

CAMBRIDGE INTERNATIONAL EXAMINATIONS

Cambridge Ordinary Level

MARK SCHEME for the October/November 2015 series

4040 STATISTICS

4040/23

Paper 2, maximum raw mark 100

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MARK SCHEME NOTES

The following notes are intended to aid interpretation of mark schemes in general, but individual mark schemes may include marks awarded for specific reasons outside the scope of these notes.

Types of mark

- M Method marks, awarded for a valid method applied to the problem.
- A Accuracy mark, awarded for a correct answer or intermediate step correctly obtained. For accuracy marks to be given, the associated Method mark must be earned or implied.
- B Mark for a correct result or statement independent of Method marks.

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 M or B mark is dependent on an earlier, asterisked, mark in the scheme.

The symbol * 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.

Abbreviations

- AG** answer given on question paper
- awrt** answer which rounds to
- cao** correct answer only
- dep** dependent
- ft** follow through after error
- oe** or equivalent
- SC** special case
- soi** seen or implied
- www** without wrong working

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- 1 (i) 9, 12 B1
- (ii) Pair of polygons M1
 Labelled or key B1
 Correct plots vertically A1
 Correct plots horizontally A1✓
(ft their boundaries, provided difference of 3. All consistent with possible exception of end points)
- (iii) Children at aqua splash are older **oe** B1
(general comment required, it is not enough to comment on one age group only)
- 2 (i) $(45 - 50)/10 = (x - 62.7)/7.4$ M1
 59 A1
- (ii) $(82 - 45.1)/8.2 = (x - 62.7)/7.4$ M1
 96 A1
- (iii) $(37.5 - 50)/10 = (39 - 48.5)/a$ M1
 7.6 A1
- 3 (a) (i) $P(A) = 0.3$ or $(1 - 0.7)$ seen B1
 Use of $P(A \cap B) = P(A) + P(B) - P(A \cup B)$ or " 0.3 " + $0.6 - 0.7$ M1
 0.2 A1
- (ii) $P(A) \times P(B) = "0.3" \times 0.6 \neq "0.2"$ M1
 So not independent A1✓
- (b) C and D, D and F B1
- 4 (i) Suitable scale and axis labelling B1
 Key/bars labelled B1
 Correct bars for country A: 9, 35, 56 B1
 Correct bars for country B: 14, 47, 39 B1
- (ii) Country A has greater urban area **oe** B1
 Country B had greater proportion of its area that is urban **oe** B1
- 5 (a) Advantage: Quicker, cheaper, easier to handle (less data) (**oe**) B1
 Disadvantage: May not be representative, less accurate (**oe**) B1
- (b) (i) True if the original population contains equal numbers of males and females/gender is relevant, otherwise not true B1*
 So sometimes true B1dep
- (ii) A random sample could produce these numbers/true if there is some order to the list, but not true if the list is random B1*
 So sometimes true B1dep

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6	(i)	$7 \times 39 - 6 \times 38$ or $38 + 1 \times 7$ 45	M1 A1
	(ii)	$\Sigma x^2/6 - 38^2 = 71$ use of formula for var/sd $\Sigma x^2 = 9090$ for 6 days Σx^2 for 7 days = "9090" + "45" ² (11 115) Var = $11\ 115/7 - 39^2$ = 66.9 (awrt)	M1 A1 M1 A1
7	(i)	2/5 or 3/5 seen (2/5 \times 3/5) White and black or black and white Product of 2 probs \times 2 (oe) 12/25	B1 M1 M1 A1
	(ii)	(3/5 \times 3/5 \times 2/5) Product of 3 probs \times 3 (oe) (3/5) ³ "P(2 black)" + "P(3 black)" (dep on at least one previous M) 81/125	M1 M1 M1 M1dep A1
		OR	
		(2/5 \times 2/5 \times 3/5) Product of 3 probs \times 3 (oe) (2/5) ³ 1 - "P(0 black)" - "P(1 black)" (dep on at least one previous M) 81/125	(M1 M1 M1 M1dep A1)
	(iii)	Without replacement understood, i.e. $n \times (n - 1)$ in denominator (2/5 \times 1/4 \times [3/3]) "(2/5 \times 1/4 \times [3/3])" \times 3 3/10	M1 M1 M1 A1
	(iv)	Evidence of bwbb 3/5 \times 2/4 \times 2/3 \times 1/2 [\times 1] or 3!2!/5! 1/10	M1 M1 A1

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8	<p>(i) 16, 37, 70, 92, 108, 116, 120</p> <p>(ii) 60th value (<i>allow 60.5th</i>) 20 + ("60" – 37)/33 × 10 (26.9696...) 27.0 (<i>condone 27</i>)</p> <p>(iii) 80/100 × 120 or 120 – 20/100 × 120 [96] 40 + ("96" – 92)/16 × 20 45 (SC B1 for 13.8)</p> <p>(iv) 8/10 × 21 + 16 = 32.8 (33 people less than 18) 7/20 × 8 + 108 = 110.8 (111 people less than 67) 8/10 × 21 or 2/10 × 21 or 7/20 × 8 or 13/20 × 8 Full attempt at total less than 18 or ≥ 18 or < 67 or ≥ 67 OR 2/10 × 21 (= 4.2) AND 7/20 × 8 (= 2.8) "111" – "33" OR "4.2" + 33 + 22 + 16 + "2.8" 78 78/120 × 100 = 65%</p> <p>(v) Data is grouped/actual ages not known and assumed to be evenly distributed within each class</p>	<p>B1</p> <p>B1 M1 M1 A1</p> <p>M1 M1 M1 A1</p> <p>M1</p> <p>M1* M1dep A1 A1</p> <p>B1 B1</p>
9	<p>(i) 7.50 × 98/100 oe or 7.50 × 106/100 oe 7.35 and 7.95</p> <p>(ii) 100s in first column 8.52/8.10 [× 100] or 8.36/8.10 [× 100] or 7.01/7.20 [× 100] 105, 103, 97 and 97 (awrt) (<i>A1 for two or three correct</i>) (<i>–1 if all correct but not to nearest whole number</i>)</p> <p>(iii) 10 × 8.10, 6 × 7.50, 5 × 7.20 [81:45:36] ÷ 9 gives 9, 5 and 4 Each worker does same number of hours</p> <p>(iv) Any one weight × price relative 9 × "103" + 5 × 106 + 4 × "97" + 2 × 108 ÷ (9 + 5 + 4 + 2) awrt 103</p> <p>(v) There has been an increase of 3% in the total wage bill between 2011 and 2013 assuming that number of workers/hours worked at each grade has remained the same</p>	<p>M1 A1</p> <p>B1 M1 A2</p> <p>M1 M1 B1</p> <p>M1 M1 M1 A1✓</p> <p>B1✓ B1 B1</p>

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10	(i)	To remove variation, in order to find the trend/to make predictions (OR To find the trend, in order to make predictions B1 B1)	B1 B1
	(ii)	So that moving average values coincide with original data items (B1 for mention of 4 being even)	B2
	(iii)	$a = 95.9$ $b = 226.2$ $c = 58.2$	B1 B1 B1
	(iv)	$64.1 - 57.5 = [6.6]$ $63.2 - 56.4 = [6.8]$ attempt at a suitable difference (may be negative) Sum of two such differences $\div 2$ (may be negative) 6.7 (thousand)	M1 M1 A1
	(v)	Correct plots (B1 for six or seven correct plots) ft their c Suitable trend line	B2✓ B1
	(vi)	Number of marriages is decreasing (not each quarter)	B1
	(vii)	Reading from graph + their (iv) (e.g. $55.5 + 6.7$) 61.9 to 62.3 thousand or 61 900 to 62 300 (ft their (iv) and their trend line)	M1 A1✓
11	(i)	(a) $1/2, 1/3, 1/6$ oe seen (B1 for 1 or 2 correct) $"1/2" \times 1 + "1/3" \times 2 + "1/6" \times 3 = [5/3 \text{ or } 1.67]$ $"5/3" - 2 [= -1/3]$ allow (\pm) award earlier if $"1/2" \times -1 + "1/3" \times 0 + "1/6" \times 1$ = loss of 0.33 (must state 'loss')	B2 M1 M1 A1
	(b)	(i) At least one of $1/2 \times 1/2$ or $1/3 \times 1/3$ or $1/6 \times 1/6$ $1/2 \times 1/2 + 1/3 \times 1/3 + 1/6 \times 1/6 [= 14/36 = 7/18]$ $"7/18" \times x = 2$ $x = 36/7 = 5.1\dots$ \$5	M1 M1 M1 A1 A1✓
		(ii) $"7/18" \times 90 [= 35]$ (" $7/18$ " must be a probability) $90 \times 2 - "35" \times "5"$ or $("36/7" - 5) \times "35"$ \$5 profit (condone 'profit' missing)	M1 M1 A1
	(ii)	$"2/3" \times y + "1/3" \times 2y = 2$ where " $2/3$ " and " $1/3$ " are probabilities 1.50 3	M1 A1 A1