**CAMBRIDGE INTERNATIONAL EXAMINATIONS**

**Cambridge Ordinary Level**

# MARK SCHEME for the October/November 2015 series

## 4040 STATISTICS

**4040/23** Paper 2, maximum raw mark 100

This mark scheme is published as an aid to teachers and candidates, to indicate the requirements of the examination. It shows the basis on which Examiners were instructed to award marks. It does not indicate the details of the discussions that took place at an Examiners' meeting before marking began, which would have considered the acceptability of alternative answers.

Mark schemes should be read in conjunction with the question paper and the Principal Examiner Report for Teachers.

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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

**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

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

**8 (i)** 16, 37, 70, 92, 108, 116, 120 B1

**(ii)** $60^{th}$ value *(allow $60.5^{th}$)* B1
20 + M1
("60" – 37)/33 × 10 (26.9696…) M1
27.0 *(condone 27)* A1

**(iii)** 80/100 × 120 or 120 – 20/100 × 120 [96] M1
40 + M1
("96" – 92)/16 × 20 M1
45 A1
*(**SC** B1 for 13.8)*

**(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 M1
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) M1*
"111" – "33" OR "4.2" + 33 + 22 + 16 + "2.8" M1dep
78 A1
78/120 × 100 = 65% A1

**(v)** Data is grouped/actual ages not known B1
and assumed to be evenly distributed within each class B1

**9 (i)** 7.50 × 98/100 **oe** or 7.50 × 106/100 **oe** M1
7.35 and 7.95 A1

**(ii)** 100s in first column B1
8.52/8.10 [× 100] or 8.36/8.10 [× 100] or 7.01/7.20 [× 100] M1
105, 103, 97 and 97 (**awrt**) *(A1 for two or three correct)* A2
*(–1 if all correct but not to nearest whole number)*

**(iii)** 10 × 8.10, 6 × 7.50, 5 × 7.20 [81:45:36] M1
÷ 9 gives 9, 5 and 4 M1
Each worker does same number of hours B1

**(iv)** Any one weight × price relative M1
9 × "103" + 5 × 106 + 4 × "97" + 2 × 108 M1
÷ (9 + 5 + 4 + 2) M1
**awrt** 103 A1√

**(v)** There has been an increase of 3% B1√
in the total wage bill between 2011 and 2013 B1
assuming that number of workers/hours worked at each grade has remained the same B1

**10 (i)** To remove variation, in order to find the trend/to make predictions B1 B1
*(OR To find the trend, in order to make predictions B1 B1)*

**(ii)** So that moving average values coincide with original data items B2
*(B1 for mention of 4 being even)*

**(iii)** $a$ = 95.9 B1
$b$ = 226.2 B1
$c$ = 58.2 B1

**(iv)** 64.1 – 57.5 = [6.6]
63.2 – 56.4 = [6.8] attempt at a suitable difference *(may be negative)* M1
Sum of two such differences ÷ 2 *(may be negative)* M1
6.7 (thousand) A1

**(v)** Correct plots *(B1 for six or seven correct plots)* **ft** *their c* B2✓
Suitable trend line B1

**(vi)** Number of marriages is decreasing *(not each quarter)* B1

**(vii)** Reading from graph + *their* **(iv)** (e.g. 55.5 + 6.7) M1
61.9 to 62.3 thousand or 61 900 to 62 300 *(ft their **(iv)** and their trend line)* A1✓

**11 (i) (a)** 1/2, 1/3, 1/6 **oe** seen B2
*(B1 for 1 or 2 correct)*
"1/2" × 1 + "1/3" × 2 + "1/6" × 3 = [5/3 or 1.67] M1
"5/3" – 2 [= –1/3] allow (±) award earlier if "1/2" × –1 + "1/3" × 0 + "1/6" × 1 M1
= loss of 0.33 *(must state 'loss')* A1

**(b) (i)** At least one of 1/2 × 1/2 or 1/3 × 1/3 or 1/6 × 1/6 M1
1/2 × 1/2 + 1/3 × 1/3 + 1/6 × 1/6 [= 14/36 = 7/18] M1
"7/18" × $x$ = 2 M1
$x$ = 36/7 = 5.1… A1
$5 A1✓

**(ii)** "7/18" × 90 [= 35] *("7/18" must be a probability)* M1
90 × 2 – "35" × "5" or ("36/7" – 5) × "35" M1
$5 profit *(condone 'profit' missing)* A1

**(ii)** "2/3" × $y$ + "1/3" × 2$y$ = 2 where "2/3" and "1/3" are probabilities M1
1.50 A1
3 A1