# General Certificate of Secondary Education

# Statistics 3311

## Higher Tier

# Mark Scheme

*2008 examination - June series*

Mark schemes are prepared by the Principal Examiner and considered, together with the relevant questions, by a panel of subject teachers.  This mark scheme includes any amendments made at the standardisation meeting attended by all examiners and is the scheme which was used by them in this examination.  The standardisation meeting ensures that the mark scheme covers the candidates' responses to questions and that every examiner understands and applies it in the same correct way.  As preparation for the standardisation meeting each examiner analyses a number of candidates' scripts: alternative answers not already covered by the mark scheme are discussed at the meeting and legislated for.  If, after this meeting, examiners encounter unusual answers which have not been discussed at the meeting they are required to refer these to the Principal Examiner.

It must be stressed that a mark scheme is a working document, in many cases further developed and expanded on the basis of candidates' reactions to a particular paper. Assumptions about future mark schemes on the basis of one year's document should be avoided; whilst the guiding principles of assessment remain constant, details will change, depending on the content of a particular examination paper.

**The following abbreviations are used on the mark scheme:**

**M**      Method marks awarded for a correct method.

**A**      Accuracy marks awarded when following on from a correct method.
          It is not necessary always to see the method.  This can be implied.

**B**      Marks awarded independent of method.

**M dep**  A method mark which is dependent on a previous method mark being
          awarded.

**ft**     Follow through marks.  Marks awarded for correct working following a
          mistake in an earlier step.

**SC**     Special Case.  Marks awarded for a common misinterpretation which
          has some mathematical worth.

**oe**     Or equivalent.

**eeoo**   Each error or omission.

# Higher Tier

| Q | Answer | Mark | Comments |
|---|---|---|---|
| 1(a) | 23 | B1 | |
| 1(b) | West Midlands | B1 | |
| 1(c) | Rounding | B1 | Accept rounding errors, mistakes caused by rounding; not accept that the rounding is wrong or error in rounding |
| 1(d) | $\frac{78}{100} \times 160 = 124.8$ | B1 B1 | Sight of 78% oe B1<br>Not 78<br>160 or 160 000 B1 |
| | 124 800 | B1 | 124.8 SC2; 125 000 SC2; 125 SC1 |
| 1(e) | Correct heights | B1 | 80  17  3 |
| | Layout (rectangles joined) | B1 | For consistency with previous charts |
| | Shading / key | B1 | Allow if key written on each rectangle |
| 1(f) | Wales highest % over 12 months | B1 | Must imply % or proportion<br>not number or amount |
| | Scotland highest % under 6 months | B1 | |

| Q | Answer | Mark | Comments |
|---|---|---|---|
| **2(a)** | Only females | B1 | Too small a sample  B0; biased  B0<br>ref. to stratification  B0<br>No females in house  B0 |
| | Restricted house types/cost<br>(only those costing £450 000) | B1 | |
| **2(b)(i)** | Select random numbers in the range<br>01 - 500 | B1 | Use of tables / computer generated data<br>For hat selection ; 500 numbers in a hat  B1 |
| | Match random numbers to list | B1 | Pick out 50  B1 |
| **2(b)(ii)** | Improves representativeness of<br>sample | B1 | Fair amount  B1<br>Fair amount of each type  B1<br>Fairer  B0 |
| **2(b)(iii)** | $\frac{100}{500} \times 50 = 10$ | M1, A1 | M1  For 100 or 99/500 × 50<br>A1  For correct method and answer<br>9.9  M1  A0 |
| **2(c)(i)** | Overlapping limits / no instructions | B1 | Unequal intervals B0<br>Do not have a mortgage B1 for either part<br>but not both |
| **2(c)(ii)** | Personal | B1 | Biased B0; people may not pay monthly<br>or it may vary  B1 |

| Q | Answer | Mark | Comments |
|---|---|---|---|
| **3(a)** | £3 300 | B1 | |
| **3(b)** | £25 700 – £24 700 = £1 000 | M1, A1 | 25.7 – 24.7  M1 |
| **3(c)** | Median | B1 | £25 000 |
| | Quartiles in box | B1 | £23 400 – 26 500 |
| | Tails | B1 | £22 300 – 26 900<br>Must be on grid |
| **3(d)(i)** | North West | B1 | |
| **3(d)(ii)** | North East, below median | B1 | Accept md. = £24 800 |
| | West Mids, range too large | B1 | Range = £4 600 ; has large range B0 |

| Q | Answer | Mark | Comments |
|---|--------|------|----------|
| **4(a)(i)** | $\dfrac{45}{150}$ | B1 | $\dfrac{3}{10}$ or .3 |
| **4(a)(ii)** | $\dfrac{95}{150}$ | M1, A1 | $\dfrac{19}{30}$ or $0.63(\dot{3})$<br><br>Sight of 95 or 22 + 25 + 48 M1 |
| **4(a)(iii)** | $150 - (22 + 12 + 25 + 5 + 6 + 10 + 48)$ | M1 | |
| | $\dfrac{\textit{Their } 22}{150}$ | M1 dep | |
| | $\dfrac{22}{150}$ | A1 | $\dfrac{11}{75}$ or $0.146\dot{6}$ min 2 d.p |
| **4(a)(iv)** | $\dfrac{59}{150}$ | M1 | For sight of 59 or 22 + 12 + 25 |
| | | A1 | $0.393\dot{3}$ 2 d.p |
| **4(b)** | $\dfrac{11}{69}$ or 0.1594 | B1 | For sight of 11 |
| | | M1 | M1 For their 69 as denominator |
| | | A1 | cao min 2 d.p |
| **4(c)(i)** | Discrete | B1 | |
| **4(c)(ii)** | Continuous | B1 | |

| Q | Answer | Mark | Comments |
|---|--------|------|----------|
| **5(a)** | $\dfrac{48}{360} \times 135 = 18$ | M1 | For either method $63/135 \times 360 = 168$ |
| | | A1 | For 18 or 168 |
| | | A1 | ft for 135 – 63 – 45 – their 18 or<br>   or 360 – 120 – 48 – their 168 |
| | 9 and 24 | A1 | cao |
| **5(b)** | Angles $\pm 2$ degrees | B1 | No ft |
| | Labels | B1 | Labels correct in relation to size and only four sectors |
| **5(c)** | $\left(\dfrac{4.8}{4.1}\right)$ squared | M1 | |
| | $\times 135 = (185)$ | M1 dep | Any other method must be full method leading to 185 for M2 |
| | Difference = 50 | A1 | |

| Q | Answer | Mark | Comments |
|---|--------|------|----------|
| **6(a)** | $\frac{5250}{75} = 70$ minutes | M1, A1 | Where $x$ is a reasonable attempt at mid point |
| **6(b)** | $\sum fx^2 = 452\,100$ | M1 | $\sum f(x - \bar{x})^2 = 84\,600$  $x$ must be consistent with mean calculation |
| | Sub. in formula | M1 | Square root of 1128 seen |
| | $= 33.58\,(5711)$ | A1 | Accept if use $n - 1$; gives square root of $1143.24 = 33.812$ |
| **6(c)** | Frequency density .3  .45  1.5  .45  .2 | M1, A1 | Two or more fd's for M1 |
| | Correct heights | A1 | ft  Heights with vertical axis scaled |
| | Correct horizontal position | B1 | |
| **6(d)(i)** | Region $70 \pm 2$ (33.6) | M1, A1 | For limits 2.8, 137.2  <br> M1  For their mean $\pm 2 \times 33.6$ |
| | Correct shading | B1 | Shading in 0 - 20 bar and shading within 100 - 160 bar but not on class limits |
| **6(d)(ii)** | Approx 95% | B2 | For measurement  oe <br> 92 - 95 inc.  B2 <br> 5 - 8 inc.  B1 |
| **6(e)** | Accept: Normal or Bell shaped | B1 | No skew <br> Positive skew <br> Symmetrical |

| Q | Answer | Mark | Comments |
|---|--------|------|----------|
| **7(a)** | $(10 \times 615) + \ldots\ldots\ldots.. = £\,41\,034$ | M1, A1 | Attempt at all four products and summed |
| | $\left(\frac{41034}{31560}\right) \times 100$ | M2 | M1  For their $\frac{41034}{31560}$ dep on first M1 <br><br> M1 dep  For $\times 100$ |
| | $= 130(.0)$ or 130% | A1 | 30 % seen  SC3 |
| **7(b)(i)** | $\frac{140}{190} \times 100 = 73.7\%$ | M1, A1 | $\left(\frac{330}{190} \times 100\right) - 100 = 73.7$  Accept 74% |
| **7(b)(ii)** | Smaller weighting, less impact on Part (a) | B1 | Largest group / skilled have lower % increase: or semi-skilled have highest % increase but few workers <br> Smaller number of employees B1 <br> Lots of employees in other sectors B1 <br> Larger increase than others B0 |

| Q | Answer | Mark | Comments |
|---|--------|------|----------|
| **8(a)** | $\dfrac{80}{n} = \dfrac{33}{280}$ | M1, M1 | $\dfrac{33}{280}$ M1        $\dfrac{80}{n}$ M1 |
| | $n = \left(\dfrac{80 \times 280}{33}\right)$ | M1 dep | or $\dfrac{80}{.11785}$ M1 for isolating n |
| | $= 679$ | A1 | Allow 678 or 680 |
| **8(b)** | $\dfrac{25 - 35}{6} = -1.67$   Jim | M1, A1 | Accept + 1.67 |
| | $\dfrac{25 - 40}{10} = -1.5$      Shaun | A1 | |
| | Shaun: closer to zero | A1 ft | Closer to mean; lower standardised score<br>Shaun with justification has to be Z scores between ± 4 |

| Q | Answer | Mark | Comments |
|---|--------|------|----------|
| **9(a)** | $10 + 29 + 29 + 10 + 29 + \left(\frac{3}{4} \times 44\right)$ | M1 | |
| | $\left(\frac{101}{160}\right) \times 100 = 63.(1)\ldots$ | M1 dep, A1 | M1 For $\frac{their\ 101}{160} \times 100$ |
| **9(b)** | $\frac{100}{160} \times \frac{99}{159} = 0.389$ | M1 | M1 For $\frac{x}{160}$ where $x = 29 + 44 + 27$ |
| | | M1 | M1 dep For $\left(Their\ \frac{x}{160}\right) \times$ (any prob.) |
| | | M1 | $\left(\frac{x}{160}\right) \times \left(\frac{x-1}{159}\right)$ dep |
| | | A1 | or $\frac{165}{424}$ \qquad SC2 for $\frac{25}{64}$ |
| **9(c)** | Cumulative frequency | B1 | 10  39  68  112  139  160 |
| | Upper limits | B1 | ft  Must be a cumulative fn |
| | Their heights | B1 | cf  step polygon 2/4 |
| | Linked | B1 | Attempt at straight line link, not curve |
| **9(d)(i)** | Read off at 80 or 80.5 | B1 | (Approx 13 miles) ft  on cumulative polygon or step polygon |
| **9(d)(ii)** | Read off at 16$^{th}$ and 144$^{th}$ point | M1, A1 | ft (Accept 5.7 and 23) must show reading at 16 and 144 for  M1 |
| | Difference | A1 | ft (Accept 17.3 miles) |
| **9(e)** | Covers a  larger spread of data | B1 | |
| **9(f)(i)** | Increase by 1 | B1 | Just increased  B0 |
| **9(f)(ii)** | No change | B1 | |

| Q | Answer | Mark | Comments |
|---|---|---|---|
| **10(a)** | Line passing through double mean | B1 | For line through $\bar{x}$, $\bar{y}$ and positive |
| | Given co-ordinates and correct length | B1 dep | For line through 5, 30 500 and covers range of data |
| **10(b)(i)** | Attempt at difference and division | M1 | |
| | £ 5 300 | A1 ft | 5.3 seen  SC1 |
| **10(b)(ii)** | Increase in running costs for each additional member of staff | B1 | Extra cost per each additional member of staff<br><br>Average running cost per member of staff |
| **10(c)** | Estimate from line is higher | B1 | More employees but cheaper to run<br><br>Can use their l of bf for estimate and draw conclusion |
| **10(d)** | Ranks | B1, B1 | Either |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 7 | 6 | 8 | 3.5 | 5 | 3.5 | 2 | 1 | B1 |
| 6 | 7 | 8 | 3 | 4 | 5 | 1 | 2 | B1 |

or

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 2 | 3 | 1 | 5.5 | 4 | 5.5 | 7 | 8 | B1 |
| 3 | 2 | 1 | 6 | 5 | 4 | 8 | 7 | B1 |

| Q | Answer | Mark | Comments |
|---|---|---|---|
| | $d$ and $\sum d^2$ ( $= 7.5$ ) | M1, M1 | $\sum d^2 = 9$ for use of 3     M1  For d<br><br>$\sum d^2 = 7$ for use of 5     M1  For $\sum d^2$ |
| | Sub. in formula;<br>rank co-efficient = 0.91(07) | M1, A1 | |

| Q | Answer | Mark | Comments |
|---|---|---|---|
| **11(a)** | Time or cost | B1 | oe |
| **11(b)** | Limits at 151.2 and 148.8 | M1, A1 | $\frac{0.8}{100} \times 150$  M1  Both limits  A1 |
| | Limits shown | B1 | |
| | Plot | B2 | −1 for each error on tolerances |
| **11(c)** | Stop process outside limits on samples 4 and 8 | B1, B1 | ft  On correct interpretation of their chart<br>B1  For action<br>B1  For samples 4 and 8 referenced |