

Edexcel GCE
Statistics S2
Gold Level G3
(Mark Scheme)

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Question Number	Scheme	Marks
1.	<p>(a) The <u>list</u> of <u>ID</u> numbers</p> <p>(b) $F \sim B(50, 0.02)$</p>	<p>B1 (1)</p> <p>B1 B1 (2)</p> <p>3</p>
2.	<p>(a) $H_0 : p = 0.2$ $H_1 : p > 0.2$ B1 Under H_0, $X \sim \text{Bin}(10, 0.2)$ B1 $P(X \geq 4) = 1 - P(X \leq 3)$ OR $P(X < 4) = 0.9672$ $= 1 - 0.8791$ $P(X > 5) = 0.0328$ $= 0.1209$ CR $X > 5$ A1 0.1209 > 0.05. Insufficient evidence to reject H_0 so teacher's claim is supported.</p>	<p>B1 B1 M1 A1 M1 A1ft [6]</p>
3.	<p>(a) $X \sim \text{Po}(9)$ may be implied by calculations in part a or b</p> <p>$P(X \leq 3) = 0.0212$ $P(X \geq 16) = 0.0220$</p> <p>CR $X \leq 3; \cup X \geq 16$</p> <p>(b) $P(\text{rejecting } H_0) = 0.0212 + 0.0220$ $= 0.0432$ or 0.0433</p>	<p>M1</p> <p>A1; A1 (3)</p> <p>M1 A1 cao (2) (5 marks)</p>
4.	<p>(a) A <i>statistic</i> is a function of X_1, X_2, \dots, X_n that does not contain any unknown parameters</p> <p>(b) The <u>probability</u> distribution of Y or the distribution of all possible values of Y (o.e.)</p> <p>(c) Identify (ii) as not a statistic Since <u>it contains</u> unknown parameters $\underline{\mu}$ and $\underline{\sigma}$.</p>	<p>B1 B1 (2)</p> <p>B1 1)</p> <p>B1 dB1 (2) (5 marks)</p>

Question Number	Scheme	Marks
5. (a)	Mode = 3 from graph	B1 (1)
(b)	$\int_0^3 kx^2 dx = 0.5 \Rightarrow \left[\frac{kx^3}{3} \right]_0^3 = 0.5$ <p>So $\frac{27k}{3} - 0 = 0.5 \Rightarrow k = \frac{1}{18}$ (using median = 3)</p>	M1 A1 M1d A1 (4)
(c)	<p>Height of triangle = $\frac{1}{18} \times 3^2 = \frac{1}{2}$</p> <p>Area of triangle = $\frac{1}{2} \times (a-3) \times \frac{1}{2} = \frac{1}{2}$ so $a = 5$ cao</p>	B1ft M1 A1 (3)
(d)	From graph distribution is negative skew (left tail is longer) $\mu < \text{median}$ for negative skew so $E(X) < 3$	B1 B1d (2)
	[N.B. $E(X) = 2\frac{23}{24}$]	10

6.	[$X = \text{number of customers joining the queue in the next 10 mins} \sim \text{Po}(3)$]	
(a)	$P(X = 4) = P(X \leq 4) - P(X \leq 3)$ or $\frac{e^{-3}3^4}{4!}$ $0.8153 - 0.6472 = 0.1681$ or $0.1680313\dots$ (awrt 0.168)	M1 A1 (2)
(b)	Y [= number of customers joining the queue in the next 20 mins] $\sim \text{Po}(6)$ $P(Y > 10) = 1 - P(Y \leq 10)$ $= 1 - 0.9574 = 0.0426(209\dots)$ (awrt 0.0426)	B1 M1 A1 (3)
(c)	$P(T > 3.5) = \mathbf{0.3}$	B1 (1)
(d)	$C \sim B(5, 0.3)$ $P(C \geq 3) = 1 - P(C \leq 2)$ $= 1 - 0.8369 = 0.1631$ (Or 0.16308..) (awrt 0.163)	M1 M1 A1 (3)
(e)	$P(\text{Bethan is served in } < 4 \text{ minutes}) = 0.8$ (o.e.) $J = \text{number joining the queue in 4 mins has } J \sim \text{Po}(1.2)$ $P(J = 0) = e^{-1.2} = 0.30119\dots$ $P(\text{Bethan is served and } J = 0) = 0.8 \times e^{-1.2} = 0.240955\dots$ (awrt 0.241)	B1 M1 A1 A1 (4)
		[13]

Question Number	Scheme	Marks
7.	Attempt to write down combinations	at least one seen
	(1,1,1), (1,1,2) any order (1,2,2) any order, (2,2,2)	no extra combinations
	Range 0 and 1	0 and 1 only
	[P(range = 0) =] $(0.65)^3 + (0.35)^3$ = 0.3175 or $\frac{127}{400}$	either range
	[P(range = 1) =] $(0.35)^2(0.65) \times 3 + (0.65)^2(0.35) \times 3$ = 0.6825 or $\frac{273}{400}$	
		M1 A1 B1 M1 A1 cao A1 cao (6) Total 6

8.	(a) (i)	a <u>population parameter</u> proposed by <u>the null hypothesis</u> compared with an <u>alternative hypothesis</u> .	B1
	(ii)	The critical region is the <u>range of values</u> or <u>a test statistic</u> or <u>region where the test is significant</u> that would lead to <u>the rejection of H₀</u> .	B1g B1h (3)
	(b)	Let X represent the number of incoming calls : $X \sim \text{Po}(9)$ From table $P(X \geq 16) = 0.0220$ $P(x \leq 3) = 0.0212$ Critical region ($x \leq 3$ or $x \geq 16$)	B1 M1 A1 A1 B1 (5)
	(c)	Significance level = $0.0220 + 0.0212$ = 0.0432 or 4.32%	B1 (1)
	(d)	$H_0 : \lambda = 4.5$; $H_1 : \lambda < 4.5$ (accept : $H_0 : \lambda = 4.5$; $H_1 : \lambda < 4.5$) Using $X \sim \text{Po}(4.5)$ $P(X \leq 1) = 0.0611$ CR $X < 0$ awrt 0.0611 0.0611 > 0.05. 1 ≥ 0 or 1 not in the critical region There is evidence to Accept H ₀ or it is not significant There is no evidence that there are less calls during school holidays.	B1 M1 A1 M1 B1cao (5)

Question Number	Scheme	Marks
9.	(a) $X \sim \text{Po}(2)$ $P(X = 4) = \frac{e^{-2} \times 2^4}{4!} = 0.0902$	awrt 0.09 M1 A1 (2)
(b)	$Y \sim \text{Po}(8)$ $P(Y > 10) = 1 - P(Y \leq 10) = 1 - 0.8159 = 0.18411\dots$	B1 awrt 0.184 M1 A1 (3)
(c)	$F = \text{no. of faults in a piece of cloth of length } x$ $F \sim \text{Po}(x \times \frac{2}{15})$ $e^{-\frac{2x}{15}} = 0.80$ $e^{-\frac{2}{15} \times 1.65} = 0.8025\dots$, $e^{-\frac{2}{15} \times 1.75} = 0.791\dots$ These values are either side of 0.80 therefore $x = 1.7$ to 2 sf	M1 A1 M1 A1 (4)
(d)	Expected number with no faults $= 1200 \times 0.8 = 960$ Expected number with some faults $= 1200 \times 0.2 = 240$ So expected profit $= 960 \times 0.60 - 240 \times 1.50,$ $= \text{£}216$	M1 A1 M1, A1 (4) (13 marks)

Statistics for S2 Practice Paper Gold 3

Mean average scored by candidates achieving grade:

Qu	Max Score	Modal score	Mean %	ALL	A*	A	B	C	D	E	U
1	3		52.3	1.57	1.91	1.79	1.56	1.42	1.24	1.12	0.77
2	6		65.2	3.91	4.60	4.43	2.95	2.53	1.53	1.09	0.36
3	5		57.6	2.88		3.61	3.00	2.54	1.94	1.24	0.63
4	5		44.8	2.24		2.99	2.08	1.64	1.30	1.13	0.71
5	10		48.8	4.88	7.42	6.22	4.60	3.87	3.34	2.70	1.79
6	13		78.2	10.16	12.02	11.01	9.76	8.40	7.39	6.22	4.06
7	6		51.2	3.07	4.60	3.95	2.99	2.33	1.85	1.39	0.79
8	14		54.7	7.66		10.55	6.43	4.06	3.56	1.83	0.59
9	13		62.8	8.17		10.61	8.29	6.86	5.67	4.69	2.41
	75		59.4	44.54		55.16	41.66	33.65	27.82	21.41	12.11