

Please check the examination details below before entering your candidate information

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| Candidate surname    |                      |                      |                      | Other names          |                      |                      |                      |
| Centre Number        |                      |                      |                      | Candidate Number     |                      |                      |                      |
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**Pearson Edexcel International Advanced Level**

**Wednesday 22 January 2025**

Afternoon (Time: 1 hour 30 minutes) **Paper reference** **WST03/01**

**Mathematics** □ □

**International Advanced Subsidiary/Advanced Level**

**Statistics S3**

**You must have:**  
Mathematical Formulae and Statistics Tables (Yellow), calculator

Total Marks

**Candidates may use any calculator permitted by Pearson regulations. Calculators must not have the facility for symbolic algebraic manipulation, differentiation and integration, or have retrievable mathematical formulae stored in them.**

#### Instructions

- Use **black** ink or ball-point pen.
- If pencil is used for diagrams/sketches/graphs it must be dark (HB or B).
- **Fill in the boxes** at the top of this page with your name, centre number and candidate number.
- Answer **all** questions and ensure that your answers to parts of questions are clearly labelled.
- Answer the questions in the spaces provided  
– *there may be more space than you need.*
- You should show sufficient working to make your methods clear. Answers without working may not gain full credit.
- Values from the statistical tables should be quoted in full. If a calculator is used instead of the tables, the value should be given to an equivalent degree of accuracy.
- Inexact answers should be given to three significant figures unless otherwise stated.

#### Information

- A booklet 'Mathematical Formulae and Statistical Tables' is provided.
- There are 7 questions in this question paper. The total mark for this paper is 75
- The marks for **each** question are shown in brackets  
– *use this as a guide as to how much time to spend on each question.*

#### Advice

- Read each question carefully before you start to answer it.
- Try to answer every question.
- Check your answers if you have time at the end.
- If you change your mind about an answer, cross it out and put your new answer and any working underneath.

Turn over ►

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1. The table below gives information about the final positions of 10 football teams in the English Premier League and their average match day attendance for one season. The table also shows some of the average match day attendance ranks.

| Team                     | Final position | Average match day attendance | Average match day attendance rank |
|--------------------------|----------------|------------------------------|-----------------------------------|
| Arsenal                  | 5              | 59 776                       | 2                                 |
| Brighton and Hove Albion | 9              | 30 988                       |                                   |
| Chelsea                  | 3              | 36 424                       |                                   |
| Leicester City           | 8              | 32 440                       |                                   |
| Liverpool                | 2              | 53 027                       |                                   |
| Manchester City          | 1              | 53 739                       |                                   |
| Manchester United        | 6              | 72 992                       | 1                                 |
| Tottenham Hotspur        | 4              | 56 523                       |                                   |
| West Ham United          | 7              | 57 915                       |                                   |
| Wolverhampton Wanderers  | 10             | 30 725                       |                                   |

(Source from: [www.statista.com](http://www.statista.com))

By completing the ranks for average match day attendance,

- (a) calculate the value of the Spearman's rank correlation coefficient for these data.  
Show your working clearly. (4)
- (b) Stating your hypotheses clearly, test at the 1% level of significance, whether or not there is evidence of a positive correlation between the final position of a football team in the English Premier League and its average match day attendance. (4)

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**Question 1 continued**

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**Question 1 continued**

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**(Total for Question 1 is 8 marks)**

2. The manager of a shop investigates the number of customers served by staff that work in the shop.

The manager records the number of customers being served in 100 consecutive five-minute time intervals.

The results are shown in the table below.

| Number of customers | 0 | 1  | 2  | 3  | 4 | 5 | 6 or more |
|---------------------|---|----|----|----|---|---|-----------|
| Frequency           | 5 | 38 | 32 | 17 | 7 | 1 | 0         |

The manager plans to test whether or not a Poisson model is suitable for these data.

- (a) Show that the sample mean number of customers served is 1.86 (1)

The manager uses the sample mean to calculate the following expected frequencies, correct to 3 decimal places.

| Number of customers | 0      | 1      | 2      | 3      | 4     | 5     | 6 or more |
|---------------------|--------|--------|--------|--------|-------|-------|-----------|
| Expected frequency  | 15.567 | 28.955 | 26.928 | 16.696 | 7.763 | 2.888 | $r$       |

- (b) Explain why the value of  $r$  is 1.203 (1)

The manager combines cells 4, 5 and '6 or more', before continuing the test.

- (c) Explain why it is necessary for the manager to do this. (1)

After combining these cells, the manager calculates that  $\sum \frac{(O - E)^2}{E} = 12.2$  correct to 3 significant figures.

- (d) Carry out the manager's test at the 1% significance level.  
You should clearly state the hypotheses, the degrees of freedom and the critical value used. (4)

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**Question 2 continued**

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**(Total for Question 2 is 7 marks)**



**Question 3 continued**

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Question 3 continued

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**Question 3 continued**

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**(Total for Question 3 is 12 marks)**

4. The random variable  $X$  is normally distributed with unknown mean  $\mu$  and known variance  $\sigma^2$

A random sample of  $n$  observations of  $X$  produced a 99% confidence interval for  $\mu$  of (0.900, 0.964)

- (a) Show that the standard error used to find this confidence interval is 0.0124 to 3 significant figures.

(3)

Using the same random sample,

- (b) find a 95% confidence interval for  $\mu$

Give your answers to 3 decimal places.

(4)

The  $r$  % confidence interval using the same random sample has a width of 0.04

- (c) Calculate the value of  $r$

(5)

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**Question 4 continued**

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**Question 4 continued**

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5. A research company takes a sample of 120 students living in London and a sample of 80 students living in Birmingham. The company asks the students to state their favourite science subject from Biology, Chemistry and Physics.

The research company uses quota sampling rather than simple random sampling.

- (a) (i) Give one advantage of using quota sampling.  
(ii) Give one disadvantage of using quota sampling.

(2)

The results of the survey are shown in the table.

|            | Biology | Chemistry | Physics | Total |
|------------|---------|-----------|---------|-------|
| London     | 66      | 37        | 17      | 120   |
| Birmingham | 40      | 19        | 21      | 80    |

The data are to be used to determine whether or not a student's favourite science subject is independent of the place where they live.

- (b) Calculate
- (i) the expected frequency for the class Biology and London,
  - (ii) the expected frequency for the class Biology and Birmingham.

(3)

Before the two classes for Biology are included  $\sum \frac{(O - E)^2}{E} = 4.549$  to 3 decimal places.

- (c) Test at the 10% level of significance, whether or not a student's favourite science subject is independent of the place where they live.  
Show your working clearly, stating your hypotheses, the degrees of freedom, the test statistic and the critical value used.

(7)



**Question 5 continued**

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**(Total for Question 5 is 12 marks)**



## Question 6 continued

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7. A company sells two types of board, short or long.

The weight of a short board,  $S$  kg, has distribution  $N(7.7, 0.01^2)$

The weight of a long board,  $L$  kg, has distribution  $N(20, 0.02^2)$

A random sample of 3 short boards and 4 long boards is taken.

- (a) Find the probability that the total weight of the 3 short boards and the 4 long boards is more than 103.15 kg

(4)

A random sample of 2 long boards is taken.

- (b) Find the probability that the weights of these 2 long boards differ by more than 0.01 kg

(5)

A random sample of  $(n + 1)$  short boards is taken, with weights  $S_1, S_2, S_3, \dots, S_{n+1}$

The random variable  $T$  is defined as

$$T = nS_1 - \sum_{r=2}^{n+1} S_r$$

Given that, to 4 decimal places,  $P(T > 2) = 0.0233$

- (c) calculate the value of  $n$

(6)

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**Question 7 continued**

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**(Total for Question 7 is 15 marks)****TOTAL FOR PAPER IS 75 MARKS**