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AS STATISTICS

Unit Statistics 2

SS02

Wednesday 13 June 2018 Morning

Time allowed: 1 hour 30 minutes

For this paper you must have:

- the blue AQA booklet of formulae and statistical tables.

You may use a graphics calculator.

At the top of the page, write your surname and other names, your centre number, your candidate number and add your signature.

[Turn over]



J U N 1 8 S S O 2 0 1

INSTRUCTIONS

- Use black ink or black ball-point pen. Pencil should only be used for drawing.
- Answer ALL questions.
- Write the question part reference (eg (a), (b)(i) etc) in the left-hand margin.
- You must answer each question in the space provided for that question. If you require extra space, use an AQA supplementary answer book; do NOT use the space provided for a different question.
- Do not write on blank pages.
- Show all necessary working; otherwise marks for method may be lost.
- Do all rough work in this book. Cross through any work that you do not want to be marked.
- The FINAL answer to questions requiring the use of tables or calculators should normally be given to three significant figures.



INFORMATION

- The marks for questions are shown in brackets.
- The maximum mark for this paper is 75.

ADVICE

Unless stated otherwise, you may quote formulae, without proof, from the booklet. You do not necessarily need to use all the space provided.

DO NOT TURN OVER UNTIL TOLD TO DO SO



Answer ALL questions.

Answer each question in the space provided for that question.

- 1** A ferry company has recorded for many years the number of people in each car that it transports. The table shows the percentage of cars for each number of people in a car.

Number of people in car	1	2	3	4	5	6 or more
Percentage of cars	24	36	15	22	3	0

It may be assumed that the number of people in a car is independent of the number of people in any other car.

- (a) Find the probability that a randomly chosen car transported on the ferry contains more than 2 people. [1 mark]
- (b) On a particular sailing there are two green cars on the ferry.

Calculate the probability that one green car contains fewer than 3 people and the other green car contains more than 3 people. [2 marks]

- (c) Calculate the mean number of people per car transported by the ferry, and show that the standard deviation is 1.16, correct to three significant figures. [5 marks]



- (d) The charge, $\pounds C$, for transport using the ferry is $\pounds 68$ for a car and driver, and an extra $\pounds 24$ for each **ADDITIONAL** person in the car.

Find the mean and the standard deviation of C .
[2 marks]

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- 2** A scientist has been monitoring the population of small rodents on an island every April for many years. The population shows a cyclical pattern.

The scientist's data are shown in the table on page 12 and these are plotted on **FIGURE 1** on page 13, together with a set of appropriate moving averages.

- (a) One of the moving averages has been omitted.
- (i) Calculate the value of the omitted moving average. [2 marks]
 - (ii) Plot this omitted moving average on **FIGURE 1** and draw a trend line. [2 marks]
 - (iii) Describe the variation of the data points about your trend line. [1 mark]
- (b) Estimate the number of rodents per hectare expected for 2017, showing how you have obtained your estimate. [4 marks]
- (c) The population measured by the scientist for 2016 was 5.1 rodents per hectare, and for 2017 the population measured was 9.2 rodents per hectare.

Make one comment about each of these values. [2 marks]

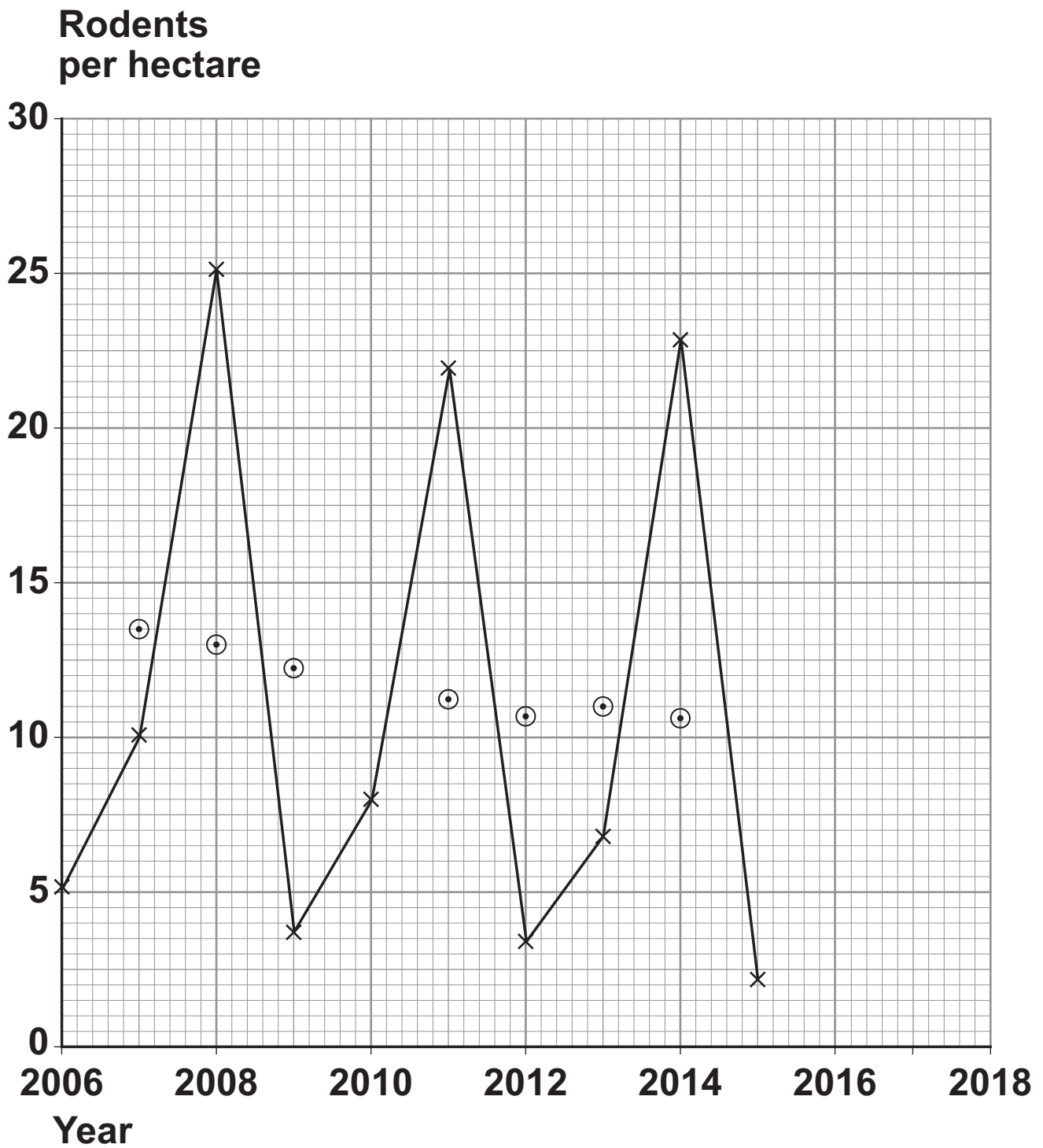
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Year	Rodents per hectare
2006	5.2
2007	10.1
2008	25.2
2009	3.7
2010	8.0
2011	21.9
2012	3.4
2013	6.8
2014	22.8
2015	2.2



FIGURE 1



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- 3 Ruth suffers from occasional severe headaches known as migraines. The migraines occur at a constant average rate of 3 per year.**

Ruth's brother, Steve, also suffers from migraines. Steve's migraines occur at a constant average rate of 4 per year.

The migraines suffered by Ruth and Steve occur randomly and independently.

Find the probability that:

- (a) during a given year, Ruth suffers at least 2 migraines; [2 marks]**
- (b) during a period of THREE years, Steve suffers exactly the number of migraines that on average he would expect to suffer; [3 marks]**
- (c) during a period of TWO years, the total number of migraines suffered by Ruth and Steve is more than 10; [2 marks]**
- (d) during a particular year, Ruth suffers fewer than 2 migraines, and Steve suffers more migraines than Ruth. [3 marks]**



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- 4** In a large factory there are 400 full-time employees and 140 part-time employees. The distance, x km, travelled to the factory by the full-time employees is distributed as shown in the table on page 26.

FIGURE 2, on page 27, is a cumulative frequency diagram showing the percentage of PART-TIME employees with distance travelled to the factory.

- (a) (i) On FIGURE 2, draw a similar cumulative frequency diagram for the FULL-TIME employees. [4 marks]**

- (ii) State the value needed to complete this statement:**

“10% of the PART-TIME employees

travel more than _____ km to

the factory.” [1 mark]

- (b) What additional information is needed in order to draw an accurate box-and-whisker diagram to illustrate the data for distance travelled by full-time employees? [1 mark]**



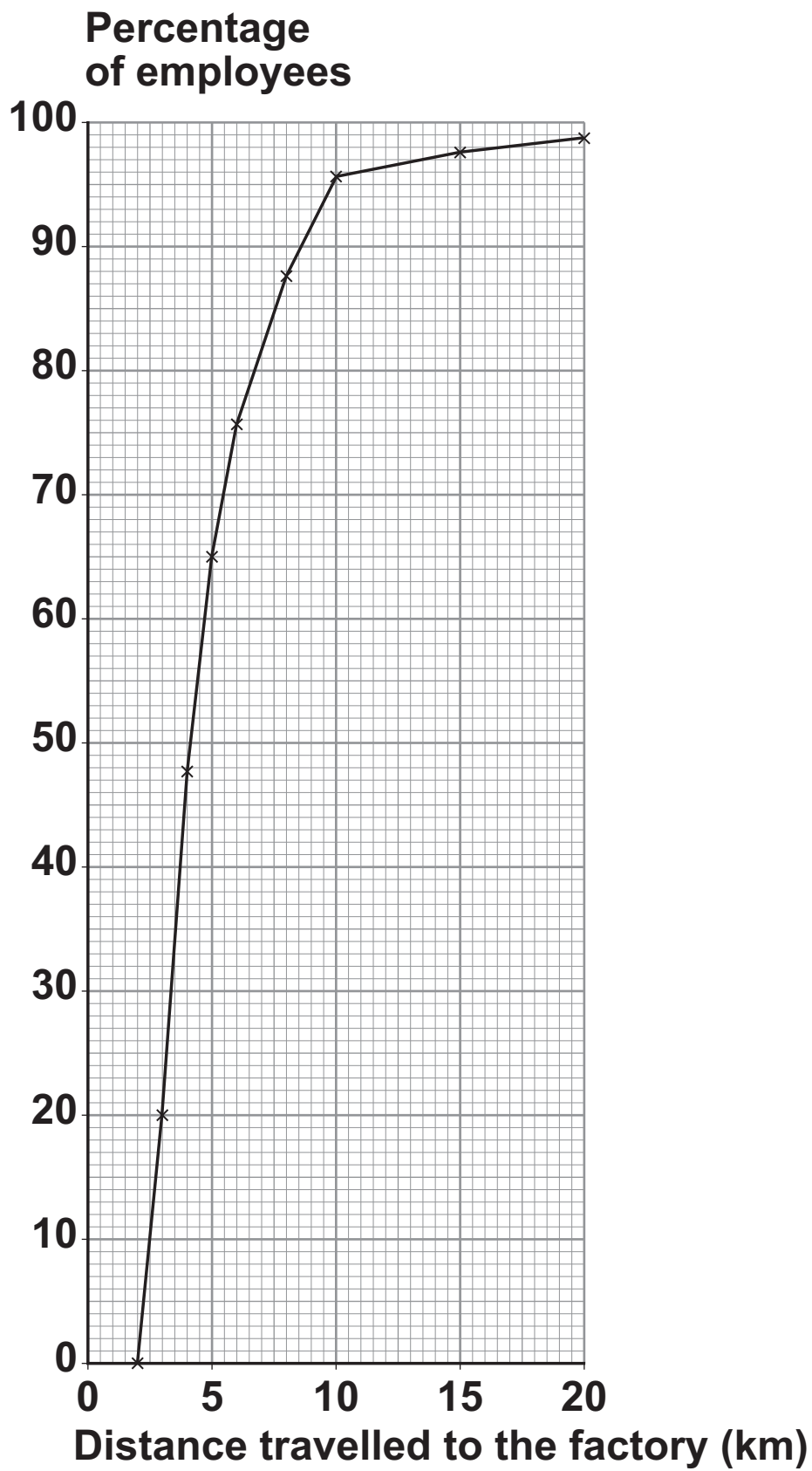
- (c) Compare the distances travelled by full-time and part-time employees, referring to numerical values of:
- (i) a measure of central tendency;
 - (ii) a measure of spread.
- [4 marks]

[Turn over]



Distance travelled (x km)	Number of full-time employees
$x \leq 2$	0
$2 < x \leq 3$	16
$3 < x \leq 4$	26
$4 < x \leq 5$	38
$5 < x \leq 6$	40
$6 < x \leq 8$	98
$8 < x \leq 10$	74
$10 < x \leq 15$	56
$15 < x \leq 20$	40
$x > 20$	12



FIGURE 2**[Turn over]**

[illegible]

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- 5** **TABLES 1 AND 2 contain data relating to the New Zealand economy.**

TABLE 1 shows, by industry, the Gross Domestic Product (GDP), the number of employees and the number of enterprises at March 2016.

- (a) The sum of the data figures in the Employees column is 2 100, not 2 102.
Given that all the figures are correct, explain this discrepancy. [1 mark]**
- (b) Calculate an estimate for:**
- (i) the mean number of employees per enterprise in 'Wholesale trade'; [2 marks]**
 - (ii) the GDP per employee in 'Information and telecommunication'. [2 marks]**
- (c) What PERCENTAGE of the enterprises is engaged in 'Construction'? [1 mark]**



TABLE 1

Table of New Zealand GDP figures cannot be reproduced here due to third-party copyright restrictions.

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- 5(d) **TABLE 2 shows the New Zealand GDP data for 2015 and 2016.**

TABLE 2

Table of New Zealand GDP figures cannot be reproduced here due to third-party copyright restrictions.



Show that, between 2015 and 2016, 'Mining' had the greatest PERCENTAGE DECLINE in GDP. [3 marks]

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[illegible]

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- 6** A study of puffins on a particular Scottish Island in 1977 found that the mean weight of a puffin sitting on eggs was 405.3 grams and that the standard deviation was 31.2 grams.

A further study was conducted in 2017 to investigate the mean weight of a puffin sitting on eggs on that island.

The weights, in grams, recorded for the first 5 puffins measured in 2017 were:

435

361

369

403

365

- (a) Conduct a hypothesis test, using the 5% level of significance, to investigate whether the mean weight of a puffin sitting on eggs had **CHANGED** since 1977.

Assume that the standard deviation remained unchanged at 31.2 grams, and state two other necessary assumptions. [8 marks]



- (b) When the 2017 study was concluded, 196 puffins had been measured, with a mean weight of 400.9 grams and a standard deviation of 28.4 grams.

This study reported that the data showed, at the $\alpha\%$ significance level, that the mean weight of a puffin had decreased since 1977.

Find the least possible integer value of α , showing calculations to justify your answer.
[3 marks]

- (c) If the value of 400.9 grams represented the actual mean weight of a puffin in 2017, state whether, in your answer to part (a), you made a Type I error, a Type II error or no error.
[1 mark]

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- 7** **Padraig is a student investigating the effects of running, on people who do not exercise regularly but are taking part in a fun run organised by 12 charities. He plans to select a sample of 40 runners out of 2000 taking part.**

The organisers have given Padraig a list of the runners, numbered from 0001 to 2000, and stating the charity supported by each runner.

Padraig plans to measure the pulse rate of each person in his sample at the end of the run. He wants to investigate how the pulse rate is associated with the sex and age of the runner.

- (a) Explain why the list given to Padraig is insufficient to allow him to select a sample stratified to help his investigation. [2 marks]**
- (b) (i) Explain how Padraig could use the numbers on the list to select a simple random sample.**
 - (ii) State, in this context, one PRACTICAL disadvantage of using this sampling method to collect his data. [4 marks]**
- (c) Padraig considers selecting his sample of 40 systematically from the runners in the order that they finish the run.**
 - (i) Explain in detail how Padraig would do this.**
 - (ii) State, in this context, one advantage and one disadvantage of using this sampling method to collect his data, compared to using a RANDOM sample. [4 marks]**



- (d) Runners from each charity taking part will wear T-shirts with the name of their charity clearly printed on the front and back. Padraig decides to obtain his sample by selecting 4 charities at random and then selecting 10 runners who finish the run from each of those charities.
- (i) Name this method of sampling.
- (ii) State, in this context, one advantage and one disadvantage of using this sampling method to collect his data, compared to using a sample selected **SYSTEMATICALLY**. [3 marks]

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END OF QUESTIONS



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