Y1S6 XMQs and MS

(Total: 75 marks)

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 1. P3_2018      Q1 .  5 marks - Y1S1 Data collection

 2. P3_2018      Q3 . 11 marks - Y1S6 Statistical distributions

 3. P31(AS)_2018 Q5 .  8 marks - Y1S6 Statistical distributions

 4. P31(AS)_2019 Q3 .  6 marks - Y1S6 Statistical distributions

 5. P31(AS)_2020 Q3 .  6 marks - Y1S6 Statistical distributions

 6. P31(AS)_2020 Q5 .  8 marks - Y1S6 Statistical distributions

 7. P31(AS)_2022 Q5 .  8 marks - Y1S6 Statistical distributions

 8. P31_2019     Q4 .  9 marks - Y1S6 Statistical distributions

 9. P31_2021     Q6 .  7 marks - Y1S6 Statistical distributions

10. P31_2022     Q3 .  7 marks - Y1S2 Measures of location and spread
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SECTION A: STATISTICS

Answer ALL questions. Write your answers in the spaces provided.

1. Helen believes that the random variable C, representing cloud cover from the large data set, can be modelled by a discrete uniform distribution.

(a) Write down the probability distribution for C.
(2)

(b) Using this model, find the probability that cloud cover is less than 50%
(1)

Helen used all the data from the large data set for Hurn in 2015 and found that the proportion of days with cloud cover of less than 50% was 0.315

(c) Comment on the suitability of Helen's model in the light of this information.
(1)

(d) Suggest an appropriate refinement to Helen's model.
(1)

Section A: STATISTICS

Qu 1	Scheme	Marks	AO
(a)	c: 0, 1, 2, 3, 4, 5, 6, 7, 8 $P(C = c)$: $\frac{1}{9}$, $\frac{1}{9}$, $\frac{1}{9}$, $\frac{1}{9}$, $\frac{1}{9}$, $\frac{1}{9}$, $\frac{1}{9}$, $\frac{1}{9}$, $\frac{1}{9}$	B1 B1ft (2)	1.2 1.2
(b)	$P(C < 4) = \frac{4}{9}$ (accept 0.444 or better)	B1 (1)	3.4
(c)	Probability lower than expected suggests model is <u>not</u> good	B1ft (1)	3.5a
(d)	e.g. Cloud cover will vary from month to month and place to place So e.g. use a non-uniform distribution	B1 (1)	3.5c
		(5 marks)	

	Notes
(a)	1st B1 for a correct set of values for c. Allow $\left\{\frac{1}{8}, \frac{2}{8}, \ldots \frac{8}{8}\right\}$ 2nd B1ft for correct probs from their values for c, consistent with discrete uniform distrib'n Maybe as a prob. function. Allow $P(X = x) = \frac{1}{9}$ for $0 \leqslant x \leqslant 8$ provided $x = \{0, 1, 2, \ldots, 8\}$ is clearly defined somewhere.
(b)	B1 for using correct model to get $\frac{4}{9}$ (o.e.)
SC	**Sample space {1, …, 8}** If scored B0B1 in (a) for this allow $P(C < 4) = \frac{3}{8}$ to score B1 in (b)
(c)	B1ft for comment that states that the model proposed is or is not a good one based on their model in part (a) and their probability in (b) **|(b) – 0.315| > 0.05** Allow e.g. "it is not suitable"; "it is not accurate" etc **|(b) – 0.315| ⩽ 0.05** Allow a comment that suggests it <u>is</u> suitable **No prob in (b)** Allow a comparison that mentions 50% or 0.5 and rejects the model **No prob in (b) and no 50% or 0.5** or **(b) > 1** scores B0 Ignore any comments about location or weather patterns.
(d)	B1 for a sensible refinement considering variations in month or location Just saying "not uniform" is B0 **Context & "non-uniform"** Allow mention of different locations, months <u>and</u> non-uniform <u>or</u> use more locations to form a new distribution with probabilities based on frequencies **Context & "binomial"** Allow mention of different locations, months <u>and</u> binomial **Just refined model** Model must be outlined and discrete and non-uniform e.g. higher probabilities for more cloud cover <u>or</u> lower probabilities for less cloud cover **Continuous model** Any model that is based on a continuous distribution. e.g. normal is B0

3. In an experiment a group of children each repeatedly throw a dart at a target.
For each child, the random variable H represents the number of times the dart hits the target in the first 10 throws.

Peta models H as B(10, 0.1)

(a) State two assumptions Peta needs to make to use her model.
(2)

(b) Using Peta's model, find $P(H \geqslant 4)$
(1)

For each child the random variable F represents the number of the throw on which the dart first hits the target.

Using Peta's assumptions about this experiment,

(c) find $P(F = 5)$
(2)

Thomas assumes that in this experiment no child will need more than 10 throws for the dart to hit the target for the first time. He models $P(F = n)$ as

$$P(F = n) = 0.01 + (n - 1) \times \alpha$$

where α is a constant.

(d) Find the value of α
(4)

(e) Using Thomas' model, find $P(F = 5)$
(1)

(f) Explain how Peta's and Thomas' models differ in describing the probability that a dart hits the target in this experiment.
(1)

Qu 3	Scheme	Marks	AO
(a)	The probability of a dart hitting the target is constant (from child to child and for each throw by each child) (o.e.)	B1	1.2
	The throws of each of the darts are independent (o.e.)	B1	1.2
		(2)	
(b)	[P($H \geqslant 4$) = 1 – P($H \leqslant 3$) = 1 – 0.9872 = 0.012795.. =] awrt **0.0128**	B1	1.1b
		(1)	
(c)	P(F = 5) = $0.9^4 \times 0.1$, = 0.06561	M1,	3.4
	= awrt **0.0656**	A1	1.1b
		(2)	
(d)	n: 1, 2, …, 10; P($F = n$): 0.01, $0.01 + \alpha$, …, $0.01 + 9\alpha$	M1	3.1b
	Sum of probs = 1 $\Rightarrow \frac{10}{2}\left[2\times 0.01+9\alpha\right]=1$	M1A1	3.1a 1.1b
	[i.e. $5(0.02 + 9\alpha) = 1$ or $0.1 + 45\alpha = 1$] so α = **0.02**	A1	1.1b
		(4)	
(e)	P(F = 5| Thomas' model) = **0.09**	B1ft	3.4
		(1)	
(f)	Peta's model assumes the probability of hitting target is constant (o.e.) **and** Thomas' model assumes this probability increases with each attempt(o.e.)	B1	3.5a
		(1)	
		(11 marks)	

Table in (d):

n	1	2	…	10
P($F = n$)	0.01	$0.01 + \alpha$	…	$0.01+9\alpha$

	Notes
(a)	1st B1 for stating that the probability (or possibility or chance) is constant (or fixed or same) 2nd B1 for stating that throws are independent ["trials" are independent is B0]
(b)	B1 for awrt 0.0128 (found on calculator)
(c)	M1 for a probability expression of the form $(1-p)^4 \times p$ where $0 < p < 1$ A1 for awrt 0.0656
SC	Allow M1A0 for answer only of 0.066
(d)	1st M1 for setting up the distribution of F with at least 3 correct values of n and P($F = n$) in terms of α. (Can be implied by 2nd M1 or 1st A1) 2nd M1 for use of sum of probs = 1 **and** clear summation or use of arithmetic series formula (allow 1 error or missing term). (Can be implied by 1st A1) 1st A1 for a correct equation for α 2nd A1 for α = 0.02 (must be exact and come from correct working)
(e)	B1ft for value resulting from $0.01 + 4\times$"their α" (provided α and the answer are probs) **Beware** If their answer is the same as their (c) (or a rounded version of their (c)) score B0
(f) **ALT**	B1 for a suitable comment about the probability of hitting the target Allow idea that Peta's model suggests the dart may never hit the target but Thomas' says that it will hit at least once (in the first 10 throws).

5. A biased spinner can only land on one of the numbers 1, 2, 3 or 4. The random variable X represents the number that the spinner lands on after a single spin and $P(X = r) = P(X = r + 2)$ for $r = 1, 2$

Given that $P(X = 2) = 0.35$

(a) find the complete probability distribution of X.

(2)

Ambroh spins the spinner 60 times.

(b) Find the probability that more than half of the spins land on the number 4
Give your answer to 3 significant figures.

(3)

The random variable $Y = \dfrac{12}{X}$

(c) Find $P(Y - X \leqslant 4)$

(3)

Qu	Scheme	Marks	AO
5(a)	P(X = 4) = P(X = 2) so P(X = 4) = 0.35 P(X = 1) = P(X = 3) and P(X = 1) + P(X = 3) = 1 – 0.7 So x: 1, 2, 3, 4 P(X = x): 0.15, 0.35, 0.15, [0.35]	M1 A1 (2)	2.1 1.1b
(b)	Let A = number of spins that land on 4 $A \sim$ B(60, "0.35")	B1ft	3.3
	[P(A > 30) =] 1 – P($A \leqslant$ 30) = 1 – 0.99411… = **awrt 0.00589**	M1 A1 (3)	3.4 1.1b
(c)	$Y - X \leqslant 4 \Rightarrow \frac{12}{X} - X \leqslant 4$ <u>or</u> $12 - X^2 \leqslant 4X$ (since $X > 0$) o.e.	M1	3.1a
	i.e. $0 \leqslant X^2 + 4X - 12 \Rightarrow 0 \leqslant (X+6)(X-2)$ so $X \geqslant 2$	M1	1.1b
	$\text{P}(Y - X \leqslant 4) = \text{P}(X \geqslant 2) = 0.35 + 0.15 + 0.35$ = <u>**0.85**</u>	A1 (3)	3.2a
		(8 marks)	

	x	1	2	3	4

Notes

(a) M1 for using the given information to obtain P(X = 4)

Award for statement P(X = 4) = P(X = 2) <u>or</u> writing P(X = 4) = 0.35

A1 for getting fully correct distribution (any form that clearly identifies probs)

e.g. can be list P(X = 1) = 0.15, P(X = 3) = …etc
or as a probability function $\text{P}(X = x) = \begin{cases} 0.15 & x = 1, 3 \\ 0.35 & x = 2, 4 \end{cases}$

[Condone missing P(X = 2) as this is given in QP]

(b) B1 for selecting a suitable model, sight of B(60, their 0.35) o.e. in words
f.t. their P(X = 4) from part (a).
Can be implied by P($A \leqslant$ 30) = awrt 0.9941 or final answer = awrt 0.00589

M1 for using their model and interpreting "more than half"
Need to see 1 – P($A \leqslant$ 30) . Can be implied by awrt 0.00589
Can ignore incorrect LHS such as P($A \geqslant 30$)

A1 for awrt 0.00589

(c) 1st M1 for translating the prob. problem into a <u>correct</u> mathematical inequality
Just an inequality in 1 variable. May be inside a probability statement.

ALT **Table of values:**

X	1	2	3	4
Y	12	6	4	3

<u>or</u> values of $Y - X$ = 11, 4, 1, – 1

2nd M1 for solving the inequality leading to a range of values, allow 1 or 2 slips
May be a quadratic or cubic but must lead to a set of values of X or $Y - X$

ALT **Table or values:** They must state clearly which values are required

Both Ms can be implied by a correct answer (or correct ft of their distb'n)

A1 for interpreting the inequality and solving the problem i.e. 0.85 cao

3. A fair 5-sided spinner has sides numbered 1, 2, 3, 4 and 5

The spinner is spun once and the score of the side it lands on is recorded.

(a) Write down the name of the distribution that can be used to model the score of the side it lands on.

(1)

The spinner is spun 28 times.

The random variable X represents the number of times the spinner lands on 2

(b) (i) Find the probability that the spinner lands on 2 at least 7 times.

(ii) Find $P(4 \leqslant X < 8)$

(5)

Question	Scheme	Marks	AOs
3(a)	(Discrete) uniform (distribution)	B1	1.2
		(1)	
(b)	B(28, 0.2)	B1	3.3
(i)	$\text{P}(X \geq 7) = 1 - \text{P}(X \leq 6)$ [= 1 – 0.6784…]	M1	3.4
	awrt **<u>0.322</u>**	A1	1.1b
(ii)	$\text{P}(4 \leq X < 8) = \text{P}(X \leq 7) - \text{P}(X \leq 3)$ [= 0.818… – 0.160…]	M1	3.1b
	awrt **<u>0.658</u>**	A1	1.1b
		(5)	
			(6 marks)

Notes

(a)	Continuous uniform is B0
(b)	**B1:** for identifying correct model, B(28, 0.2) allow B, bin or binomial may be implied by one correct answer or sight one correct probability i.e. awrt 0.678, awrt 0.818 or awrt 0.160 B(0.2, 28) is B0 unless it is used correctly
(i)	**M1:** Writing or using $1 - \text{P}(X \leq 6)$ or $1 - \text{P}(X < 7)$ **A1:** awrt 0.322 (correct answer only scores M1A1)
(ii)	**M1:** Writing or using $\text{P}(X \leq 7) - \text{P}(X \leq 3)$ or $\text{P}(X < 8) - \text{P}(X < 4)$ or $\text{P}(X = 4) + \text{P}(X = 5) + \text{P}(X = 6) + \text{P}(X = 7)$ Condone P(4) as P(X = 4), etc. **A1:** awrt 0.658 (correct answer only scores M1A1)

3. In a game, a player can score 0, 1, 2, 3 or 4 points each time the game is played.

The random variable S, representing the player's score, has the following probability distribution where a, b and c are constants.

s	0	1	2	3	4
$P(S = s)$	a	b	c	0.1	0.15

The probability of scoring less than 2 points is twice the probability of scoring at least 2 points.

Each game played is independent of previous games played.

John plays the game twice and adds the two scores together to get a total.

Calculate the probability that the total is 6 points.

(6)

Question	Scheme	Marks	AOs
3	Overall method	M1	2.1
	$a+b=2c+0.5$ oe **or** $a+b=2(1-a-b)$	B1	2.2a
	$a+b+c=0.75$ oe	B1	1.1b
	$3c=0.25$ $\left[c=0.0833...\text{ or }\frac{1}{12}\right]$	M1	1.1b
	P(scoring 2,4 or 4,2 or 3,3) = $2\times"\frac{1}{12}"\times0.15+0.1^2$	M1	3.1b
	$=0.035$ oe	A1cso	1.1b
		(6)	
			(6 marks)

Notes

3	**M1:**	A fully correct method with all the required steps. For gaining 2 correct equations with at least one correct(allow if unsimplified). Attempting to solve to find a value of *c* followed by **correct method** to find the probability
	B1:	Forming a correct equation from the information given in the question
	B1:	A correct equation using the sum of the probabilities equals 1
	M1:	Correct method for solving 2 equations to find *c* Implied by $c=\frac{1}{12}$
	M1:	Recognising the ways to get a total of 6. Condone missing arrangments or repeats. Do not ignore extras written unless ignored in the calculation. May be implied by $m\times"\frac{1}{12}"\times0.15+n\times0.1^2$ where *m* and *n* are positive integers
	A1cso:	Cao 0.035, $\frac{7}{200}$ oe

5. Afrika works in a call centre.

She assumes that calls are independent and knows, from past experience, that on each sales call that she makes there is a probability of $\frac{1}{6}$ that it is successful.

Afrika makes 9 sales calls.

(a) Calculate the probability that at least 3 of these sales calls will be successful.

(2)

The probability of Afrika making a successful sales call is the same each day.

Afrika makes 9 sales calls on each of 5 different days.

(b) Calculate the probability that at least 3 of the sales calls will be successful on exactly 1 of these days.

(2)

Rowan works in the same call centre as Afrika and believes he is a more successful salesperson.

To check Rowan's belief, Afrika monitors the next 35 sales calls Rowan makes and finds that 11 of the sales calls are successful.

(c) Stating your hypotheses clearly test, at the 5% level of significance, whether or not there is evidence to support Rowan's belief.

(4)

Question	Scheme	Marks	AOs
5(a)	Let C = the number of successful calls. $C \sim \mathrm{B}\left(9, \frac{1}{6}\right)$	M1	3.3
	$\mathrm{P}(C \geq 3) = 1 - \mathrm{P}(C \leq 2) = 0.1782\ldots$ **awrt 0.178**	A1	1.1b
		(2)	
(b)	Let X = the number of occasions when at least 3 calls are successful. $\mathrm{P}(X = 1) = 5 \times (\text{"0.1782..."}) \times (\text{"0.8217..."})^4$	M1	1.1b
	$= 0.4061\ldots$ **awrt 0.406**	A1	1.1b
		(2)	
(c)	$\mathrm{H}_0 : p = \frac{1}{6}$ $\quad \mathrm{H}_1 : p > \frac{1}{6}$	B1	2.5
	Let R = the number of successful calls $R \sim \mathrm{B}\left(35, \frac{1}{6}\right)$	M1	3.3
	$\mathrm{P}(R \geq 11) = 1 - \mathrm{P}(R \leq 10) = 0.02...$	A1	3.4
	There is sufficient evidence to support that **Rowan** has more successful sales calls than Afrika.	A1	2.2b
		(4)	
			(8 marks)

Notes

5(a)	**M1:**	For selecting the right model
	A1:	awrt 0.178
(b)	**M1:**	For $5 \times (\text{"their}(a)\text{"}) \times (\text{"}1 - \text{their}(a)\text{"})^4$
	A1:	awrt 0.406
(c)	**B1:**	for correctly stating both hypotheses in terms of p or π Accept $p = 0.1\dot{6}$
	M1:	For selecting a suitable model. May be implied by a correct probability or CR
	A1:	Correct probability statement and answer of 0.02 or better (0.02318…) (CR $R \geq 11$ and either $\mathrm{P}(R \leq 9) = 0.9450$ or $\mathrm{P}(R \leq 10) = 0.9768$ or $1 - \mathrm{P}(R \leq 10) = 0.0232$)
	A1:	Dependent on M1A1 but can ignore hypotheses. For conclusion in context supporting **Rowan's** belief **/ Rowan** is a better sales person
		Do not accept Rowan can reject H_0

5. Manon has two biased spinners, one red and one green.

The random variable R represents the score when the red spinner is spun.
The random variable G represents the score when the green spinner is spun.

The probability distributions for R and G are given below.

r	2	3
$P(R = r)$	$\frac{1}{4}$	$\frac{3}{4}$

g	1	4
$P(G = g)$	$\frac{2}{3}$	$\frac{1}{3}$

Manon spins each spinner once and adds the two scores.

(a) Find the probability that

(i) the sum of the two scores is 7

(ii) the sum of the two scores is less than 4

(3)

The random variable $X = mR + nG$ where m and n are integers.

$$P(X = 20) = \frac{1}{6} \qquad \text{and} \qquad P(X = 50) = \frac{1}{4}$$

(b) Find the value of m and the value of n

(5)

Qu	Scheme	Mark	AO
5. (a)(i)	Require $R = 3$ and $G = 4$ so probability is $\frac{3}{4}\times\frac{1}{3}$	M1	2.1
	$= \underline{\frac{1}{4}}$ or $\underline{\mathbf{0.25}}$	A1	1.1b
(ii)	[R must be 2 and $G = 1$so $\frac{1}{4}\times\frac{2}{3}$] = $\underline{\frac{1}{6}}$	A1	1.1b
		(3)	
(b)	$P(X = 50) = 0.25$ must mean $R = 3$ and $G = 4$	M1	3.1a
	so $3m + 4n = 50$	A1	1.1b
	$P(X = 20) = \frac{1}{6} \Rightarrow R = 2, G = 1$ so $2m + n = 20$	A1	2.1
	Solving: $3m + 4(20 – 2m) = 50$ (o.e.)	M1	1.1b
	$\underline{\boldsymbol{m = 6}}$ and $\underline{\boldsymbol{n = 8}}$	A1	3.2a
		(5)	
		(8 marks)	

	Notes
(a)(i)	M1 for sight of $\frac{3}{4}\times\frac{1}{3}$ or $\frac{1}{4}\times\frac{2}{3}$ as a single product BUT allow e.g. $\frac{3}{4}\times\frac{1}{3}+\frac{1}{3}\times\frac{3}{4}$ to score M1 However if the products are later added e.g. $\frac{3}{4}\times\frac{1}{3}+\frac{1}{4}\times\frac{2}{3}$ it is M0 May be implied by one correct answer to (i) or (ii) A1 for $\frac{1}{4}$ or 0.25 or exact equivalent (allow 25%)
(ii)	A1 for $\frac{1}{6}$ or exact equivalent
(b)	**For the 1st 4 marks condone incorrect labelling e.g. *R* for *m* or *G* for *n* if intention is clear** 1st M1 for identifying either set of cases ($R = 2, G = 1, X = 20$) or ($R = 3, G = 4, X = 50$) Allow 1st M1 for $P(X = 20) = \frac{1}{4}\times\frac{2}{3}$ **or** $P(X = 50) = \frac{3}{4}\times\frac{1}{3}$ **NOT** just $P(X = 20) = \frac{1}{6}$ etc <u>or</u> $\frac{1}{4}m+\frac{2}{3}n=20$ **or** $\frac{3}{4}m+\frac{1}{3}n=50$ and might score 2nd M1 (answer is $m = 64$, $n = 6$) <u>or</u> $\frac{1}{4}m+\frac{2}{3}n=\frac{1}{6}$ **or** $\frac{3}{4}m+\frac{1}{3}n=\frac{1}{4}$ and might score 2nd M1 (answer is $m = \frac{4}{15}$, $n = \frac{3}{20}$) <u>or</u> $2m+n=\frac{1}{6}$ **or** $3m+4n=\frac{1}{4}$ and might score 2nd M1 (answer is $m = \frac{1}{12}$, $n = 0$) <u>or</u> $2m+n=50$ **and** $3m+4n=20$ and might score 2nd M1 (answer is $m = 36$, $n = – 22$) 1st A1 for one correct equation 2nd A1 for **both** correct equations and no incorrect equations, unless they attempt to solve the correct 2 equations only 2nd M1 for attempt to solve <u>their</u> two linear equations in m and n (reduce to an equation in one variable, condone one sign error). May be implied by $m = 6$ and $n = 8$.
Calc	If they use one of the 4 sets of equations for 1st M1 and use a calculator to write down the answer, we will allow this mark for sight of the correct answers to those equations as given above. 3rd A1 $m = 6$ and $n = 8$ only (no incorrect labelling here) Correct answer by trial can score 5/5 if no incorrect working seen.

4. Magali is studying the mean total cloud cover, in oktas, for Leuchars in 1987 using data from the large data set. The daily mean total cloud cover for all 184 days from the large data set is summarised in the table below.

Daily mean total cloud cover (oktas)	0	1	2	3	4	5	6	7	8
Frequency (number of days)	0	1	4	7	10	30	52	52	28

One of the 184 days is selected at random.

(a) Find the probability that it has a daily mean total cloud cover of 6 or greater.

(1)

Magali is investigating whether the daily mean total cloud cover can be modelled using a binomial distribution.

She uses the random variable X to denote the daily mean total cloud cover and believes that $X \sim B(8, 0.76)$

Using Magali's model,

(b) (i) find $P(X \geqslant 6)$

(2)

(ii) find, to 1 decimal place, the expected number of days in a sample of 184 days with a daily mean total cloud cover of 7

(2)

(c) Explain whether or not your answers to part (b) support the use of Magali's model.

(1)

There were 28 days that had a daily mean total cloud cover of 8
For these 28 days the daily mean total cloud cover for the **following** day is shown in the table below.

Daily mean total cloud cover (oktas)	0	1	2	3	4	5	6	7	8
Frequency (number of days)	0	0	1	1	2	1	5	9	9

(d) Find the proportion of these days when the daily mean total cloud cover was 6 or greater.

(1)

(e) Comment on Magali's model in light of your answer to part (d).

(2)

Question	Scheme	Marks	AOs
4 (a)	$\frac{132}{184} = 0.71739...$ awrt **<u>0.717</u>**	B1	1.1b
		(1)	
(b)(i)	$P(X \geq 6) = 1 - P(X \leq 5)$ or $P([X =]6) + P([X =]7) + P([X =]8)$	M1	3.4
	$= 1 - 0.296722...$ awrt **<u>0.703</u>**	A1	1.1b
		(2)	
(b)(ii)	$184 \times P(X = 7)$ $[= 184 \times 0.2811\ldots]$	M1	1.1b
	$= 51.7385...$ awrt **<u>51.7</u>**	A1	1.1b
		(2)	
(c)	Part (a) and part (b)(i) are similar **and** the expected number of 7s (51.7 or 0.281) matches with the number of 7s found in the data set (52 or 0.283) so Magali's model is supported.	B1ft	3.5a
		(1)	
(d)	$\frac{23}{28} = 0.82142...$ awrt **<u>0.821</u>**	B1	1.1b
		(1)	
(e)	Any one of… • Part (d)/'0.821' differs from part (a)/(b)(i)/(0.7…) • there is a **greater/different probability of high cloud cover/more likely to have high cloud cover** if the previous day had high cloud cover • **independence(o.e.)** does not hold	B1	2.4
	…therefore Magali's (binomial) model may not be suitable.	dB1	3.5a
		(2)	
			(9 marks)

Notes

	Allow fractions, decimals or percentages throughout this question.
(a)	Allow equivalent fraction, e.g. $\frac{33}{46}$
(b)(i)	**M1:** for writing or using $1 - P(X \leq 5)$ or $P(X = 6) + P(X = 7) + P(X = 8)$ **A1:** awrt 0.703 (correct answer scores 2 out of 2)
(b)(ii)	**M1:** for $184 \times P(X = 7)$ o.e. e.g., $184 \times [P(X \leq 7) - P(X \leq 6)]$ **A1:** awrt 51.7
(c)	**B1ft:** comparing '0.717' with '0.703' <u>and</u> '51.7 or '0.281' with 52 or 0.283 **and** concluding that Magali's model **is supported** (must be comparing prob. with prob. <u>and</u> days with days). Allow not supported or mixed conclusions if consistent with their f.t. answers in (a) and (b)
(e)	**B1:** Any bullet point **dB1:** (dep on previous B1) for Magali's model may not be suitable (o.e.) Condone not accurate for not suitable **SC:** part (d) is similar to part (a)/(b)(i) **and** a compatible conclusion (i.e. Magali's model is supported) to score B1B1.

6. The discrete random variable X has the following probability distribution

x	a	b	c
$P(X = x)$	$\log_{36} a$	$\log_{36} b$	$\log_{36} c$

where

- a, b and c are distinct integers $(a < b < c)$
- all the probabilities are greater than zero

(a) Find

(i) the value of a

(ii) the value of b

(iii) the value of c

Show your working clearly.

(5)

The independent random variables X_1 and X_2 each have the same distribution as X

(b) Find $P(X_1 = X_2)$

(2)

Qu 6	Scheme	Marks	AO
(a)	[Sum of probs = 1 implies] $\log_{36} a + \log_{36} b + \log_{36} c = 1$	M1	3.1a
	$\Rightarrow \log_{36}(abc) = 1$ so *abc* = 36	A1	3.4
	All probabilities greater than 0 implies each of *a*, *b* and *c* > 1	B1	2.2a
	$36 = 2^2 \times 3^2$ (or 3 numbers that multiply to give 36 e.g. 2, 2, 9 etc)	dM1	2.1
	Since *a*, *b* and *c* are distinct must be **2, 3, 6** **(*a* = 2, *b* = 3, *c* = 6)**	A1	3.2a
		(5)	
(b)	$(\log_{36} a)^2 + (\log_{36} b)^2 + (\log_{36} c)^2$	M1	3.4
	[= 0.0374137…+ 0.09398737…+0.25]		
	= 0.38140… awrt **0.381**	A1	1.1b
		(2)	
		(7 marks)	
	Notes		
(a)	1st M1 for a start to the problem using sum of probabilities leading to eq'n in *a*, *b* and *c*		
	1st A1 for reducing to the equation *abc* = 36 [Must follow from their equation.]		
NB	Can go straight from *abc* = 36 to the answer for full marks for part (a).		
	B1 for deducing that each value > 1 (may be implied by 3 integers all > 1 in the next line)		
	2nd dM1 (dep on M1A1) for writing 36 as a product of prime factors or 3 values with product = 36 and none = 1		
	2nd A1 for 2, 3 and 6 as a list or *a* = 2, *b* = 3 and *c* = 6		
SC **Ans only**	**M0M0** If no method marks scored but a correct answer given score: M0A0B1M0A1 (2/5) This gets the SC score of 2/5 [Question says show your working clearly]		
(b)	M1 for a correct expression in terms of *a*, *b* and *c* or values; ft their integers *a*, *b* and *c* Condone invisible brackets if the answer implies they are used.		
	A1 for awrt 0.381		

3. Dian uses the large data set to investigate the Daily Total Rainfall, r mm, for Camborne.

(a) Write down how a value of $0 < r \leqslant 0.05$ is recorded in the large data set.

(1)

Dian uses the data for the 31 days of August 2015 for Camborne and calculates the following statistics

$$n = 31 \qquad \sum r = 174.9 \qquad \sum r^2 = 3523.283$$

(b) Use these statistics to calculate

(i) the mean of the Daily Total Rainfall in Camborne for August 2015,

(ii) the standard deviation of the Daily Total Rainfall in Camborne for August 2015.

(3)

Dian believes that the mean Daily Total Rainfall in August is less in the South of the UK than in the North of the UK.
The mean Daily Total Rainfall in Leuchars for August 2015 is 1.72 mm to 2 decimal places.

(c) State, giving a reason, whether this provides evidence to support Dian's belief.

(2)

Dian uses the large data set to estimate the proportion of days with no rain in Camborne for 1987 to be 0.27 to 2 decimal places.

(d) Explain why the distribution B(14, 0.27) might **not** be a reasonable model for the number of days without rain for a 14-day summer event.

(1)

Question	Scheme	Marks	AOs
3(a)	tr	B1	1.2
		(1)	
(b)(i)	$\mu = \frac{174.9}{31} = 5.6419\ldots$ awrt 5.64	B1	1.1b
(ii)	$\sigma_r = \sqrt{\frac{3523.283}{31} - \mu^2}$	M1	1.1b
	$= 9.04559\ldots$ awrt 9.05	A1	1.1b
		(3)	
(c)	Leuchars is in the North and Camborne is in the South	M1	2.4
	The mean is smaller for Leuchars than Camborne therefore there is no evidence that Dian's belief is true	A1ft	2.2b
		(2)	
(d)	eg $p = 0.27$ is unlikely to be constant.	B1	2.4
		(1)	
			(7 marks)

Notes:

(a)	**B1**	Allow Tr or trace or Trace
(b)(i)	**B1**	For a correct mean awrt 5.64
(ii)	**M1**	For a correct expression for sd including the $\sqrt{\ }$ Ft their mean
	A1	awrt 9.05 (Allow $s = 9.1932\ldots$ awrt 9.19) NB awrt to 9.05 or 9.19 with no working is M1 A1
(c)	**M1**	For stating Leuchars is North of Camborne oe eg Camborne is further south
	A1ft	M1 must be awarded. A correct conclusion **and** correct comment about the means ft their mean in (b) Allow No
	SC	for No **and** there are only 2 places used so there is insufficient data. Mark as M0A1 on epen
(d)	**B1**	A correct reason referring to • independence (needs context as to what is independent) eg consecutive 14 days unlikely to be independent. • probability [of rain] not being constant. • Allow a comment that conveys the idea that the proportion of days with no rain will be different over the year.