Mark Scheme (Results)

Autumn 2020

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General Marking Guidance

Total marks

The total number of marks for the paper is 60.

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.
- 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	H_0: (Population) median Paper 1 score = (population) median Paper 2 score H_1: (Population) median Paper 1 score ≠ (population) median Paper 2 score	B1	1.3	oe **Accept** $\eta_1 = \eta_2$ etc
	Differences			
	<table><tr><td>**District**</td><td>**Differences**</td></tr><tr><td>A</td><td>-10</td></tr><tr><td>B</td><td>-2</td></tr><tr><td>C</td><td>1</td></tr><tr><td>D</td><td>-5</td></tr><tr><td>E</td><td>4</td></tr><tr><td>F</td><td>-7</td></tr><tr><td>G</td><td>-8</td></tr><tr><td>H</td><td>3</td></tr><tr><td>I</td><td>-1</td></tr><tr><td>J</td><td>-2</td></tr></table>	M1	1.3	Effort to find differences Accept ±
	Rank table:			
	<table><tr><td>**District**</td><td>**+**</td><td>**-**</td></tr><tr><td>A</td><td></td><td>10</td></tr><tr><td>B</td><td></td><td>3.5</td></tr><tr><td>C</td><td>1.5</td><td></td></tr><tr><td>D</td><td></td><td>7</td></tr><tr><td>E</td><td>6</td><td></td></tr><tr><td>F</td><td></td><td>8</td></tr><tr><td>G</td><td></td><td>9</td></tr><tr><td>H</td><td>5</td><td></td></tr><tr><td>I</td><td></td><td>1.5</td></tr><tr><td>J</td><td></td><td>3.5</td></tr></table>	M1	1.3	Ranking their differences, smallest mod value with rank 1
	Sum of + ranks (and sum of – ranks)	M1	1.3	PI Attempt to sum ranks
	ts: $T = 12.5$ (or $T = 42.5$)	A1	1.3	cao for either correct

Question	Scheme	Marks	AO	Notes
1 (cont)	cv = 8 (or 47)	B1	1.3	
	$12.5 > 8$ (or ts > cv) **or** $42.5 < 47$ (or ts < cv) so do not reject H_0	B1dep	2.1b	Comparison of ts and cv in **same tail** **or** correct conclusion PI
	There is insufficient evidence to suggest that there is any difference in difficulty between Paper 1 and Paper 2.	E1dep	2.1a	Must be in context. Must not be definite in conclusion. Dep on ts and cv both correct
	Total	**8**		

Question	Scheme	Marks	AO	Notes
2	**Unlikely to be representative**			
	Question 1 has restricted options. There is no way for people to say they disliked the Prom Party plans…			
	…so people who disapprove of the Prom Party plans are unlikely to finish the survey, (causing bias).			
	Both questions are leading questions, (which may lead to bias).			Accept separate comments on positive language (wonderful) for Prom Party, and negative language (obstructing) for Star Prom.
	The sample of responses is voluntary, so it is unlikely to be representative.			
	Students from other years may pick up and complete the survey.			Indication that someone not in year 11 could complete the survey
	Not all year 11 students may use the school entrance regularly.			
	Students who are late may rush into school and miss the survey, so the sample obtained will probably not be representative of the whole group.			

Question	Scheme	Marks	AO	Notes
2 (cont)	**Likely to be representative**			
	Accessible to all year 11 students in the survey.			
		E1, E1, E1, E1	3.1a, 3.1a, 3.1a, 3.1a	E1 for each sensible comment (max E4)
	Total	**4**		

Question	Scheme	Marks	AO	Notes
3(a)	The heights of the bars alternate between two distinct curves.	E1	1.1	**or** any mention of full and half-sizes. oe
	Not all shoes are made in half size so fewer of these sizes are likely to be sold.	E1	2.1a	
3(b)	Normal distribution (with continuity correction)…	E1	2.1a	condone Binomial
	…for whole sizes, and a separate (normal) distribution for half sizes.	E1	2.1a	Separate distributions for whole and half sizes
	(The normal distribution is suitable as) the curves are bell-shaped.	E1	2.1a	
3(c)	$\dfrac{2\,250\,000}{127\,500\,000} = \dfrac{2.25}{127.5}$	M1	1.2	PI Attempt at proportion, denominator must be correct.
	$= 0.0176$	A1	1.2	awfw 0.015~0.02

Question	Scheme	Marks	AO	Notes
3(d)	**Possible reasons**			
	(e.g.) Women who have smaller feet may buy fewer pairs of shoes than other women.			Some sensible consideration that some women (with a certain sized foot) may buy more or fewer pairs of shoes than other women.
	The pattern may be different for shoes bought in other years.			
	Some young girls may wear size 3 women's shoes.			
	Some who bought a size 3 shoe may usually wear a size 2.5 or 3.5 shoe.			
		E1	2.1b	
3(e)	Approximate female population = $\dfrac{2500}{2} = 1250$	B1	1.2	PI This may be sensibly rounded down to account for young girls etc awfw 900~1300
	$0.0176 \times 1\,250$	M1ft	1.2	PI Their (c) × their B1 (or 2 500)
	$= 22.1$ (3 s.f.)	A1	1.2	awfw 13.5~26

Question	Scheme	Marks	AO	Notes
3(f)	There are likely to be many women in the town with feet that fit in the glass slipper…	E1	3.1a	
	…so this method is unlikely to uniquely identify Cinderella.	E1dep	3.1a	**or** Prince Charming's method is not effective. Dep on previous E1
	Total	**13**		

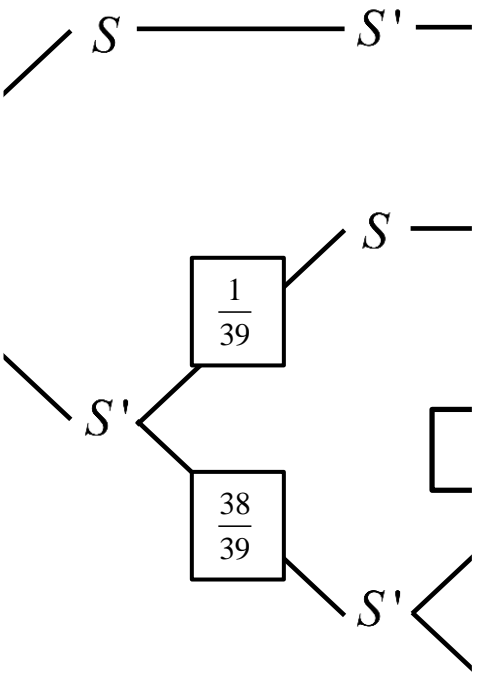| Question	Scheme	Marks	AO	Notes
4	**Possible criticisms**			
	[Sampling]			
	• The sample includes the whole population (so the test may be invalid).			
	• The sample is not random.			
	[Assumptions]			
	• The data may not be bivariate normal.			Accept either variable may not be normally distributed
	• There may be a nonlinear relationship between the variables.			
	• The data may have outliers.			
	• Qualifications or populations may not be mutually exclusive			
	[Effect size]			
	• The size of the coefficient is close to 0, indicating a very weak correlation (if any).			
	[Motivation]			
	• (As no practical explanation is given for why these variables may be associated) the correlation may be spurious.			

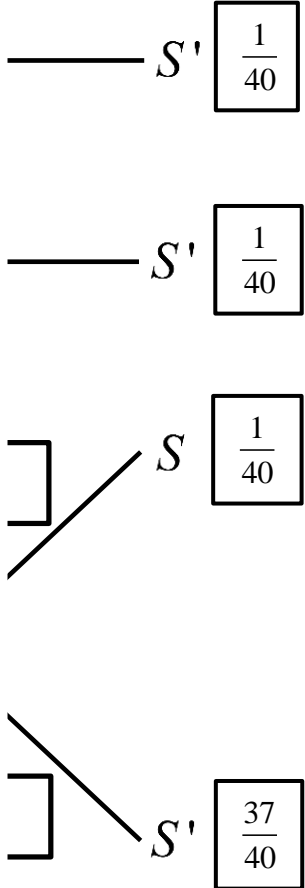| Question	Scheme	Marks	AO	Notes
4 **(cont)**	• The comparison of these two variables is fairly meaningless.			No sensible practical application. **or** Sharon's choice of variables is very random. **or** We have no reason for why she has chosen these and have no hypotheses as to what she is investigating.
	[Conclusion]			
	• The conclusion is too definite; this is only evidence towards a conclusion.			
	• You cannot have an association between **populations**, only between **variables**.			**or** Sharon has written 'populations' instead of 'proportions'.
	• The conclusion does not state what kind of association (positive or negative).			
	• The conclusion is only valid on the population divided **by district**. (Population divided by other strata may give different conclusions.)			
		E1, E1, E1, E1	3.1a, 3.1a, 3.1a, 3.1b	E1 for each sensible criticism (max E4)
	Total	**4**		

Question	Scheme	Marks	AO	Notes
5(a)	**Assumptions:**			
	The probability of a win by the home team is constant.			
	The results of individual matches are independent (of one another).			
	There are only two outcomes, home team wins, or home team does not win.			**Accept:** Home team loses.
		E1, E1	2.1b, 2.1b	E1 for each assumption (max E2)
5(b)(i)	**Winner of the toss**			
	Fewer than half of the matches were won by the winner of the toss, (so evidence suggests that winning the toss does not give an advantage)	E1	2.1b	**or** $480 < 500$ seen
5(b)(ii)	**Second batting team**			
	[X_1 = number of home-team wins] [$X_1 \sim B(1000, p)$]			
	H$_0$: $p = 0.5$ H$_1$: $p > 0.5$	B1	1.3	May be instead awarded in (iii)
	$P(X_1 \geq 522)$	M1	1.3	May be instead awarded in (iii)
	$= 0.0869$ (3 s.f.)	A1	1.3	awrt
	[> 0.05]			
	so there is insufficient evidence to suggest that batting second gives an advantage.	E1	2.1a	

Question	Scheme	Marks	AO	Notes
5(b)(iii)	**Home team**			
	[X_2 = number of home-team wins] [$X_2 \sim B(1000, p)$]			
	H$_0$: $p = 0.5$ H$_1$: $p > 0.5$			B1 may be awarded here if not awarded in (ii).
	$P(X_2 \geq 576)$			M1 may be awarded here if not awarded in (ii).
	$= 8.60 \times 10^{-7}$ (3 s.f.)	A1	1.3	awrt =0.000 000 860
	[< 0.05]			
	so there is evidence to suggest that playing at home does give an advantage.	E1	2.1a	
5(c)	**Constant p**			
	This is unlikely to be valid…			
	…as some teams have better players than others.			oe
	Independence			
	This is unlikely to be valid…			
	…as if one team wins most matches in the past, they are more likely to win future matches.			or similar Be generous

Question	Scheme	Marks	AO	Notes
5(c) (cont)	**Two outcomes**			
	This is valid…			
	…as the options are 'win' or 'not win'.			**or** only matches with a winner have been selected.
		E1, E1, E1	3.1a, 3.1a, 3.1a	E1 for (at least) one correct decision: valid/not valid. E2 for one correct decision with valid reason. E3 for two correct decisions, each with a valid reason.
	Total	**12**		

Question	Scheme	Marks	AO	Notes
6(a)	(It is preferable to use sampling) without replacement…	E1	2.1b	
	…as viewers will not want to watch the same advertisement twice (in a single break).	E1	2.1a	
6(b)	$\dfrac{25\,000}{1\,000\,000}$	B1	1.2	Clear method shown
	$=\dfrac{1}{40}$			Answer given
6(c)	40	B1	1.2	cao
6(d)	If the company's advertisement is selected first or second (S), then it is guaranteed not to be picked afterwards (S').	E1	1.1	oe
6(e)		B1ft	1.1	oe Their (b) in top box **and** $1 - $ (b) in bottom box

Question	Scheme	Marks	AO	Notes
6(e) (cont)	First advertisement — Second advertisement S —— S' —— S —— $\dfrac{1}{39}$ S' $\dfrac{38}{39}$ S'	M1ft	1.1	Denominators = (Denom in (b) – 1)

Question	Scheme	Marks	AO	Notes
6(e) (cont)	t ·ment **Second** **advertisement** · ———— S' ———— S ———— $\dfrac{1}{39}$ ' $\dfrac{38}{39}$ $\dfrac{1}{38}$ S' $\dfrac{37}{38}$	A1	1.1	All six probabilities correct.

Question	Scheme	Marks	AO	Notes
6(e) **(cont)**	**Third advertisement** S' $\dfrac{1}{40}$ S' $\dfrac{1}{40}$ S $\dfrac{1}{40}$ S' $\dfrac{37}{40}$	M1ft	1.2	PI Evidence of **multiplying** along branches **Note:** top branch correct is not evidence of M1
		A1	1.2	oe All four correct
6(f)	$\dfrac{1}{40}+\dfrac{1}{40}+\dfrac{1}{40}=3\times\dfrac{1}{40}=1-\dfrac{37}{40}$	M1	1.2	Any of these PI
	$=\dfrac{3}{40}=0.075$	A1	1.2	oe

Question	Scheme	Marks	AO	Notes
6(g)	With replacement:			
	P(Not selected) $= \left(\dfrac{39}{40}\right)^3$ $= 0.9269$	M1	1.2	PI **or** evidence of binomial distribution
	P(Selected at least once) $= 1 - 0.927 = 0.0731$	A1	1.2	awrt 0.073
	It is more desirable to use sampling **without** replacement…	E1	2.1b	
	…as the probability of selection in a single advertisement break is greater.	E1	2.1b	oe
6(h)	[$X = $ Number of times the company's advertisement plays]			
	$X \sim B(7, 0.06)$	M1	2.1a	PI Use of binomial distribution
	$P(X \geq 2)$	M1	1.2	PI
	$= 0.0618$ (3 s.f.)	A1	1.2	awrt
	Total	**19**		