Pearson Edexcel

Mark Scheme (Topic Test)

Experimental Design

Pearson Edexcel GCE
In Statistics (9ST0)

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General Marking Guidance

Total marks

The total number of marks for the paper is 80.

Mark types

The Edexcel Statistics mark schemes use the following types of marks:

- **M** **Method** marks,
  awarded for 'knowing a method and attempting to apply it',
  unless otherwise indicated.
- **A** **Accuracy** marks can only be awarded if the relevant method (M) marks have been earned.
- **B** **Unconditional accuracy** marks are independent of M marks
- **E** **Explanation** marks

NOTE: Marks should not be subdivided.

Abbreviations

These are some of the marking abbreviations that will appear in the mark schemes.

- ft follow through
- PI possibly implied
- cao correct answer only
- cso correct solution only
  (There must be no errors in this part of the question)
- awrt answers which round to
- awfw answers which fall within (a given range)
- SC special case
- nms no method shown
- oe or equivalent
- dep dependent (on a given mark or objective)
- dp decimal places
- sf significant figures
- ✱ The answer is printed on the paper

Further notes

- All candidates must receive the same treatment. Examiners must mark the first candidate in exactly the same way as they mark the last.
- Mark schemes should be applied **positively**. Candidates must be rewarded for what they have shown they can do rather than penalised for omissions.
- Examiners should mark according to the mark scheme not according to their perception of where the grade boundaries may lie.
- There is **no ceiling** on achievement. All marks on the mark scheme should be used appropriately.
- All the marks on the mark scheme are designed to be awarded. Examiners should always award full marks if deserved, i.e. if the answer matches the mark scheme. Examiners should also be prepared to award zero marks if the candidate's response is not worthy of credit according to the mark scheme.
- Where some judgement is required, mark schemes will provide the principles by which marks will be awarded and exemplification may be limited.
- When examiners are in doubt regarding the application of the mark scheme to a candidate's response, the team leader must be consulted.
- All A marks are 'correct answer only' (cao), unless shown, for example, as A1ft to indicate that previous wrong working is to be followed through.
- All M marks are 'possibly implied' (PI) unless specifically stated otherwise in the 'Notes' column.
- After a **misread**, the subsequent A marks affected are treated as A1ft, but manifestly absurd answers should never be awarded A marks.
- **Crossed out** work should be marked UNLESS the candidate has replaced it with an alternative response.
- If **two solutions** are given, each should be marked, and the resultant mark should be the mean of the two marks, rounded down to the nearest integer if needed.

Question	Scheme	Marks	AO	Notes
1(a)	Paired Comparison			
	Randomised Block Design			
		B1	1.1	Either
1(b)	Randomisation			
	Completely randomised design			
	Randomised controlled trial			
	Randomised block design			
	Blind Trial / Double blind trial			
		B1	1.1	Any
1(c)	To estimate the size of experimental error			
	To investigate whether the results of the original investigation are valid			
	To build confidence in the results of the original investigation			
		B1	1.1	Any
	Total	**3**		

Question	Scheme	Marks	AO	Notes
2	**Possible weaknesses** *Reasons why it is a weakness*			
	Strategy 1			
	Sets of CVs are not randomised *This means there may be bias arising from one set of CVs being easy to review*			
	No pairing/blocking *Any difference in times may be due to the differences in CVs, not systems*			
		B1	2.1b	Any weakness
		E1dep	3.1a	Sensible reason about weakness Dependent on previous B1
	Strategy 2			
	The order of reviewing systems is not randomised *An employee reviewing a CV under one system may be familiar with the CV already and may be quicker*			
	The CVs are subject to order bias / the CVs have already been seen once *Since the CVs have been processed once, it is likely that it would be quicker to process the same set of CVs the second time*			
		B1	2.1b	Any weakness
		E1dep	3.1a	Sensible reason about weakness Dependent on previous B1
	Total	**4**		

Question	Scheme	Marks	AO	Notes
3(a)(i)	**Randomly assign** each volunteer to the placebo or vaccine group…	E1	2.1b	Random assignment
	…by assigning each a random integer 0 or 1 / putting names into a hat / using a coin flip	E1	2.1b	Details of sensible random process May be awarded in (a)(ii)
3(a)(ii)	Block by age / sex at birth	E1	2.1b	Sensible blocking factor
	Once volunteers are blocked, randomly assign each volunteer to either the placebo or the vaccine group	E1	2.1b	Any details of random process may be seen here for second E1 in (a)(i)
3(b)	**Possible replication factors (not exhaustive)**			
	All volunteers should be healthy			
	All volunteers should not have had malaria before			
	The number of males and females in each group should be kept the same			
	The ages of volunteers should be similar / the same			
		E1, E1	2.1b, 2.1b	Any two reasonable factors
	Total	**6**		

Question	Scheme	Marks	AO	Notes
4	**Possible data to be collected (not exhaustive)**			
	The number of customers who come to the bar			
	The amount spent by customers at the bar			
	The types of drink bought by customers			
	The type of food bought by customers			
	The type of customers who spend money (local, non-local etc.)			
		E1	1.1	Any data relating to a rural bar business
	Possible data collection methods (not exhaustive)			
	Count the number of transactions every day			
	Record the amount spent every day			
	Look at the stock levels / changes every day			
		E1	1.1	Any reasonable data collection method over a specified timeframe
	Steps to reduce bias (not exhaustive)			
	Randomise the marketing/advertising over the 6 months			
	Employ several people to collect the data			
	Ensure the people who collect the data are not involved with the analysis (removes cognitive bias)			
		E1, E1	1.1, 1.1	Any two reasonable steps to reduce bias
	Steps to reduce experimental error (not exhaustive)			
	Keep the marketing/advertising the same over 6 months			
	Keep the menu/prices the same over 6 months			
	Keep the staff / service policies the same over 6 months			
		E1, E1	1.1, 1.1	Any two reasonable steps to reduce experimental error
	Total	**6**		

Question	Scheme	Marks	AO	Notes
5(a)	Where neither the patients nor the people administering the treatment are aware which group the patient has been allocated to	E1	1.1	Double blind trial explained. No context required
		E1	1.1	Full context
5(b)	The double blind trial reduces bias…	E1	3.1a	Reduces bias
	…arising from the **expectations** of both **the patients** and the **people administering the treatment**	E1	3.1a	Context oe
5(c)	The control group are the patients who have been assigned to the placebo	E1	1.1	Context required
	The experimental group are the patients who have been assigned to the experimental treatment	E1	1.1	Context required
				Groups must be correctly identified
5(d)	A placebo looks like the true treatment but has no effect on the results of the experiment…	E1	1.1	
	…such as a dummy pill / injection of inert chemicals	E1	1.1	Reasonable example of a placebo
5(e)	**Possible test** *Assumptions required*			
	Wilcoxon Rank-Sum Test *Two independent populations with similar shapes*			
	Two-Sample *t*-Test *Two independent normal populations with unknown but equal variances*			
	Two-Sample *z*-Test *Two independent populations such that each population is* *- normal with a known variance, or* *- sampled with a large sample*			
		B1	1.3	Correct independent sample hypothesis test
		E1dep	1.3	Correct assumptions for their hypothesis test Dependent on B1
	Total	**10**		

Question	Scheme	Marks	AO	Notes
6(a)	The results are based on a sample of 1 (pair of days) so may not be valid			
	Any differences in takings may be due to the particular days the data were collected, not the difference in suppliers			
		E1	3.1a	Either
6(b)	Any **variation** in results due to an **external/confounding factor**…	E1	1.1	
	…such as weather / traffic / footfall etc.	E1	1.1	Any reasonable factor not accounted for which may affect takings
6(c)(i)	Reduces **experimental error**…	E1	1.1	
	…arising from the differences between days	E1	1.1	
6(c)(ii)	Reduces **bias**…	E1	1.1	
	…arising from the difference between weeks / the order in which the suppliers were used	E1	1.1	
	Total	**7**		

Question	Scheme	Marks	AO	Notes
7(a)	**Possible experimental designs** *Purpose*			
	Double Blind Trial *To reduce bias arising from the expectations of the patients and the researchers*			
	Pairing/Blocking *To reduce the experimental error arising from the differences in the side of the body*			These may be combined for B1B1E1E1 as Randomised Block Design
	Randomisation *To reduce the bias arising from the differences in the sides*			
	Replication *To estimate the size of experimental error arising from the observers review*			
		B1, B1	1.1, 1.1	Any two of the above experimental designs
		E1dep, E1dep	1.1, 1.1	Any two associated purposes in context Each E1 dependent on previous B1
7(b)	**Possible sources of bias (not exhaustive)**			
	Patients each apply the steroid to themselves			
	Some observations are subjective (opinion-based)			
	Only patients with eruptions which might be expected to respond to the treatment were used			
	Only patients with symmetrical lesions on the limbs were used			
		E1	1.1	Any potential source of bias
	Total	**5**		

Question	Scheme	Marks	AO	Notes
8(a)	The control group are the workers who were allocated to their standard desks	B1	1.1	
	The experimental group are the workers who were allocated to the sit-stand desks	B1	1.1	
				Groups must be clearly identified
8(b)	A blind trial is where the workers are unaware which group they have been allocated to	B1	1.1	
	This is to **reduce** the **bias arising from** the **expectations** of the workers	E1	1.1	
8(c)	The workers will be working at a desk and will know if it is their standard desk or a sit-stand desk	E1	3.1a	
8(d)	**Possible sources of bias (not exhaustive)**			
	Only NHS staff were used			
	Only mainly sedentary staff were used			
	Some results are from questionnaires which rely on self-reporting			
	All experts came from the same team			
		B1, B1	1.1	Any two sensible sources of bias
8(e)	Time point (3 months/6 months/12 months)	B1	1.1	
8(f)	Wilcoxon Rank-Sum Test			
	Two-Sample *t* or *z* test			
	(One-Way / Two-Way) ANOVA			
		B1	1.3	Any valid test for at least 2 groups, with or without blocking
	Total	**9**		