Mark Scheme 4733
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1	(i) (a) Po(2): 1 – P(≤ 3) = 0.1429	M1 A1 **2**	Po(2) tables, "1 – " used Answer, a.r.t. 0.143
	(b) Po(2/3): $e^{-2/3}\frac{(\frac{2}{3})^2}{2!}$ = 0.114	M1 M1 A1 **3**	Parameter 2/3 Poisson formula correct, r = 2, any μ Answer, a.r.t. 0.114
	(ii) Foxes may congregate so not independent	B1 B1 **2**	Independent/not constant rate/singly used Any valid relevant application in context
2	N(80/7, 400/49) $\frac{13.5-\frac{80}{7}}{\frac{20}{7}}$ = 0.725 1 – Φ(0.725) = 0.2343	B1 B1 M1 A1 A1 M1 A1 **7**	80/7, a.e.f (11.43) 400/49 or 20/7 seen, a.e.f. (8.163 or 2.857) Standardise with np & npq or $\sqrt{npq}$ or nq, no $\sqrt{n}$ $\sqrt{npq}$ correct 13.5 correct Normal tables used, answer < 0.5 Answer, a.r.t. 0.234 [SR: Binomial, complete expression M1, 0.231 A1 Po(80/7) B1, complete expression M1, 0.260 A1 Normal approx to Poisson, B1B0 M1A0A1 M1A0]
3	H_0: p = 0.3 H_1: $p \neq 0.3$ B(8, 0.3) P(≤ 4) = 0.9420; P(> 4) = 0.0580 P(≤ 5) = 0.9887; P(> 5) = 0.0113 Compare 0.025 or critical value 6 Do not reject H_0 Insufficient evidence that manufacturer's claim is wrong	B1 B1 M1 A1 M1 M1 A1√ **7**	NH stated, must be this form (or π) AH stated, must be this form (or π) [μ: B1 both] B(8, 0.3) stated or implied Any one of these four probabilities seen *Either* compare P(≥ 5) & 0.025 / P(≤ 4) & 0.975 *Or* critical region ≥ 6 with 5 H_0 not rejected, can be implied, needs essentially correct method Correct conclusion in context [SR: Normal, Poisson: can get B2M1A0M0M1A1 P(≤ 5): first 4 marks. P(= 5): first 3 marks only.]
4	(i) B(80, 0.02) approx Po(1.6) 1 – P(≤ 1) = 1 – 0.5249 = 0.4751	M1 M1 M1 A1 **4**	B(80, 0.02) seen or implied, e.g. N(1.6, 1.568) Po(np) used 1 – P(≤ 1) used Answer, a.r.t. 0.475 [SR: Exact: M1 M0 M0, 0.477 A1]
	(ii) P(≤ 4) = 0.9763, P(≥ 5) = 0.0237 P(≤ 5) = 0.9940, P(≥ 6) = 0.0060 Therefore least value is 6	M1 A1 A1 **3**	Evidence for correct method, e.g. answer 6 At least one of these probabilities seen Answer 6 only [SR N(1.6,1.568): 2.326 = (r – 1.6)/√1.568 M1 r = 5 or (with cc) 6 A1 Exact: M1 A0 A1]

5	(i) $\frac{0-\mu}{\mu/2} = -2$, independent of μ $1 - \Phi(2) = 1 - 0.9772 = 0.0228$	M1 A1 A1 A1 **4**	Standardise, allow –, allow $\mu^2/4$ $z = 2$ or -2 z-value independent of μ and any relevant statement Answer, a.r.t. 0.023
	(ii) $\Phi[(9-6)/3]$ $\Phi(1.0) = 0.8413$ $[\Phi(1.0)]^3$ $= 0.59546$	M1 A1 M1 A1 **4**	Standardise and use Φ *[no √n]* 0.8413 [not 0.1587] Cube previous answer Answer, in range [0.595, 0.596]
	(iii) Annual increases not independent	B1 **1**	Independence mentioned, in context. Allow "one year affects the next" but not "years not random"
6	H_0: $\mu = 32$; H_1: $\mu > 32$, where μ is population mean waist measurement $\overline{W} = 32.3$ $s^2 = 52214.50/50 - \overline{W}^2$ [= 1] $\hat{\sigma}^2 = 50/49 \times s^2$ [= 50/49 or 1.0204]	B1 B1 B1 M1 M1	One hypothesis correctly stated, *not x* or $\bar{x}$ or $\bar{w}$ Both completely correct, μ used Sample mean 32.3 seen Correct formula for s^2 used Multiply by 50/49 or √
	α: $z = (32.3 - 32)\times\sqrt{49}$ $= 2.1$ Compare 2.1 with 3.09 or 0.0179 with 0.001	M1 A1 B1	Correct formula for z, can use s, aef, need $\mu = 32$ $z = 2.1$ or $1 - \Phi(z) = 0.0179$, *not* -2.1 Explicitly compare their 2.1 with 3.09(0) or their 0.0179 with 0.001
	β: CV $= 32 + 3.09 \div\sqrt{49}$ $= 32.44$ Compare CV with 32.3	M1 B1 A1√	$32 + z \times \sigma/\sqrt{n}$ [allow ±, s, any z] $z = 3.09$ and (later) compare $\bar{x}$ CV in range [32.4, 32.5], √ on k
	Do not reject H_0 Insufficient evidence that waists are actually larger	M1√ A1√ **10**	Correct conclusion, can be implied, needs essentially correct method including $\sqrt{n}$, any reasonable σ, but not from $\mu = 32.3$ Interpreted in context
7	(i) $\frac{80-c}{8/\sqrt{12}} = 2.326$ $c = 74.63$	M1 A1 **4** B1 A1	Equate standardised variable to Φ^{-1}, allow – √12, 8 correct 2.326 or a.r.t 2.33 seen, signs must be correct Answer, a.r.t. 74.6, cwo, allow ≤ or ≥
	(ii) (a) Type I error (b) Correct	B1√ **1** B1√ **1**	"Type I error" stated, needs evidence "Correct" stated or clearly implied Wrong c: $74 < c < 75$, B1√ B1√ $c < 74$, both "correct", B1. $75 < c < 80$, both "Type I", B1 Also allow if only one is answered
	(iii) $\frac{74.63-\mu}{8/\sqrt{12}} = -1.555$ Solve for μ $\mu = 78.22$	M1*dep A1√ dep*M1 A1 **4**	$\frac{c-\mu}{8/\sqrt{12}} = (\pm)\Phi^{-1}$, allow no √12 but not 80, not 0.8264 Correct including sign, √ on their c Solve to find μ, dep, answer consistent with signs Answer, a.r.t. 78.2

8	(i)	$\int_0^1 x^n dx = \left[\frac{x^{n+1}}{n+1}\right]_0^1 = \frac{1}{n+1}$ $k/(n+1) = 1$ so $k = n+1$	M1 M1 A1 **3**	Integrate x^n, limits 0 and 1 Equate to 1 and solve for k Answer $n+1$, *not* 1^{n+1}, c.w.o.
	(ii)	$\int_0^1 x^{n+1} dx = \left[\frac{x^{n+2}}{n+2}\right]_0^1 = \frac{1}{n+2}$ $\mu = \frac{k}{n+2} = \frac{n+1}{n+2}$ **AG**	M1 A1 A1 **3**	Integrate x^{n+1}, limits 0 and 1, not just $x.x^n$ Answer $\frac{1}{n+2}$ Correctly obtain given answer
	(iii)	$\int_0^1 x^5 dx = \left[\frac{x^6}{6}\right]_0^1$ $[= \frac{1}{6}]$ $\sigma^2 = \frac{4}{6} - \left(\frac{4}{5}\right)^2 = \frac{2}{75}$	M1 M1 A1 **3**	Integrate x^5, limits 0 and 1, allow with n Subtract $\left(\frac{4}{5}\right)^2$ Answer $\frac{2}{75}$ or a.r.t. 0.027
	(iv)	$N\left(\frac{4}{5}, \frac{2}{7500}\right)$	B1 B1 B1√ **3**	Normal stated Mean $\frac{4}{5}$ or $\frac{n+1}{n+2}$ Variance their (iii)/100, a.e.f., allow √
	(v)	Same distribution, translated Mean 0 Variance $\frac{2}{75}$	M1 A1√ B1√ **3**	Can be negative translation; *or* integration, must include correct method for integral (Their mean) – $\frac{4}{5}$, c.w.d. Variance same as their (iii), or $\frac{2}{75}$ by integration