		$E(X) = (2\times0.6)+(3\times0.2)+(4\times0.1)+(5\times0.06)+(6\times0.04)$	M1	For Σrp (at least 3 terms correct) Provided 5 reasonable probabilities seen.	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)
			$E(X) = 2.74$ or ${}^{137}/_{50}$	A1	CAO If probs wrong but sum = 1 allow max M1A0M1M1A1. If sum ≠ 1 allow max M1A0M1M1A0 (provided all probabilities ≥ 0 and <1)	
			$E(X^2) = (4\times0.6)+(9\times0.2)+(16\times0.1)+(25\times0.06)+(36\times0.04)$ $= 8.74$ or ${}^{437}/_{50}$	M1*	For $\Sigma r^2 p$ (at least 3 terms correct)	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.
			$\text{Var}(X) = 8.74 - 2.74^2 = 1.23$ or 1.232 or ${}^{3081}/_{2500}$	M1* dep A1 **[5]**	for – their $E(X)^2$ FT their E(X) provided Var(X) > 0	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 = $\dfrac{(25\times147)+(45\times109)+(55\times182)+(70\times317)+(140\times175)}{930}$ $\dfrac{750\times7+1250\times22+1750\times26+2500\times18+4000\times7}{80}=\dfrac{151250}{80}$ = (£)70.19 or (£)70.2	M1 A1	For midpoints (at least 3 correct) (allow 25.005, 45.005 etc leading to answer 70.20) CAO (exact answer 70.19355…) Correct answers obtained from use of calculator statistical functions gain full marks Condone answer of (£)70.20	M0A0M0A0 unless using midpoints Answer must NOT be left as improper fraction as this is an estimate 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 use of midpoints 25.5, 45.5, 55.5, 70.5, 140.5 allow SC1 for £70.69 and SC1 for 36.89 For attempt at S_{xx} Should include sum of at least 3 correct multiples $fx^2 - \Sigma x^2/n$	
			$S_{xx}=5846450-\dfrac{65280^2}{930}=1264215.161$ or $5846450-930\times70.19^2$ $s=\sqrt{\dfrac{1264215}{929}}=\sqrt{1360.83}=36.89$ or (£)36.9 Allow any answer between 36.87 and 36.90 without checking working	M1 A1 **[4]**	Do not FT their incorrect mean for A1 (exact answer 36.88949…) Condone answer of (£)36.90 If both mean and sd over-specified, just deduct one mark	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… 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

<table>
<tr><th colspan="3">Question</th><th>Answer</th><th>Marks</th><th colspan="2">Guidance</th></tr>
<tr><td>6</td><td>(iii)</td><td></td><td>
<table>
<tr><th>Price</th><th>Frequency</th><th>Group width</th><th>Frequency density</th></tr>
<tr><td>$10 \le x \le 40$</td><td>147</td><td>30</td><td>4.90</td></tr>
<tr><td>$40 < x \le 50$</td><td>109</td><td>10</td><td>10.90</td></tr>
<tr><td>$50 < x \le 60$</td><td>182</td><td>10</td><td>18.20</td></tr>
<tr><td>$60 < x \le 80$</td><td>317</td><td>20</td><td>15.85</td></tr>
<tr><td>$80 < x \le 200$</td><td>175</td><td>120</td><td>1.46</td></tr>
</table>
</td><td>M1

A1</td><td>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</td><td>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)</td></tr>
<tr><td></td><td></td><td></td><td>


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.</td><td>B1

B1

B1
[5]</td><td>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</td><td>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</td></tr>
</table>

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 $P(X \leq 3) - P(X \leq 2) = 0.9316 - 0.7892 = 0.1424$	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*)	$P(X \geq 3) = 1 - P(X \leq 2) = 1 - 0.7892 = 0.2108$	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.

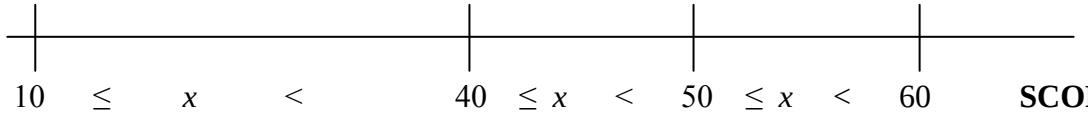
NOTE RE OVER-SPECIFICATION OF ANSWERS

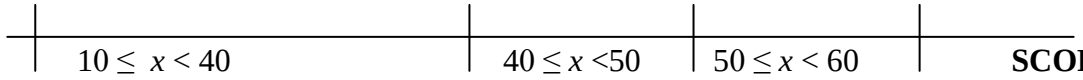
If answers are grossly over-specified, deduct the final answer mark. Note in Q6i only deduct 1 mark even if both mean and sd over-specified. Probabilities should also be rounded to a sensible degree of accuracy. In general final non probability answers should not be given to more than 4 significant figures. Allow probabilities given to 5 sig fig.

ANNOTATION RULES

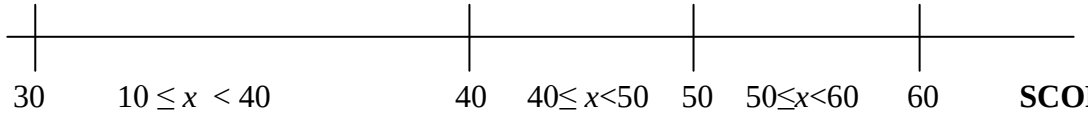
See note 12 above and particularly 12a. Remember to put full annotation on all practice and standardisation scripts unless the candidate has scored full marks or zero. In addition for all marking in Q6(iii), if the candidate has not scored full marks then show which B marks have been awarded in the right 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





BUT



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 if defined (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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4766 Statistics 1

General Comments:

As last year, the majority of candidates coped very well with this paper and a large number scored at least 60 marks out of 72. There was no evidence of candidates being unable to complete the paper in the allocated time. Most candidates had adequate space in the answer booklet without having to use additional sheets. Candidates who did need additional space often used the last page of the answer book, but a number did not, presumably not realising that it was available. It is also pleasing to report that losing marks due to over-specification was less of a problem than in previous years. Some candidates lost a mark in question 6 part (i) due to giving their answer to the mean and/or the standard deviation to 5 significant figures. A very small number gave probabilities to more than 5 significant figures thus again losing a mark.

Candidates usually scored very well on question 4 on frequency distributions, question 6 parts (i) and (iii) on data measures and histograms and on question 7 parts (i) on the binomial distribution. Even part (ii) of question 7, where candidates had to state hypotheses and define *p*, was very well answered. This is very pleasing, as up until recently, this topic has caused many candidates problems.

Questions on which candidates did not score so highly included question 3 parts (iii) and (iv) on probability, question 5 part (iii) on conditional probability and the latter parts of question 7 on hypothesis testing. In question 1, a surprisingly large number of candidates did not know how to find the quartiles correctly from a stem and leaf diagram, although most then knew the definition of outliers, so were able to gain marks in part (ii). Questions 2 and 3 caused difficulties to some candidates who scored highly in other areas of the paper. These two questions appeared to be a little less routine and required engagement with the scenario.

Candidates sometimes did not read the question carefully enough, so explanations did not always answer what was asked or explanations were missed out entirely. Candidates have, in most cases, been well prepared for calculations required in the paper but less so for analysing their findings. Although many candidates gave well written explanations, the poor handwriting, grammar and/or use of English made it difficult to work out what some others were trying to say. There were also problems with fours that looked like sixes or nines and ones and sevens that were difficult to tell apart.

Comments on Individual Questions:

Q1(i) The vast majority of candidates found the median correctly. A small minority misread/ignored the key to the stem and leaf diagram and gave an incorrect answer of 290. However under half of candidates found the quartiles correctly, with many using 5th and 15th values, which was penalised.

Q1(ii) Most candidates gained full marks, often on follow through from quartiles which were slightly out. The most common error was to use the median in calculations. A few candidates started from scratch and calculated mean and standard deviation. Some managed this successfully, but others made errors in their calculations, or incorrectly used a combination of both methods such as mean ± 1.5 × interquartile range.

Q2(i) Many candidates thought that not losing meant winning, and hence gave the common wrong answer of $0.5^3 = 0.125$. Others tried to consider combinations of wins and draws, often without success. The fact that the question part was only worth 1 mark should have been a clue to the fact that there was an easier approach.

Q2(ii) This was generally well answered although a few candidates interpreted this as 'find three separate probabilities which they did, and listed them but with no addition thus scoring zero.

Q2(iii) Only a small proportion of candidates used the most elegant approach (the first method in the mark scheme) and of those who did, many forgot to multiply by 6. Most candidates gave lists or tree diagrams to show P(WWL) etc., but many then did not multiply by 3, so the most common answer was 0.22, rather than the correct 0.66.

Q3(i) This was generally well answered.

Q3(ii) Again this was generally well answered, although some candidates truncated their decimal rather than correctly rounding. The use of fractions was preferable here.

Q3(iiii) Only around two thirds of candidates scored the mark here. The most common error was to use combinations.

Q3(iv) Again about two thirds of candidates scored both marks, with many scoring the marks for their answer to part (iii), correct or not, multiplied by 6, rather than for the fairly simple $^{3}/_{5} \times {}^{2}/_{4} \times {}^{1}/_{3}$.

Q4(i) Generally the solution of the equation to find k was carried out well, although not always entirely efficiently. Most candidates seemed to know that the sum of the probabilities should be 1, although not all thought it necessary to say so. However some did not include addition signs and so lost the marks, and others seemed to have no idea about addition of fractions, thinking that the sum of the probabilities was $^{5k}/_{70}$. Those who used $k = 1.2$ and verified the sum got some very easy marks, although not all were convincing enough to get full credit. The vast majority used the correct probabilities in part (ii), although not all tabulated them in a table to get the third mark in part (i).

Q4(ii) This part was very well answered with about 80% of candidates scoring full marks. A few candidates only found $\mathrm{E}(X^2)$ and a few used spurious division. Very few candidates attempted to find $\mathrm{E}(X- \mu)^2$ and those who did were rarely successful.

Q5(i) This part was very well answered but a considerable number of candidates assumed that the probabilities were independent and calculated $\mathrm{P}(R) \times \mathrm{P}(S)$. Some were more confused about the correct formula to use and calculated $\mathrm{P}(R) \times \mathrm{P}(R \cup S)$.

Q5(ii) The idea of the Venn diagram was well understood, and most candidates produced a fully correct solution (often following through from an error in part (i)). Very few noticed the contradiction produced by their wrong answer, which gave the outer zone as 0.0936 instead of 0.06 from the question.

Q5(iii) Among those who had not made the independence error in part (i), the correct answer was quite common. The explanation of what the probability means was usually correct but sometimes lacked sufficient detail. There were a few candidates who 'reversed' the statement and gave an explanation of $\mathrm{P}(S|R)$.

Q6(i) This part was fairly well answered with over half of candidates gaining full credit. A few had no idea how to proceed, but most used correct midpoints, although some made slips with them or occasionally used figures such as 25.5, 45.5, etc. The standard deviation proved more difficult for a number of candidates with a variety of wrong methods seen. Very few used the statistical functions on their calculator to do this question, despite this being the recommended method. A few candidates over-specified either or both of their final answers and so lost a mark.

Q6(ii) Candidates found this part rather more challenging, although almost half scored full marks. Trying to establish the proportion they were after was the biggest stumbling block. However, some were then unsure what to do with the figure of 145.83 once they had found it. Some rounded down to 145 (probably the most common mistake of those who understood what they needed to do) and others failed to finish by finding the percentage, just giving the final answer as a decimal 0.157.

Q6(iii) This part was again well answered with around 80% of candidates gaining at least 4 marks out of 5. Various errors were seen, but none very commonly. The most frequently seen were: using frequency rather than frequency density, using a non-linear scale on one of the axes (usually the horizontal axis), stopping the horizontal axis at 120, and labelling the horizontal axis 'Class width'.

Q6(iv) Over 90% of candidates scored the one mark available here.

Q6(v) A good number of candidates achieved full marks, and the question was answered better than question 6 part (ii) which is a similar calculation. Of those who got the calculation incorrect most started with 240/990 or 20/990, rather than 200/990. The explanation over certainty was well answered with most candidates achieving this mark, whether or not they got the first 2 marks.

Q6(vi) Although this is essentially a simple question, almost a third of candidates scored zero. Candidates struggled to provide acceptable comparisons, with many relying on terms such as "central tendency" when comparing the means, and relatively few discussing averages. A more encouraging proportion of candidates were able to provide a good interpretation for the differences in the standard deviations. Some thought that central tendency was something to do with variation. A number of candidates were unable to construct a proper, legible, grammatically correct sentence.
Q7(i)(*A*) This was very well answered.
Q7(i)(*B*) Again this was well answered, usually by use of tables, although some candidates did calculate the three probabilities, add and subtract from 1. A few candidates forgot to subtract from 1, and a few just subtracted P(X = 2) from 1.

Q7(i)(*C*) The majority of the candidates found this part straightforward, but a small minority lost the mark when they rounded their final answer to 1 or 2.

Q7(ii) As in recent years, candidates did well on this part, with over 80% gaining at least 3 marks out of 4. Most candidates scored the first two marks for the hypotheses, with many knowing that they needed to define p, thus scoring the third mark. A valid explanation of the reason for the form of the alternative hypothesis was usually given, even if not always very well worded.

Q7(iii)(*A*) Only about half of the candidates scored any marks here at all. Many candidates did not use any numbers so could not gain all the marks, but were awarded special case 2 if they gave a very convincing explanation. Some of those that did state that P($X \leq 0$) = 0.1216 then failed to show a comparison with 10% or 0.1 and so only scored 1 mark.

Q7(iii)(*B*) Those candidates who had 0.1216 in the previous part usually gave the correct answer of 13%. Some who did not get marks in the previous part did give the correct answer, so they probably simply did not know how to verbalise the previous answer. However under half scored the mark, some by simply failing to round to an integer.

Q7(iv) There were many good, clear answers to this part of the question but there were still a good proportion of candidates that were tempted to use point probabilities. A significant number who did use the correct probability (or probabilities if using a critical region method) failed to give the conclusion of the test in context. Some lost the final mark for commenting that the proportion had not changed instead of had not reduced and some gave a conclusion which was too assertive.

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GCE Mathematics (MEI)

				Max Mark	a	b	c	d	e	u
4751	01	C1 – MEI Introduction to advanced mathematics (AS)	Raw	72	63	57	52	47	42	0
			UMS	100	80	70	60	50	40	0
4752	01	C2 – MEI Concepts for advanced mathematics (AS)	Raw	72	56	49	42	35	29	0
			UMS	100	80	70	60	50	40	0
4753	01	(C3) MEI Methods for Advanced Mathematics with Coursework: Written Paper	Raw	72	58	52	47	42	36	0
4753	02	(C3) MEI Methods for Advanced Mathematics with Coursework: Coursework	Raw	18	15	13	11	9	8	0
4753	82	(C3) MEI Methods for Advanced Mathematics with Coursework: Carried Forward Coursework Mark	Raw	18	15	13	11	9	8	0
			UMS	100	80	70	60	50	40	0
4754	01	C4 – MEI Applications of advanced mathematics (A2)	Raw	90	64	57	51	45	39	0
			UMS	100	80	70	60	50	40	0
4755	01	FP1 – MEI Further concepts for advanced mathematics (AS)	Raw	72	59	53	48	43	38	0
			UMS	100	80	70	60	50	40	0
4756	01	FP2 – MEI Further methods for advanced mathematics (A2)	Raw	72	60	54	48	43	38	0
			UMS	100	80	70	60	50	40	0
4757	01	FP3 – MEI Further applications of advanced mathematics (A2)	Raw	72	60	54	49	44	39	0
			UMS	100	80	70	60	50	40	0
4758	01	(DE) MEI Differential Equations with Coursework: Written Paper	Raw	72	67	61	55	49	43	0
4758	02	(DE) MEI Differential Equations with Coursework: Coursework	Raw	18	15	13	11	9	8	0
4758	82	(DE) MEI Differential Equations with Coursework: Carried Forward Coursework Mark	Raw	18	15	13	11	9	8	0
			UMS	100	80	70	60	50	40	0
4761	01	M1 – MEI Mechanics 1 (AS)	Raw	72	58	50	43	36	29	0
			UMS	100	80	70	60	50	40	0
4762	01	M2 – MEI Mechanics 2 (A2)	Raw	72	59	53	47	41	36	0
			UMS	100	80	70	60	50	40	0
4763	01	M3 – MEI Mechanics 3 (A2)	Raw	72	60	53	46	40	34	0
			UMS	100	80	70	60	50	40	0
4764	01	M4 – MEI Mechanics 4 (A2)	Raw	72	55	48	41	34	27	0
			UMS	100	80	70	60	50	40	0
4766	01	S1 – MEI Statistics 1 (AS)	Raw	72	59	52	46	40	34	0
			UMS	100	80	70	60	50	40	0
4767	01	S2 – MEI Statistics 2 (A2)	Raw	72	60	55	50	45	40	0
			UMS	100	80	70	60	50	40	0
4768	01	S3 – MEI Statistics 3 (A2)	Raw	72	60	54	48	42	37	0
			UMS	100	80	70	60	50	40	0
4769	01	S4 – MEI Statistics 4 (A2)	Raw	72	56	49	42	35	28	0
			UMS	100	80	70	60	50	40	0
4771	01	D1 – MEI Decision mathematics 1 (AS)	Raw	72	48	43	38	34	30	0
			UMS	100	80	70	60	50	40	0
4772	01	D2 – MEI Decision mathematics 2 (A2)	Raw	72	55	50	45	40	36	0
			UMS	100	80	70	60	50	40	0
4773	01	DC – MEI Decision mathematics computation (A2)	Raw	72	46	40	34	29	24	0
			UMS	100	80	70	60	50	40	0
4776	01	(NM) MEI Numerical Methods with Coursework: Written Paper	Raw	72	55	49	44	39	33	0
4776	02	(NM) MEI Numerical Methods with Coursework: Coursework	Raw	18	14	12	10	8	7	0
4776	82	(NM) MEI Numerical Methods with Coursework: Carried Forward Coursework Mark	Raw	18	14	12	10	8	7	0
			UMS	100	80	70	60	50	40	0
4777	01	NC – MEI Numerical computation (A2)	Raw	72	55	47	39	32	25	0
			UMS	100	80	70	60	50	40	0
4798	01	FPT - Further pure mathematics with technology (A2)	Raw	72	57	49	41	33	26	0

		UMS	100	80	70	60	50	40	0

GCE Statistics (MEI)

			Max Mark	a	b	c	d	e	u
G241	01 Statistics 1 MEI (Z1)	Raw	72	59	52	46	40	34	0
		UMS	100	80	70	60	50	40	0
G242	01 Statistics 2 MEI (Z2)	Raw	72	55	48	41	34	27	0
		UMS	100	80	70	60	50	40	0
G243	01 Statistics 3 MEI (Z3)	Raw	72	56	48	41	34	27	0
		UMS	100	80	70	60	50	40	0

GCE Quantitative Methods (MEI)

			Max Mark	a	b	c	d	e	u
G244	01 Introduction to Quantitative Methods MEI	Raw	72	58	50	43	36	28	0
G244	02 Introduction to Quantitative Methods MEI	Raw	18	14	12	10	8	7	0
		UMS	100	80	70	60	50	40	0
G245	01 Statistics 1 MEI	Raw	72	59	52	46	40	34	0
		UMS	100	80	70	60	50	40	0
G246	01 Decision 1 MEI	Raw	72	48	43	38	34	30	0
		UMS	100	80	70	60	50	40	0

Level 3 Certificate and FSMQ raw mark grade boundaries June 2016 series

For more information about results and grade calculations, see www.ocr.org.uk/ocr-for/learners-and-parents/getting-your-results

Level 3 Certificate Mathematics for Engineering

		Max Mark	a*	a	b	c	d	e	u
H860	01 Mathematics for Engineering	This unit has no entries in June 2016							
H860	02 Mathematics for Engineering								

Level 3 Certificate Mathematical Techniques and Applications for Engineers

			Max Mark	a*	a	b	c	d	e	u
H865	01 Component 1	Raw	60	48	42	36	30	24	18	0

Level 3 Certificate Mathematics - Quantitative Reasoning (MEI) (GQ Reform)

			Max Mark	a	b	c	d	e	u
H866	01 Introduction to quantitative reasoning	Raw	72	55	47	39	31	23	0
H866	02 Critical maths	Raw	60	47	41	35	29	23	0
		Overall	132	111	96	81	66	51	0

Level 3 Certificate Mathematics - Quantitive Problem Solving (MEI) (GQ Reform)

			Max Mark	a	b	c	d	e	u
H867	01 Introduction to quantitative reasoning	Raw	72	55	47	39	31	23	0
H867	02 Statistical problem solving	Raw	60	40	34	28	23	18	0
		Overall	132	103	88	73	59	45	0

Advanced Free Standing Mathematics Qualification (FSMQ)

			Max Mark	a	b	c	d	e	u
6993	01 Additional Mathematics	Raw	100	59	51	44	37	30	0

Intermediate Free Standing Mathematics Qualification (FSMQ)

			Max Mark	a	b	c	d	e	u
6989	01 Foundations of Advanced Mathematics (MEI)	Raw	40	35	30	25	20	16	0

Version	Details of change
1.1	Correction to Overall grade boundaries for H866
	Correction to Overall grade boundaries for H867