Paper 2: Statistics and Mechanics Mark Scheme

Question	Scheme	Marks	AOs
1(a)	Systematic (sample) cao	B1	1.2
(b)	In LDS some days have gaps because the data was not recorded	B1	2.4
(c)	$\left[\bar{t} = \frac{374}{20} = 18.7\right]$ $\sigma_t = \sqrt{\frac{7600}{20} - \bar{t}^2}$ $[= \sqrt{30.31}\ ]$	M1	1.1a
	$= 5.5054\ldots$ awrt **<u>5.51</u>** (Accept use of $s_t = \sqrt{\frac{7600 - 20\bar{t}^2}{19}}$ $= 5.6484\ldots$)	A1	1.1b
			(4 marks)

Notes:

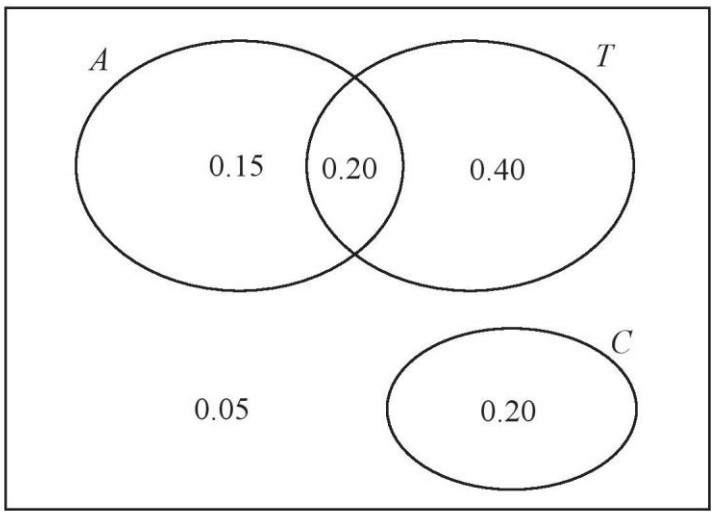
(b)
B1: A correct explanation

(c)
M1: For a correct expression for $\bar{t}$ and σ_t or s_t
ft an incorrect evaluation of $\bar{t}$
A1: For σ_t = awrt 5.51 or s_t = awrt 5.65

Question	Scheme	Marks	AOs
2	$17 + 45 + \frac{1}{3} \times 9$ $[= 65]$	M1	2.2a
	$(7 - 8)$ **<u>14</u>** or $(16 - 20)$ **<u>5</u>** [Values may be seen in the table]	M1 A1	3.1a 1.1b
	Percentage of motorists is $\frac{"65"}{6 + "14" + 17 + 45 + 9 + "5"} \times 100$	M1	3.1b
	$=$ **<u>67.7%</u>**	A1	1.1b
			(5 marks)

Notes:

M1: For a fully correct expression for the number of motorists in the interval
M1: For clear use of frequency density in (4- 6) or (13- 15) cases to establish the fd scale. Then use of area to find frequency in one of the missing cases
A1: For both correct values seen
M1: For realising that total is required and attempting a correct expression for %
A1: For awrt 67.7%

Question	Scheme	Marks	AOs
3(a)	$p = [1 - 0.75 - 0.05 =]$ **0.20**	B1	1.1b
		(1)	
(b)	$q =$ **0.15**	B1ft	1.1b
	$P(A) = 0.35 \quad P(T) = 0.6 \quad P(A \text{ and } T) = 0.20$ $\quad P(A) \times P(T) = 0.21$	M1	2.1
	Since $0.20 \neq 0.21$ therefore A and T are **not** independent	A1	2.4
		(3)	
			
(c)	P(not [A or C]) = **0.45**	B1	1.1b
		(1)	
			(5 marks)

Notes:

(a)

B1: cao for $p = 0.20$

(b)

B1: Ft for use of their p and P(A or T) to find q i.e. $0.75 - "p" - 0.40$ **or** $q = 0.15$

M1: For the statement of all probabilities required for a suitable test and sight of any appropriate calculations required

(c)

A1: All probabilities correct, correct comparison and suitable comment

B1: cao for 0.45

Question	Scheme	Marks	AOs
4(a)	IQR = 2.3 and $20.6 \gg 2.4 + 1.5 \times 2.3$ (= 5.85) (Compare correct values)	B1	1.1b
		(1)	
(b)(i)	e.g. It is a piece of data and we should consider all the data o.e.	B1	2.4
(ii)	e.g. It is an extreme value and could unduly influence the analysis **or** It could be a mistake	B1	2.4
		(2)	
(c)	e.g. "as humidity increases rainfall increases"	B1	2.2b
		(1)	
(d)	e.g. a 10% increase in humidity gives rise to a 1.5 mm increase in rainfall **or** represents 0.15mm of rainfall per percentage of humidity	B1	3.4
		(1)	
(e)(i)	Not a good method since only uses 11 days from one location in one month	B1	2.4
(ii)	e.g. She should use data from more of the UK locations and more of the months **or** using a spreadsheet or computer package she could use all of the available UK data	B1	2.4
		(2)	
			(7 marks)

Continued question 4
Notes:
(a) **B1:** For sight of the correct calculation and suitable comparison with 20.6
(b)(i) **B1**: For a suitable reason for including the data point
(b)(ii) **B1:** For a suitable reason for excluding the data point
(c) **B1:** For a suitable interpretation of positive correlation mentioning humidity and rainfall
(d) **B1:** For a suitable description of the rate: rainfall per percentage of humidity including reference to values
(e)(i) **B1:** For a comment that supports the idea that her sampling method was not a good one
(e)(ii) **BI:** For some sensible suggestions that would give a better representation of the data across the UK. Must show some awareness of the fact that LDS has different locations and more months of data available but must be clear they are NOT using any overseas locations
N.B. B0 for a comment that says use more than one location without specifying that only UK locations are required

Question	Scheme	Marks	AOs
5(a)	$P(X \geqslant 16) = 1 - P(X \leqslant 15)$	M1	1.1b
	$= 1 - 0.949077\ldots$ = awrt **<u>0.0509</u>**	A1	1.1b
		(2)	
(b)	$H_0 : p = 0.3$ $H_1 : p \neq 0.3$ (Both correct in terms of p or π)	B1	2.5
		(1)	
(c)	$[Y \sim B(20, 0.3)]$ sight of $P(Y \leqslant 2) = 0.0355$ or $P(Y \leqslant 9) = 0.9520$	M1	2.1
	Critical region is $\{Y \leqslant \mathbf{2}\}$ or (o.e.)	A1	1.1b
	$\{Y \geqslant \mathbf{10}\}$ (o.e.)	A1	1.1b
		(3)	
(d)	$[0.0355 + (1 - 0.9520)] = 0.0835$ **or** **<u>8.35%</u>**	B1ft	1.1b
		(1)	
(e)	(Assuming that the 20 customers represent a random sample then) 12 is in the CR so the manager's suspicion is supported	B1ft	3.2a
		(1)	
(f)	e.g. (e) requires the 20 customers to be a random sample or independent and the members of the scout group may invalidate this so binomial distribution would not be valid (and conclusion in (e) is probably not valid)	B1	3.5a
		(1)	
			(9 marks)

Continued question 5
Notes:
(a) **M1:** For dealing with P($X \geqslant 16$) – they need to use cumulative prob. function on calc **A1:** awrt 0.0509 (from calculator)
(b) **B1**: For both hypotheses in terms of p or π and H_1 must be 2-tail
(c) **M1:** For correct use of tables to find probability associated with critical value **A1:** For the correct lower limit of the CR. Do not award for P($Y \leqslant 2$) **A1:** For the correct upper limit
(d) **B1:** ft on their 0.0355 and (1 – their 0.9520) provided each probability is less than 0.05
(e) **B1:** ft for a comment that relates 12 to their CR and makes a consistent comment relating this to the manager's suspicion
(f) **BI:** For a comment that: gives a suitable reason based on lack of independence **or** the sample not being random **so** the binomial model is not valid

Question	Scheme	Marks	AOs
6.	Using distance = total area under graph (e.g. area of rectangle + triangle **or** trapezium **or** rectangle – triangle)	M1	2.1
	e.g. $D = UT + \frac{1}{2} Th$, where h is height of triangle	A1	1.1b
	Using gradient = acceleration to substitute $h = aT$	M1	1.1b
	$D = U T + \frac{1}{2} aT^2$ *	A1 *	1.1b
		(4)	
			(4 marks)

Notes:
M1: For use of distance = total area to give an equation in D, U, T and one other variable **A1:** For a correct equation **M1:** For using gradient = a to eliminate the other variable to give an equation in D, U, T and a *only* **A1*:** For a correct given answer