Qualification Accredited

Oxford Cambridge and RSA

# A LEVEL

*Examiners' report*

# *MATHEMATICS B (MEI)*

**H640**
For first teaching in 2017

## H640/02 Summer 2019 series

Version 1

# Contents

# Introduction

Our examiners' reports are produced to offer constructive feedback on candidates' performance in the examinations. They provide useful guidance for future candidates. The reports will include a general commentary on candidates' performance, identify technical aspects examined in the questions and highlight good performance and where performance could be improved. The reports will also explain aspects which caused difficulty and why the difficulties arose, whether through a lack of knowledge, poor examination technique, or any other identifiable and explainable reason.

Where overall performance on a question/question part was considered good, with no particular areas to highlight, these questions have not been included in the report. A full copy of the question paper can be downloaded from OCR.

# Paper 2 series overview

This is the second series of the reformed linear A Level Maths specification, and the first to be sat by candidates following the standard two year programme. H640/02 is the second of three compulsory components in the A Level assessment. It assesses Pure Mathematics and Statistics and contributes 36.4% of the total A level.

Candidates are expected to have studied statistics using the large data set and to have routinely used spreadsheets, graphing software and the iterative and statistical functions on calculators when studying this course.

| | | |
|---|---|---|
| | **AfL** | The large data set used in this 2019 (and the 2018) assessment was LDS_1<br>https://www.ocr.org.uk/Images/400305-large-data-set-lds_1-h630-2018-h640-2018-2019-pre-release-data-mei.xlsx .<br>The large data set to be used in the 2020 assessment will be LDS_2<br>https://www.ocr.org.uk/Images/400306-large-data-set-lds_2-h630-2019-h640-2020-pre-release-data-mei.xlsx . |

To do well in this component, candidates need to be familiar with the command words detailed in the specification and to use their calculators efficiently in a variety of contexts. They also need to have a thorough working knowledge of terminology used, such as "concave down" to describe the shape of a curve, and the difference between "association" and "correlation" when commenting on bivariate data.

| | | |
|---|---|---|
| | **OCR support** | A poster detailing the different command words and what they mean is available here: https://teach.ocr.org.uk/italladdsup |

# Section A overview

Section A proved accessible to most candidates, with many earning two thirds of the marks or more. However, a surprising number of candidates were unfamiliar with some of the terminology, such as "mid-range", or with the command word "determine" and only a minority appeared to make efficient use of their calculator in 3(a)

## Question 1 (a)

**1** Fig. 1 shows the probability distribution of the discrete random variable $X$.

| $x$ | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|
| $\mathrm{P}(X=x)$ | 0.2 | 0.1 | $k$ | $2k$ | $4k$ |

**Fig. 1**

**(a)** Find the value of $k$. **[2]**

Candidates who did well in this question had a clear understanding of random variables and were able to complete the arithmetic successfully. Candidates who did less well made arithmetic slips in one or both parts.

A small minority of candidates multiplied the probabilities by the *x*-values in part (a) and made no progress in part (b).

## Question 1 (b)

**(b)** Find $\mathrm{P}(X \neq 4)$. **[2]**

Arithmetic slips were also seen in part (b).

Those candidates who multiplied the probabilities by the *x*-values in part (a) were unable to progress with the second part of the question.

## Question 2 (a)

**2** Given that $y=(x^2+5)^{12}$,

**(a)** Find $\frac{\mathrm{d}y}{\mathrm{d}x}$. **[2]**

Candidates who did well on part (a) were familiar with the Chain rule. Arithmetical slips were seen.

## Question 2 (b)

**(b)** Hence find $\int 48x(x^2+5)^{11}\,dx$. **[2]**

Candidates who did well were familiar with the Chain rule and recognised the connection between parts (a) and (b).

Candidates who did less well made arithmetic slips in this part, or attempted part (b) using integration by parts.

## Question 3 (a)

**3** Fig. 3 shows the time Lorraine spent in hours, $t$, answering e-mails during the working day. The data were collected over a number of months.

| Time in hours, $t$ | $0 \leqslant t < 1$ | $1 \leqslant t < 2$ | $2 \leqslant t < 3$ | $3 \leqslant t < 4$ | $4 \leqslant t < 6$ | $6 \leqslant t < 8$ |
|---|---|---|---|---|---|---|
| Number of days | 28 | 36 | 42 | 31 | 24 | 12 |

**Fig. 3**

**(a)** Calculate an estimate of the mean time per day that Lorraine spent answering e-mails over this period. **[1]**

Candidates who did well in this question used their calculator efficiently in part (a) – there was no need to show any working. Those that did attempt part (a) long hand often made arithmetic errors.

## Question 3 (b)

**(b)** Explain why your answer to part **(a)** is an estimate. **[1]**

In part (b) only about half the candidates were able to explain clearly why their answer to part (a) is an estimate, with vague or partially correct explanations seen.

## Question 3 (c)

When Lorraine accepted her job, she was told that the mean time per day spent answering e-mails would not be more than 3 hours.

**(c)** Determine whether, according to the data in Fig. 3, it is possible that the mean time per day Lorraine spends answering e-mails is in fact more than 3 hours. **[1]**

Candidates that did well in part (c) recognised that the request to "determine" necessitated providing some supporting calculations.

| | | |
|---|---|---|
| | **AfL** | Questions involving the interpretation of a mathematical model should be answered with reference to the context of the question and not simply using generic textbook descriptions. Short calculations that support an argument should be encouraged, rather than mini-essays. |

## Exemplar 1

if all times were at the top of the class :

$\frac{\Sigma x}{n} = \frac{590}{173} = 3.41 > 3 \therefore$ is possible

Exemplar 1 shows a clear justification for full credit in part (c).

## Exemplar 2

The estimated mean is 2·81 so it is possible that the actual mean hours spent answering emails is over 3 hours if, in each group of data, most of the values are above the midpoints of each group used to estimate the mean

Exemplar 2 shows insufficient justification for full credit in part (c). The candidate has shown a general understanding of the disadvantages of working with grouped data but has not applied this knowledge explicitly in the context of the data given in this question.

## Question 4 (a)

**4** Fig. 4 shows the graph of $y = \sqrt{1+x^3}$.

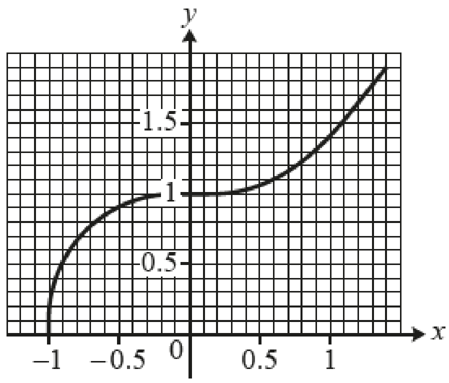



**Fig. 4**

**(a)** Use the trapezium rule with $h = 0.5$ to find an estimate of $\int_{-1}^{0} \sqrt{1+x^3}\,dx$, giving your answer correct to 6 decimal places. **[3]**

Candidates who did well in this question knew how to apply the trapezium rule and gave full details of their calculation.

Candidates who did less well either ignored the request for an answer to 6 decimal places or made slips in the arithmetic.

A surprising number of candidates were unable to make any progress with this question. Common errors were to substitute *h* = 0.5 in the formula but to then work with 4 strips, to use *x* = 0.5 instead of *x* = – 0.5 and a few candidates substituted *x*-values in the formula instead of *y*-values.

## Question 4 (b)

**(b)** State whether your answer to part **(a)** is an under-estimate or an over-estimate, justifying your answer. **[1]**

Candidates who did well understood how their calculated value related to the value of the integral and were able to explain this either by referencing that the curve is concave down, the behaviour of the gradient of the interval or by supplying an annotated diagram.

A surprising number of candidates were unable to explain clearly why their value was an underestimate – or they explained why it was an over-estimate with a correct reason for an underestimate.

## Question 5 (a)

**5** Fig. 5 shows the number of times that students at a sixth form college visited a recreational mathematics website during the first week of the summer term.

| Number of visits to website | 0 | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|
| Number of students | 24 | 38 | 17 | 12 | 4 | 2 |

**Fig. 5**

**(a)** State the value of the mid-range of the data. **[1]**

Candidates who did well in this question were familiar with the terminology and gave concise and correct answers. Candidates who did less well calculated the median instead of the mid-range in part (a).

## Question 5 (b)

**(b)** Describe the shape of the distribution. **[1]**

The majority of candidates correctly identified that the distribution had a positive skew.

## Question 5 (c)

**(c)** State the value of the mode. **[1]**

The majority of candidates correctly stated the mode value.

## Question 6

**6** Find $\int \frac{32}{x^5} \ln x \, dx$. **[4]**

Candidates who did well in this question were able to apply the method of integration by parts successfully and remembered to include the constant of integration in their final answer.

Candidates who did less well made sign errors or omitted the constant in their final answer.

A significant minority of candidates either didn't recognise that integration by parts was the correct approach or were unable to apply it successfully.

# Section B overview

Many candidates seemed familiar with the techniques being tested and were able to apply them with some degree of success. However, many were less successful in supplying correct supporting commentary in the statistics questions or applying their knowledge to problem solving questions.

## Question 7 (a)

**7** The area of a sector of a circle is $36.288\,\text{cm}^2$. The angle of the sector is $\theta$ radians and the radius of the circle is $r$ cm.

**(a)** Find an expression for $\theta$ in terms of $r$. **[1]**

Candidates who did well in this question worked with the correct formula and simplified their answer.

Candidates who did not do well either worked with the wrong formula, usually area = $r^2\theta$ or area = $\frac{1}{2}r\theta^2$.

## Question 7 (b)

The perimeter of the sector is $24.48$ cm.

**(b)** Show that $\theta = \dfrac{24.48}{r} - 2$. **[1]**

Candidates who did well in this question started with a correct formula and supplied a correct intermediate step to derive the given formula. Some candidates attempted to work backwards from the given answer; this should be discouraged since it rarely provides a clear mathematical argument for full credit. Some candidates converted to degrees; whilst in theory this could provide a valid mathematical argument, the majority using this method did not complete the 'show that' request by converting back into radians to confirm the given answer.

## Question 7 (c)

**(c)** Find the possible values of $r$. **[3]**

Candidates who did well in this question equated the answers to parts (a) and (b) and manipulated their equation successfully to produce a quadratic, which was then usually solved correctly. Candidates who did less well often knew what approach to adopt but were unable to deal with the algebra successfully.

## Question 8 (a)

**8** A team called "The Educated Guess" enter a weekly quiz. If they win the quiz in a particular week, the probability that they will win the following week is 0.4, but if they do not win, the probability that they will win the following week is 0.2.

In week 4 The Educated Guess won the quiz.

**(a)** Calculate the probability that The Educated Guess will win the quiz in week 6. **[3]**

Candidates who did well in this question realised the need to work with P(LW) and P(WW). Many successfully went on to earn all 3 marks, although a few made slips with the arithmetic.

Candidates who did not do well incorporated the probability of winning in week 4 – often this was arbitrarily assigned the value of 0.5 and some thought they needed to work with the probabilities for the first three weeks as well.

## Question 8 (b)

Every week the same 20 quiz teams, each with 6 members, take part in a quiz. Every member of every team buys a raffle ticket. Five winning tickets are drawn randomly, without replacement. Alf, who is a member of one of the teams, takes part every week.

**(b)** Calculate the probability that, in a randomly chosen week, Alf wins a raffle prize. **[2]**

Candidates who did well in this question understood that the desired probability is simply $5\times\frac{1}{120}$, although a few obtained the correct answer from working out 1 – P(Alf doesn't win).

Candidates who did less well often found $\frac{1}{24}$ successfully, but then went on to use it in the binomial distribution.

## Question 8 (c)

**(c)** Find the smallest number of weeks after which it will be 95% certain that Alf has won at least one raffle prize. **[4]**

Candidates who did well in this question subtracted their answer to part (b) from 1 and then compared this value to the power of *n* with 0.05. Often the marks given were FT marks for working with an incorrect probability. Many used trial and improvement instead of logarithms to achieve their final answer.

However, the majority of candidates were unable to make meaningful progress with this question, often working with *n* × their *p.*

## Question 9 (a)

**9** You are given that

$\mathrm{f}(x) = 2x + 3$ for $x < 0$ and

$\mathrm{g}(x) = x^2 - 2x + 1$ for $x > 1$.

**(a)** Find $\mathrm{gf}(x)$, stating the domain. **[3]**

Candidates who did well in this question were able to complete the algebraic manipulation successfully and understood how to find the correct domain for the composite function.

Candidates who did less well did not deal with the domain successfully and / or spoiled their answer for the formula by dividing unnecessarily by 4.

## Question 9 (b)

**(b)** State the range of $\mathrm{gf}(x)$. **[1]**

Very few candidates were able to find this successfully and generally this topic seems to be poorly understood.

## Question 9 (c)

**(c)** Find $(\mathrm{gf})^{-1}(x)$. **[5]**

Candidates who did well in this question understood how to "make y the subject" either by completing the square or expressing their answer to part (a) as a perfect square. They wrote their answer in the form "$(\mathrm{gf})^{-1}$ = " as opposed to "$y$ = " . The very best candidates made the connection between their answer to part (b) and the domain for the inverse of the composite function.

Candidates who did less well left their answer in the form "$y$ = " and made no attempt to identify a domain.

Candidates who did not do well subtracted $8x$ from each side and then took square roots.

## Question 10 (a)

**10** Club 65–80 Holidays fly jets between Liverpool and Magaluf. Over a long period of time records show that half of the flights from Liverpool to Magaluf take less than 153 minutes and 5% of the flights take more than 183 minutes.

An operations manager believes that flight times from Liverpool to Magaluf may be modelled by the Normal distribution.

**(a)** Use the information above to write down the mean time the operations manager will use in his Normal model for flight times from Liverpool to Magaluf. **[1]**

Most candidates did well in this question and simply wrote down the correct answer.

Candidates who did not do well usually wrote the answer 168.

## Question 10 (b)

**(b)** Use the information above to find the standard deviation the operations manager will use in his Normal model for flight times from Liverpool to Magaluf, giving your answer correct to 1 decimal place. **[3]**

Candidates who did well in this question used the standard Normal distribution in conjunction with the given information to obtain a value for the standard deviation, giving their answer to the specified precision.

Candidates who did less well worked with either an incorrect $z$-score or an incorrect mean. Sometimes they gave their answer to a different precision.

## Question 10 (c)

**(c)** Data is available for 452 flights. A flight time of under 2 hours was recorded in 16 of these flights. Use your answers to parts **(a)** and **(b)** to determine whether the model is consistent with this data. **[3]**

Candidates who did well in this question used their model to obtain a value for $P(X < 120)$ and then made a sensible comparison with 16/452 = 0.035…They made efficient use of their calculators.

Candidates who did less well made errors in calculating their probabilities, sometimes transposing $\mu$ and $\sigma$. Sometimes they did not communicate their reasoning clearly.

## Question 10 (d)

The operations manager suspects that the mean time for the journey from Magaluf to Liverpool is less than from Liverpool to Magaluf. He collects a random sample of 24 flight times from Magaluf to Liverpool. He finds that the mean flight time is 143.6 minutes.

**(d)** Use the Normal model used in part **(c)** to conduct a hypothesis test to determine whether there is evidence at the 1% level to suggest that the mean flight time from Magaluf to Liverpool is less than the mean flight time from Liverpool to Magaluf. **[7]**

Candidates who did well in this question set out their hypotheses clearly in terms of $\mu$, going on to define it as the population mean flight time from Magaluf to Liverpool. They clearly showed how they achieved their probability, making a clear comparison with the significance level. They went on to give a clear conclusion in context.

Candidates who did less well gave incomplete/incorrect definitions and conclusions.

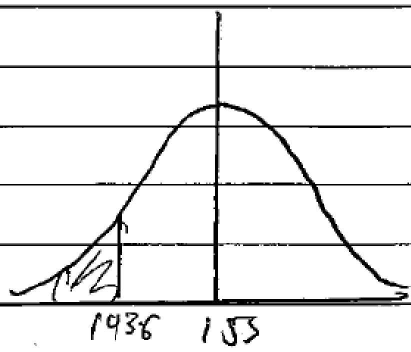
Candidates who did badly used an incorrect parameter without defining it clearly and/or used continuity corrections and/or worked with $n = 452$ or $n = 1$.

## Exemplar 3

$\bar{X} = 143.6$ Let $\mu$ be the mean ~~to~~ flight time from Magaluf to Liverpool

$n = 24$

$\sigma = 18.2$




$X \sim N(153, 18.2^2)$

$\bar{X} \sim N\left(153, \frac{18.2^2}{24}\right)$

$H_0 : \mu = \cancel{14}\,153$

$H_1 : \mu < 153$ 1% s.l.

4.s.f.

$P(\bar{X} < 143.6) = 0.005699$

$\sigma$ of sample $= \sqrt{\frac{18.2^2}{24}}$

3.715

$\therefore$ $0.005699 < 0.01$, there is sufficient evidence to reject $H_0$, ie, the mean flight time from Magaluf to Liverpool is less than the mean flight time from ~~Livep~~ Liverpool to Magaluf.

The hypotheses are correctly set up but the definition of $\mu$ is incomplete, so the second B1 is not earned.

The rest of the work is good, apart from the final conclusion, as there is no element of suggestion that the mean flight time from Magaluf to Liverpool may be lower than the mean flight time from Liverpool to Magaluf – it is too assertive.

## Question 10 (e)

**(e)** Identify two ways in which the Normal model for flight times from Liverpool to Magaluf might be adapted to provide a better model for the flight times from Magaluf to Liverpool. **[2]**

Candidates who did well on this question considered how the mean and the standard deviation might be adjusted to improve the model.

Candidates who did badly wrote in generalities – "collect more data" was commonly seen.

## Question 11 (a)

**11** Fig. 11 shows the graph of $y = x^2 - 4x + x\ln x$.

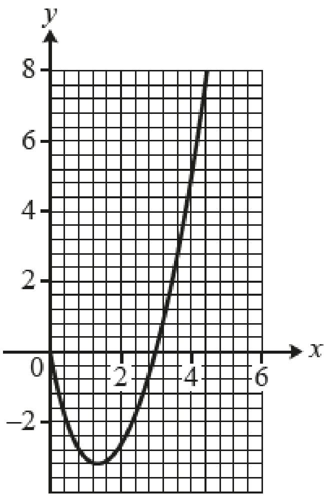



**Fig. 11**

**(a)** Show that the $x$-coordinate of the stationary point on the curve may be found from the equation $2x - 3 + \ln x = 0$. **[4]**

Candidates who did well showed how $\frac{dy}{dx}$ was found and explained why it was set equal to zero.

Candidates who did less well made slips in applying the Product rule and/or forgot to set their derivative equal to zero.

## Question 11 (b)

**(b)** Use an iterative method to find the $x$-coordinate of the stationary point on the curve $y = x^2 - 4x + x\ln x$, giving your answer correct to 4 decimal places. **[4]**

Candidates who did well in this question used either the Newton-Raphson method or fixed point iteration. They showed the iterates and used their calculators efficiently to achieve the specified 4 decimal place accuracy.

Candidates who did less well made slips in their iterative formulae or (quite commonly) gave the final answer as 1.3450.

Candidates who struggled with this question solved f($x$) = 0 instead of $\frac{dy}{dx} = 0$ or used the equation solver or a non-iterative method to find the root.

## Question 12 (a)

**12** The jaguar is a species of big cat native to South America. Records show that 6% of jaguars are born with black coats. Jaguars with black coats are known as black panthers. Due to deforestation a population of jaguars has become isolated in part of the Amazon basin. Researchers believe that the percentage of black panthers may not be 6% in this population.

**(a)** Find the minimum sample size needed to conduct a two-tailed test to determine whether there is any evidence at the 5% level to suggest that the percentage of black panthers is not 6%. **[3]**

Candidates who did well in this question worked with $0.94^n$ and compared it with 0.025. Many achieved a correct answer by trial and improvement instead of the traditional log approach.

Candidates who did less well worked with $0.06^n$.

Some candidates were unable to make any meaningful progress with this question.

## Question 12 (b)

A research team identifies 70 possible sites for monitoring the jaguars remotely. 30 of these sites are randomly selected and cameras are installed. 83 different jaguars are filmed during the evidence gathering period. The team finds that 10 of the jaguars are black panthers.

**(b)** Conduct a hypothesis test to determine whether the information gathered by the research team provides any evidence at the 5% level to suggest that the percentage of black panthers in this population is not 6%. **[7]**

Candidates who did well in this question set up the hypotheses correctly and went on to use their calculators efficiently to calculate the required probability. This usually led to a correct comparison with the significance level and a correct conclusion, although this was not always put into context successfully. A few candidates spoiled their answers by being too assertive in their final conclusion.

Candidates who did less well gave an incomplete definition of $p$ and/or worked with P($X$ > 10) instead of P($X \geq 10$).

Candidates who didn't do well worked with P($X$ = 10).

## Exemplar 4

**12(b)**

70 sites → 30 randomly selected. $X \sim B(n, p)$.

83 filmed, 10 black panthers.

$p$ : probability of a black coat (panther).

$H_0$ : $p = 0.06$.

$H_1$ : $p \neq 0.06$.

5% significance level ∴ 2.5% either side.

| $x$ | $P$ | |
|---|---|---|
| ~~0~~ | ~~0.00559~~ | ~~< 0.05~~ |
| 1 | 0.03 | ~~<~~ 0.05 |
| 2 | 0.1186. | > 0.05. |

~~n = 20~~ $X$ - n.o of black panthers.

$X \sim B(83, 0.06)$. 0.025 0.975.

~~CR: x~~

~~CR =~~ ~~x~~

| $X$ | $P$ |
|---|---|
| ~~10~~ | ~~0.98927~~ |
| 8 | 0.939 |
| 9 | 0.9732. |
| 10 | 0.98927 |

~~CR~~ : $P(X \geq 10) = 0.0268 > 0.025$

11, 12. $P(X \geq 11) = 0.01073 < 0.025$. less than s.L.

CR : $P(X \geq 11)$ and $(X \leq 1)$.

10 is not in ~~the~~ the critical region and so we ~~reject~~ accept $H_0$. There is not ~~a~~ significant evidence at the 5% level. to suggest the population is not 6%. ~~but less than 6%~~.

The hypotheses are correctly set up but the definition of $p$ is incorrect, so the second B1 is not earned.

This candidate opts for the critical region approach. The correct upper tail is identified, and as the lower tail is irrelevant to the conclusion it may be ignored in this case, so the incorrect identification of 1 being in the critical region was not penalised. The rest of the work is good. However, the final conclusion in context is incomplete, and so this response earns 5/7.

## Question 13 (a)

**13** The population of Melchester is 185 207. During a nationwide flu epidemic the number of new cases in Melchester are recorded each day. The results from the first three days are shown in Fig. 13.

| Day | 1 | 2 | 3 |
|---|---|---|---|
| Number of new cases | 8 | 24 | 72 |

**Fig. 13**

A doctor notices that the numbers of new cases on successive days are in geometric progression.

**(a)** Find the common ratio for this geometric progression. **[1]**

Candidates who did well in this question recognised the geometric progression and completed parts (a), (b) and (c) successfully.

## Question 13 (b)

The doctor uses this geometric progression to model the number of new cases of flu in Melchester.

**(b)** According to the model, how many new cases will there be on day 5? **[1]**

This part was also well answered by the majority of candidates.

## Question 13 (c)

**(c)** Find a formula for the **total** number of cases from day 1 to day $n$ inclusive according to this model, simplifying your answer. **[1]**

Candidates who did less well on this part either didn't attempt to simplify their answer or they simplified it incorrectly, $12^n$ was frequently seen.

## Question 13 (d)

**(d)** Determine the maximum number of days for which the model could be viable in Melchester. **[3]**

Candidates who did well in this part recognised that the request to 'Determine the maximum number of days the model could be viable' necessitated showing supporting calculations and formed a correct equation or inequality. Some candidates were unable to solve their equation, or made slips with manipulating the inequality.

## Question 13 (e)

**(e)** State, with a reason, whether it is likely that the model will be viable for the number of days found in part **(d)**. **[1]**

Those candidates that were successful with part (d) were usually successful in explaining their result in context. A satisfactory reason for it being unlikely that the model would be viable for this long usually ensued.

Sometimes a circular argument was presented in this part

## Question 14 (a)

**14** The pre-release material includes data concerning crude death rates in different countries of the world. Fig. 14.1 shows some information concerning crude death rates in countries in Europe and in Africa.

| | Europe | Africa |
|---|---|---|
| $n$ | 48 | 56 |
| minimum | 6.28 | 3.58 |
| lower quartile | 8.50 | 7.31 |
| median | 9.53 | 8.71 |
| upper quartile | 11.41 | 11.93 |
| maximum | 14.46 | 14.89 |

**Fig. 14.1**

**(a)** Use your knowledge of the large data set to suggest a reason why the statistics in Fig. 14.1 refer to only 48 of the 51 European countries. **[1]**

Candidates who did well in this question commented that the data may not have been available in the other three countries.

Candidates who did not do well were over-imaginative in their responses, making comments on the countries being outliers or at war, but not linking this explicitly with the result that the data was not available.

## Question 14 (b)

**(b)** Use the information in Fig. 14.1 to show that there are no outliers in either data set. **[3]**

Candidates who did well used the criteria for outliers based on the interquartile range and compared their results with the given smallest and largest values.

Those who did less well made a slip with the arithmetic or did not make any specific comparison.

Candidates who did not do well tried to work with the mean and standard deviation or were unable to use the criteria based on interquartile range, median $\pm$ 1.5 $\times$ IQR being a common error.

## Question 14 (c)

The crude death rate in Libya is recorded as 3.58 and the population of Libya is recorded as 6411 776.

**(c)** Calculate an estimate of the number of deaths in Libya in a year. **[1]**

Candidates who did well were familiar with the LDS and understood that crude death rate is quoted per thousand. They gave their answer as a suitable whole number.

Candidates who did not do well assumed the crude death rate was per 100 people or per day.

## Question 14 (d)

The median age in Germany is 46.5 and the crude death rate is 11.42. The median age in Cyprus is 36.1 and the crude death rate is 6.62.

**(d)** Explain why a country like Germany, with a higher median age than Cyprus, might also be expected to have a higher crude death rate than Cyprus. **[1]**

Candidates who did well commented on the higher proportion of older people in Germany.

Candidates who did badly commented how people might die a crude death, that Germany has a larger population or guessed at, for example, higher crime rates.

## Question 14 (e)

Fig. 14.2 shows a scatter diagram of median age against crude death rate for countries in Africa and Fig. 14.3 shows a scatter diagram of median age against crude death rate for countries in Europe.

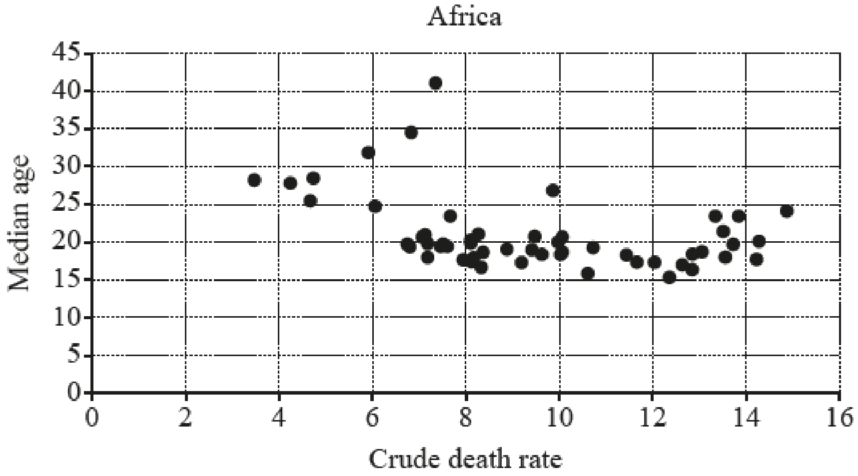



**Fig. 14.2**

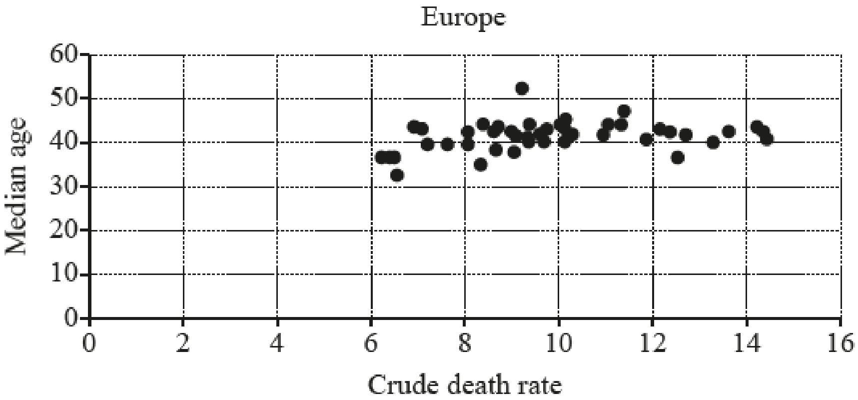



**Fig. 14.3**

The rank correlation coefficient for the data shown in Fig. 14.2 is $-0.281206$.

The rank correlation coefficient for the data shown in Fig. 14.3 is $0.335215$.

**(e)** Compare and contrast what may be inferred about the relationship between median age and crude death rate in countries in Africa and in countries in Europe. **[2]**

Candidates who did well in this question understood the difference between association and correlation and commented accordingly. They commented on the nature of the association and the relative strength of the association for each continent.

Candidates who did not do well were in the majority. They commented on correlation and/or the strength of the linear relationship. Some candidates did not really address the question at all, instead writing commentaries on the different social and economic conditions in the two continents.

## Question 15

**15 You must show detailed reasoning in this question.**

The screenshot in Fig. 15 shows the probability distribution for the continuous random variable $X$, where $X \sim \mathrm{N}(\mu, \sigma^2)$.

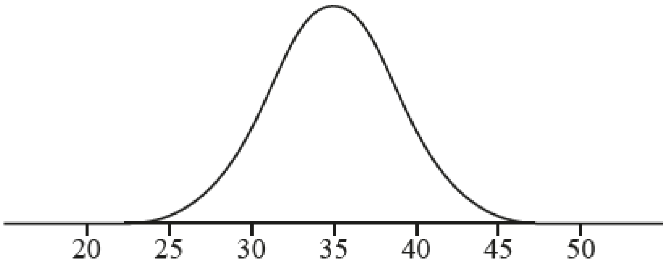



**Fig. 15**

The distribution is symmetrical about the line $x = 35$ and there is a point of inflection at $x = 31$.

Fifty independent readings of $X$ are made. Show that the probability that at least 45 of these readings are between 30 and 40 is less than 0.05. **[6]**

Candidates who did well in this question knew the connection between the point of inflection and the standard deviation. They worked with the correct Normal distribution to find the correct probability before using the associated binomial distribution, usually successfully.

Candidates who did less well found $\mu$ and $\sigma$ correctly but then either used continuity corrections or divided $\sigma$ by 50 before using the Normal distribution. A few candidates found 0.7887 correctly and then were unable to make progress.

Candidates who did not do well in this question were often unable to progress beyond $\mu$ = 35.

## Copyright information

# Supporting you

For further details of this qualification please visit the subject webpage.

## Review of results

If any of your students' results are not as expected, you may wish to consider one of our review of results services. For full information about the options available visit the OCR website. If university places are at stake you may wish to consider priority service 2 reviews of marking which have an earlier deadline to ensure your reviews are processed in time for university applications.

activeresults

***Review students' exam performance with our free online results analysis tool. Available for GCSE, A Level and Cambridge Nationals.***

It allows you to:

- review and run analysis reports on exam performance
- analyse results at question and/or topic level*
- compare your centre with OCR national averages
- identify trends across the centre
- facilitate effective planning and delivery of courses
- identify areas of the curriculum where students excel or struggle
- help pinpoint strengths and weaknesses of students and teaching departments.

*To find out which reports are available for a specific subject, please visit ocr.org.uk/administration/support-and-tools/active-results/

Find out more at ocr.org.uk/activeresults

## CPD Training

Attend one of our popular CPD courses to hear exam feedback directly from a senior assessor or drop in to an online Q&A session.

Please find details for all our courses on the relevant subject page on our website.

www.ocr.org.uk

The small print

## OCR Resources: *the small print*

OCR's resources are provided to support the delivery of OCR qualifications, but in no way constitute an endorsed teaching method that is required by OCR. Whilst every effort is made to ensure the accuracy of the content, OCR cannot be held responsible for any errors or omissions within these resources. We update our resources on a regular basis, so please check the OCR website to ensure you have the most up to date version.

This resource may be freely copied and distributed, as long as the OCR logo and this small print remain intact and OCR is acknowledged as the originator of this work.

Our documents are updated over time. Whilst every effort is made to check all documents, there may be contradictions between published support and the specification, therefore please use the information on the latest specification at all times. Where changes are made to specifications these will be indicated within the document, there will be a new version number indicated, and a summary of the changes. If you do notice a discrepancy between the specification and a resource please contact us at: resources.feedback@ocr.org.uk.

Whether you already offer OCR qualifications, are new to OCR, or are considering switching from your current provider/awarding organisation, you can request more information by completing the Expression of Interest form which can be found here: www.ocr.org.uk/expression-of-interest

Please get in touch if you want to discuss the accessibility of resources we offer to support delivery of our qualifications: resources.feedback@ocr.org.uk

## Looking for a resource?

There is now a quick and easy search tool to help find **free** resources for your qualification:

www.ocr.org.uk/i-want-to/find-resources/


**www.ocr.org.uk**

OCR Customer Support Centre

**General qualifications**

Telephone 01223 553998
Facsimile 01223 552627
Email general.qualifications@ocr.org.uk




Cambridge Assessment

CERTIFIED ISO 9001

UKAS MANAGEMENT SYSTEMS 001