MARK SCHEME for the October/November 2009 question paper

for the guidance of teachers

4040 STATISTICS

4040/02   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 must be read in conjunction with the question papers and the report on the examination.

- CIE will not enter into discussions or correspondence in connection with these mark schemes.

1 (i) Any valid argument relating to use of true, rather than stated, class limits.   B1

(ii) 2 15 35 57 74 79   B1

(iii) Determination of 60th item as the upper quartile   B1
129.5 +
['their 3'/17] × 20   M1
133.0 g   (must be 1dp)   A1
        [6]

2 (i) Any valid comment relating to the fact that $P(A) + P(B)$ is greater than 1.   B1

(ii) $P(A \cup B) = P(A) + P(B) - P(A \cap B) = 0.55 + 0.7 - 0.4$
Correct use of formula   M1
$= 0.85$ A1
In **(iii)** allow ft only if results are valid probabilities.

(iii) (a) $1 - 0.85 = 0.15$ WWW   (ft 1 – 'their 0.85')   B1ft

     (b) Use of $P(A) + P(B) - 2P(A \cap B) = 0.55 + 0.7 - 0.8$
or 'their **(ii)**' – 0.4
or 0.6 – 'their **(iii) (a)**'
Any valid method   M1
0.45   A1ft
        [6]

3 (i) A (Simple) random sampling   B1
D Systematic sampling   B1

(ii) Unbiased A C D   Biased B E
(−1 each error or omission)   B2

(iii) B biased because the claims do not all have an equal chance of selection   B1
E biased because doesn't involve random selection (or any other valid statement)   B1
        [6]

4 A   False   B1
   B   False   B1
   C   False   B1
   D   True   B1
   E   True   B1
   F   False   B1
        [6]

5 (i) Three dual bars with all heights correct.   B1*
Full annotation.   B1*dep

(ii) Two bars of equal height with sections numerically correct.   B1**
Full annotation   B1**dep

(iii) Dual chart illustrates comparison of the two years for each hospital   B1
Sectional chart illustrates comparison of use of each hospital in each year   B1

    [6]

6   (i) Attempted use of an assumed mean of 299   M1
Mean of X = 0.63   A1
Use of X-values in a correct formula for s.d. or variance   M1
s.d. = 0.43   A1

  (ii) Mean of results = 299.63   B1ft
s.d. of results = 0.43   B1ft

    [6]

7   (a) Any appreciation of the mean being affected by both increases   M1
Attempt to use a valid standardisation procedure for the mean   M1
{[230 – 20] × 35} / 30 + 25 or valid argument using multiples of s.d. above or below
mean   M1
Mean = $270   A1
Any appreciation of the s.d. being affected by only the per subject increase   M1
New s.d. = 90 × (35/30)   M1
= $105   A1

  (b) (i) 32 and 24 seen as marks for Papers I and II   B1
48 × (5/4) = 60   B1
Final mark = 32 + 24 + 60 = 116   B1

    (ii) Correct standardisation method applied (may be implied by correct answer for
either Paper I or Paper II mark)   M1*
Scaled Paper I mark = 35   A1
Scaled Paper II mark = 30   A1
Scaled Paper III mark = 50   B1
Summing the scaled marks   dep M1*
35 + 30 + 50 = 115   A1

    [16]

8 (i) Attempt to sum relevant angles and express as a proportion of 360 M1
P(W) = 1/10 = 0.1 A1
P(L) = ½ = 0.5 A1
P(SA) = 2/5 = 0.4 A1
(The M1 may be implied by any one correct probability.)

Sequence of outcomes	Probability	Amount won ($)
W	1/10 = 0.1	5
L	½ = 0.5	0
SA W	1/25 = 0.04	6
SA L	1/5 = 0.2	1
SA SA W	2/125 = 0.016	7
SA SA SA	8/125 = 0.064	3
SA SA L	2/25 = 0.08	2

(ii) Correct sequences (–1 each error or omission) B2

(iii) Correct probabilities (–1 each error or omission, but allow ft from **(i)** for first two) B2

(iv) Correct amounts won (–1 each error or omission) B2

(v) Appreciation of need to select outcomes which win $2. M1
0.08 (ft sum of prob of selected outcomes) A1ft

(vi) Attempt at correct method of finding expected amount won M1*
$1.40 A1
Comparison of result with $2. dep M1*
Loss of 60 cents. A1ft

[16]

9 (i) Insurance and Tax = 440 = 450 B1
Maintenance = 55 × (19000/1000) M1
= 1045 = 1050 A1
Fuel (0.9 × 19000 × 7.8)/100 M1
= 1333.8 A1
= 1350 A1

(ii) Any attempt to relate weights to total costs M1
3 : 7 : 9 A1

(iii) Fuel price relative = (1.08/0.9) × 100 = 120
(needn't be evaluated, but to score MUST include '×100') B1
Following M-marks may score using 'their' figures
[(111 × 3) + (108 × 7) + (120 × 9)]/(3 + 7 + 9) correct numerator M1
divided by correct denominator dep M1*
= 2169/19 = 114.2 A1

(iv) (2820 × 'their 114.2')/100   M1
      = \$3220   must be to nearest \$10   A1

(v) Any valid comments score, e.g.
      May have changed to a car with a different consumption   B1
      May have travelled a considerably different distance   B1

                                                  [16]

10 **(i)** $.2 \times .2 \times .2$ or $1/5 \times 1/5 \times 1/5$ M1
      = 0.008 or 1/125   A1

(ii) $(.2)^3 + (.35)^3 + (.45)^3$ or $(1/5)^3 + (7/20)^3 + (9/20)^3$
      sum of three products each containing three terms   M1
      sum of correct products   A1
      = 0.142 or 71/500   A1

      In **(iii)**, **(v)** and **(vi)** accept decimal results to 3sf or more.

(iii) $.35 \times .35 \times .45$ or $7/20 \times 7/20 \times 9/20$ M1*
      ×3   dep M1*
      = 0.165375 or 1323/8000   A1

(iv) $.35 \times .45 \times .2$ or $7/20 \times 9/20 \times 1/5$ M1
      ×6   M1
      = 0.189 or 189/1000   A1

(v) Sight of 0.65 or 13/20 (anywhere)   B1
      $.35 \times .35 \times .65 \times 3$ or $7/20 \times 7/20 \times 13/20 \times 3$ M1
      = 0.238875 or 1911/8000   A1

(vi) ['their **(i)**] / ['their **(ii)**']   M1
      = 0.0563 or 4/71   A1ft

                                                  [16]

11 **(i)** Because each value is the average of an even number of observations
      (or equivalent comment.)   B1

(ii) w =246   x =483   y = 59.375   one mark for each   B3

(iii) The value for quarter I of 2008 is not given (or equivalent comment)   B1

(iv) Suitable scales used   B1
      Full annotation   B1
      Correct plots (ft 'their' y)   –1 each error or omission   B3

(v) Single straight line passing centrally through the plotted points   M1
      The overall trend is a gradual decrease in sales   A1

(vi) Any appreciation of the fact that the quarterly components must sum to 0   M1
      q = 6.9   A1

(vii) Attempt to read the line at the correct point AND subtract 5.9   M1
      Value from 'their' reading   A1ft

                                                  [16]