# AQA

# GCSE
# STATISTICS
# 8382/2H

Higher Tier  Paper 2

**Mark scheme**

June 2023

Version: Final 1.1

Mark schemes are prepared by the Lead Assessment Writer and considered, together with the relevant questions, by a panel of subject teachers. This mark scheme includes any amendments made at the standardisation events which all associates participate in and is the scheme which was used by them in this examination. The standardisation process ensures that the mark scheme covers the students' responses to questions and that every associate understands and applies it in the same correct way. As preparation for standardisation each associate analyses a number of students' scripts. Alternative answers not already covered by the mark scheme are discussed and legislated for. If, after the standardisation process, associates encounter unusual answers which have not been raised they are required to refer these to the Lead Examiner.

It must be stressed that a mark scheme is a working document, in many cases further developed and expanded on the basis of students' 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.

Further copies of this mark scheme are available from aqa.org.uk

**Glossary for Mark Schemes**

GCSE examinations are marked in such a way as to award positive achievement wherever possible. Thus, for GCSE Statistics papers, marks are awarded under various categories.

If a student uses a method which is not explicitly covered by the mark scheme the same principles of marking should be applied. Credit should be given to any valid methods. Examiners should seek advice from their senior examiner if in any doubt.

| | |
|---|---|
| **M** | Method marks are awarded for a correct method which could lead to a correct answer. |
| **A** | Accuracy marks are awarded when following on from a correct method. It is not necessary to always see the method. This can be implied. |
| **B** | Marks awarded independent of method. |
| **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. |
| **M dep** | A method mark dependent on a previous method mark being awarded. |
| **B dep** | A mark that can only be awarded if a previous independent mark has been awarded. |
| **oe** | Or equivalent. Accept answers that are equivalent. <br> eg accept 0.5 as well as $\frac{1}{2}$ |
| **[a, b]** | Accept values between a and b inclusive. |
| **[a, b)** | Accept values a ≤ value < b |
| **3.14 …** | Accept answers which begin 3.14 eg 3.14, 3.142, 3.1416 |
| **Use of brackets** | It is not necessary to see the bracketed work to award the marks. |

Examiners should consistently apply the following principles.

**Diagrams**

Diagrams that have working on them should be treated like normal responses.  If a diagram has been written on but the correct response is within the answer space, the work within the answer space should be marked.  Working on diagrams that contradicts work within the answer space is not to be considered as choice but as working, and is not, therefore, penalised.

**Responses which appear to come from incorrect methods**

Whenever there is doubt as to whether a student has used an incorrect method to obtain an answer, as a general principle, the benefit of doubt must be given to the student.  In cases where there is no doubt that the answer has come from incorrect working then the student should be penalised.

**Questions which ask students to show working**

Instructions on marking will be given but usually marks are not awarded to students who show no working.

**Questions which do not ask students to show working**

As a general principle, a correct response is awarded full marks.

**Misread or miscopy**

Students often copy values from a question incorrectly.  If the examiner thinks that the student has made a genuine misread, then only the accuracy marks (A or B marks), up to a maximum of 2 marks are penalised.  The method marks can still be awarded.

**Further work**

Once the correct answer has been seen, further working may be ignored unless it goes on to contradict the correct answer.

**Choice**

When a choice of answers and/or methods is given, mark each attempt.  If both methods are valid then M marks can be awarded but any incorrect answer or method would result in marks being lost.

**Work not replaced**

Erased or crossed out work that is still legible should be marked.

**Work replaced**

Erased or crossed out work that has been replaced is not awarded marks.

**Premature approximation**

Rounding off too early can lead to inaccuracy in the final answer.  This should be penalised by 1 mark unless instructed otherwise.

**Continental notation**

Accept a comma used instead of a decimal point (for example, in measurements or currency), provided that it is clear to the examiner that the student intended it to be a decimal point.

| Q | Answer | Marks | Comments |
|---|--------|-------|----------|
| **1(a)** | $\dfrac{23}{50}$ | B1 | |

| Q | Answer | Marks | Comments |
|---|--------|-------|----------|
| **1(b)** | $\dfrac{5}{9}$ | B1 | |

| Q | Answer | Marks | Comments |
|---|--------|-------|----------|
| **2** | 7 | B1 | |

| Q | Answer | Marks | Comments |
|---|--------|-------|----------|
| **3** | Multivariate | B1 | |

| Q | Answer | Mark | Comments |
|---|---|---|---|
| **4(a)** | $\dfrac{807\,300}{62\,260\,000} \times 1000$ | M1 | |
| | [12.9, 13] | A1 | SC1  digits 129 |
| | **Additional Guidance** | | |
| | Do not penalise further work seen after a correct answer | | |

| Q | Answer | Mark | Comments |
|---|---|---|---|
| **4(b)** | Jack's conclusion may be wrong<br>and<br>valid reason | B1 | eg  we would need to know the population (to find the number of births) |
| | **Additional Guidance** | | |
| | Accept the UK has a higher population than Iceland | | |
| | Accept "it" to refer to Iceland | | |
| | Accept "Jack is correct if Iceland has a larger population." | | B1 |
| | "Jack is correct" with no valid justification | | B0 |

| Q | Answer | Mark | Comments |
|---|---|---|---|
| **5(a)** | Student ability / previous results / target grades | B1 | oe |
| | **Additional Guidance** | | |
| | Whether students have a suitable device for the app | | B1 |

| Q | Answer | Mark | Comments |
|---|---|---|---|
| **5(b)(i)** | 68 | B1 | |

| Q | Answer | Mark | Comments |
|---|---|---|---|
| **5(b)(ii)** | (LQ =) 57(%)   or   (UQ =) 77(%) | M1 | |
| | 77(%) − 57(%) = 20(%) | A1 | |
| | **Additional Guidance** | | |
| | Check diagram for working | | |

| Q | Answer | Mark | Comments |
|---|---|---|---|
| 5(c) | 3 added to stem<br>and<br>label 'Book group' | B1 | oe<br>allow unambiguous labelling for 'Book group' |
| | Key correct | B1 | percent signs must be there but allow abbreviations for naming groups |
| | Left-hand side correct and ordered | B2 | B1<br>left-hand side correct but unordered<br>or<br>left-hand side ordered with up to two errors |

**Additional Guidance**

| Book group | | | | | | | App group | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | 9 | 7 | **3** | | | | |
| | | 6 | 4 | 2 | 0 | 4 | 5 | | | |
| | 8 | 7 | 6 | 5 | 0 | 5 | 2 | 3 | 7 | |
| | | | | | 9 | 6 | 4 | 5 | 6 | 8 |
| | | | | 9 | 1 | 7 | 0 | 3 | 5 | 7 |
| | | | | | 3 | 8 | 1 | 9 | | |
| | | | | | | 9 | 2 | | | |

**Key**  0 | 4 | 5  represents 40% for the Book group
and 45% for the App group

| Q | Answer | Mark | Comments |
|---|---|---|---|
| **5(d)** | Median for book = 55<br><br>or<br><br>Mean for book = [55, 56]<br><br>or<br><br>Mean for app = [68, 69] | B1ft | correct or ft their ordered stem-and-leaf |
| | (LQ for book =) 42<br><br>or<br><br>(UQ for book =) 69 | M1 | correct or ft their ordered stem-and-leaf |
| | (IQR for book =) 27 | A1ft | correct or ft their ordered stem-and-leaf<br><br>SC1  46 (book)  or  47(app)  (ranges) |
| | The book group did worse on average<br><br>or<br><br>The book group did worse as the median/mean is smaller | B1ft | oe<br><br>ft their medians or means |
| | The book group had more varied / less consistent scores (as the IQR is larger) | B1ft | oe<br><br>ft their book IQR or their ranges |
| | **Additional Guidance** | | |
| | Their comparisons must be based on figures seen and should be given in context | | |
| | Comparison of average must mention average or mean/median and must match their figures | | |
| | Check the full script for workings | | |

| Q | Answer | Mark | Comments |
|---|--------|------|----------|
| **5(e)** | Small sample | B1 | oe |
| | **Additional Guidance** | | |
| | Only tested on one class / in a single test | | B1 |
| | Specific reference to unequal revision conditions outside the classroom | | B1 |
| | Reference to extraneous variables with a specific, valid example<br><br>eg  app not working | | B1 |
| | Reference to extraneous variables with no valid example<br><br>eg  people in book group use the internet or the app as well | | B0 |
| | Reference to future experiments / ways to improve | | B0 |

| Q | Answer | Marks | Comments |
|---|--------|-------|----------|
| 6(a) | Convenience<br>or<br>Opportunity<br>or<br>Judgement | B1 | |
| | **Additional Guidance** | | |
| | Accept poor spellings but not if convenient/opportunistic/judgemental seen | | |

| Q | Answer | | Marks | Comments | |
|---|--------|---|-------|----------|---|
| | Ensures each student is equally likely to be chosen. | | B1 | oe | |
| | **Additional Guidance** | | | | |
| | More likely to be representative | | | | B1 |
| | It's representative | | | | B1 |
| 6(b)(i) | Removes bias | | | | B1 |
| | It's random | | | | B0 |
| | It's quick | | | | B0 |
| | It's cheap | | | | B0 |
| | It's easy | | | | B0 |

| Q | Answer | | Marks | Comments | |
|---|--------|---|-------|----------|---|
| | Sample could still be unrepresentative<br>or<br>It takes a long time | | B1 | oe<br><br>eg  if the list was done alphabetically then two siblings would not be both chosen. | |
| | **Additional Guidance** | | | | |
| 6(b)(ii) | An advantage in b(i) cannot be used as a disadvantage in b(ii) | | | | |
| | Condone irrelevant/incorrect responses with correct response(s) as long as not contradictory | | | | |
| | Any pupil before the starting number will never be chosen | | | | B1 |
| | Not representative | | | | B0 |

| | There are patterns | | B0 |
|---|---|---|---|

| Q | Answer | Marks | Comments |
|---|---|---|---|
| **6(c)(i)** | Random | B1 | |
| | **Additional Guidance** | | |
| | Stratified (random) | | B1 |

| Q | Answer | Marks | Comments |
|---|---|---|---|
| **6(c)(ii)** | 0.05 × 260 | M1 | oe |
| | 13 | A1 | |
| | **Additional Guidance** | | |
| | Answer line takes precedence over working space and anything written in table | | |
| | 13 on answer line with no workings | | M1A1 |

| Q | Answer | Marks | Comments |
|---|---|---|---|
| **6(d)** | Any two correct comparisons<br><br>eg<br><br>A greater proportion of people aged 65+ prefer Magnums compared to other age groups<br>or<br>Orange ice cream was 65+ third favourite whereas it was a Fab for 25–49 | B2 | oe<br><br>both responses may be seen in one comparison<br><br>B1 for any correct comparison |
| | **Additional Guidance** | | |
| | Condone irrelevant/incorrect responses with correct response(s) as long as not contradictory | | |
| | Answers should have a comparison of different age categories (not the same one) | | |
| | 65+ like orange the most (compared to all other age groups) | | B1 |
| | 50-64 like magnums the most (compared to all other items) | | B0 |
| | Do not accept references to trends | | |
| | As the age category increases so does the popularity of magnums | | B0 |
| | References to older or younger needs to be age specific | | |

| | | |
|---|---|---|
| Reference to 'more' or 'less' implies number so does not score | | |
| Do not allow comparisons where it is not necessarily true | | |
| More 65+ liked Magnums than people aged 18–24 | B0 | |

| Q | Answer | Marks | Comments |
|---|---|---|---|
| **7(a)** | For every month, the price of the ticket increases by £32. | B1 | oe |
| | **Additional Guidance** | | |
| | The rate of change of price must also state 'increase per month' | | |
| | Increase in price (ticket) per month | | B1 |

| Q | Answer | Marks | Comments |
|---|---|---|---|
| **7(b)** | $100 = 32t - 16$ <br><br> or <br><br> $116 = 32t$ | M1 | |
| | 3 or 3.6 or 3.63 or 3.625 | A1 | |
| | **Additional Guidance** | | |
| | Trial and improvement can be used but the final answer must be correct for any marks | | |

| Q | Answer | Marks | Comments |
|---|---|---|---|
| **7(c)** | (According to the model) the price would be negative (which is not possible). | B1 | oe |
| | **Additional Guidance** | | |
| | Because there won't be £0 | | B0 |
| | Answer must be in words so $P = -16$ on its own | | B0 |

| Q | Answer | Marks | Comments |
|---|---|---|---|
| **7(d)** | No **and** the points are not on or close to the straight line | B1 | oe |
| | **Additional Guidance** | | |
| | Any reason referencing outliers does not score | | |

| No **and** the points appear to follow a curve | B1 |
| No **and** it looks like a quadratic | B1 |
| No **and** the points appear to be non-linear | B1 |
| No **and** there is not a linear relationship | B0 |
| No **and** there is a strong correlation but it isn't linear | B0 |

| Q | Answer | Marks | Comments |
|---|--------|-------|----------|
| **8(a)** | It has come from a (reputable) website which is more likely to be accurate<br><br>or<br><br>It is secondary data so we do not know how accurately it has been collected. | B1 | |

| Additional Guidance | | |
|---|---|---|
| It has come from a website which may be unreliable | | B1 |
| It has come from a website which may be inaccurate | | B1 |
| It has not been collected by you | | B0 |

| Q | Answer | Marks | Comments |
|---|--------|-------|----------|
| **8(b)** | $\dfrac{280}{283} \times 100$ | B1 | oe |

| Q | Answer | Marks | Comments |
|---|--------|-------|----------|
| **8(c)(i)** | $\dfrac{107}{100} \times 430\,000$ | M1 | oe |
| | 460 100 | A1 | |

| Q | Answer | Marks | Comments |
|---|---|---|---|
| | **Alternative method 1** | | |
| **8(c)(ii)** | $\dfrac{233}{215}$ (=1.0837… ) | M1 | oe |
| | 1.08(37….) or 108(.37…) or 8.(37…)(%) <br> and <br> Yes | A1 | Condone 1.084 or 108.4% or 8.4% |
| | **Alternative method 2** | | |
| | $\dfrac{233\,000 - 215\,000}{215\,000}$ ($\times$ 100) <br><br> (= 0.0837…) | M1 | oe |
| | 0.08(37…) or 8(.37…)(%) <br> and <br> Yes | A1 | Condone 0.084 or 8.4% |
| | **Alternative method 3** | | |
| | 215 000 $\times$ $\dfrac{107}{100}$ | M1 | oe |
| | (£)230 050 and Yes | A1 | |

| Q | Answer | Marks | Comments |
|---|---|---|---|
| **8(d)** | Ticks no and gives a suitable reason <br> eg <br> From 2017 to 2019 the house prices fell by 3.8% so 8% of a lower price is different to 8% of the original 2017 value <br> or <br> The house prices increased by 8.3(16…)% | B1 | oe |
| | **Additional Guidance** | | |
| | Ticks No and 96.2 x 1.08 = 103.896 | | B1 |

| Q | Answer | Marks | Comments |
|---|--------|-------|----------|
| | **Alternative Method 1** | | |
| **9(a)** | Any one of $(25-20)\times 90$ or $(15\div 3)\times 90 \,(=450)$ or $(45-25)\times 60 \,(=1200)$ or $(60-45)\times 80 \,(=1200)$ | M1 | oe |
| | $(25-20)\times 90 + (45-25)\times 60 + (60-45)\times 80$ or their 450 + their 1200 + their 1200 | M1dep | oe |
| | 2850 | A1 | SC1 3300 with no working |
| | **Alternative Method 2** | | |
| | $(10-0)\times 180 \,(=1800)$ or $(25-10)\times 90 \,(=1350)$ or $(45-25)\times 60 \,(=1200)$ or $(65-45)\times 80 \,(=1200)$ or 5550 | M1 | oe |
| | (their 1800 + their 1350 + their 1200 + their 1200) $-$ (their 1800 + $\frac{2}{3}\times$ their 1350) or 5550 $-$ (their 1800 + $\frac{2}{3}\times$ their 1350) or 5550 - 2700 | M1dep | oe |
| | 2850 | A1 | SC1 3300 with no working |
| | **Additional Guidance** | | |
| | For the 2$^{nd}$ M1, 'their' values to be added must come from a correct method | | |

| Q | Answer | Marks | Comments |
|---|--------|-------|----------|
| 9(b)(i) | (An exact average cannot be found) as the data has been grouped/we do not know the exact values. | B1 | oe |

| | **Additional Guidance** | |
|---|---|---|
| We are using the mid-points | B1 |
| We do not know the distribution of times within the interval | B1 |
| The time values are in a range/group | B1 |
| Because it's an estimate | B0 |

| Q | Answer | Marks | Comments |
|---|--------|-------|----------|
| 9(b)(ii) | The mean will be in the centre of the distribution where the frequency density is lower | B1 | oe<br><br>eg<br><br>there is less data in the centre where the mean will be. |

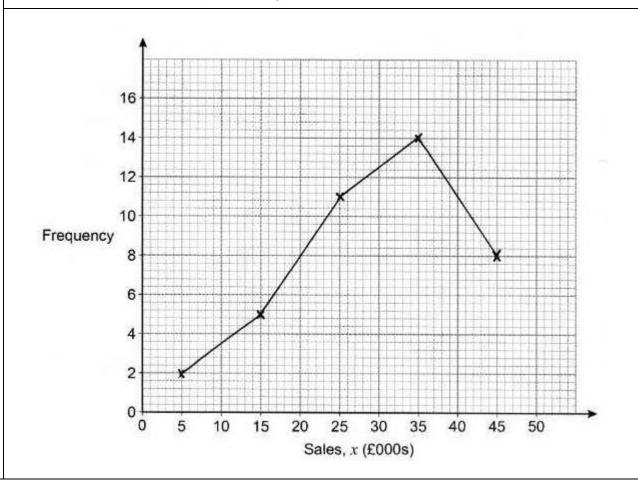| | **Additional Guidance** | |
|---|---|---|
| It is not normally distributed | B1 |
| The values are weighted towards the lower end | B1 |
| (Positive) skew | B1 |
| As the distribution has a limited range, do not accept references to the mean being affected by extreme values | |
| There is significantly/a lot more in the 1st 10 minutes so it affects the mean | B1 |
| There is more in the 1st 10 minutes so it affects the mean | B0 |
| Higher number at 0 -10 | B0 |
| Maybe affected by extraneous circumstances/anomalies/outliers | B0 |
| What about flights delayed by more than one hour | B0 |

| Q | Answer | Marks | Comments |
|---|---|---|---|
| **9(c)** | (The director may be correct because) the histogram for June is narrower (than the one for May). | B1 | oe<br><br>eg<br><br>the bars for June go from 0 to 50 but in May they go from 0 to 60.<br><br>Condone comments about the range being lower in June. |
| | (The director may be incorrect) as we don't know the actual maximum and minimum. | B1 | oe<br><br>eg<br><br>the maximum for May might be less than 50 and the minimum might be more than 0 |
| | **Additional Guidance** | | |
| | Condone irrelevant/incorrect responses with correct response(s) as long as not contradictory | | |
| | A response for the director being correct cannot be used as a response where the director may not be correct | | |
| | Histogram in June is narrower | | B1 |
| | Histogram in May is wider | | |
| | Do not allow references to taller/shorter to imply width | | |
| | For either comment, no reference to a month implies June | | |
| | In June, the longest delay was 50 minutes, whereas in May it was 60 minutes | | B0 |

| Q | Answer | Marks | Comments |
|---|--------|-------|----------|
| | Points plotted at correct heights (…,2), (…,5), (…,11), (…,14), (…,8) | M1 | $\pm\frac{1}{2}$ square tolerance condone one error |
| | Points plotted at midpoints of intervals (5,…), (15,…), (25,…), (35,…), (45,…) | M1 | $\pm\frac{1}{2}$ square tolerance condone one error |
| | Fully correct frequency polygon | A1 | ignore any lines drawn before the 1st point and after the last point mark intention of a straight line SC2 Fully correct polygon with correct bars |
| **10(a)** | **Additional Guidance** | | |
| | Bar chart only drawn then all heights must be correct $\pm\frac{1}{2}$ square tolerance for M1 | | |
| | Do not allow the 1st and last points being joined | | |

| Q | Answer | Marks | Comments |
|---|--------|-------|----------|
| **10(b)** | $\dfrac{33}{40}$ or $\dfrac{32}{39}$ seen | B1 | oe<br>eg<br>0.825 or 0.82(05…) |
| | $\dfrac{33}{40} \times \dfrac{32}{39}$ | M1dep | oe |
| | $\dfrac{44}{65}$ or $\dfrac{1353}{2000}$ or [0.6765, 0.6773] | A1 | oe<br>condone 0.68 with fully correct working |
| | **Additional Guidance** | | |
| | (With replacement) 0.68(0625) or $\dfrac{1089}{1600}$ | | SC1 |

| Q | Answer | Marks | Comments |
|---|---|---|---|
| **10(c)** | Median lies in the interval $30 \leqslant x < 40$ | B1 | may be implied by their answer or their calculation but not from the mean<br><br>eg<br><br>the 14 as the denominator or 30+ or 30 000+ in their calculation<br><br>or<br><br>sight of 20.5 or 20 |
| | $(30+) \dfrac{2.5}{14} \times 10$<br><br>or<br><br>$(30\,000+) \dfrac{2.5}{14} \times 10\,000$<br><br>or<br><br>$(30+) \dfrac{2}{14} \times 10$<br><br>or<br><br>$(30\,000+) \dfrac{2}{14} \times 10\,000$ | M1 | oe |
| | £31 800<br>or<br>£31.8 thousands<br>or<br>£31 400<br>or<br>£31.4 thousands | A1 | oe |
| | **Additional Guidance** | | |
| | Digits 314 or 318 with no incorrect working | | SC2 |
| | Numbers 142(8.57) or 1.42(857) or 178(5.714) or 1.78(5714) with no incorrect working | | |

| | | Answer | Marks | Comments |
|---|---|---|---|---|
| **11(a)** | | A suitable hypothesis, eg<br><br>Participants who complete the swim section quickly complete the cycle section quickly<br><br>or<br><br>There is a positive correlation between the times taken in the two sections | B1 | oe<br>do not accept questions |
| | **Additional Guidance** | | | |
| | There is no/negative correlation between the times taken in the swimming and cycling sections | | | B1 |
| | If they finish higher in swimming then they finish higher in cycling | | | B1 |
| | There is a correlation between swim and cycle times | | | B0 |

| Q | Answer | Marks | Comments |
|---|---|---|---|
| | Attempts to find sum of squared differences or $(\sum d^2) = 28$ | M1 | at least 6 of their squared values should be correct. Check table for squared differences |
| | $(1-)\dfrac{6 \times \text{their } 28}{8(8^2 - 1)}$ or $(1-)\dfrac{6 \times (\text{their } (4+1+9+...))}{8(8^2 - 1)}$ | M1dep | oe eg $\dfrac{168}{504}$ or $\dfrac{1}{3}$ or 0.33(3…) |
| 11(b)(i) | $\dfrac{2}{3}$ or [0.666, 0.667] or 0.67 | A1ft | oe SC3 for 0.7 with fully correct workings ft for their $\sum d^2$ (must be $\geq 0$) provided $0 \leq SRCC \leq 1$ |

**Additional Guidance**

| Athlete | Swim (min : sec) | Cycle (min : sec) | Rank Swim | Rank Cycle | Difference | |
|---|---|---|---|---|---|---|
| Brownlee | 17:24 | 55:04 | 1 | 3 | –2 | 4 |
| Schoeman | 17:25 | 55:01 | 2 | 1 | 1 | 1 |
| Murray | 18:20 | 55:35 | 8 | 5 | 3 | 9 |
| Pereira | 18:03 | 55:52 | 7 | 6 | 1 | 1 |
| Van Riel | 17:27 | 55:03 | 4 | 2 | 2 | 4 |
| Mola | 17:37 | 56:18 | 6 | 8 | –2 | 4 |
| Royle | 17:26 | 55:05 | 3 | 4 | –1 | 1 |
| Bailie | 17:31 | 56:11 | 5 | 7 | –2 | 4 |

| Q | Answer | Marks | Comments |
|---|---|---|---|
| **11(b)(ii)** | There is positive correlation between the swim times and the cycle times<br>or<br>Athletes who were fast in the swimming also tended to be fast in the cycling | B1ft | oe<br><br>eg<br><br>positive agreement/ relationship/association between the rankings of the times.<br><br>ft if $-1 \leqslant$ their (bi) $\leqslant 1$ (unless clear restart) |

| Additional Guidance | |
|---|---|
| Ignore any adjectives describing the strength of the relationship | |
| Some context should be included, eg reference to times | |
| If $-0.2 \leqslant$ their (bi) $\leqslant 0.2$ then condone no correlation as a comment | |
| If $-0.2 \leqslant$ their (bi) $\leqslant 0.2$, allow correct reference to positive or negative correlation | |
| The ranks/positions of the athletes in the two sections were similar | B1 |
| They do well on both events/sections | B0 |
| They do well | B0 |
| Positive correlation | B0 |
| The times are closely related | B0 |

| Q | Answer | Marks | Comments |
|---|---|---|---|
| **11(c)** | Yes **and** the value is closer to −1 (or more negative than −0.26)<br><br>or<br><br>Yes **and** -0.26 is further from -1<br><br>or<br><br>Yes **and** – 0.26 is closer to 0 (or more positive than -0.5)<br><br>or<br><br>Yes **and** -0.5 is further from 0 | B1 | oe |

| **Additional Guidance** | | |
|---|---|---|
| There must be reference to -1 or 0 | | |
| Yes **and** 'it's a bigger negative correlation because it's closer to -1 | | B1 |
| Yes **and** the value for cycle and run is closer to 0 | | B1 |
| Yes **and** 'a lower number below 0 shows a stronger negative correlation' | | B1 |
| Yes and 'it's a bigger negative correlation' | | B0 |
| −0.5 is smaller than −0.26 | | B0 |

| Q | Answer | Marks | Comments |
|---|--------|-------|----------|
| **12** | 14.5 | B1 | |

| Q | Answer | Marks | Comments |
|---|--------|-------|----------|
| **13(a)** | All 4 points plotted correctly | B2 | $\pm \frac{1}{2}$ square tolerance<br><br>B1 at least 2 or 3 points plotted correctly |
| | **Additional Guidance** | | |
| |  | | |

| Q | Answer | Marks | Comments |
|---|--------|-------|----------|
| **13(b)** | $x = 150$ | B1 | |
| | $y = 0.5$ | B1 | |

| Q | Answer | Marks | Comments |
|---|---|---|---|
| 13(c)(i) | Sample 5 was beyond the warning limit so yes (it was appropriate to take another sample immediately) | B1 | oe |

| Q | Answer | Marks | Comments | |
|---|---|---|---|---|
| 13(c)(ii) | The machine should be stopped<br>or<br>The machine should be reset | B1 | oe | |
| | **Additional Guidance** | | | |
| | The machine should be fixed/adjusted/recalibrated/serviced/ replaced | | | B1 |
| | Take another sample/retest | | | B0 |

| Q | Answer | Marks | Comments |
|---|---|---|---|
| **14(a)** | $\dfrac{80-60}{15}$<br><br>or<br><br>$1.6 \times 15 + 60$ | M1 | oe |
| | $1.6 > 1.3333….$<br><br>or<br><br>$84$ | A1 | |

| Q | Answer | Marks | Comments |
|---|---|---|---|
| **14(b)(i)** | Daisy's mark was higher than Helen's | B1 | oe |

| Additional Guidance | |
|---|---|
| It's higher/better | B1 |
| They were both below average | B0 |

| Q | Answer | Marks | Comments |
|---|---|---|---|
| **14(b)(ii)** | Daisy's mark was below average/the mean | B1 | oe |

| Additional Guidance | |
|---|---|
| Daisy's mark was in the bottom 50% of marks | B1 |
| Daisy's mark is closer to the mean | B0 |

| Q | Answer | Marks | Comments |
|---|---|---|---|
| **15(a)** | $\dfrac{380}{3} \times 405$ <br><br> or <br><br> $380 \div \dfrac{3}{405}$ | M1 | oe |
| | 51 300  ( $\approx 51\,000$ ) | A1 | |

| Q | Answer | Marks | Comments |
|---|---|---|---|
| | **Alternative Method 1 – percentage change** | | |
| | Ticks yes and <br><br> $\dfrac{51300 - 59000}{59000} \times 100$ <br><br> $(= 13.1\%)$ or $(= \text{-}13.1\%)$ <br><br> or <br><br> $\dfrac{7700}{59000} \times 100 \approx 13\%$ | B1ft | oe <br><br> ft on their answer from 15(a) <br><br> If they use 51000 then <br><br> $\dfrac{8000}{59000} \times 100 = 13.6\%$ |
| | **Alternative Method 2 – use of multiplier** | | |
| **15(b)** | Ticks yes and <br><br> 59000 x 0.87 = 51330 <br><br> or <br><br> 0.13 x 59000 = 7670 and 59000 – 7670 = 51330 <br><br> or <br><br> $\dfrac{51000}{0.87} = 58620(.69)$ <br><br> or <br><br> $\dfrac{51300}{0.87} = 58965(.52)$ <br><br> or <br><br> $(1 - \dfrac{51300}{59000})$ x 100 <br><br> or <br><br> $(1 - \dfrac{51000}{59000})$ x 100 | B1ft | oe <br><br> ft on their answer from 15(a) <br><br> If they use 51000 then <br><br> $\dfrac{8000}{59000} \times 100 = 13.6\%$ |

| | | 3 **different** comments relating to accuracy and assumptions, <br><br> eg 3 from <br><br><br><br> • it is assumed that the frogs are caught from the same area(s) <br> a larger sample size is needed (to be more confident about the true size of the population) <br> • (the gap between when the frogs were caught was a week so) there was enough time for the populations to mix <br> • Type of weather/conditions (affecting ease of re-capture) <br> • Time of day when sample is taken <br> • All frogs have an equal chance of being caught <br> • It is assumed that the tags have not fallen off the frogs/tags have fallen off <br> • Frogs might have been born/ die/migrate/hibernate/killed by predators (etc) affecting population size | B3 | B2 for any two different comments <br><br> B1 for any one comment |
|---|---|---|---|---|

| **Additional Guidance** | |
|---|---|
| The tagged frogs may be more susceptible to attack from predators | B1 |
| Where in lake sample taken from | B1 |
| Climate change with reference to time span between estimate and experiment | B1 |
| Changes in habitat/environment between estimate and samples | B1 |
| Changes in habitat/environment between samples | B0 |
| Climate change | B0 |
| Time of year | B0 |
| Human interruption/disturbance | B0 |