



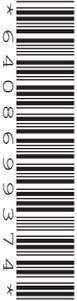
Oxford Cambridge and RSA

Level 3 Certificate

Quantitative Problem Solving (MEI)

H867/02 Statistical Problem Solving

Wednesday 25 May 2016 – Morning
Time allowed: 2 hours

**You must have:**

- the Insert (inserted)
- the Statistical Tables (ST1) (inserted)

You may use:

- a scientific or graphical calculator



First name										
Last name										
Centre number						Candidate number				

INSTRUCTIONS

- Use black ink. You may use an HB pencil for graphs and diagrams.
- Complete the boxes above with your name, centre number and candidate number.
- Answer **all** the questions.
- Write your answer to each question in the space provided.
- Additional paper may be used if required but you must clearly show your candidate number, centre number and question number(s).
- Do **not** write in the barcodes.
- You are advised that an answer may receive **no marks** unless you show sufficient detail of the working to indicate that a correct method is being used.

INFORMATION

- The total mark for this paper is **60**.
- The marks for each question are shown in brackets [].
- This document consists of **16** pages.
- Final answers should be given to a degree of accuracy appropriate to the context.

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Answer **all** the questions.

Section A (30 marks)

- 1** Akosua has just started a new job in an office not far from where she lives. She wants to decide on the best way of getting to and from work. Her only options are to drive her car or to walk.

She times herself walking and driving on a number of days. She takes the time from going out of her front door to sitting down at her desk, and then rounds it up to the nearest minute. She puts her times in order and records them in this table.

Times in minutes	
Walking to work	25 26 26 26 27
Walking home	23 24 24 25 26
Driving to work	7 8 8 8 9 10 15 19 28 35
Driving home	8 8 9 10 10 10 11 18 34 42

- (i)** State two conclusions that she can draw from the data in the table. **[2]**

Akosua thinks that she will walk on some days and on other days she will drive. However, the data she has recorded in the table do not give her enough information to decide whether to walk or drive on any particular day.

- (ii) (A)** Suggest two other pieces of helpful information that Akosua could have recorded. **[2]**

- (B)** What would you advise her to do next? **[1]**

1 (i)	
1 (ii)(A)	
1 (ii)(B)	

2 This is part of an article in a newspaper.

Computer games take over

These days many children are spending more time playing computer games than in the classroom. Secret evidence obtained by this newspaper shows them spending over 30 hours a week zapping aliens.

...

This newspaper calls on the government to protect our children from the damage they are doing to themselves.

Jake is a sociology student. He felt the article was misleading and decided to write a letter to the newspaper in response, but first he collected some data. He asked for volunteers among the younger brothers and sisters of all his friends to take part in a survey and 40 of them (20 girls and 20 boys) agreed to do so.

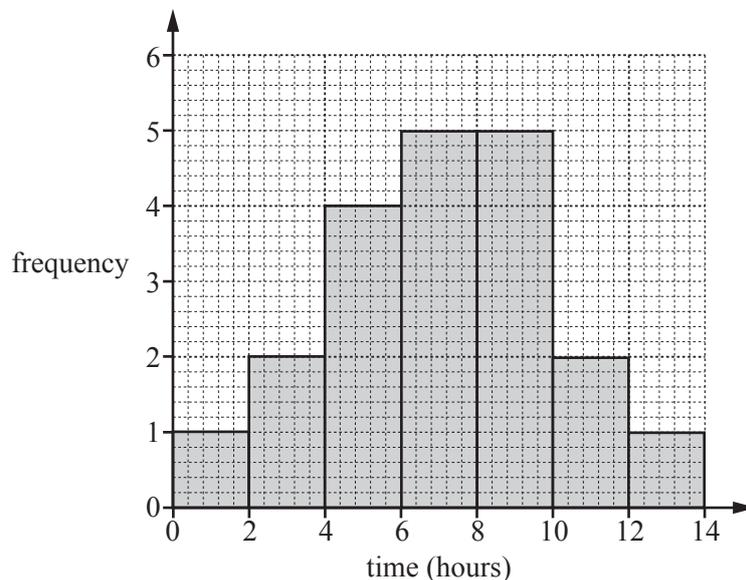
(i) Which of the following terms best describes Jake's sample?

Opportunity, simple random, stratified, quota, cluster, self-selected.

[1]

2 (i)	

The children recorded the time that they spent playing computer games over one week. The results for the girls are shown in the frequency chart below.



(ii) State one feature of the chart that suggests that the Normal distribution might be an appropriate model.

Jake decides to use a Normal model with mean 7 and standard deviation 3. Show that the total number of girls playing for between 4 and 10 hours is approximately what would be predicted by this model.

Show that if Jake's model is applied to all girls, virtually none of them play computer games for over 30 hours a week.

[6]

Among the boys, 18 played for less than 10 hours during the week and the mean of their times was 4 hours 40 minutes. The mean time for all 20 of the boys was 7 hours 30 minutes.

(iii) Show that at least 1 of the boys played for more than 30 hours. **[3]**

(iv) Write down two points that Jake could make in his letter to the newspaper. **[2]**

2 (iii)	
2 (iv)	

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- 3 An industrial development is proposed in a rural area. It is known that bats that fly close to the type of structure that is planned may be killed. A group of local conservationists are concerned that bats living nearby will be badly affected. All bats are protected.

The group carry out a survey of bats at two nearby sites over one week. Table 3.1 gives the numbers of each species at each site, together with information about their abundance (how common they are) nationally.

Species	Abundance	Site A	Site B	Total
Pipistrelle	Common	135	91	226
Noctule	Uncommon	10	5	15
Serotine	Uncommon	10	5	15
Greater horseshoe	Rare	20	2	22
Other bats	–	1	3	4
	Total	176	106	282

Table 3.1

The group are not only interested in the numbers of bats but also whether there are different proportions of each species at the two sites A and B. This might give information about where the different bats live and fly.

They decide to carry out a χ^2 test on the data, using a 5% significance level.

- (i) State the null and alternative hypotheses for the test. [1]
- (ii) Complete Table 3.2 and explain why the category 'Other bats' has not been included. [2]

3 (i)																									
3 (ii)	<table border="1"> <thead> <tr> <th>Observed frequency, f_o</th> <th>Site A</th> <th>Site B</th> <th>Total</th> </tr> </thead> <tbody> <tr> <td>Pipistrelle</td> <td>135</td> <td>91</td> <td></td> </tr> <tr> <td>Noctule</td> <td>10</td> <td>5</td> <td></td> </tr> <tr> <td>Serotine</td> <td>10</td> <td>5</td> <td></td> </tr> <tr> <td>Greater horseshoe</td> <td>20</td> <td>2</td> <td></td> </tr> <tr> <td>Total</td> <td></td> <td></td> <td>278</td> </tr> </tbody> </table>	Observed frequency, f_o	Site A	Site B	Total	Pipistrelle	135	91		Noctule	10	5		Serotine	10	5		Greater horseshoe	20	2		Total			278
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	Serotine	10	5																						
	Greater horseshoe	20	2																						
	Total			278																					

Table 3.2

(iii) Complete Table 3.3 and carry out the test.

State which species has the greatest influence on the result.

[8]

3 (iii)

Expected frequency, f_e	Site A	Site B	Total
Pipistrelle			
Noctule			
Serotine			
Greater horseshoe			
Total			278

Table 3.3

(answer space continued on next page)

3 (iii)	(continued)

(iv) The group were hoping to find information about where the different bats live and fly.

Comment on whether this information is provided by the data in Table 3.1 and by the result of the χ^2 test. [2]

3 (iv)	

Section B (30 marks)

The questions in this section are based on the pre-release data. A hard copy of this is provided with this examination paper.

4 (i) Estimate the number of babies born in a year in Japan. [2]

(ii) The death rate in Japan was 9.38 people per 1000 population in the year when the pre-release data were collected.

Estimate the population of Japan one year later. (Emigration and immigration should be ignored.)

In what respect is Japan's population different from that of the world as a whole? [3]

4 (i)	
4 (ii)	

5 (i) For how many countries is the population given in the pre-release data?

State briefly the spreadsheet techniques you would use to place the total world population in cell C241 and the mean value of the countries' population in C242.

Given that the total population is 7 174 654 290, calculate the mean value per country, giving your answer to the nearest 100.

Show that the population of Malaysia is just above the mean size and that of Uzbekistan is just below it. [6]

(ii) How many countries have populations above the mean size? How many below it?

What does this tell you about the populations of the countries in the world? [3]

5 (i)	

5 (ii)	

- 6 Jessica is an economics student. She is interested in which countries have high GDP per capita, G . She identifies the 8 countries with the highest values of G . They are given in Table 6.1, together with their populations.

G rank	Country	Population	G rank	Country	Population
1	Qatar	2 123 160	5	Luxembourg	520 672
2	Liechtenstein	37 313	6	Monaco	30 508
3	Bermuda	69 839	7	Singapore	5 567 301
4	Macau	587 914	8	San Marino	32 742

Table 6.1

- (i) Jessica notices that they are all small countries and so, on the basis of this sample, she puts forward the following conjecture.

‘There is negative correlation between GDP per capita and population.’

Give one reason why this is not a good sample on which to base a conjecture.

[1]

- (ii) Jessica then comes up with another sample of size 8. The following countries are involved: Angola, Mozambique, Kiribati, Haiti, Hong Kong, Slovenia, Norway and Mexico.

In the spreadsheet of pre-release data, Angola is in the row numbered 7. List the row numbers of all the countries in this sample in the order in which they are given above. Explain how Jessica has selected the sample.

[2]

6 (i)	
6 (ii)	

Jessica uses this sample to carry out a hypothesis test of her conjecture, at the 5% significance level, using Spearman’s rank correlation coefficient.

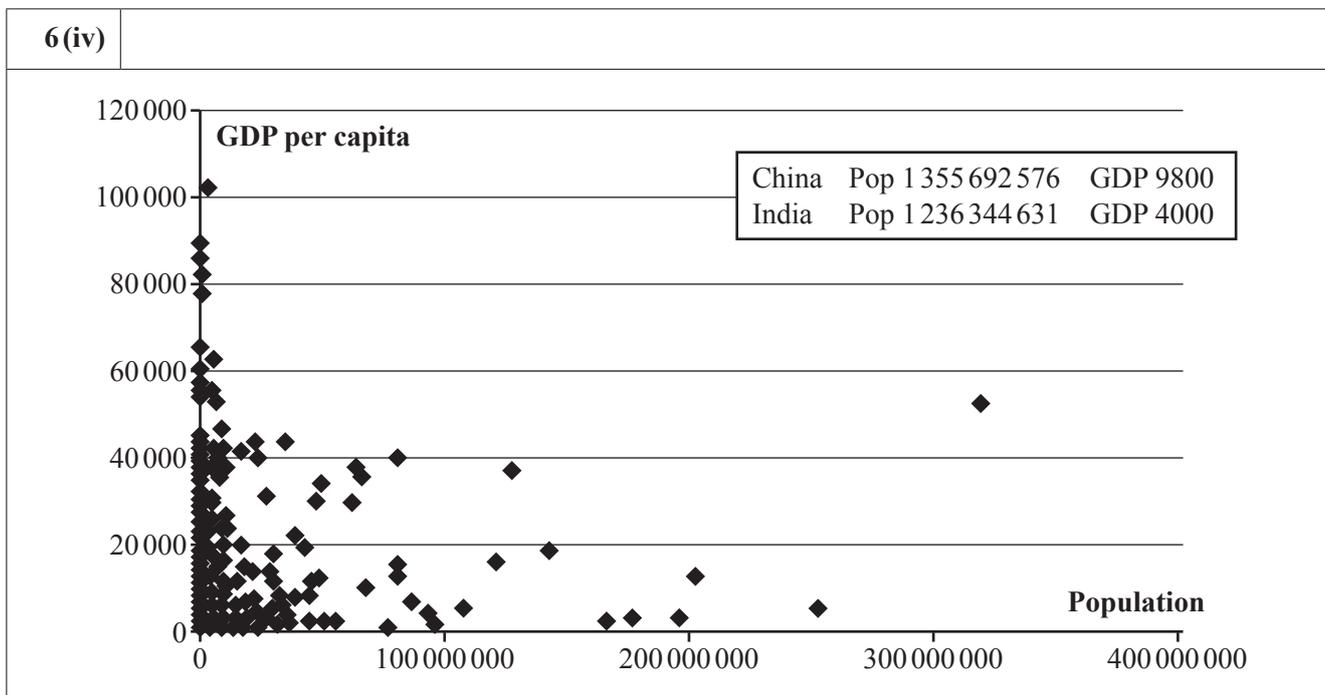
- (iii) State the null and alternative hypotheses.

Complete Table 6.2, carry out the test and show that the result is not significant.

[8]

(iv) The scatter diagram below uses the actual values of population and GDP per capita. Identify Qatar, Bermuda and USA on the diagram below. [3]

(v) Imagine that you are talking to Jessica about her conjecture. Write down two points that you would make to her. [2]



6 (v)

END OF QUESTION PAPER

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