Mark Scheme (Results)

June 2025

Pearson Edexcel GCE
In Statistics (9ST0)
Paper 03: Statistics in Practice

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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.

9ST0_03 – Mark scheme

Question	Scheme	Marks	AO	Notes
1(a)(i)	$X \sim \text{Po}(86)$	M1	1.2	OR $X \sim B\left(365, \frac{86}{365}\right)$
	$\text{P}(X \geq 90) = 0.347$	A1	1.2	P($X \geq 90$) = 0.33-0.34
1(a)(ii)	$X \sim \text{Po}(172)$	M1	1.2	OR $X \sim B\left(730, \frac{86}{365}\right)$
	$\text{P}(X \leq 160) = 0.191$	A1	1.2	P($X \leq 160$)=0.15-0.16
1(b)	**For all responses** Hail days must be independent of each other	E1	2.1a	
	May not be appropriate because if it hails on one day it may be more likely to hail on the next day	E1dep	2.1b	Dependent on first E1
	For Poisson distribution in (a) Hail days must occur at a constant average rate	E1	2.1a	
	May not be appropriate because there may be times of the year when hail days are more likely	E1dep	2.1b	Dependent on 3rd E1
	For Binomial distribution in (a) The probability that a hail day occurs must be constant	(E1)	(2.1a)	
	May not be appropriate because there may be times of the year when hail days are more likely	(E1dep)	(2.1b)	(Dependent on 3rd E1)
	OR Fixed number of days in a year Is not appropriate because leap years have more days			
	Total	**8**		

Question	Scheme	Marks	AO	Notes
2(a)	$H_0: \eta_d = 0$ $H_1: \eta_d \neq 0$ Where d = France – Ireland	B1	1.3	Oe
	+, +, -, -, +, +, + (or reversed)	M1	1.2	Attempt to find signs
	$X \sim B(7, 0.5)$	M1	1.2	Use of B(…,0.5)
	$P(X \leq 2) = 0.227$	A1	1.2	Awfw 0.226 ~ 0.228
	0.227 > 0.025 Do not reject H_0.	M1	2.1b	oe
	There is not significant evidence to claim that there is a difference between the **average** number of visitors to the UK from France and from Ireland	E1dep	2.1a	Dependent on p-value and correct comparison both being correct Conclusion must be in context and not definite
2(b)	Pairing reduces experimental error	E1	3.1a	
	Due to which quarters are selected	E1	3.1a	Or an example of how non-pairing could affect the outcome

Question	Scheme	Marks	AO	Notes
2(c)	Using out of data/older data is no longer relevant to future use **Possible suggestions (not exhaustive)** Trends in visitor numbers will change over time due to higher costs of living Visitor numbers may have been affected by major events since 2019 Tastes in products/services may have changed	E1 E1dep		A reasonable contextual example must be given
	Total	**10**		

Question	Scheme	Marks	AO	Notes
3(a)	Any two from: It is not possible to find a midpoint for greater than 360 The midpoint for 0 to 180 is unlikely to represent the average of this group of runners. The groups overlap It would only be an estimate as we don't have the raw data	E1, E1	1.1	Any two correct responses
3(b)	H_0: A normal distribution is a suitable model for the times H_1: A normal distribution is not a suitable model for the times	B1	1.3	Oe
	$X \sim N(265.87, 72.18^2)$ $P(X < 180) = 0.117$ $P(180 < X < 210) = 0.102$ $P(210 < X < 240) = 0.141$	M1	1.3	Use of normal distribution seen or used
	$P(240 < X < 270) = 0.163$ $P(270 < X < 300) = 0.159$ $P(300 < X < 360) = 0.222$ $P(X > 360) = 0.0961$	M1	1.3	Obvious attempt to calculate probabilities for each interval
	Expected values 17.6, 15.4, 21.1, 24.4, 23.9, 33.3, 14.4	M1	1.3	Multiply each probability by 150

3(b)	$\frac{(12-17.6)^2}{17.6} = 1.76$ $\frac{(22-15.4)^2}{15.4} = 2.88$ $\frac{(35-21.1)^2}{21.1} = 9.18$ $\frac{(24-24.4)^2}{24.4} = 0.01$ $\frac{(18-23.9)^2}{23.9} = 1.44$ $\frac{(25-33.3)^2}{33.3} = 2.07$ $\frac{(14-14.4)^2}{14.4} = 0.01$	M1	1.3	Attempt to use $\frac{(O-E)^2}{E}$
		M1	1.3	Addition of their contributions
	TS = 1.76 + 2.88 + … = 17.4	A1	1.3	awfw 17~18
	Df = 4	M1	1.3	**their** k-3 df correct cv implies 4df
	CV = 9.488	A1	1.3	p = 0.00165 implies correct TS and Df
	17.4 > 9.488 Reject Ho	M1	2.1b	Or p-value compared to 0.05
	There is significant evidence to say that the normal distribution is not a suitable model for the times in the men's race in the London Marathon 2022			

3(c)	$H_0: \mu_{\text{London}} = \mu_{Berlin}$ $H_1: \mu_{\text{London}} < \mu_{Berlin}$	B1	1.3	oe. Subscripts must be clearly defined
	$ts = \frac{(265.87-272.82)-0}{\sqrt{\frac{72.18^2}{150}+\frac{73.24^2}{150}}}$	M1	1.3	Difference of means in numerator
		M1	1.3	Sum of variances in denominator
	$= (\pm)0.828$	A1	1.3	AWRT 0.83 or p = 0.204
	cv = $(\pm)1.6449$	B1	1.3	0.204>0.05 implies correct cv
	0.828 < 1.6449 Do not reject Ho	M1	2.1b	
	There is not significant evidence to claim that the **mean** completion time for the men's London Marathon is shorter than that for the men's Berlin Marathon	E1dep	2.1a	
ALT 3(c)	$H_0: \mu_{London} = \mu_{Berlin}$ $H_1: \mu_{London} < \mu_{Berlin}$	(B1)	1.3	**Oe** **Subscripts must be clearly defined**
	ts=272.82-265.87=6.95	(M1)	1.3	**PI**
	Evidence of using inverse normal to find cv with a mean of 0 and two tails $\sqrt{\frac{72.18^2}{150}+\frac{73.24^2}{150}} = 8.396$ or $\frac{72.18^2}{150}+\frac{73.24^2}{150} = 70.494$	(M1) (A1)	1.3 1.3 1.3	
	$cv = 0 \pm 1.6449 \times 8.396 = \pm 13.81...$	(B1)	2.1b	**Awrt 13.8** **p = 0.204**

	$6.95 < 13.8$ Do not reject H_0 There is not significant evidence to claim that the **mean** completion time for the men's London Marathon is shorter than that for the men's Berlin Marathon	(M1) (E1dep))	2.1a	0.204>0.05 implies correct cv
3(d)	Samples were large So the Central Limit Theorem (CLT) applies	E1 E1	3.1a 3.1a	oe.
	Total	**21**		

Question	Scheme	Marks	AO	Notes
4(a)	Quota or Judgemental	B1	1.1	Either Allow: Stratified random sampling
4(b)	$2103 - 547 - 925 = 631$ $\frac{631}{2103} = 0.3(00)$	B1	1.1	AG
4(c)	Each voter is independent of the others The probability that a voter intends to vote for other parties is the same for all voters	B1 B1	2.1a 2.1a	Assumptions must be given in context
4(d)	$X \sim$ B(50, 0.3) P($X > 20$) = 0.0478	M1 A1	2.1a 1.2	
4(e)	$\mu = 500 \times 0.3 = 150$ $\sigma^2 = 500 \times 0.3 \times 0.7 = 105$ $(\sigma = 10.247\ldots)$ $X \sim \mathrm{N}(150, 105)$ P($X \geq 170.5$) 0.0227	B1 B1 M1 A1	1.1 1.1 1.2 1.2	 Continuity correction awrt 0.023
4(f)	It is very unlikely that you would see as many as 171 voters for other parties in a sample of 500 if the proportion is 0.3 Therefore this sample provides some evidence to say that the true proportion may not be 0.3	E1 E1	2.1b 2.1a	
	Total	**12**		

Question	Scheme	Marks	AO	Notes
5(a)	"Blinding" patients stops their expectations affecting the outcome of the trial	E1	3.1b	Oe.
5(b)	$\bar{x} = \frac{47}{10} = 4.7$	B1	1.2	cao
	$s = \sqrt{\frac{1}{10-1}\left(233 - \frac{47^2}{10}\right)}$ $s = 1.16$	M1 A1	1.2 1.2	use of formula for s
	$4.7 \pm 2.262 \times \frac{1.16}{\sqrt{10}}$	M1	1.3	use of $1.16/\sqrt{10}$
	$(3.87, 5.53)$	B1 A1	1.3 1.3	$t_9 = 2.26(2)$ awrt (3.9, 5.5)
5(c)	Otherwise the selection is subject to the bias of the person picking the patients If it's not random then the epidemiologist could pick only patients suffering with the worst/best symptoms Sample must be random for the conclusions/inferences to be valid	E1	3.1b	Any sensible reason
5(d)	4.2 lies within the confidence interval	B1ft	2.1b	oe comparison of 4.2 with their confidence interval
	… so there is not enough evidence to suggest that the European Medicines Agency's claim is incorrect	E1dep	2.1a	oe dependent on previous B1

5(e)	$s^2 = \frac{(10-1)\times 1.16^2 + (8-1)\times 1.05^2}{10+8-2}$ 1.24 to 3sf.	B1*	1.1	AG
5(f)	$d = \frac{5.3-4.7}{\sqrt{1.24}} = 0.5388$ Medium effect	B1 B1dep	1.2 2.1a	awrt 0.539 Dep on first B1
5(g)	0.136 is still reasonably likely that the population means are the same The hypothesis test that the epidemiologist carried out did not show sufficient evidence for a difference in the mean time between the placebo and the medicine However Cohen's d (0.49) shows a medium effect or 0.6 (the difference between the two sample means) of a day is only around 14 hours The sample size is small or Giving patients a medicine is potentially expensive or If the effect is only a medium one then it may not be cost effective	E1 E1 E1 E1	2.1a 3.1b 3.1b 3.1b	May compare to some significance level Comment on hypothesis test Comment about effect size Practical consideration
5(h)	Collect data so that effects of the drug on age/obesity/sex etc. could be investigated Take a larger sample	E1 E1	3.1a 3.1a	
	Total	**19**		

Question	Scheme	Marks	AO	Notes
6(a)	**Possible suggestions (not exhaustive)** Location Current population of badgers in the area Time of year Weather/climate	E1, E1	2.1b	Any two sensible comments
6(b)	**Possible suggestions (not exhaustive)** To explain the reasoning behind their approach So they don't go "off track" during their experiment So they don't change their methods to fit the data	E1, E1	3.1a	Any two sensible comments
6(c)(i)	Type II error	B1	1.1	
6(c)(ii)	Increase the significance level Increasing sample size Using a more powerful test Increase the probability of a Type I error	B1	1.1	Any of these

6(d)	The conclusion is about the whole of the UK whereas the data was only collected in a small number of areas of the country The data is recorded during two consecutive months of the year, so no observations are made for 10 months. There may be reasons why more or fewer male/female badgers can be observed at different times of year, such as pregnancy, nursing, torpor, etc. So the conclusion is too strong for the way that the data was collected	E1 E1	3.1b 3.1b	
6(e)	**Possible suggestions (not exhaustive)** Survey more areas of the country Survey over a longer period of time/for a wider variety of times Survey cubs born rather than overall population			Any sensible suggestions
		E1, E1	3.1a	
	Total	**10**		

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