Hypothesis Testing 2 MS

Q1.

4	(i)	$P(X \leqslant 1) = (0.75)^{20} + 20(0.75)^{19}(0.25)$ $= 0.0243$	M1 A1	Attempt correct expression
		$P(X \leqslant 2) = (0.75)^{20} + 20(0.75)^{19}(0.25) + {}^{20}C_2(0.75)^{18}(0.25)^2$ $= 0.0913$ or 0.0912	M1 A1	Attempt correct expression OR Find P(2) $= 0.0669$ or 0.0670
		Critical region is 0 or 1 pkt contain gift or < 2 pkts contain gift oe	A1 [5]	dep M1M1 & their $P(X \leqslant 1) < 0.05 <$ their $P(X \leqslant 2)$ (S.R. Use of Normal: $N(5.3.75^2)$ used B1 $-1.645=(x + 0.5 - 5)/\sqrt{3.75}$ M1 $x < 1.31$ A1 (3/5))
	(ii)	P(Type I) = 0.0243 (3 sfs)	B1ft [1]	ft their $P(X \leqslant 1)$ dep < 0.05 ft Normal
	(iii)	2 is outside rej reg No evidence to reject claim	M1 A1ft [2]	or $P(X \leqslant 2) > 0.05$ No contradictions

Q2.

7	(i)	$n > 50$	B1		Accept n large
		$np = 0.8$, which is < 5	B1	[2]	Accept p small
	(ii)	$\lambda = 9.6$	B1		
		$e^{-9.6}(\frac{9.6^3}{3!} + \frac{9.6^4}{4!} + \frac{9.6^5}{5!})$	M1		Any λ Accept end errors.
		$= 0.0800$ (3 sfs)	A1	[3]	Allow 0.08
	(iii)	H_0: Pop mean for 10 days = 8 H_1: Pop mean for 10 days < 8	B1		or Pop mean for 1 day = 0.8 Pop mean for 1 day < 0.8 Allow λ or μ but not just 'mean'
		$e^{-8}(1 + 8 + \frac{8^2}{2!})$	M1		Any λ. Accept end errors. NB P(2) only used scores M0M0 Accept CR method
		$= 0.0138$ or 0.0137	A1		CR = 0, 1, 2 all working must be shown
		Compare 0.02 Evidence that mean number of absentees has decreased	M1 A1ft	[5]	Valid comparison with 0.02 or CR No contradictions Reject H_0 / accept H_1 only if H_0 / H_1 correctly defined
Total				**[10]**	
		Total for paper		**[50]**	

Hypothesis Testing 2 MS

Q3.

7	(i)	Conclude die is biased when it isn't oe $^5C_3\left(\frac{1}{6}\right)^3\left(\frac{5}{6}\right)^2 + 5\left(\frac{1}{6}\right)^4\left(\frac{5}{6}\right) + \left(\frac{1}{6}\right)^5 + 5$ $= \frac{23}{648}$ or 0.0355 (3 sf)	B1 M1 A1 [3]	In context or $1 - \left(^5C_2\left(\frac{1}{6}\right)^2\left(\frac{5}{6}\right)3 + 5\left(\frac{1}{6}\right)\left(\frac{5}{6}\right)^4 + \left(\frac{5}{6}\right)^5\right)$ allow 1 end error
	(ii)	State or attempt P(0, 1, 2) with $p = \frac{2}{3}$ $^5C_2\left(\frac{2}{3}\right)^2\left(\frac{1}{3}\right)^3 + 5\left(\frac{2}{3}\right)\left(\frac{1}{3}\right)^4 + \left(\frac{1}{3}\right)^5$ $= \frac{17}{81}$ or 0.210 (3 sf)	M1 M1 A1 [3]	Or 1– P(3,4,5) Attempt at correct expression Allow 0.21
	(iii)	Est Var(P_s) $= \frac{0.625 \times (1 - 0.625)}{80}$ $(= \frac{3}{1024})$ $z = 2.054$ (or 2.055) $0.625 \pm z \times \sqrt{\frac{'3'}{1024}}$ = 0.514 to 0.736 (3 sf)	M1 B1 M1 A1 [4]	Any z

Q4.

3	(i)	$\frac{73.1-75.2}{\frac{5.7}{\sqrt{n}}} = -1.563$ $n = \{-1.563 \times 5.7 \div (-2.1)\}^2$ $n = 18$ Assume s.d. for the region is 5.7	M1 A1 A1 B1 [4]	For standardising (with $\sqrt{n}$) Any correct expression for n or $\sqrt{n}$. May be implied by ans.
	(ii)	H_0: pop mean (or μ) = 75.2 H_0: pop mean (or μ) < 75.2 1.563 comp 1.555 Evidence that plants shorter	B1 M1 A1 [3]	Both (could be stated in (i)) For comparison of z values / areas / x values CWO. No contradictions
			[Total: 7]	

Hypothesis Testing 2 MS

Q5.

6 (i)	H_0: Pop mean (or λ or μ) is 5.3 H_1: Pop mean (or λ or μ) is less than 5.3	B1	Both
	$P(X \leq 1) = e^{-5.3}(1 + 5.3)$ $P(X \leq 2) = e^{-5.3}(1 + 5.3 + \frac{5.3^2}{2})$ /P(X=2)	M1	Both attempted
	$P(X \leq 1) = 0.0314$ or 0.0315 & $P(X \leq 2) = 0.102$/ P(X=2)=0.7071	A1	Both correct
	CR is 0 or 1 cases	A1	Dep. M1 and $P(X \leq 1) < 0.05 < P(X \leq 2)$
	No evidence mean has decreased	B1f [5]	ft their CR
(ii)	Concluding mean has decreased when it hasn't	B1	In context
	'0.0314 or 0.0315'	B1ft[2]	ft their $P(X \leq 1)$, dep. < 0.05
(iii)	(Po(18.4)) N(18.4, 18.4)	B1 B1ft	Stated or implied B1 for N(18.4, ..); B1f for var. = 18.4
	$\frac{20.5-18.4}{\sqrt{18.4}}$ (= 0.490)	M1	For standardising with or without cc.Allow without √
	1 – Φ('0.490')	M1	Use of tables and attempt to find area consistent with their working
	= 0.312 (3 s.f.)	A1 [5]	
	[Total: 12]		

Q6.

6 (i)	P(Type I) = 1 - P(≥ 4 assuming $p = 0.7$) $1-({}^6C_4 \times 0.7^4 \times 0.3^2 + {}^6C_5 \times 0.7^5 \times 0.3 + 0.7^6)$ (= 1 – 0.744) = 0.256 (3 s.f.)	M1 M1 A1 [3]	or P(≤ 3 assuming $p = 0.7$) May be implied ${}^6C_3 \times 0.7^3 \times 0.3^3 + {}^6C_2 \times 0.7^2 \times 0.3^4 + {}^6C_1 \times 0.7 \times 0.3^5 + 0.3^6$ Allow one end error = 0.256 (3 s.f.) SR if zero scored allow B1 for use of B(6, 0.7) in any two or more terms
(ii)	P(Type II) = P(≥ 4 assuming $p = 0.35$) $= {}^6C_4 \times 0.35^4 \times 0.65^2 + {}^6C_5 \times 0.35^5 \times 0.65 + 0.35^6$ = 0.117	M1 M1 A1 [3]	May be implied Allow one end error SR if zero scored allow B1 for use of B(6, 0.35) in any two or more terms
(iii)	Type 1 They will reject Luigi's belief, although it might be true.	B1 B1 [2]	In context