

Please check the examination details below before entering your candidate information

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

**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 8 questions in this question paper. The total mark for this paper is 50.
- 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.

Replication	Paired Comparison
Completely Randomised Design	Randomised Block Design
Randomised Controlled Trial	Blind Trial
Double Blind Trial	Randomisation

Above is a list of experimental designs. Using this list,

- (a) Identify an experimental design which can reduce experimental error. (1)
- (b) Identify an experimental design which can reduce bias. (1)
- (c) Explain the purpose of replication. (1)
- (Total 3 marks)**
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2. A recruitment agency is investigating a new system designed to reduce the average time taken to review curriculum vitae (CVs).
- The agency decides to use 10 experienced employees to review CVs using the existing system and the new system.
- Two strategies for comparing the systems are proposed.
- Strategy 1:** There are two sets of CVs, set A and set B. Each contains the same number of CVs. Each employee reviews set A on the existing system and set B on the new system. The times taken are compared.
- Strategy 2:** There is one set of CVs which each employee reviews once on the existing system and then again on the new system. The times taken are compared.
- State **one** weakness of each of these strategies.
- For **each** weakness, explain why it is a weakness. (4)
- (Total 4 marks)**
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3. A pharmaceutical company wishes to test the efficacy of a new safe vaccine developed to immunise people against a new strain of malaria.

A controlled trial is proposed where the new vaccine is to be tested against a placebo. To test the vaccine using a pilot study, the pharmaceutical company recruits 20 volunteers, *A* to *T*.

The age and sex at birth of each of these volunteers are shown in the table below.

Volunteer	<i>A</i>	<i>B</i>	<i>C</i>	<i>D</i>	<i>E</i>	<i>F</i>	<i>G</i>	<i>H</i>	<i>I</i>	<i>J</i>
Sex at birth	M	M	M	M	M	F	F	M	M	F
Age (Years)	30	54	57	53	32	32	23	62	54	18
Volunteer	<i>K</i>	<i>L</i>	<i>M</i>	<i>N</i>	<i>O</i>	<i>P</i>	<i>Q</i>	<i>R</i>	<i>S</i>	<i>T</i>
Sex at birth	M	M	M	F	F	M	F	F	F	F
Age (Years)	19	73	76	78	75	36	58	67	25	67

Two designs for this investigation are proposed: a completely randomised design and a randomised block design.

- (a) Explain how the pharmaceutical company can allocate the volunteers to the placebo and vaccine such that the experimental design is

(i) a completely randomised design,

(2)

(ii) a randomised block design.

(2)

- (b) Suggest **two** factors that should be considered in order for the experiment to be replicated.

(2)

(Total 6 marks)

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4. James owns a bar in a rural area. He is interested in analysing the trends and patterns in his business over a 6 month period.

Design an experiment for James so he can investigate these trends.

Your answer must include:

- what data he should collect,
- how he should collect it,
- what steps he can take to reduce bias,
- what steps he can take to reduce experimental error.

(6)

(Total 6 marks)

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5. An experimental treatment for Parkinson's Disease has obtained clearance for clinical trials. Patients with Parkinson's volunteer to take part in this clinical trial and is selected for suitability using a predetermined set of criteria.
- The trial is a double blind trial in which the patient selected at random to be in the control group is given a placebo.
- The percentage improvement after four weeks of treatment was assessed and the results were recorded in a spreadsheet.
- (a) Explain, in the context of this question, what is meant by a double blind trial. (2)
- (b) Explain, in the context of this question, the purpose of a double blind trial. (2)
- (c) Identify the control group and the experimental group. (2)
- (d) Explain, in the context of this question, what is meant by a placebo. (2)
- (e) Give an example of a suitable statistical hypothesis test that can be used to analyse these data. State any assumptions about the underlying population required for this test. (2)
- (Total 10 marks)**
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6. A second-hand book dealer decides to find out whether changing his supplier would increase his takings.
- In his first investigation, he used the old supplier one day and the new supplier the next day. Using the old supplier his takings were £265 and with the new supplier they were £411.
- He concluded that changing his supplier would increase his takings.
- (a) Explain why the conclusion drawn from his first investigation may be invalid. (1)

His second investigation took place over two weeks. The supplier was randomly chosen for Week 1, with the other supplier used for Week 2. The results are given in the spreadsheet printout below.

	A	B	C	D	E	F	G	H	I	J	K	L	M
1		<b>Week 1</b>						<b>Week 2</b>					
2	<b>Day</b>	Mon	Tues	Wed	Thur	Fri	Sat	Mon	Tues	Wed	Thurs	Fri	Sat
3	<b>Supplier</b>	Old	New	New	New	Old	New	New	Old	Old	Old	New	Old
4	<b>Takings</b>	£198	£173	£107	£607	£323	£571	£153	£138	£144	£144	£195	£166

- (b) Explain, with reference to his second investigation, what is meant by experimental error. (2)
- (c) Explain, with reference to his second investigation, the advantages of using
- (i) a paired comparison; (2)
- (ii) randomisation. (2)
- (Total 7 marks)**
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7. The following is an extract from an investigation into the effects of a steroid.

*Betamethasone phosphate and hydrocortisone: Only patients with eruptions which might be expected to respond to local steroid therapy were admitted to the trial and all had symmetrical lesions on the limbs.*

*The two steroids were supplied in a water-miscible base and in identical tubes labelled B (blue label) and Y (yellow label). The concentration of hydrocortisone was 1% and that of betamethasone phosphate 0.1%.*

*Only the manufacturer was aware of the identity of the tubes until the trial was completed.*

*The patients were supplied with a tube of each steroid and instructed to apply Y to one limb and B to the other. The side treated with B was selected at random. If all four limbs were involved then B was applied to one upper limb and the contralateral lower limb, thus giving two paired results on one patient.*

*Subjective and objective observations were made from five to ten days after entering the trial. Whenever possible two observers reviewed each patient, and care was taken that the reviewer was not aware of the side of application of B and Y till the assessment had been made.*

[Source: [www.jstor.org/stable/20356369](http://www.jstor.org/stable/20356369)]

- (a) Describe **two** experimental designs used in this experiment. For each design, comment on its purpose.

(4)

- (b) Give **one** potential source of bias.

(1)

(Total 5 marks)

8. The following is an extract from a BBC article in 2018 about standing-desk workers.

*New research suggests that standing desks, which allow employees to alter their position during the day, may boost performance at work.*

*A number of NHS staff were given new desks and set goals for standing time. After a year, researchers found sitting time was reduced by more than an hour a day compared with their colleagues.*

*Employees who reduced time sitting, by using desks that also allowed them to work while on their feet, also said they were less tired and more engaged.*

*The research team, led by Loughborough University and experts from Leicester, assessed 146 mainly sedentary NHS staff.*

*Seventy-seven were put in an intervention group and given height-adjustable workstations – also known as sit-stand desks – while the remaining 69 continued with their standard desks.*

*Working time spent sitting was measured at the start of the study and again three, six and 12 months later. At the start of the study, overall sitting time was 9.7 hours per day.*

*Over the course of the experiment, sitting time was lower by 50.62 minutes per day at three months, 64.4 minutes per day at six months, and 82.39 minutes per day at 12 months.*

*Those who were given sit-stand desks also reported improvements in musculoskeletal problems, according to the research published in the British Medical Journal (BMJ).*

*A questionnaire filled out by the participants also suggested employees who used the sit-stand desks were less anxious and cited an improved quality of life - but no notable changes were found for job satisfaction, cognitive function or sickness absence.*

[Source: <https://www.bbc.co.uk/news/uk-45819203>]

- (a) Explain in the context of this experiment which is the control group and which is the experimental group. (2)
- (b) Explain the meaning and purpose of a blind trial. (2)
- (c) Explain why this experiment cannot be run as a blind trial. (1)
- (d) Give **two** potential sources of bias in this experiment. (2)
- (e) State **one** blocking factor used in this experiment. (1)
- (f) Suggest **one** hypothesis test which could have been used to analyse the results. (1)

(Total 9 marks)

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**TOTAL FOR PAPER: 50 MARKS**