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AS/A LEVEL GCE

Examiners' report

MATHEMATICS

3890-3892, 7890-7892

4734/01 Summer 2018 series

Version 1

Contents

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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.

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Paper 4734/01 series overview

There were 359 candidates, similar to most recent years.

Candidates found this paper rather more difficult than previous examination series. This was largely due to questions 1 and 7. Questions similar to Q1 have been set before, but candidates found it difficult nevertheless. Q7 was much more difficult than previous questions on contingency tables.

The presentation of many candidates' work is still a cause for concern. Centres must remind candidates that if their work is illegible it will not receive any marks.

It is pleasing to see that candidates have been taught not to be over-assertive in their conclusions to hypothesis tests.

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Question 1

1 The random variables X and Y have independent Poisson distributions with parameters 2 and 3 respectively, and $Z = 3X + 4Y$. Find $P(Z = E(Z))$. **[5]**

Almost all of the candidates found E(*Z*) correctly. Most then made one of three errors, using Po(18), N(18,18) or N(18,66). Of the candidates who knew how to proceed, some overlooked the case when *X* = 6 and *Y* = 0. The candidates who included (6, 0) almost always went on to gain all 5 marks.

Question 2

2 A 95% confidence interval for the mean μ of a certain population, based on a sample of size 35, is [6.0061, 7.9939]. Find the minimum sample size such that the width of a 95% confidence interval for μ is less than 1. **[4]**

Most candidates answered this question correctly. Others, having found $\sigma = 3$ correctly, made the error of stating that $\frac{1.96 \times 3}{\sqrt{n}} < 1$. Some used *z* = 1.645.

Question 3

3 The cumulative density function of the continuous random variable X is given by

$$F(x) = \begin{cases} 0 & x < 1, \\ \dfrac{2x-2}{x+3} & 1 \leqslant x \leqslant 5, \\ 1 & x > 5. \end{cases}$$

Given that $Y = 2X - 3$, find the probability density function of Y. **[6]**

Most candidates answered this question correctly, by finding F(*y*) and differentiating. Others, who began by finding f(*x*) and substituting $X = \frac{Y+3}{2}$, did not use integration by substitution to complete the solution.

Question 4

4 The mean number of matches in a box is claimed to be 48. A random sample of 7 boxes is taken and the number of matches in each box is counted. The results are shown below.

48 45 46 47 47 46 48

Stating a necessary assumption, test at the 2.5% significance level whether the mean number of matches in a box is less than 48. **[8]**

Almost all of the candidates completed the necessary numerical working successfully. Some lost marks for failing to give an adequate assumption and/or an adequate conclusion.

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Question 5 (i)

5 A certain brand of ice cream is sold in cartons of different sizes. Large cartons contain ice cream whose mass is normally distributed with mean 412 g and standard deviation 10 g. Small cartons contain ice cream whose mass is normally distributed with mean 112 g and standard deviation 8 g.

(i) Find the probability that the total mass of ice cream in two randomly chosen large cartons and two randomly chosen small cartons is greater than 1 kg. **[4]**

Most candidates answered both parts of Q5 correctly. In both parts, some candidates made errors in finding the variance of the combined distributions. In some lower ability answers there was confusion between grams and kilograms.

Question 5 (ii)

(ii) Find the probability that the mass of ice cream in a randomly chosen large carton is greater than 4 times the mass of ice cream in a randomly chosen small carton. **[4]**

Question 6 (i)

6 The continuous random variable X has probability density function

$$f(x) = \begin{cases} k\cos x & 0 \leqslant x < \frac{\pi}{4}, \\ k\sin x & \frac{\pi}{4} \leqslant x \leqslant \frac{\pi}{2}, \\ 0 & \text{otherwise.} \end{cases}$$

(i) Show that $k = \frac{1}{\sqrt{2}}$. **[3]**

Most candidates answered this question correctly. Some spotted that the distribution is symmetrical, which made the solution easier. Some lower ability answers integrated incorrectly.

Question 6 (ii)

(ii) Find $P(X \leqslant 1)$. **[3]**

Most candidates answered this question correctly. Some made the error $1 < \frac{\pi}{4}$.

Question 6 (iii)

(iii) Find the upper quartile of X. **[3]**

Most candidates answered this question correctly.

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Question 7 (i)

7 Greyhound racing in England involves six dogs racing over distances of approximately 500 m. The dogs wear jackets numbered from 1 to 6. A researcher observes that the winning dog in exactly 24 of 80 randomly chosen races wore jacket number 3.

(i) The probability that a randomly chosen race is won by the dog wearing jacket number 3 is denoted by p. Calculate an approximate 99% confidence interval for p. **[3]**

Most candidates answered this question correctly. Common errors were use of an incorrect value for z and use of $\frac{0.3 \times 0.7}{80^2}$ for the variance.

Question 7 (ii)

(ii) Explain whether your result from part **(i)** is consistent with p taking the value 0.2. **[1]**

Question 7 (iii)

Greyhound racing meetings in England usually consist of 12 races. The researcher chooses 100 such meetings at random and, at each meeting, he records how many of the 12 races were won by the dog wearing jacket number 3. The results for the 100 meetings are given in the table below.

Number of races won by the dog wearing jacket number 3	0	1	2	3	4	5	6	7	8 or more
Observed frequency	9	18	33	17	14	6	2	1	0

(iii) Show that the proportion of races won by the dog wearing jacket number 3 at the 100 meetings was 0.2. **[2]**

Question 7 (iv)

The expected frequencies using a binomial distribution with $n = 12$ are given in the table below.

Number of races won by the dog wearing jacket number 3	0	1	2	3	4	5	6	7	8 or more
Expected frequency	6.87	20.62	28.35	23.62	13.29	5.32	1.55	0.33	0.05

(iv) Show how for the case where 4 races were won by dog number 3 the expected frequency of 13.29 was calculated. **[2]**

Question 7 (v)

(v) Carry out a χ^2 test, at the 5% significance level, to test the null hypothesis that the data can be well modelled by a binomial distribution with $n = 12$. **[6]**

Almost all of the candidates began by combining the last 4 classes, and went on to find the test statistic correctly. Some used an incorrect critical value. Almost all the candidates knew that
Test Statistic < Critical Value means that the null hypothesis should not be rejected.

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Question 8 (i)

8 The numbers of hours of sunshine observed on 8 randomly chosen days in London were as follows.

9.3 3.9 11.8 5.0 10.6 0.0 6.1 2.7

The numbers of hours of sunshine observed on 6 randomly chosen days in Berlin were as follows.

7.3 2.5 6.0 9.8 12.1 4.6

It may be assumed that the number of hours of sunshine in each city is normally distributed.

(i) Carry out a suitable t-test, at the 1% significance level, to test whether the mean daily number of hours of sunshine in Berlin is higher than the mean daily number of hours of sunshine in London. **[9]**

Most candidates realised that a pooled sample t-test was required. The necessary calculations were performed accurately by almost all of the candidates. Some candidates did not gain the final mark because their conclusion was either inadequate or over-assertive .Some candidates who did not pool the samples were able to gain up to 5 marks.

Question 8 (ii)

(ii) Explain how the observations could be modified so as to use a paired-sample t-test, and explain why this would be preferable. **[2]**

Most candidates realised that the data should be collected on the same day in each city. They went on to point out that using a paired sample would remove variation caused by the seasons.

Question 9

9 The results of an examination are represented in the contingency table below, in which x and y are integers.

	Pass	Fail	Total
Females	x	y	50
Males	y	x	50
Totals	50	50	100

The null hypothesis, that there is no association between examination result and gender, was rejected at the 5% significance level. Given that $x > y$, find the smallest possible value of x. **[7]**

Almost all candidates found that all expected values were 25. Many candidates made errors in the next stage of the solution, making mistakes with the modulus sign or omitting Yates' correction. Some others stated that $x - 25 - 0.5 = x - 24.5$. The best candidates dealt with the modulus sign correctly and used $y = 50 - x$ to obtain the correct quadratic equation, which they solved correctly.

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