Mark Scheme (Results)

Summer 2019

Pearson Edexcel GCE In Statistics 1
Paper 6683/01

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General Marking Guidance

- 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.
- Crossed out work should be marked UNLESS the candidate has replaced it with an alternative response.

EDEXCEL GCE MATHEMATICS

General Instructions for Marking

1. The total number of marks for the paper is 75.

2. The Edexcel Mathematics mark schemes use the following types of marks:

- **M** marks: method marks are awarded for 'knowing a method and attempting to apply it', unless otherwise indicated.
- **A** marks: Accuracy marks can only be awarded if the relevant method (M) marks have been earned.
- **B** marks are unconditional accuracy marks (independent of M marks)
- Marks should not be subdivided.

3. Abbreviations

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

- bod – benefit of doubt
- ft – follow through
- the symbol $\surd$ will be used for correct ft
- cao – correct answer only
- cso - correct solution only. There must be no errors in this part of the question to obtain this mark
- isw – ignore subsequent working
- awrt – answers which round to
- SC: special case
- oe – or equivalent (and appropriate)
- dep – dependent
- indep – independent
- dp decimal places
- sf significant figures
- * The answer is printed on the paper
- ⌐ The second mark is dependent on gaining the first mark ⌙

4. All A marks are 'correct answer only' (cao.), unless shown, for example, as A1 ft to indicate that previous wrong working is to be followed through. After a misread however, the subsequent A marks affected are treated as A ft, but manifestly absurd answers should never be awarded A marks.

5. For misreading which does not alter the character of a question or materially simplify it, deduct two from any A or B marks gained, in that part of the question affected.

6. If a candidate makes more than one attempt at any question:
   - If all but one attempt is crossed out, mark the attempt which is NOT crossed out.
   - If either all attempts are crossed out or none are crossed out, mark all the attempts and score the highest single attempt.

7. Ignore wrong working or incorrect statements following a correct answer

Question Number	Scheme	Marks
1 (a)	[34 – 8] = **<u>26</u>**	B1 (1)
(b)	**<u>22</u>** (kg)	B1 (1)
(c)	One extra value in each quarter so no change	B1 (1)
		[3]
Notes		
(a)	B1	
(b)	B1	
(c)	B1 for stating "no change" with a suitable reason eg one in each quartile one in each section of the box plot **Do not** accept within the range **or** median, quartiles, max, min stay the same **or** Spread evenly balanced	

Question Number	Scheme	Marks
2. (a)	$10\times0.8 + 5\times3.4 + 5\times4.2 + 10\times0.6 = [8 + 17 + 21 + 6]$ $= \underline{\mathbf{52}}$	M1 A1 (2)
(b)(i)	$\sum fx = 10\times"8" + 17.5\times"17" + 22.5\times"21" + 30\times"6" \ [=1030]$ $\bar{x} =$ 19.807…= awrt **19.8**	M1 A1
(ii)	$\sum fx^2 = 10^2\times"8" + 17.5^2\times"17" + 22.5^2\times"21" + 30^2\times"6" [= 22037.5]$ $\sigma_x = \sqrt{\frac{"22037.5"}{"52"} - ("19.807...")^2}$ or $\sqrt{31.4534...}$ $\sigma_x =$ 5.6083…= awrt **5.61**	M1 M1 A1 (5)
(c)	$Q_2 = [20] + \frac{1}{21}\times5$ allow use of (n + 1) giving $[20] + \frac{1.5}{21}\times5$ = 20.238…= awrt **20.2**	M1 A1 (2)
(d)	e.g. Adam assumed that times in each interval were all at the interval midpoint	B1 (1)
(e)	Adam: – 0.2 or – 0.3 Peta : 0.163 [Different answers suggest not uniform.] Use shorter intervals/ more bars	B1 B1 (2) **[12]**

Notes

(a) M1 for an attempt at freq. density x width : at least 2 correct terms
A1 for 52

(b)(i) M1 for attempt at Σfx with at least 3 correct terms 80, 297.5, 472.5, 180 (ft their frequencies) or $950 < \Sigma fx < 1200$
A1 for awrt 19.8

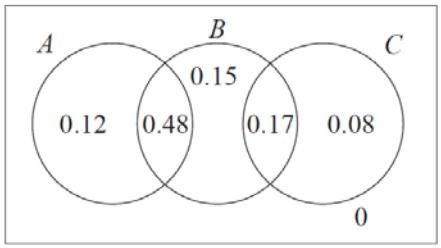
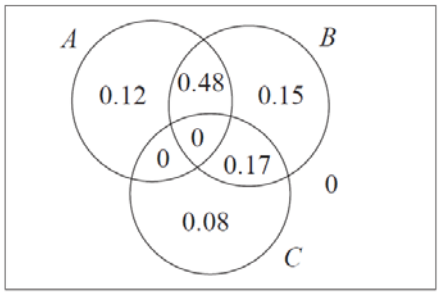
(ii) 1st M1 for attempt at Σfx^2 with $\geqslant$ 3 correct terms 800, 5206.25, 10631.25, 5400 (ft their freq) or $20\,000 < \sum fx^2 < 25\,000$
2nd M1 for a correct expression including $\sqrt{\ }$ (ft their values or allow $20000 < \Sigma fx^2 < 25000$ if no Σfx^2 given)
A1 for awrt 5.61 (allow s = awrt 5.66)

(c) M1 for a correct fraction that would lead to $[20] + \frac{1}{21}\times5$ or $[25] - \frac{20}{21}\times5$ (condone incorrect end point). Allow if method correct for their value of n
A1 for awrt 20.2 (use of (n + 1) awrt 20.4)

(d) B1 for a suitable comment (allow times/data are uniformly distributed/evenly spread [in the interval])

(e) B1 for both correct values (correct signs and correct to 1 sf for Adam and 3sf for Peta)
SC when $n \neq 52$ allow for an expression for Adam or awrt – 0.2 or awrt – 0.3

B1 for a sensible suggestion involving more bars eg group sizes smaller or larger number of time intervals but **do not** accept larger time intervals

Question Number	Scheme	Marks
3. (a)(i)	$\{P(A \cap B)\} = 0.8 \times 0.6 =$	M1
	0.48	A1
(ii)	$\{P(A \cap C) =\}$ **0**	B1
		(3)
(b)	 	B1 M1A1 M1A1 B1 B1
		(7)
(c)	$[P(B \mid C')] = \dfrac{P(B \cap C')}{P(C')} = \dfrac{"0.48"+"0.15"}{1-0.25}$	M1A1ft
	$= \mathbf{0.84}$	A1
		(3)
(d)	$P(B) \times P(C) = 0.2 \neq P(B \cap C)\,["0.17"]$	M1
	[So B and C] are not independent	A1
		(2)
ALT	$P(B) = [0.80] \neq P(B \mid C')$	M1
	So B and C' (and therefore B and C) are not independent	A1
		[15]

Notes

(a)(i) M1 for use of $P(A) \times P(B)$ and at least one correct substitution

(b) 1st B1 for a box and 3 labelled circles and 0 outside the circles

1st M1 for $P(A \cap B)$ = their 0.48 and $P(A \cap B') = 0.6$ – their 0.48

1st A1 for 0.48 and 0.12 correctly placed [If they have an $A \cap C$ then $P(A \cap C)$ must = 0]

2nd M1 for use of the addition rule to get $P(A \cup B)$ and method for $P(C \cap [A \cup B]')$ eg $1-(0.6+0.8-"0.48")$

2nd A1 for 0.08 correctly placed[plus any relevant zeros if required]

2nd B1 for $P(B \cap C) = 0.17$

3rd B1 for 0.15 correctly placed

Examples of Alternatives last 4 marks

3rd B1 0.15 placed correctly
2nd M1 $0.8-"0.48"-"0.15"$
2nd A1 0.17 placed correctly
2nd B1 0.08 placed correctly

2nd M1
$0.8-x+0.25=1-"0.12"$
2nd A1 0.17 placed correctly
2nd B1 0.08 placed correctly
3rd B1 0.15 placed correctly

$x+z=0.8$
M1 for $z+c=0.25$
$x+z+c=0.88$
2nd A1 0.08 placed correectly
2nd B1 0.17 placed correctly
3rd B1 0.15 placed correctly

(c) M1 for a correct ratio expression and either a correct numerator or denominator (ft their VD)

1st A1ft for a correct ratio of probabilities (ft their probabilities from VD)

2nd A1 for 0.84 or any exact equivalent fraction

(d) M1 for a full reason ft their values from VD Must have 0.2, or $P(B) \neq P(B \mid C)$ = "0.68"

$P(B) \times P(C) \neq P(B \cap C)$ is M0

A1 correct conclusion dependent on having correct values used.

Question Number	Scheme	Marks
4. (a)	[J = Journey time] P(J < 20) = $\mathrm{P}\left(Z < \frac{20-25}{6}\right)$ {= P(Z < – 0.833…)}	M1
	= 1 – 0.79767…	M1
	= 0.202328… awrt **0.202 or 0.203**	A1
		(3)
(b)	(1 – "0.202328…")× "0.202328…" ,× 2	M1,M1
	= 0.322783… awrt **0.323**	A1
		(3)
(c)	P($J > m$) = 0.01 $\Rightarrow$ $\mathrm{P}\left(Z > \frac{m-25}{6}\right) = 0.01 \Rightarrow \frac{m-25}{6} = 2.3263$	M1 B1
	m = 38.95808726… awrt **39.0**	A1
		(3)
(d)	More reliable suggests reduction of or smaller standard deviation	B1
		(1)
(e)	[X = new journey time so $X \sim \mathrm{N}(25, \sigma^2)$] P($X > 30$) = 0.15	M1
	$\frac{30-25}{\sigma} = 1.0364$	M1 B1
	σ = awrt **4.8**	A1
		(4)
		[14]

Notes

(a)
1st M1 for standardising with 20, 25 and 6. Accept ±
2nd M1 for attempting $1 - p$ [where $0.5 < p < 0.8$]. Beware 1 – 0.83 (or their z value) is M0
A1 for awrt 0.202 (use of tables awrt 0.203) (Correct ans only 3/3)

(b)
1st M1 for $p(1 - p)$ for any probability p
2nd M1 for 2×a probability such that answer is also a probability
A1 for awrt 0.323 or 0.324 [NB use of 0.202 will give 0.322 and lose this A mark]

(c)
M1 for standardising with m, 25 and 6 and setting equal to a z value $|z| > 2$
B1 for $z = \pm 2.3263$ or better (calculator gives 2.326347877…)
A1 for awrt 39.0 (allow 39 from fully correct working)

Ans only
For answer only in [38.9575, 38.9585] score 3/3 for awrt 38.98 score M1B0A1

(d)
B1 for suitable comment that standard deviation should be smaller

(e)
1st M1 for a suitable probability statement including the 30 and 0.15, may be implied
2nd M1 for standardising with 30, 25 and σ and setting equal to a z value $1 < |z| < 1.5$
B1 for z = 1.0364 or better (calc. 1.0364338…) If B0 for 2.32 or 2.33 in (c) allow awrt 1.04
A1 for awrt 4.8

Ans only
For answer only of awrt 4.82 allow full marks, awrt 4.8 score M1M1B0A1 unless B0 for 2.32 or 2.33 in (c)

Question Number	Scheme	Marks
5. (a)	(Discrete) uniform	B1 (1)
(b)(i)	$P(X \leqslant 2) = 0.5$ [or $\frac{1}{4}+\frac{1}{4}$]	M1
	Probability that no more than 2 on all 3 rolls is $(0.5)^3$ = **0.125** or $\frac{1}{8}$	A1 (2)
(ii)	e.g. sequence 1, 2, 3 probability is $(0.25)^3$ [= 0.015625 or $\frac{1}{64}$]	M1
	4 cases (1, 2, 4 etc) and 6 arrangements so probability = $\frac{1}{64}\times 4\times 6$ or $\frac{1}{4^3}\times 4!$	M1
	= **0.375** or $\frac{3}{8}$	A1 (3)
(c)	**1** 2 **3** **4** 2 2 3 **4** **3** **3** **3** **4** **4** **4** **4** **4**	B2/1/0 (– 1 eeoo) (2)
(d)	m | 1 | 2 | 3 | 4 $P(M = m)$ | $\frac{1}{16}$ | $\frac{3}{16}$ | $\frac{5}{16}$ | $\frac{7}{16}$	M1 A1ft (2)
(e)(i)	$E(M) = \frac{1}{16}[1 + 6 + 15 + 28]$	M1
	$= \frac{50}{16}$ or $\frac{25}{8}$ or 3.125	A1ft (2)
(ii)	$E(M^2) = \frac{1}{16}\left[1+2^2\times 3+3^2\times 5+4^2\times 7\right]$ or $\frac{1}{16}[1+12+45+112]\{=\frac{170}{16}\}$	M1
	$\text{Var}(M) = "\frac{170}{16}" - \left("\frac{50}{16}"\right)^2$	M1
	$= \frac{55}{64}$ or 0.859375	A1 (3)
(f)	Identify the two shaded cases in table of (c) or $\frac{2}{16}\Big/\frac{7}{16}$	M1
	$= \frac{2}{7}$	A1 (2)
		[17]

Notes

(a) B1 for uniform but "continuous uniform" is B0

(b)(i) M1 for correct probability for $P(X \leqslant 2)$

A1 for 0.125 or exact equivalent

(ii) 1st M1 for $\frac{1}{64}$ for any one sequence

2nd M1 for $\times 4$ or $\times 6$ or the 4 possible combinations or 6 arrangements of 1 combination

A1 for 0.375 or any exact equivalent e.g. $\frac{3}{8}$

(c) B2 for all correct, B1 for 8 correct (on epen record as B1B0)

(d) M1 for a correct sample space and at least 2 correct probs (ft their table) Allow numbers not in sample space if prob 0

A1ft for a fully correct ft probability distribution from their table.

(e)(i) M1 for a correct expression using their values

A1ft for any exact equivalent from their dist'

(ii) 1st M1 for any correct expression for $E(M^2)$ using their values

2nd M1 for correct method for Var (M) [ft their values] If $E(M^2)$ not stated then it is M0 unless correct

A1 for any exact form of the answer.

(f) M1 for identifying the two cases in table (c) or a correct ratio of probs (ft their table)

A1 for $\frac{2}{7}$ or any exact equivalent or awrt 0.286 For correct answer only with no working 2/2

Question Number		Scheme	Marks
6.	**(a)**	May be suitable since points lie close to a straight line	B1 (1)
	(b)	$S_{vy} = 16\,475 - \frac{42 \times 2400}{8}$ [= 3875]	M1
		$r = \frac{"3875"}{\sqrt{389\,400 \times 42}}$	M1
		= 0.958184… awrt **0.958**	A1 (3)
	(c)	It is consistent since r is close to 1 (o.e.)	B1 (1)
	(d)	Use line $v = a + by$	M1
		$b = \frac{S_{vy}}{S_{yy}} = \frac{"3875"}{42}$ = [92.2619…]	M1
		$a = \overline{v} - b\overline{y}$ i.e. $a = 300 - "92.26..." \times 5.25 =$ [–184.375...]	M1
		v = – 184.37… + 92.26… y i.e. a = awrt – 184 and b = awrt 92.3	A1
		Let $y = 5$	M1
		v = 276.9345… = awrt **277**	A1 (6)
	(e)	Every extra year of study increases vocabulary by about "92" words	B1ft (1)
	(f)	Model has a poor fit for $y = 2$ (it suggests $v = 0$)	B1
		Suggest a curved model that levels out (or less steep) from 1 to n ($3 < n < 5$)	B1
		Or two lines of different gradients (< 4 and ⩾ 4)(needs to be sketched)	(2)
			[14]

Notes

(a)	B1 for suggesting that it is suitable and providing a suitable supporting statement eg points have a linear relationship. **Do not** allow a line (of best fit) can be drawn or it has a positive correlation. Allow not suitable, a curve would be better with an explanation why a curve would be better.
(b)	1st M1 for a correct expression for Svy (implied by 3875) 2nd M1 for a correct expression for r (ft their 3875 but use of 16 475 is M0) A1 for awrt 0.958
(c)	B1 $0 < r < 1$ for saying it is consistent with suitable reason (e.g. strong (positive) correlation) N**B** must be consistent with (a) so not suitable in (a) means it must be **not** consistent
(d)	1st M1 for selecting the appropriate regression line (implied by equation in form $v = a + by$) 2nd M1 for a correct expression for gradient (ft their 3875 but use of 16 475 is M0) 3rd M1 for a correct method for intercept (ft their gradient) 1st A1 for v = (awrt) – 184 + (awrt) 92.3 y 4th M1 for substituting $y = 5$ in their equation 2nd A1 for awrt 277 (allow 278 if all other marks scored) NB: wrong line y = awrt 2.26 + 0.00995v can get M0M0M0A0M1A1 awrt 275
(e)	B1ft for a comment conveying the idea of increase in words per year and sight of "92" NB using $y = a + bv$ allow the idea of increase in time of "awrt 0.01" years per word learnt
(f)	B1 for identifying model doesn't fit well for eg $y = 2$ suggest v = close to 0 or $v = 80$ y = awrt 2.87 B1 for suggesting some variation … sketch on scatter diagram or axes drawn with curve not crossing horizontal axis or two straight lines different gradients (Allow it going through (0,0))

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