## *Linear Interpolation Mark Scheme (Edexcel)*

**Q1.**

| Question | Scheme | Marks |
|---|---|---|
| (a) | $\sum ft = 4837.5$ (allow 4838 or 4840) | B1 |
| | $\text{Mean} = \frac{"4837.5"}{200} = 24.1875$ awrt **24.2** or $\frac{387}{16}$ | M1 A1 |
| | $\sigma = \sqrt{\frac{134281.25}{200} - \left(\frac{4837.5}{200}\right)^2}$ | M1 |
| | $= 9.293$ ..... (accept $s$ =9.32) awrt **9.29** | A1 |
| | | **(5)** |
| (b) | $Q_2 = [20.5] + \frac{(100/100.5 - 62)}{88} \times 5 = 22.659...$ awrt **22.7** | M1 A1 |
| | | **(2)** |
| (c) | $Q_1 = 10.5 + \frac{(50/50.25)}{62} \times 10 [= 18.56]$ (*) ($n+1$ gives 18.604…) | B1 cso |
| | | **(1)** |
| (d) | $Q_3 = 25.5$ (Use of $n+1$ gives 25.734…) | B1 |
| | IQR = 6.9 (Use of $n+1$ gives 7.1) | B1 ft |
| | | **(2)** |
| (e) | The data is skewed (condone "negative skew") | B1 |
| | | **(1)** |
| (f) | Mean decreases and st. dev. remains the same. [Must mention mean and st. dev.] (from(a)) | B1 |
| | The median and quartiles would decrease. [Must refer to median and at least $Q_1$.] ((b)(c)) | B1 |
| | The IQR would remain unchanged (from (d)) | B1 **(3)** |
| | | **(14 marks)** |

| | Notes |
|---|---|
| | **Correct answers only score full marks in each part except (c)** |
| (a) | B1 for 4837.5 or 4838 or 4840 seen. |
| | If no $\sum ft$ seen (or attempt at $\sum ft$ seen), B1 can be implied by a correct mean of awrt 24.2 |
| | 1st M1 for attempt at their $\frac{\sum ft}{\sum f}$ allow 1sf so $\sum f$ = awrt 200 and $\sum ft$ = awrt 5000. |
| | Or award M1 for a clear attempt at mean where at least 4 correct products of $\sum ft$ are seen |
| | 2nd M1 for correct expression including square root seen. Follow through their mean. Allow a transcription error in 134281.25 but not an incorrect re-calculation. |
| (b) | M1 for a correct fraction ×5. Ignore end point but must be +. Allow use of $(n+1)$ giving 100.5… |
| (c) | B1cso for a fully correct expression including end point. NB Answer is given. Allow use of $(n+1)$ giving 50.25…but use of 50.5 scores B0 |
| (d) | 1st B1 for 25.5 (or awrt 25.7 using $n+1$) |
| | 2nd B1ft for their $Q_3$ – their $Q_1$ (or 18.6) (provided > 0) Accept awrt 2sf. Correct ans. only scores 2/2 |
| (e) | B1 Must mention that the data is skewed or not symmetrical. Do not award for "outliers" |
| (f) | 1st B1 for one correct comment from the above. May refer to parts (a), (b), (c) or (d) |
| | 2nd B1 for two correct comments from the above |
| | 3rd B1 for all 3 correct comments from the above |

**Q2.**

| Qu | Scheme | Marks | AO |
|---|---|---|---|
| (a) | From [5,20) fd = 3 or 1 large square = 2.5 passengers o.e. | M1 | 2.2a |
| | Correct bar above [0, 5) | A1 | 1.1b |
| | Correct bar above [20, 40) | A1 | 1.1b |
| | | (3) | |
| (b) | For [40, 65) **130** passengers or for [65, 80) **60** passengers | M1 | 2.1 |
| | For attempt to find total number of passengers = **331** | A1ft | 1.1b |
| | [Median = ] $40+\frac{\frac{1}{2}("331")-140}{"130"}\times 25$ or $65-\frac{270-\frac{1}{2}("331")}{"130"}\times 25$ (o.e.) | M1 | 1.1b |
| | $= 44.9038\ldots =$ awrt **44.9** | A1 | 1.1b |
| | | (4) | |
| (c) | Upper outlier limit = $58.9 + 1.5\times(58.9 - 27.3) = 106\ (.3) > 90$ | M1 | 2.4 |
| | So oldest passenger is not an outlier | A1 | 2.2a |
| | | (2) | |
| | | **(9 marks)** | |

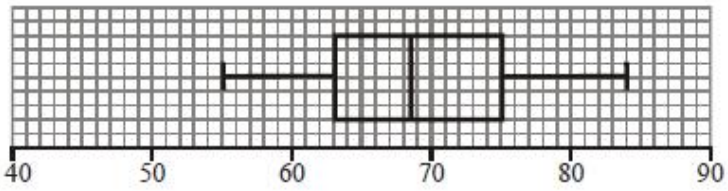
| | Notes |
|---|---|
| (a) | M1 for attempt at fd or a suitable method to deduce the scale for the histogram<br>May be implied by one correct bar.<br>1st A1 for first bar [0, 5) with fd = 1 or 2 large squares high<br>2nd A1 for third bar with fd = 4.5 or 9 large squares high |
| (b) | 1st M1 for an attempt using their fd to find the missing frequencies. May be in table<br>1st A1ft for a clear attempt to find the total number of passengers (ft their 130 and 60)<br>2nd M1 for any expression/equation leading to correct $Q_2$ Must be using 40-65 class<br>2nd A1 for awrt 44.9 (allow $(n + 1)$ leading to 45) |
| (c) | M1 for finding the upper outlier limit ( expression or awrt 106 ) and stating or implying > 90<br>A1 dep on M1 seen for deducing NOT an outlier |

**Q3.**

| Question | Scheme | Marks | AOs |
|---|---|---|---|
| **(a)** | Tr(ace) (data needs to be converted to numbers before the calculation can be carried out) | B1 | 2.4 |
| | | **(1)** | |
| **(b)** | [1+] $\frac{138-131}{24} \times 4$ | M1 | 2.1 |
| | $= 2.1666\ldots$ awrt **2.17** | A1 | 1.1b |
| | | **(2)** | |
| **(c)** | $\sigma = \sqrt{\frac{7704.1875}{184} - \left(\frac{539.75}{184}\right)^2} = 5.7676\ldots$ $\sigma$ = awrt **5.77** | M1<br>A1 | 1.1b<br>1.1b |
| | | **(2)** | |
| **(d)(i)** | Using class midpoints to estimate the mean assumes that the values are uniformly distributed **within the class(es)**. | B1 | 2.4 |
| **(ii)& (iii)** | This is not the case here as the majority of the data (in the first class) are 0. | B1 | 2.3 |
| | The actual mean is likely to be smaller than the estimate (since the first group has more values at 0 and close to 0) | dB1 | 2.2b |
| | | **(3)** | |
| | | | **(8 marks)** |

| Notes | |
|---|---|
| **(a)** | **B1:** Identifying tr(ace) data<br>Ignore comments about n/a, missing data, anomalies, etc. |
| **(b)** | **M1:** Correct fraction $\frac{7}{24} \times 4$ allow working down [5] $- \frac{155-138}{24} \times 4$<br>allow a correct equation leading to a correct fraction e.g. $\frac{x-1}{5-1} = \frac{138-131}{155-131}$ for M1<br>Use of $(n+1)$ with 138.75 allow $\frac{7.75}{24} \times 4$<br>**A1:** awrt 2.17 (condone $\frac{13}{6}$) awrt 2.29 from $(n+1)$ (condone $\frac{55}{24}$) |
| **(c)** | **M1:** Correct expression for standard deviation (allow mean = awrt 2.93)<br>**A1:** awrt 5.77 correct answer only scores M1A1 (allow $s = 5.78$)<br><br>**SC:** 5.76 with no working scores M1A0 |
| **(d)(i)** | **B1:** Explaining that data assumed to be spread evenly across each class (o.e.)<br>e.g. The midpoint of each class is the mean of each class<br>or all the values in the class are located at the midpoint<br>condone normally distributed within each class |
| **Mark together (ii)&(iii)** | **B1:** Demonstrating an understanding of the LDS that the majority of data values (in the first class) are at 0 or close to 0 (trace).<br>**dB1:** (dependent upon 2nd B1) Correct inference based on knowledge of the LDS<br><br>**SC:** If B1 is scored in (i) for 'The data are spread evenly across each class,' then in (ii) 'The data are not evenly distributed in the classes' scores B1 but in (iii) 'the actual mean is smaller' with no further justification scores B0 |

**Q4.**

| Question | Scheme | Marks |
|---|---|---|
| (a) | [Range = 48 − 9] = **39** | B1 (1) |
| (b) | [IQR = 25 − 12 ]= **13** | B1 (1) |
| (c) | Median = $65+\frac{[9]}{13}\times 5 = \frac{890}{13}$ = awrt **68.5°** $\left[\text{Condone: } 65+\frac{[9.5]}{13}\times 5 = 68.7\right]$ | M1 A1 (2) |
| (d) | Lower Quartile = $60+\frac{9}{15}\times 5 = \mathbf{63}$ (*) | M1 A1cso (2) |
| (e)(i) | $63-1.5\times(75-63)=45$<br>$75+1.5\times(75-63)=93$<br>No data above 93 and no data below 45 or 55>45 etc or there are no outliers. | M1A1<br>A1 |
| (ii) |  | M1<br>A1ft (5) |
| (f) | Median for the 70°angle is closer (to 70°)[ than the 20° median is to 20°]<br>The range/IQR for the 70° angle box plot is smaller/shorter<br>Therefore, students were more accurate at drawing the 70° angle. | B1<br>B1<br>dB1 (3) |
| | | (14 marks) |

| | Notes |
|---|---|
| (c) | M1 for an attempt (should have 65 or 70, 13 and 5)NB working down: $70-\frac{[4]}{13}\times 5$<br>Allow any correct method leading to $\frac{890}{13}$, the "5" may be implied by 65 and 70 seen<br>A1 awrt 68.5 (condone 68.7 if $(n+1)$ is used). Ans only of 68.5 is 2/2 but 68.7 needs M1 |
| (d) | M1 for correct expression for the lower quartile (condone 9.25 if $(n+1)$ used)<br>Watch out for working down e.g. $65-\frac{6}{15}\times 5$ (M1) but e.g. $\frac{60+65}{2}=62.5=63$ is M0<br>A1 for correct solution with no incorrect working seen (condone $(n+1)$ giving 63.08..) |
| (e)(i) | M1 for either correct calculation (may be implied by one correct limit)<br>A1 for either 45 or 93<br>A1 for 45 and 93 and conclusion |
| (ii) | M1 for a box with 1 whisker drawn on each side (must see the line drawn)<br>A1ft their median $63 < Q_2 < 75$ but quartiles (63 and 75), 55 and 84 must be correct. |
| Accuracy | Use 0.5 sq. accuracy so condone median on 68 or 69 if 68.5 seen |
| (f) | 1st B1 for correct comparison of their **medians** (63 < (c) < 75) to true value<br>2nd B1 for correct comparison of their **range** or **IQR** ("spread" is B0)<br>Allow saying IQRs of 12 and 13 are similar. Ignore mention of "skewness" or "outliers"<br>3rd dB1 dependent upon at least one previous B1 being scored for choosing 70° |