

Please check the examination details below before entering your candidate information

Candidate surname					Other names									
Pearson Edexcel Level 3 GCE					Centre Number					Candidate Number				
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Critical Regions and p-Values														
Statistics Advanced Topic Test														
You must have: Statistical formulae and tables booklet Calculator										Total Marks <input type="text"/>				

**Candidates may use any calculator allowed by Pearson regulations.
Calculators must not 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.
- Unless otherwise stated, inexact answers should be given to three significant figures.
- Unless otherwise stated, statistical tests should be carried out at the 5% significance level.

Information

- A booklet ‘Statistical formulae and tables’ is provided.
- There are 3 questions in this question paper. The total mark for this paper is 25.
- 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.

1. (a) State the meaning of a critical region.

(1)

The Met Office keeps detailed records of daily temperatures measured in Central England. During the period 1900 – 1959, the percentage of days with a mean daily temperature of below 5 °C was 21.5%.

[Source: <https://www.metoffice.gov.uk/hadobs/hadcet/data/>]

Maksym believes that the mean daily temperature has increased due to the effects of climate change, so the proportion of days with a mean daily temperature of below 5 °C has decreased. He randomly selects 12 days during the period of 2020 – 2025 and finds only one of these days had a mean daily temperature of below 5 °C.

- (b) Using a p -value method, carry out a test to investigate Maksym's claim.

(5)

- (c) (i) Determine the critical region, if one exists, for the test carried out in part (b).

(2)

- (ii) Use your answer to (c)(i) to state one advantage of using a critical region method over a p -value method in this case.

Justify your answer.

(2)

(Total 10 marks)

2. The mean shipment weight of HIV test kits being shipped to Rwanda in 2008 was recorded as 1001 kg.

Rhodri is a humanitarian logistics officer working for an international aid organisation. He believes that the weight of HIV test kits being shipped to Rwanda has changed over time.

Rhodri takes a random sample of 7 shipments of HIV test kits shipped to Rwanda in 2014 and records the weights, in kg, as follows:

2712 1383 2771 1992 2820 766 3996

[Source: <https://github.com/austinlasseter/datasets-shipping-logistics>]

A normal distribution with a standard deviation of 953 kg is assumed for the shipment weights of HIV test kits.

- (a) Using a critical region method, carry out a test to determine whether or not the shipment weight of HIV test kits has changed between 2008 and 2014. (6)
- (b) Calculate the p -value for this test. (2)
- (c) Interpret your answer to part (b) in context. (2)

(Total 10 marks)

3. Beatrice is a football statistician analysing the match statistics for Manchester United in the 2024/25 season.

Beatrice collects data for the number of times Manchester United wins, draws and loses as well as whether the games were played at their home venue or an away venue. A **chi-squared test** is then carried out to determine whether or not there is **an association** between the match result and whether the game was played at home or away.

Beatrice also collects data on the number of goals scored by Manchester United in the 2024/25 season by selecting a random sample of both home and away games. She conducts a **Wilcoxon Rank-Sum test** to determine whether or not there is significant evidence to suggest the number of goals scored in home matches is **higher** than the number of goals scored in away matches. She uses a statistical software package to calculate the p -value.

Finally, Beatrice calculates the win rate for Manchester United in the 2024/25 season. She uses a **two-sample proportion test** to determine whether or not there is significant evidence to suggest the win rate for the 2024/25 season is **lower** than that of the 2023/24 season for Manchester United.

The p -values for each test are shown in **Figure 1** below.

Test	p -value
Chi-squared for association	0.403
Wilcoxon Rank-Sum Test	0.537
Proportion test	0.0492

Figure 1

[Data Source: <https://footystats.org/clubs/manchester-united-fc-149>]

- (a) Use **Figure 1** to write a report summarising these findings for the purposes of printing in a footballing magazine aimed at the general public. (4)
- (b) Give an advantage of using p -values instead of critical regions in this case. (1)

(Total 5 marks)

TOTAL FOR PAPER: 25 MARKS