

**OXFORD CAMBRIDGE AND RSA EXAMINATIONS  
A2 GCE  
4767/01  
MATHEMATICS (MEI)  
Statistics 2  
QUESTION PAPER  
WEDNESDAY 14 JUNE 2017: Morning  
DURATION: 1 hour 30 minutes  
plus your additional time allowance  
MODIFIED ENLARGED 24pt**

**Candidates answer on the Printed Answer Book or any suitable paper provided by the centre. The Printed Answer Book may be enlarged by the centre.**

**OCR SUPPLIED MATERIALS:  
None**

**OTHER MATERIALS REQUIRED:  
Scientific or graphical calculator  
READ INSTRUCTIONS OVERLEAF**



## **INSTRUCTIONS TO CANDIDATES**

**Write your name, centre number and candidate number in the spaces provided on the Printed Answer Book or on the paper provided. Please write clearly and in capital letters.**

**IF YOU USE THE PRINTED ANSWER BOOK WRITE YOUR ANSWER TO EACH QUESTION IN THE SPACE PROVIDED. If additional space is required, you should use the lined page(s) at the end of this booklet. The question number(s) must be clearly shown.**

**Use black ink. HB pencil may be used for graphs and diagrams only.**

**Read each question carefully. Make sure you know what you have to do before starting your answer.**

**Answer ALL the questions.**

**You are permitted to use a scientific or graphical calculator in this paper.**

**Final answers should be given to a degree of accuracy appropriate to the context.**

## **INFORMATION FOR CANDIDATES**

**The number of marks is given in brackets [ ] at the end of each question or part question on the Question Paper.**

**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.**

**The total number of marks for this paper is 72.**

**Any blank pages are indicated.**

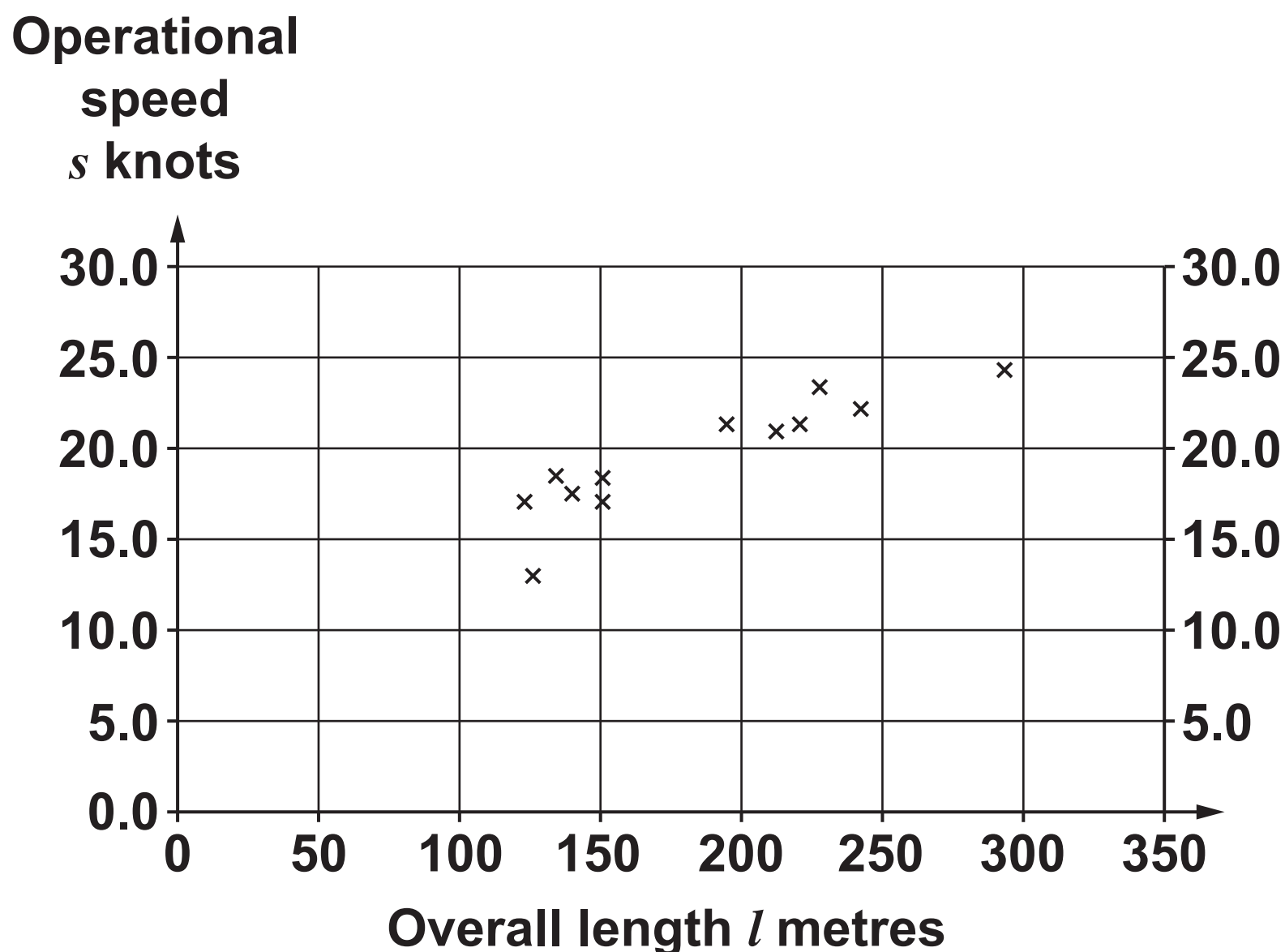
## **INSTRUCTION TO EXAMS OFFICER/INVIGILATOR**

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- 1 The scatter diagram below illustrates the overall lengths  $l$  metres and the typical operational speeds  $s$  knots (nautical miles per hour) of 12 container ships. The length of a ship is one of the factors which determines its typical operational speed.



Summary statistics for these data are as follows:

$$n = 12, \quad \sum l = 2219, \quad \sum s = 234.6, \quad \sum l^2 = 443\,867,$$

$$\sum s^2 = 4700.56, \quad \sum ls = 45\,149.0.$$

- (i) State which of the two variables  $l$  and  $s$  is the independent variable and which is the dependent variable. Briefly explain your answers. [2]
- (ii) Calculate the equation of the regression line of  $s$  on  $l$ . [5]
- (iii) Interpret the coefficient of  $l$  in terms of the relationship between overall length and speed in the equation of the regression line found in part (ii). [2]

- (iv) Calculate the value of the residual for the data point where  $l = 126$  and  $s = 13.0$ . [3]
- (v) Use the equation of the regression line in part (ii) to calculate an estimate of the operational speed of a ship with overall length of 100 metres. Comment on the reliability of this estimate. [2]

If the data point in part (iv) is removed from the data set, the equation of the new regression line is

$$s = 0.0453l + 11.5.$$

- (vi) Recalculate the estimate for an overall length of 100 metres using this new equation. Discuss which of these two estimates you think is likely to be more reliable. [3]

**2 At a small hospital maternity department, there is an average of 1.3 births per day. Throughout this question, you should assume that births occur independently, at random times, and at a uniform average rate.**

**(i) Briefly explain the meaning of each of the three terms ‘independently’, ‘random’ and ‘uniform’, in the context of births at the maternity department. [3]**

**$X$  represents the number of births at the hospital on a randomly chosen day.**

**(ii) State the distribution of  $X$  and also the variance of  $X$ . [2]**

**(iii) Find  $P(X > 3)$ . [2]**

**(iv) Find the probability that there are exactly 3 births in a period of 3 days. [2]**

**There is an average of 0.4 home births per WEEK in the area served by the hospital.**

**(v) Find the probability that the total number of births in a week (at home and in hospital) is at least 10. [2]**

**(vi) Use a suitable approximating distribution to find the probability that there is a total of at least 50 births in a period of 4 weeks. [5]**

**(vii) How realistic do you think the assumption of independence made at the start of this question is? [2]**

**3 The random variable  $X$  represents the weight, in grams, of a particular type of chocolate bar. It is known that  $X$  is Normally distributed with mean 50.7 and variance 0.72. On the wrapper it states that the bar weighs 50 grams.**

**(i) Find the proportion of these chocolate bars that actually weigh at least 50 grams. [3]**

**(ii) A quality control manager wishes to increase this proportion to 95%.**

**(A) Find the required value of the mean if the variance remains unchanged. [4]**

**(B) Find the required value of the variance if the mean remains unchanged. [2]**

**The weights of another type of chocolate bar are also Normally distributed. On the wrapper it states that the bar weighs 25 grams. It is known that 99% of these bars weigh at least 25.0 grams and 75% of them weigh at least 25.4 grams.**

**(iii) Find the probability that one of these bars weighs at least 26.0 grams. [6]**

**(iv) One bar of the first type (with the original mean and standard deviation) and 2 bars of the second type are selected at random. Find the probability that at least one of the bars has a weight less than that stated on its wrapper. [2]**

- 4 (a) In an investigation into dietary supplements, a random sample of 200 adults was selected. Each of them was asked whether or not they regularly take dietary supplements. The 200 adults were categorised as 'Male under 50', 'Male 50 or older', 'Female under 50', 'Female 50 or older'. Their answers to the question are summarised in the table below.

	Yes	No
Male under 50	13	33
Male 50 or older	18	31
Female under 50	24	37
Female 50 or older	24	20

- (i) Write down null and alternative hypotheses for a test to examine whether there is any association between category of adult and whether or not they regularly take dietary supplements. [1]

The expected frequencies under the null hypothesis for the usual  $\chi^2$  test are shown in the table below.

Expected frequency	Yes	No
Male under 50	18.17	27.83
Male 50 or older	19.36	29.65
Female under 50	24.10	36.91
Female 50 or older	17.38	26.62

- (ii) Verify the expected frequency of 18.17 for Male under 50 answering Yes. [2]



The contributions to the test statistic are shown in the table below.

Contribution	Yes	No
Male under 50	1.4710	0.9604
Male 50 or older	0.0949	0.0619
Female under 50	0.0004	0.0002
Female 50 or older	2.5215	1.6463

- (iii) Verify the contribution to the test statistic of 1.4710 for Male under 50 answering Yes. [2]
- (iv) Given that the total of the contributions is 6.757, correct to 3 decimal places, complete the test at the 10% significance level. [4]
- (v) For each category of adult, comment briefly on how their taking of dietary supplements compares with what would be expected if there were no association. [3]
- (b) The breaking strength of a particular type of rope is known to be Normally distributed with mean 562 kg and a standard deviation of 27.4 kg when the rope is dry. A researcher believes that the breaking strength may be different when the rope is wet. He selects a random sample of 12 pieces of wet rope and finds that the mean of their breaking strengths is 547 kg. Carry out a test at the 10% significance level to investigate the researcher's belief. You may assume that the breaking strengths of wet ropes of this type are still Normally distributed with standard deviation 27.4 kg. [8]

**END OF QUESTION PAPER**

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