Qualification Accredited

OCR
Oxford Cambridge and RSA

AS LEVEL

Examiners' report

FURTHER MATHEMATICS B (MEI)

H635
For first teaching in 2017

Y412/01 Summer 2019 series

Version 1

Contents

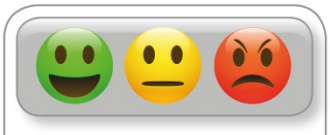
Would you prefer a Word version?

Did you know that you can save this pdf as a Word file using Acrobat Professional?

Simply click on **File > Save As Other . . .** and select **Microsoft Word**

(If you have opened this PDF in your browser you will need to save it first. Simply right click anywhere on the page and select ***Save as . . .*** to save the PDF. Then open the PDF in Acrobat Professional.)

If you do not have access to Acrobat Professional there are a number of **free** applications available that will also convert Word to PDF (search for pdf to word converter).



We value your feedback

We'd like to know your view on the resources we produce. By clicking on the icon above you will help us to ensure that our resources work for you.

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 Y412 series overview

Y412 is one of six available options. Candidates must take Core Pure (Y410) and then choose at least two of the optional papers to be credited AS Level in Further Mathematics B (MEI). Candidates are expected to know the content of AS Level Mathematics (H630) and Y410.

The majority of candidates performed well on this Statistics paper. The more successful candidates ensured that question parts were fully answered; candidates are advised to check that this has been done before moving on to the next part. Candidates should pay extra care over wording of answers when a request includes the specification defined command words.

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

Candidates should familiarise themselves with the various forms of hypotheses used in the different types of test. They should also follow the structure as outlined in the sample and practice paper mark schemes, including the provision of a non-assertive conclusion.

Candidates should avoid over-specification of final answers; final answers containing more than 4 significant figures are likely to be considered as being over-specified.

On the whole, candidates seemed to be suitably prepared to answer most questions.

Question 1 (a)

1 The discrete random variable X has probability distribution defined by

$$P(X = r) = k(r^2 + 3r) \text{ for } r = 1, 2, 3, 4, 5, \text{ where } k \text{ is a constant.}$$

(a) Complete the table below, using the copy in the Printed Answer Booklet giving the probabilities in terms of k. **[1]**

r	1	2	3	4	5
$P(X = r)$	$4k$	$10k$			

This proved a straight forward introduction to the paper for the majority of candidates.

Question 1 (b)

(b) Show that the value of k is 0.01. **[2]**

Responses to this question were mostly good, however many lacked sufficient detail to respond to the 'Show that' instruction.

	AfL	The command words 'Show that' with the answer given require candidates in questions such as this to explicitly write the equation to be solved in full, i.e. $4k + 10k + 18k + 28k + 40k = 1$.

Question 1 (c)

(c) Draw a graph to illustrate the distribution. **[2]**

Many candidates provided suitably labelled, scaled axes and a correct graph. All candidates should make use of rulers when drawing such graphs.

Question 1 (d)

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

Some candidates did not know the difference between positive skew and negative skew.

Question 1 (e)

(e) Find each of the following.

- $E(X)$
- $Var(X)$ **[2]**

The majority of candidates found these manually, but the expectation was that these values would be found using the statistical functions of their calculator.

Question 2 (a)

2 Almost all plants of a particular species have red flowers. However on average 1 in every 1500 plants of this species have white flowers. A random sample of 2000 plants of this species is selected. The random variable X represents the number of plants in the sample that have white flowers.

(a) Name two distributions which could be used to model the distribution of X, stating the parameters of each of these distributions. **[4]**

Most candidates gained at least three marks here. Some candidates lost a mark for thinking that 1/1500 should be used as the mean for the Poisson model. Many candidates neglected to provide parameters for their two distributions. Some candidates stated Geometric as their second distribution, rather than Poisson.

Question 2 (b)

You may use either of the distributions you have named in the rest of this question.

(b) Calculate each of the following.

- $P(X = 2)$
- $P(X > 2)$ **[3]**

This was a routine calculation, performed using Statistical Distribution functions on the calculator, which was well answered by most candidates. The most common mistake was to find $1 - P(X \leq 1) = P(X > 1)$.

Question 2 (c)

(c) A random sample of 20 000 plants of this species is selected.
Calculate the probability that there are at least 10 plants in the sample that have white flowers. **[2]**

This was also answered well.

Question 3 (a)

3 A fair 8-sided dice has faces labelled 10, 20, 30, ..., 80.

(a) State the distribution of the score when the dice is rolled once. **[2]**

Many candidates stated 'Uniform' for the distribution but did not state the values.

Question 3 (b)

(b) Write down the probability that, when the dice is rolled once, the score is at least 40. **[1]**

This was answered well.

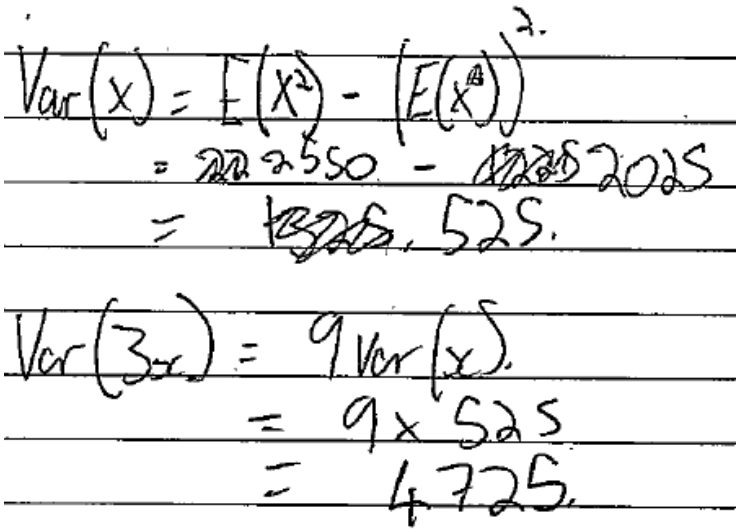
Question 3 (c) (i)

(c) The dice is rolled three times.

(i) Find the variance of the total score obtained. **[3]**

Many errors were seen. Values of 5.25 and 52.5 were often seen for the variance of X. A common mistake was for candidates to find $\text{Var}(3X)$ not the required variance of the total of three scores.

Exemplar 1



This candidate is using $3^2 \times \text{Var}(X)$ not $3 \times \text{Var}(X)$.

Question 3 (c) (ii)

(ii) Find the probability that on one of the rolls the score is less than 30, on another it is between 30 and 50 inclusive and on the other it is greater than 50. **[3]**

Most candidates correctly identified the individual probabilities of $\frac{1}{4}$, $\frac{3}{8}$ and $\frac{3}{8}$, however the multiple of six was often forgotten.

Question 4 (a)

4 A student is investigating correlations between various personality traits, two of which are conscientiousness and openness to new experiences.
She selects a random sample of 10 students at her university and uses standard tests to measure their conscientiousness and their openness. The product moment correlation coefficient between these two variables for the 10 students is 0.476.

(a) Assuming that the underlying population has a bivariate Normal distribution, carry out a hypothesis test at the 10% significance level to investigate whether there is any correlation between openness and conscientiousness in students. **[5]**

Generally, this was well answered. Some candidates did not adequately define ρ in context. Many candidates provided a suitable comparison of the test statistic with the correct critical value, a correct decision and a suitably detailed non-assertive conclusion referring to the alternative hypothesis.

Exemplar 2

$H_0: \rho = 0$ where ρ is the population pmcc.
$H_1: \rho \neq 0$ (2 tail)
10% $n = 10$
critical value = 0.5494

since $0.476 < 0.5494$, this is not significant.
There is not enough evidence to reject H_0, there is not enough evidence to suggest correlation between conscientiousness and openness to new experiences.

Here, ρ is not defined in context – i.e. as the population correlation coefficient between openness and conscientiousness.

Exemplar 3

since $0.476 < 0.5494$ we reject H_0 as there is insufficient evidence that proves there is any correlation between conscientiousness and openness

This candidate's conclusion is over-assertive. Replacing 'that proves' with 'to suggest that' would be enough to earn the final mark.

Question 4 (b)

Table 4.1 below shows the values of the product moment correlation coefficients between 5 different personality traits for a much larger sample of students. Those correlations that are significant at the 5% level are denoted by a * after the value of the correlation.

	Neuroticism	Extroversion	Openness	Agreeableness	Conscientiousness
Neuroticism	1				
Extroversion	−0.296*	1			
Openness	−0.044	0.405*	1		
Agreeableness	−0.190*	0.061	0.042	1	
Conscientiousness	−0.485*	0.145	0.235*	0.112	1

Table 4.1

The student analyses these factors for effect size.

Guidelines often used when considering effect size are given in Table 4.2 below.

Product moment correlation coefficient	**Effect size**
0.1	Small
0.3	Medium
0.5	Large

Table 4.2

(b) The student notes that, despite the result of the test in part **(a)**, the correlation between openness and conscientiousness is significant at the 5% level with this second sample.
Comment briefly on why this may be the case. **[1]**

Few candidates were aware that the critical value would be much smaller for a much larger sample.

Question 4 (c)

(c) The student intends to summarise her findings about relationships between these factors, including effect sizes, in a report.
Use the information in Tables 4.1 and 4.2 to identify two summary points the student could make. **[2]**

Few candidates provided points which 'summarised' the information provided. Few candidates understood how to interpret 'effect size'.

Question 5 (a)

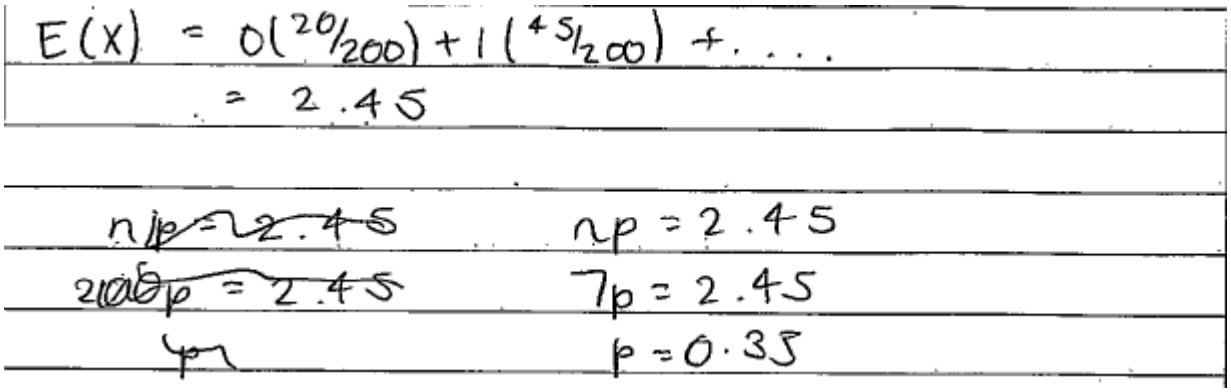
5 A researcher is investigating births of females and males in a particular species of animal which very often produces litters of 7 offspring.
The table shows some data about the number of females per litter in 200 litters of 7 offspring. The researcher thinks that a binomial distribution B(7, p) may be an appropriate model for these data.

Number of females	Number of litters
0	20
1	45
2	44
3	37
4	33
5	14
6	5
7	2

(a) Use the data to show that a suitable estimate for the value of p is 0.35. **[2]**

Many candidates did not provide sufficient justification to show how the given answer is calculated from the information provided.

Exemplar 4



Candidates are given the result and must show how this was achieved from the starting information. This candidate has made good use of their calculator, but has shown sufficient detail to explain the statistical technique.

Exemplar 5

Mean = 2.45

$np = 2.45$

$p = \frac{2.45}{7}$

$p = 0.35$

As a 'show that' question, justification for how the stated mean of 2.45 was found must be seen for full marks. This does not limit the use of the calculator's statistical functions, only that candidates need to demonstrate their understanding of the technique.

Exemplar 6

$E(x) = np$ → $(0\times20)+(1\times45)+(2\times44)\cdots+(7\times2)=490$

Mean = 490

$490 = (200\times7)p$

$490 = p$

1400

$p = 0.35$

A 'show that' question needs correct terminology and notation to be used. In this exemplar the mean has been stated as 490 which is not correct.

Question 5 (b)

(b) In this question you must show detailed reasoning.

Complete the copy of the table of expected frequencies and contributions for a chi-squared test in the Printed Answer Booklet. (Note that the classes 5, 6 and 7 have been combined as $\geqslant 5$). **[4]**

Number of females	Probability	Expected frequency	Chi-squared contribution
0	0.049 02	9.8045	10.6022
1			1.7513
2			4.1274
3	0.267 87	53.5742	
4	0.144 24	28.8476	0.5977
$\geqslant 5$	0.055 61	11.1215	8.7744

Most candidates calculated the chi-squared contribution correctly. Some candidates calculated the relevant probabilities but did not multiply these by 200 to find the expected frequencies. Rounding errors were fairly common.

Question 5 (c)

(c) Complete the test at the 5% significance level. **[6]**

Some candidates did not provide suitable hypotheses here – some referring to association rather than suitability of the binomial model. Many candidates did not identify the correct number of degrees of freedom, perhaps not realising that a further reduction was needed due to the value of *p* being estimated from the data. Hence '5' not '4' degrees of freedom was commonly seen.

Question 5 (d)

Fig. 5 shows the probability distribution B(7, 0.35) together with the relative frequencies of the observed data (the numbers of litters each divided by 200).

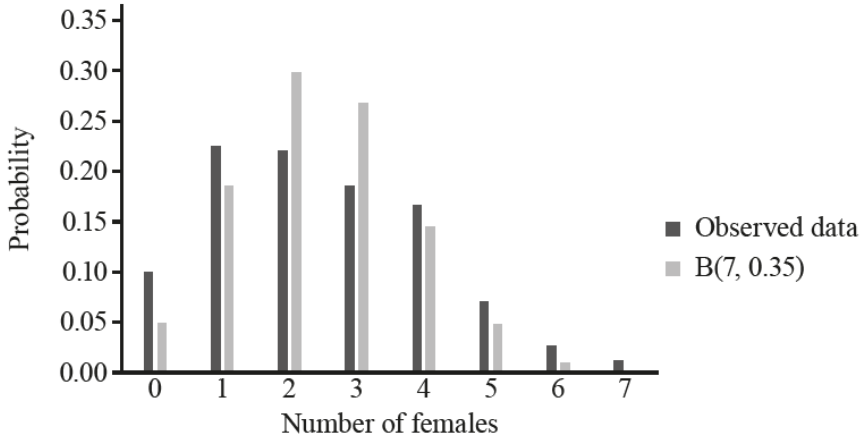


Fig. 5

(d) Comment on the result of the test completed in part **(c)** by considering Fig. 5. **[1]**

Many of the comments provided were too vague to earn credit here.

Question 6 (a)

6 A meteorologist is investigating the relationship between altitude x metres and mean annual temperature y °C in an American state.
She selects 12 locations at various altitudes and then stations a remote monitoring device at each of them to measure the temperature over the course of a year. Fig. 6 illustrates the data which she obtains.

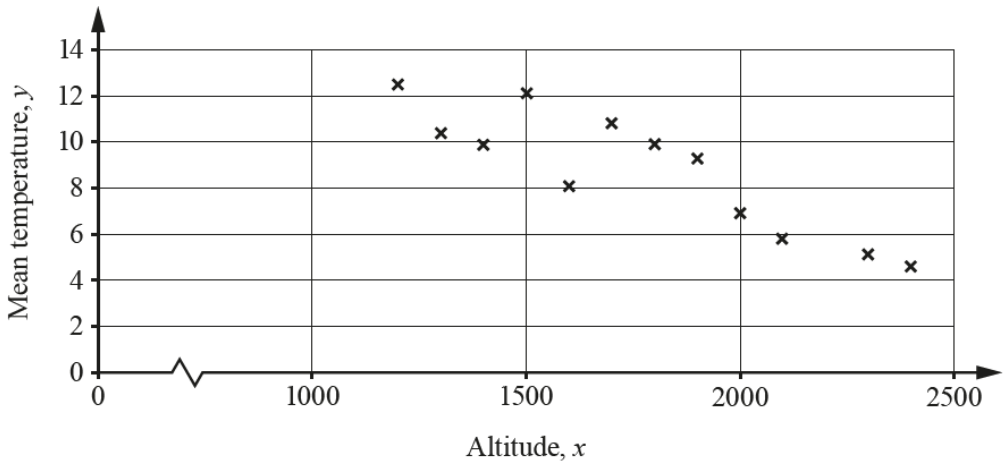


Fig. 6

(a) Explain why it would not be appropriate to carry out a hypothesis test for correlation based on the product moment correlation coefficient. **[2]**

Some candidates identified altitude as being non-random but did not explain the significance of this in terms of the appropriateness of the test.

Question 6 (b)

(b) Explain why altitude has been plotted on the horizontal axis in Fig. 6. **[1]**

This was answered well.

Question 6 (c)

Summary statistics for x and y are as follows.

$$\Sigma x = 21\,200 \quad \Sigma y = 105.4 \quad \Sigma x^2 = 39\,100\,000 \quad \Sigma y^2 = 1004 \quad \Sigma xy = 176\,090$$

(c) Calculate the equation of the regression line of y on x. **[4]**

Some candidates lost marks for calculating the gradient by using an incorrect formula. Premature rounding of values used in calculating the gradient resulted in loss of final accuracy for many.

Question 6 (d)

(d) Use the equation of the regression line to predict the values of the mean annual temperature at each of the following altitudes.

- 2000 metres
- 3000 metres **[2]**

These generally were found without problems.

Question 6 (e)

(e) Comment on the reliability of your predictions in part **(d)**. **[2]**

Those candidates referring to 'interpolation' and 'extrapolation' tended to do better than those who attempted to provide equivalent comments.

Question 6 (f)

(f) Calculate the value of the residual for the data point (1600, 8.1). **[2]**

Many candidates simply found the positive difference and thus lost a mark here.

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

OCR is part of Cambridge Assessment, a department of the University of Cambridge. *For staff training purposes and as part of our quality assurance programme your call may be recorded or monitored.*

Cambridge Assessment

CERTIFIED ISO 9001 UKAS MANAGEMENT SYSTEMS 001