Mark Scheme (Results)

Summer 2017

Pearson Edexcel GCE Mathematics/Further Mathematics

Statistics 1 (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.

PEARSON 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)
   - d… or dep – dependent
   - indep – independent
   - dp decimal places
   - sf significant figures
   - * The answer is printed on the paper or ag- answer given
   - $\lfloor$ or d… 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.

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)	$[S_{wt}] = 784 - \frac{119\times 42}{6} =, \quad \underline{-49}$	A1
	$[S_{tt}] = 2435 - \frac{119^2}{6} =, \quad 74.8\dot{3}$ or $74\frac{5}{6}$ or $\frac{449}{6}$ (accept awrt $\underline{74.8}$)	M1 A1 (3)
(b)	$S_{ss} = 5\times 10^7$ or **50 000 000** (o.e.)	B1
	$S_{st} =$ **– 49 000**	B1ft (2)
(c)	$r = \frac{"-49"}{\sqrt{50\times "74.8\dot{3}"}}$ or $\frac{"-49\,000"}{\sqrt{"5\times 10^7"\times "74.8\dot{3}"}}$ =, –0.80105... = awrt **– 0.801**	M1, A1 (2)
(d)	r is close to – 1 or $\lvert r\rvert$ is close to 1 or "**strong**" (o.e.) [negative] **correlation** … so "**yes**" or **does** support the belief	B1ft (1)
(e)	$b = \frac{"-49"}{"74.8\dot{3}"} = [-0.6547...]$, $a = \frac{42}{6} - b\times\frac{119}{6} = [19.9866...]$ or $a = 7 - b\times 19.8\dot{3}$	M1, M1
	So $\boldsymbol{w = 20.0 - 0.655t}$	A1 (3)
(f)	$\boldsymbol{s = 20\,000 - 655t}$ or $\boldsymbol{c = 20\,000}$ and $\boldsymbol{d = -655}$	B1ft B1ft (2)
(g)	**Decrease** in sales of [£] **655** (ignore any minus sign)	B1ft (1)
		[14]

	Notes
(a)	M1 for a correct expression for S_{wt} or S_{tt} (May be implied by either correct answer) 1st A1 for $[S_{wt}] = -49$ 2nd A1 for $[S_{tt}]$ = awrt 74.8 **SC** If both values correct but clearly mislabelled award M1A0A1
(b)	2nd B1ft for multiplying their S_{wt} by 1000
(c)	M1 for a correct expression using their values provided S_{tt} and S_{ss} both > 0 A1 for awrt – 0.801 (Correct ans. only M1A1, – 0.80 with no working M1A0)
(d)	B1ft for a correct comment that uses their value of r as support, provided $0.5 \le \lvert r\rvert \le 1$ For $\lvert r\rvert < 0.5$ comment must be "does not support", because "weak" (o.e.) correlation. **NB** "points lie close to a straight line" is B0 unless supported by mention of their value of r
(e)	1st M1 for a correct expression for b or awrt -0.66 or -0.65 Ft their answers from (a) 2nd M1 for a correct expression for a ft their value for b A1 for a correct equation in w and t only with $a = 20$ or awrt 20.0 and b = awrt – 0.655 (No fractions) **If their *a* and *b* are given to more than 3 sf, accept answers in (f) to 3sf or better.**
(f)	1st B1 ft for correct c or "their 20.0" $\times 1000$ 2nd B1ft for correct d or their "– 0.655" $\times 1000$ Values can be in an s, t eq'n or $c =$, $d =$ (Their a and b needn't be to 3 sf and ft their letter for t)
(g)	B1ft for stating clearly both decrease (o.e.) and [£] 655. Ft their d and allow "increase" if $d > 0$

Question Number	Scheme	Marks
2. (a)	Width (w) = **4** cm	B1
	Areas: 16 cm^2 represents 32 offices (o.e.) or their $h = \frac{6}{\text{their } w}$ (3sf) or $\frac{8}{3.2}\times 0.6$	M1
	So height (h) = **1.5** cm	A1 (3)
(b)	e.g. $(45)+\frac{20}{25}\times 5$ or $(50)-\frac{5}{25}\times 5$ (o.e.) ; = (£) **49**	M1; A1 (2)
(c)	$\frac{\sum fy}{90}=\frac{4420}{90}$, = (£) **49.11** (or better) (Allow $\frac{442}{9}$ or $49\frac{1}{9}$)	M1, A1 (2)
(d)	$\sqrt{\frac{226687.5}{90}-\bar{x}^2}=\sqrt{106.8487...}$, = 10.3367 = awrt (£) **10.3**	M1, A1 (2)
(e)	Mean ≈ median so distribution is symmetric (no skew or very little skew) [Allow mean > median or $k(\bar{x}-Q_2)$ (k>0) so +ve skew if compatible with their figures] [If using quartiles we must see Q_1 = 44.0 and Q_3 = 55.5 used]	B1ft (1)
(f)	Symmetric (or little skew) so normal (or Rika's suggestion) may be suitable	B1ft (1)
(g)	$\frac{c-50}{10}=0.8416$ [N.B. use of (1 – 0.8416) is B0]	M1, B1
	c = 58.416 = (£) 58.42 awrt **58.4**	A1 (3) **[14]**

	Notes
(a)	M1 for a correct calculation of areas 1 cm^2 = 2 offices (o.e.) A1 for h = 1.5 cm (Correct answer only 2/2)
(b)	M1 for a correct expression without end point. Allow "n + 1" so e.g. $(45)+\frac{20.5}{25}\times 5$ A1 for 49 or, if (n + 1) used, allow 49.1 (Correct answer of 49 only 2/2)
(c)	M1 for an attempt at $\frac{\sum fy}{90}$ with at least 3 correct products of $\sum fy$ or $4000\leq\sum fy\leq 5000$ A1 for 49.11 (Allow 49.1 from correct working) (Correct answer only 2/2, 49.1 only M1A0)
(d)	M1 for a correct expression including $\sqrt{}$, ft their mean. Allow use of s A1 for awrt 10.3 Allow s = awrt 10.4 if clearly used. [NB use of 49.1 gives 10.389 ⇒ A0 (Correct answer of 10.3 with no working is 2/2)
(e)	B1ft for reason and "symmetric" (or other correct) statement [Allow positive skew] Allow ft of their (b) and their (c). For "symmetric" need $\lvert\bar{x}-Q_2\rvert<1$ "correlation" is B0
(f)	B1ft Suggest normal is or isn't suitable **with** suitable reason based on (e) or mean and med
(g)	M1 for stand'ing using "c", 50 and 10 and setting equal to ± z value where $0.84\leq z\leq 0.85$ B1 for using z = ± 0.8416 or better (calc gives 0.8416212…) in standard' attempt e.g. $\sqrt{10}$ for 10 A1 for awrt 58.4 (accept 3sf here) (Ans only of awrt 58.4 is M1B0A1 but 58.416 or better is 3/3)

Question Number	Scheme	Marks
3. (a)	$p = \text{P}(B \cap C) = \text{P}(B) \times \text{P}(C) = 0.6 \times 0.25 = \underline{\underline{\mathbf{0.15}}}$ $q = [\text{P}(C) - p\,] = \underline{\underline{\mathbf{0.10}}}$	M1 A1 (2)
(b)	$r = 1 - 0.08 - [\text{P}(B) + q] = 1 - 0.08 - 0.6 - 0.1$ (o.e.) <u>or</u> $1 - 0.08 - (0.6 + 0.25 - p)$ $= \underline{\underline{\mathbf{0.22}}}$	M1 A1cao (2)
(c)	$s = [\text{P}(A) - r\,] = \underline{\underline{\mathbf{0.28}}}$ $t = [\text{P}(B) - p - s$ <u>or</u> use $\text{P}(B \cap C') - s = 0.6 \times 0.75 - \text{"0.28"}\,] = \underline{\underline{\mathbf{0.17}}}$	B1ft B1ft (2)
(d)	$\text{P}(A) \times \text{P}(B) = 0.5 \times 0.6 = 0.3$ which is <u>not</u> equal to s (= 0.28) So A and B are <u>not</u> independent	M1 A1 (2)
(e)	$\dfrac{(s+p) \text{ or } (0.6-t)}{\text{P}(A \cup C) \text{ or } [\text{P}(A) + \text{P}(C)] \text{ or } (r+s+p+q)} = \dfrac{(\text{"0.28"} + \text{"0.15"}) \text{ or } (0.6 - \text{"0.17"})}{0.5 + 0.25}$ $= \underline{\underline{\frac{43}{75}}}$	M1, A1ft A1 (3)
		[11]

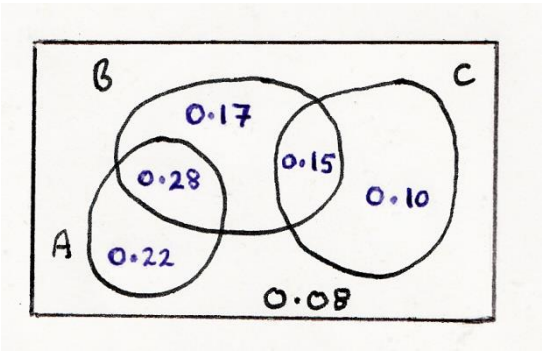
Notes

(a)
M1 for a correct expression (using independence) for p <u>or</u> 0.15
A1 for $q = 0.10$ (both correct 2/2)

Mark (b) & (c) together

(b)
M1 for a correct expression for r using $\text{P}(B \cup C)$. Can ft their $q \in [0, 0.32]$
A1cao for $r = 0.22$ (correct ans only 2/2)

(c)
1st B1ft for $s = 0.28$ <u>or</u> 0.5 – their "0.22"
2nd B1ft for $t = 0.17$ <u>or</u> 0.6 – their "0.15" – their "0.28"



Fully correct Venn diagram will score the first 6 marks
If text and VD disagree use <u>text</u> values

ALT **Find *t* then *s* then *r***
(c) 2nd B1 for $t = 0.17$ [from $1 - 0.08 - \text{P}(A) - \text{P}(C)$]
1st B1ft for $s = 0.28$ <u>or</u> $\text{P}(B)$ – "0.17" – "0.15"
(b) M1 for $r = \text{P}(A) - s$ and the A1 for 0.22

$s = 0.3$ **They assume *A* and *B* are independent and get $s = 0.3$ [from $\text{P}(A) \times \text{P}(B)$]**
(c) 1st B0 for $s = 0.3$ BUT can get 2nd B1ft for either case in the scheme
(b) M1 for $r = \text{P}(A) - s$ BUT then A0cao for $r = 0.2$

(d)
M1 for a correct $\text{P}(A) \times \text{P}(B) = 0.5 \times 0.6$ <u>or</u> 0.3 **and** a clear comparison with their $s (\neq 0.3)$
<u>Or</u> calculation of $\text{P}(A \mid B) = \frac{7}{15}$ <u>or</u> 0.467 <u>or</u> $\dfrac{\text{their } s}{0.6}$ **and** comparison with $\text{P}(A) = 0.5$ (o.e.)
A1 dep. on M1 being earned and clear statement that *A* and *B* are <u>not</u> independent

SC $s = 0.3$ dep on 1st B1ft for $s = 0.5 - 0.2$ in (c); for correct calc. <u>and</u> conclusion seen (B1). On epen M0A1

(e)
M1 for a correct ratio expression of probs: num. < den. Allow 1 – (0.08+their "*t*") on den.
Any sight of multiplication on the numerator e.g. 0.6×0.75 is M0
1st A1ft for correct ratio or ft using their values in numerator but correct denominator.
2nd A1 for $\frac{43}{75}$ or accept awrt 0.573

Question Number	Scheme	Marks
4.		
(a)	$a = \frac{1}{3}$ and $e = 1$	B1
	$c = \left[1 - \frac{5}{6}\right] = \frac{1}{6}$	B1
	$"\frac{1}{3}" + 2b = \frac{5}{6}$ or $"\frac{1}{3}" + 2b + "\frac{1}{6}" = 1$	M1
	$\Rightarrow b = \frac{1}{4}$	A1
	$d = a + b = "\frac{1}{3}" + "\frac{1}{4}"$ or $d = \frac{5}{6} - "\frac{1}{4}"$ (o.e.) so $d = \frac{7}{12}$	B1ft
		(5)
(b)	$\left[P(X^2 = 1) = a + b = \right] \frac{7}{12}$	B1ft
		(1) **[6]**

	Notes
	Probabilities not in [0, 1] score 0 for corresponding A or B marks **Allow exact decimals or equivalent fractions**
(a)	In part (a) you may see answers in the tables. If answers in the table and answers on the page disagree take the answers on the page. If jumbled working is followed by a list of answers on the page mark the list. M1 for an equation for b. Follow through their value of a and possibly c if both in [0,1] Must be seen as an equation with b the only unknown. NB $b = d - a$ is not a suitable equation and use of this is M0 1st A1 for $b = \frac{1}{4}$ or 0.25 (Correct answer only is 2/2) 3rd B1ft for $d = \frac{7}{12}$ or their a + their b but their d must satisfy $\frac{1}{3} < d < \frac{5}{6}$
(b)	B1ft for $\frac{7}{12}$ or their a + their b or their d
	Please check the two B1ft marks carefully

Question Number	Scheme	Marks
5. (a)	$[\mathrm{P}(T > 20) =]\ \mathrm{P}\left(Z > \frac{20-18}{5}\right)$	M1
	$\mathrm{P}(Z > 0.4) = 1 - 0.6554$	M1
	= **<u>0.3446</u>** <u>or</u> awrt **<u>0.345</u>**	A1
		(3)
(b)	Require $\mathrm{P}(T > 20 \mid T > 15)$ <u>or</u> $\frac{\mathrm{P}(T > 20)}{\mathrm{P}(T > 15)}$	M1
	$\frac{\text{"(a)"}}{\mathrm{P}(Z > \frac{15-18}{5})} = \frac{\text{"(a)"}}{\mathrm{P}(Z > -0.6)}$, $= \frac{\text{"0.3446"}}{0.7257}$ <u>or</u> $\frac{\text{"0.345"}}{0.726}$	M1, A1ft
	$= 0.47485\ldots =$ awrt **<u>0.475</u>**	A1
		(4)
(c)	$\mathrm{P}(T > d \mid T > 15) = 0.5$ <u>or</u> $\mathrm{P}(T < d \mid T > 15) = 0.5$	M1
	$\mathrm{P}(T > d)$ <u>or</u> $\mathrm{P}(15 < T < d) = 0.5 \times$"0.7257" =[0.36285]	A1ft
	$\mathrm{P}(T < d) =$ "0.63715"	M1
	So $\frac{d-18}{5} = 0.35$ (calculator gives 0.35085…)	A1
	$d = 19.754\ldots$ = awrt **<u>19.8</u>**	A1cso
	(Accept 19 mins 45(secs) or 19:45 but 19.45 is A0)	(5)
		[12]

Notes

(a)

1st M1 for standardising with 20, 18 and 5. Accept <u>±</u>
2nd M1 for attempting $1 - p$ [where $0.5 < p < 0.7$]. Beware $1 - 0.4$ (or their z value) is M0
A1 for awrt 0.345 (Correct ans only 3/3)

(b)

1st M1 for either correct conditional probability statement (allow "in words" or any letter except Z)
1st M1 can be implied by 2nd M1 so a mark of M0M1 should not be given.
2nd M1 for using their (a) on num. and attempting to standardise $\mathrm{P}(T > 15)$ (no <u>±</u>)on denom.
Num.>Deno. is M0
Allow one digit transcription errors from (a) e.g. 0.3464 or 0.3466 etc for 2nd M1 and 1st A1ft
1st A1ft for their 0.3446 on numerator and denominator of 0.7257 (or better: 0.7257469…)
provided Num < Denom. Allow 0.726 on the denominator
Sight of $\frac{\text{"0.3446"}}{0.7257 \text{ or } 0.726}$ will score M1M1A1ft
2nd A1 for awrt 0.475

(c)

1st M1 for a correct conditional probability statement that includes the 0.5
1st A1ft for $\mathrm{P}(T > d)$ or $\mathrm{P}(15 < T < d) = 0.5 \times$ their $\mathrm{P}(T > 15)$ [provided $\mathrm{P}(T > 15) > 0.5$]
Follow through (3sf) their $\mathrm{P}(T > 15) = 0.7257$ or better from part (b). (Allow 0.726)
Sight of $0.5 \times$ their 0.7257 = "0.36285" or better scores 1st M1 and 1st A1ft (Allow 0.363)
2nd M1 (dep on 1st M1) for $\mathrm{P}(T < d) = 1 -$ "0.36285" <u>or</u> "0.36285" + 1 – "0.7257"
= [0.6371~0.6372]
Sight of their 0.63715 or better (calc: 0.637126…) scores first 3 marks (Allow 0.637)
2nd A1 for $\frac{d-18}{5} = 0.35$ (or better) (Calc could give 0.350788…)
3rd A1cso for (d =) awrt 19.8 (accept 19.7 not awrt 19.7) **Must** come from correct work.

Beware! $0.5 \times 0.7257 = 0.36285$ and using <u>this</u> (instead of 0.35) as z value leads to 19.8 but is A0A0

Question Number	Scheme	Marks
6. (a)	$[E(X)] = \left[0\times\frac{1}{12}\right]+3\times\frac{2}{3}+6\times\frac{1}{4}$, $= \frac{7}{2}$ or **3.5**	M1, A1 (2)
(b)	$[E(X^2)] = \left[0^2\times\frac{1}{12}\right]+3^2\times\frac{2}{3}+6^2\times\frac{1}{4}$ (= 15)	M1
	$[Var(X)] = "15" - \left("\frac{7}{2}"\right)^2$	M1
	$= \frac{11}{4}$ or **2.75**	A1 (3)
(c)	$5p+2(1-p)=3$ or [allow $p + q = 1$ **and** $5p + 2q = 3$ for M1]	M1A1
	So $p = \frac{1}{3}$ **(*)**	A1 cso (3)
(d)	**P(Y = 2) =** $\frac{2}{3}$ **and P(Y = 5) =** $\frac{1}{3}$	B1 (1)
(e)	$P(S=30) = P(X=6 \text{ and } Y=5)$	M1
	$= \frac{1}{4}\times\frac{1}{3}=\frac{1}{12}$	A1cso (2)
(f)	[s] 4 6 12 15 25 (30); [P(S = s)] $\frac{2}{36}$ $\frac{16}{36}$ $\frac{6}{36}$ $\frac{8}{36}$ $\frac{1}{36}$ $\left(\frac{3}{36}\right)$	M1A1A1 (3)
(g)	$E(S) = \frac{1}{36}[4\times2+6\times16+12\times6+15\times8+25\times1+30\times3]$	M1
	$= 11\frac{5}{12}$ or $\frac{137}{12}$ or $11.41\dot{6}$	A1 (2)
(h)	$E(X^2) = 15$ and $E(S) = 11.416\ldots$ **or** $E(X^2) > E(S)$	B1ft
	… so Charlotte has the higher total score	dB1ft (2)
		[18]

	Notes
(a)	M1 for a fully correct expression (allow missing 0 term). Correct ans only is 2/2
(b)	1st M1 for a fully correct expression (allow missing 0 term) for $E(X^2)$. Allow Var(X) label 2nd M1 for their $E(X^2)$ – their $E(X)^2$
(c)	1st M1 for attempting a linear eq'n in p(or x etc). Must see = 3 and have 2 terms in p, 1 correct 1st A1 for a fully correct equation for p or for solving their eqns leading to correct eqn in p 2nd A1 for $p = \frac{1}{3}$ with M1 scored and no incorrect working seen.
(d)	B1 for correct values for P(Y = 2) and P(Y = 5). Needn't be in formal table but labelled.
(e)	M1 for $6\times5=30$ or P(30) = P(6,5) or P(30) = P(6)×P(5) or S =(XY =) 6×5 or X = 6 and Y = 5 A1cso dep on M1 scored for with no incorrect working seen e.g. 30 = $\frac{1}{3}\times\frac{1}{4}$ is A0
(f)	1st M1 for an attempt at prob. distribution with at least 3 correct (s and P(S = s))Exc' s= 30 1st A1 for 6 correct s values 2nd A1 for a fully correct prob. distribution including s = 30
(g)	M1 for attempting E(S) using their values. Must see …3 products (correct ft) decimals to 3sf A1 for $11\frac{5}{12}$ or $\frac{137}{12}$ or any exact equivalent. (Correct ans. only 2/2, awrt 11.4 only M1A0)
(h)	1st B1 for correct comparison of their E(S) and $E(X^2)$ labelled in (b) or (h) [expressions or values] 2nd d B1 dependent on a correct comparison of their values for choosing correct player.

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