

A Level Statistics

AQA Past Exam Questions

TOPIC: Hypothesis Testing

One Sample Wilcoxon Rank Test

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). Coloured pencils and highlighter pens must not be used.
- **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 **on paper**
- You should show sufficient working to make your methods clear. Answers without working may not gain full credit.
- Unless otherwise stated, statistical tests should be carried out at the 5% significance level.
- When a calculator is used, the answer should be given to three significant figures unless otherwise stated.

Information

- **You may use the** booklet 'Statistical Formulae and Tables'
- There are **6** questions in this question paper. The total mark for this paper is **61**
- 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.
- Check your answers if you have time at the end.

AQA_JUNE_2015_6a

A pharmaceutical company developed a new drug that it claimed would alleviate sleep disorders experienced by shift workers.

(a) A trial of this drug was set up and 15 healthy adult volunteers, all of whom had no major sleep disorders, were each given the new drug to take half an hour before their allocated bedtimes. The allocated bedtime for each volunteer was set to be five hours earlier than the regular bedtime for that volunteer.

The time taken to achieve persistent sleep by each of the 15 volunteers was measured. The results, in minutes, are given below.

4.2 7.4 5.0 2.8 7.3 3.5 3.9 7.2 3.6 2.2 3.7 6.5 4.8 5.9 4.1

The median time taken to achieve persistent sleep by healthy adults who have no major sleep disorders and who do not take the drug, when their regular bedtimes are moved earlier by five hours, is known to be 6.5 minutes.

Carry out a Wilcoxon signed-rank test, at the 1% significance level, to investigate whether there is a difference between the median time taken to achieve persistent sleep by healthy adults taking the drug and that for those not taking the drug, when their regular bedtimes are moved earlier by five hours. You may regard the sample of 15 volunteers as a random sample.

[8 marks]

AQA_JUNE_2011_2

The student union of a large sixth form college believed that the average time per week of term that A-level students spent on individual study at home had increased because students were becoming more aware of the need to achieve high grades.

The average time per week of term that students from the college spent on individual study at home during 2009 was 10.8 hours.

A random sample of 10 students from the college was asked to record the time spent on individual study at home for three weeks during November 2010. The average time per week, in hours, for each student was recorded as follows:

17.45 14.65 12.30 11.60 7.10 15.15 16.20 7.60 6.75 8.60

(a) (i) Carry out a Wilcoxon signed-rank test to investigate whether there had been an increase in the average time per week of term spent on individual study at home. Use the 5% level of significance

(9 marks)

(ii) Explain why your conclusion in part (a)(i) might not apply to the average time per week of term spent on individual study at home for all A-level students.

(1 mark)

(b) (i) Give one reason why a Wilcoxon signed-rank test might be preferred to a sign test in carrying out a test similar to the one carried out in part (a)(i).

(1 mark)

(ii) Give an example, in the context of an investigation of the time students spend on individual study at home, where a Wilcoxon signed-rank test would not be valid but a sign test would be valid.

(2 marks)

AQA_JUNE_2009_2

A time of 9 minutes is allocated for the completion of a task on a production line. The staff working on this production line complained to their line manager that the task took longer than the 9 minutes allocated.

The line manager agreed to investigate by taking a sample of 8 measurements of the time taken, in minutes, to complete the task. The times were as follows:

9.5 8.6 9.2 9.6 8.9 9.7 8.4 9.8

(a) Carry out a Wilcoxon signed-rank test, at the 5% significance level, to investigate whether the average time taken to complete the task is greater than 9 minutes. Interpret your conclusion in context.

(9 marks)

(b) State one assumption that should be made for the test in part (a) to be valid.

(1 mark)

AQA_JAN_2012_2

The gross annual salaries for medical specialists working in the EU during 2003 were investigated. The median gross annual salary for medical specialists working in the UK during 2003 was found to be £81 050 .

The gross annual salary, converted into £, for each of 9 randomly selected medical specialists working in France during 2003 was recorded as follows.

63 520 64 600 72 000 58 450 82 200 66 500 86 600 68 200 69 100

(a) Carry out a Wilcoxon signed-rank test, using the 5% significance level, to investigate whether, during 2003, the average gross annual salary for medical specialists working in the UK was greater than that for those working in France.

(8 marks)

(b) State one assumption that is necessary for the test in part (a) to be valid.

(1 mark)

AQA_JAN_2007_1

A psychology student carries out a test on short-term memory. She reads a list of 20 commonly used words to ten 18-year-old females.

Immediately after reading out these 20 words, she asks the females to write down as many of the words from the list as they can remember in 5 minutes. The females may be regarded as a random sample of all 18-year-old females.

The numbers of words remembered by the 18-year-old females were

10 8 5 2 11 6 13 9 14 12

The median number of words remembered by 60-year-old females in this test on short-term memory is known to be 6.

Carry out a Wilcoxon signed-rank test to determine whether there is any support for the claim that the median number of words remembered by 18-year-old females is greater than that for 60-year-old females. Use the 5% level of significance.

(8 marks)

AQA_JUNE_2010_5

Trials were carried out on a new tablet designed to speed pain relief for patients with a bone disease.

(a) A randomly selected sample of patients, all of whom had been experiencing pain because of the bone disease, were given the new tablets. They each measured the waiting time for pain relief after taking a new tablet on waking in the morning.

The times recorded, in minutes, were

47 56 38 43 20 40 57 46 32 25 66 39 44

The average waiting time for pain relief after taking the existing tablet on waking in the morning is 56 minutes.

Carry out a Wilcoxon signed-rank test, at the 1% significance level, to investigate whether the average waiting time for pain relief after taking the new tablet is less than that after taking the existing tablet.

(9 marks)

(b) (i) Give a reason why a Wilcoxon signed-rank test might be preferred to a sign test when carrying out the investigation in part (a).

(ii) Under what conditions would it not be possible to carry out a Wilcoxon signed-rank test but it would be possible to carry out a sign test?

(iii) The standard deviation for the waiting time for pain relief after the new tablet is taken on waking in the morning is known to be 13.3 minutes. It can be assumed that these times follow a normal distribution. State an appropriate test to carry out in order to investigate whether or not the mean waiting time is lower for the new tablet.

(4 marks)