

Topic Y9 Statistics (Pre-TT) [45] MARKSCHEME

1.

$\frac{20 - 25}{\sigma} = \Phi^{-1}(0.25) = -0.674$ $\sigma = 5 \div 0.674$ $= 7.42$	M1 B1 M1 A1	4	Standardise and equate to Φ^{-1} [not .7754 or .5987] z in range $[-0.675, -0.674]$, allow + (\pm) 5 \div z -value [not $\Phi(z)$ or 0.75] Answer in range [7.41, 7.42], no sign fudges [SR: σ^2 : M1B1M0A0 cc: M1B1M1A0]
--	----------------------	---	---

2.

Question	Scheme	Marks	AOs
5(a)	$P(L_x > 160) = P\left(Z > \frac{160 - 150}{25}\right)$		
	$= P(Z > 0.4)$		
	$= 1 - 0.6554$		
	$= \text{awrt } 0.345 \quad 0.34457\dots$	B1	1.1b
	Expected number = $12 \times "0.345"$	M1	1.1b
	$= 4.13$ (allow 4.14)	A1	1.1b
		(3)	
(b)	$P(L_y < 180) = 0.841621\dots$	B1	3.4
	$\frac{180 - 160}{\sigma} = 0.8416$	M1	1.1b
	$\sigma = \text{awrt } 23.8$	A1	1.1b
		(3)	
(c)	The standard deviations for two companies are close but the mean for company Y is higher	M1	2.4
	therefore choose company Y	A1	2.2b
		(2)	
(8 marks)			
Notes:			
(a) B1: awrt 0.345 M1: for multiplying their probability by 12 A1: 4.13 (allow 4.14)			
(b) B1: for use of the correct model to find the correct value of z awrt 0.842 M1: for standardising = to a Z value $0.5 < Z < 1$ A1: awrt 23.8			
(c) M1: for a correct reason following their part(b) A1: for making an inference that follows their part(b)			

3.

(a)	e.g. It requires extrapolation so will be unreliable (o.e.)	B1	1.2
		(1)	
(b)	e.g. Linear association between w and t	B1	1.2
		(1)	
(c)	$H_0: \rho = 0 \quad H_1: \rho > 0$	B1	2.5
	Critical value 0.5822	M1	1.1a
	Reject H_0		
	There is evidence that the product moment correlation coefficient is greater than 0	A1	2.2b
		(3)	

4.

$\frac{105.0 - \mu}{\sigma} = -0.7; \frac{110.0 - \mu}{\sigma} = -0.5$ <p>Solve: $\sigma = 25$ $\mu = 122.5$</p>	M1 A1 B1 M1 A1 A1	6 Standardise once, equate to Φ^{-1} , allow σ^2 Both correct including signs & σ , no cc (continuity correction), allow wrong z Both correct z -values. "1 -" errors: M1A0B1 Get either μ or σ by solving simultaneously σ a.r.t. 25.0 $\mu = 122.5 \pm 0.3$ or 123 if clearly correct, allow from σ^2 but <i>not</i> from $\sigma = -25$.
--	--------------------------------------	--

5.

(i)	${}^{30}C_{10}(0.4)^{10}(0.6)^{20}$ or $0.2915 - 0.1763 = 0.1152$	M1 A1	2	Correct formula or use of tables Answer, a.r.t. 0.115
(ii)	$30p > 5$ so $p > \frac{1}{6}$ $30q > 5$ so $q > \frac{1}{6}$ $\frac{1}{6} < p < \frac{5}{6}$	M1 M1 A1	3	$30p$ or $30pq$ used $30q$ or both solutions from $30pq$ used <i>Either</i> $\frac{1}{6} < p < \frac{5}{6}$ <i>or</i> $[\frac{1}{2} - \frac{\sqrt{3}}{6} < p < \frac{1}{2} + \frac{\sqrt{3}}{6}]$ $[0.211 < p < 0.789]$, allow \leq
(iii)	$N(12, 7.2)$ $\frac{10.5 - np}{\sqrt{npq}}$ and $\frac{9.5 - np}{\sqrt{npq}}$ $\Phi(-0.559) - \Phi(-0.9317)$ $= 0.8243 - 0.7119 = 0.1124$	B1 B1 M1 A1 M1 A1	6	12 seen 7.2 or 2.683 seen, allow 7.2^2 Both standardised, allow wrong/no cc, npq \sqrt{npq} , 10.5 and 9.5 correct, $\sqrt{\quad}$ on their np, npq Correct use of tails Answer, in range [0.112, 0.113] [SR: $\frac{1}{\sqrt{2\pi \times 7.2}} e^{-\frac{1}{2} \frac{(10-12)^2}{7.2}}$ M1A1, answer A2]

6.

(a)(i)	States both hypotheses using correct language	AO2.5	B1	$H_0 : \mu = 123$ $H_1 : \mu \neq 123$ Test statistic = $\frac{127 - 123}{70}$ $\frac{127 - 123}{\sqrt{12144}}$ = 6.30 Critical z values ± 1.96 $6.30 > 1.96$
	Finds test statistic	AO1.1a	M1	
	Obtains correct test statistic	AO1.1b	A1	
	Infers H_0 rejected by comparison of ts with cv	AO2.2b	A1	
	Concludes correctly in context, including 'some evidence'	AO3.2a	E1	Reject H_0 there is evidence (at the 5% level) to suggest the mean expenditure on bread had changed from 2012 to 2013
ALT	States both hypotheses using correct language	AO2.5	B1	$H_0 : \mu = 123$ $H_0 : \mu \neq 123$ From calculator, $P(X < 127) = 3.045 \times 10^{-10}$ $3.045 \times 10^{-10} < 0.025$
	Attempts to find p value for z -test	AO1.1a	M1	
	Finds correct p value	AO1.1b	A1	
	Infers H_0 rejected by comparison of p with 0.025	AO2.2b	A1	
	Concludes correctly in context, including 'some evidence'	AO3.2a	E1	Reject H_0 - there is evidence (at the 5% level) to suggest the mean expenditure on bread had changed from 2012 to 2013
(a)(ii)	Uses Normal model to find critical values PI	AO3.4	M1	$123 \pm 1.96 \times \frac{70}{\sqrt{12144}}$ min=121.75 and max=124.25
	Obtains correct critical values Correct accuracy required for this mark Disallow integer answers	AO1.1b	A1	
(b)(i)	States valid reason for statement 1 'not supported'	AO2.4	R1	The conclusion implies that the mean changed, not that it increased by a specific amount, so the statement is not supported
	Infers that model/test used would not imply the statement	AO2.2b	R1	
(b)(ii)	States valid reason for statement 2 'not supported'	AO2.4	R1	The conclusion implies that there is evidence that the mean has changed, but expenditure increase may be due to price changes, so statement is not supported
	Infers that model/test used would not imply the statement	AO2.2b	R1	
	Total		11	