Mark Scheme (Results)

Summer 2017

Pearson Edexcel Level 3 Award
In Statistical Methods (AST30)

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1 All candidates must receive the same treatment. Examiners must mark the first candidate in exactly the same way as they mark the last.

2 Mark schemes should be applied positively. Candidates must be rewarded for what they have shown they can do rather than penalised for omissions.

3 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.

4 Where some judgement is required, mark schemes will provide the principles by which marks will be awarded and exemplification may be limited.

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

6 Mark schemes will indicate within the table where QWC is being assessed. The strands are as follows:

i) *that text is legible and that spelling, punctuation and grammar are accurate so that meaning is clear*
Comprehension and meaning is clear by using correct notation and labeling conventions.

ii) *select and use a form and style of writing appropriate to purpose and to complex subject matter*
Reasoning, explanation or argument is correct and appropriately structured to convey mathematical reasoning.

iii) *organise information clearly and coherently, using specialist vocabulary when appropriate*.
The mathematical methods and processes used are coherently and clearly organised and the appropriate mathematical vocabulary used.

7 With working

If there is a wrong answer indicated on the answer line always check the working in the body of the script (and on any diagrams), and award any marks appropriate from the mark scheme.
If working is crossed out and still legible, then it should be given any appropriate marks, as long as it has not been replaced by alternative work.
If it is clear from the working that the "correct" answer has been obtained from incorrect working, award 0 marks. Send the response to review, and discuss each of these situations with your Team Leader.
If there is no answer on the answer line then check the working for an obvious answer.
Any case of suspected misread loses A (and B) marks on that part, but can gain the M marks. Discuss each of these situations with your Team Leader.
If there is a choice of methods shown, then no marks should be awarded, unless the answer on the answer line makes clear the method that has been used.

8 Follow through marks

Follow through marks which involve a single stage calculation can be awarded without working since you can check the answer yourself, but if ambiguous do not award.
Follow through marks which involve more than one stage of calculation can only be awarded on sight of the relevant working, even if it appears obvious that there is only one way you could get the answer given.

9 Probability

Probability answers must be given as fractions, percentages or decimals. If a candidate gives a decimal equivalent to a probability, this should be written to at least 2 decimal places (unless tenths).

Incorrect notation should lose the accuracy marks, but be awarded any implied method marks.
If a probability answer is given on the answer line using both incorrect and correct notation, award the marks.

If a probability fraction is given then cancelled incorrectly, ignore the incorrectly cancelled answer.

Guidance on the use of codes within this mark scheme

M1 – method mark
A1 – accuracy mark
B1 – Working mark
C1 – communication mark
QWC – quality of written communication
oe – or equivalent
cao – correct answer only
ft – follow through
sc – special case
dep – dependent (on a previous mark or conclusion)
indep – independent
isw – ignore subsequent working
awrt – answer which rounds to

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Question		**Working**	**Answer**	**Mark**	**Notes**
1	(a)		All the staff at the company	1	B1 for all the staff at the company oe
	(b)		One advantage and one disadvantage	2	B1 for advantage e.g. accurate **or** unbiased **or** more representative **or** reliable oe B1 for disadvantage e.g. time-consuming, expensive, harder to do, more data to handle oe
2		$^{12}/_{120} \times 30$	3	2	M1 for $^{12}/_{120} \times 30$ A1 cao
3	(a)	$\frac{30}{n} = \frac{6}{40}$ $(40 \times 30) \div 6$	200	2	M1 for $\frac{30}{n} = \frac{6}{40}$ oe A1 cao
	(b)		A correct assumption	1	B1 for an assumption about the population not changing **or** an assumption about the tags still remaining on the dolphins **or** the dolphins are well mixed between the samples **or** the second sample was from the same region

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Question	Working	Answer	Mark	Notes
4 (a)		Both advantages	2	B1 for advantage e.g. easy to obtain **or** quicker **or** lots of data can be collected B1 for advantage e.g. you know how the data were obtained **or** accuracy is known **or** reliable **or** more accurate
(b)		**Bill** | **Ben** 19 | 4 8 6 | 20 | 3 9 8 0 | 21 | 2 5 8 9 9 8 7 2 | 22 | 2 5 9 8 6 4 | 23 | 1 Key: 6 | 20 | 3 represents 206 cm for Bill and 203 cm for Ben	3	M1 for correct leaves for either Bill **or** Ben A1 for both Bill **and** Ben correct B1 for a correct key
(c)	Bill / Ben Q2: 228 / 215 IQR: 18 / 19 range: 33 / 37 skew: -ve / -ve	Two correct comparisons	2	B2 for 2 correct comparisons from: • Bill's median > Ben's median • Bill's IQR/range < Ben's IQR/range • Both have negative skew (B1 for one correct comparison)

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Question		**Working**	**Answer**	**Mark**	**Notes**
5	(a)		0.35 on first branch 0.3, 0.7, 0.95, 0.05 on second branches	2	B2 for all five probabilities in the correct place. (B1 for 0.35 in the correct place **or** 0.3 **and** 0.7 in the correct place **or** 0.95 **and** 0.05 in the correct place)
	(b)(i)	0.65 × 0.3	0.195	4	M1 for 0.65 × 0.3 A1 for 0.195 oe
	(b)(ii)	(0.65 × 0.3) + (0.35 × 0.95)	0.5275		M1 for '(b)(i)' + (0.35 × 0.95) A1 for 0.5275 oe
6	(a)	(191 – 185) ÷ 5	1.2	2	M1 for ±(191 – 185) ÷ 5 A1 cao
	(b)	-1.4 × 5 + 185	178	2	M1 for -1.4 × 5 + 185 oe A1 cao
7	(a)	$\sum d^2 = 208$ $1 - \frac{6 \times 208}{10(10^2-1)}$	-0.26	3	B1 for $\sum d^2 = 208$ M1 for $1 - \frac{6 \times their(208)}{10(10^2-1)}$ A1 cao
	(b)(i)		Negative	2	B1 for negative **or** ft a sensible answer in part (a)
	(b)(ii)		Correct interpretation		B1 for there is disagreement between the 2 judges oe **or** ft part (b) (i)

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Question	**Working**	**Answer**	**Mark**	**Notes**
8 (a)(i)		750	2	B1 cao
(a)(ii)		160		B1 cao
(b)	650 – 1.5 ×160	410 < 440 so Brett is correct	3	M1 for 650 – 1.5 ×160 A1 for 410 A1 for 410 < 440 so Brett is correct
(c)		Correct box plot drawn	3	M1 for correct box plot with at least one feature from: • Correct median • Correct upper and lower quartiles • Correct least and greatest A1 for 2 correct features A1 for all 3 features
(d)		Two correct comparisons	2	B2 for two correct comparisons from: • Brett's cows median < Alan's cows median • Brett's cows IQR/range > Alan's cows IQR/range • Alan's cows are negatively skewed and Brett's cows are symmetrically distributed

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Question		**Working**	**Answer**	**Mark**	**Notes**
9	(a)	Bars of heights 2, 4.4, 3.5, 3.3, 3, 1	Histogram	4	M1 for calculating frequency density (may be implied by 1 bar at correct height) A2 for four blocks with correct width **and** heights (A1 for 2 correct blocks) B1 for correct vertical scale **and** correctly labelled f.d **or** key
	(b)	(47.5 × 10 + … +82.5 × 5) ÷ 120	63.46	3	M1 $\sum fx$ (=7615) must be midpoints condone one error M1 '7615' ÷120 A1 for 63.4 to 63.5
	(c)	$\sqrt{\frac{495025}{120} - \left(\frac{7615}{120}\right)^2}$	9.91	2	M1 for $\frac{495025}{120} - \left(\frac{7615}{120}\right)^2$ **or** $\frac{495025}{120} - (\text{'}mean\text{'})^2$ A1 for 9.90 to 9.91
10	(a)		Correct sample space diagram	1	B1 for all total scores
	(b)		$^5/_{36}$	1	B1 for $^5/_{36}$ oe
	(c)	$^5/_{36} \times 200$	28	2	M1 for '$(^5/_{36})$' ×200 (may be implied by 27.7 **or** 27.8) A1 cao

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Question		**Working**	**Answer**	**Mark**	**Notes**
11	(a)		Correct interpretation	1	B1 for 16.2% increase (from 2011 to 2012)
	(b)	$^{594}/_{523} \times 100$ $^{655}/_{594} \times 100$	113.6 110.3	2	M1 for $^{594}/_{523} \times 100$ (= 113.6) **or** $^{655}/_{594} \times 100$ (=110.3) A1 for 113.5 to 113.6 **and** 110.2 to 10.3 **NB** check table
	(c)	$\sqrt[4]{102.5 \times 116.2 \times 113.6 \times 110.3}$	110.5	2	M1 for $\sqrt[4]{102.5 \times 116.2 \times '113.6' \times '110.3'}$ A1 for 110.5
	(d)		Average yearly increase of 10.5%	2	B2 for (average) yearly/annual increase **and** '10.5%' oe (B1 for (average) yearly/annual increase **or** '10.5%' oe
12	(a)		Upward	1	B1 for upward oe
	(b)	450 – (595 to 600)	-145 to -150	2	M1 for 450 – (595 to 600) **or** (600 to 595) – 450 A1 -145 to -150
13	(a)		$^{31}/_{125}$	2	M1 for $^{(16+15)}/_{125}$ A1 for $^{31}/_{125}$ oe
	(b)		$^{25}/_{48}$	2	M1 for $^{a}/_{48}$ **or** $^{25}/_{n}$ $a<48$ **or** $25<n<125$ A1 $^{25}/_{48}$ oe

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Question	**Working**	**Answer**	**Mark**	**Notes**
14 (a)		Mean 1600 Standard deviation 200	2	B1 for mean 1600 B1 for standard deviation 200
(b)		Normal distribution curve drawn	2	B1 for a bell shaped curve centred on 1800 B1dep for curve starting at 1500 **and** ending at 2100 **and** for bulb B curve taller than bulb A curve
(c)		Two correct comparisons	2	B1ft for correct comparisons of means e.g. mean for bulb B> mean for bulb A B1ft for correct comparisons of standard deviations (accept ranges) e.g. standard deviation for bulb A > standard deviation for bulb B
15 (a)		0.6	1	B1 for 0.6 oe
(b)		0.2	1	B1 for 0.2 oe
(c)	$\mathrm{P}(B \cap C) = \mathrm{P}(B) + \mathrm{P}(C) - \mathrm{P}(B \cup C)$ $0.2\mathrm{P}(C) = \mathrm{P}(C) - 0.24$ $0.8\mathrm{P}(C) = 0.24$	0.3	3	M1 for use of addition rule **and** replacing $\mathrm{P}(B \cap C)$ with $\mathrm{P}(B) \times \mathrm{P}(C)$ M1 for $0.8\mathrm{P}(C) = 0.24$ A1 for 0.3 oe
16	${}^{10}C_6\left(\frac{2}{5}\right)^6\left(\frac{3}{5}\right)^4$	0.111	3	M1 for $\left(\frac{2}{5}\right)^6\left(\frac{3}{5}\right)^4$ M1 for ${}^{10}C_6\left(\frac{2}{5}\right)^6\left(\frac{3}{5}\right)^4$ A1 for awrt 0.111

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Question	Working	Answer	Mark	Notes
17	$P\left(\frac{80-92.5}{13.7} < Z < \frac{100-92.5}{13.7}\right)$ 0.7088 – 0.1814	0.5274	5	M1 for either $\frac{80-92.5}{13.7}$ **or** $\frac{100-92.5}{13.7}$ M1 for $\frac{80-92.5}{13.7}$ **and** $\frac{100-92.5}{13.7}$ M1 for 1 – 0.8186 (=0.1814) A1 for 0.7088 A1 cao
18 (a)		11396.8	1	B1 for awrt 11396.8
(b) (i)	$\frac{620}{\sqrt{826 \times 11396.8}}$	0.202	3	M1 for $\frac{620}{\sqrt{826 \times Part(a)}}$ A1 for awrt 0.202
(ii)		Positive correlation		A1 for (weak) positive correlation **or** ft part (b) (i)

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