Version



General Certificate of Education (A-level) January 2013

Statistics

SS04

(Specification 6380)

Statistics 4

Final



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Key to mark scheme abbreviations

Μ	mark is for method
m or dM	mark is dependent on one or more M marks and is for method
А	mark is dependent on M or m marks and is for accuracy
В	mark is independent of M or m marks and is for method and accuracy
E	mark is for explanation
\sqrt{or} ft or F	follow through from previous incorrect result
CAO	correct answer only
CSO	correct solution only
AWFW	anything which falls within
AWRT	anything which rounds to
ACF	any correct form
AG	answer given
SC	special case
OE	or equivalent
A2,1	2 or 1 (or 0) accuracy marks
–x EE	deduct <i>x</i> marks for each error
NMS	no method shown
PI	possibly implied
SCA	substantially correct approach
с	candidate
sf	significant figure(s)
dp	decimal place(s)

No Method Shown

Where the question specifically requires a particular method to be used, we must usually see evidence of use of this method for any marks to be awarded.

Where the answer can be reasonably obtained without showing working and it is very unlikely that the correct answer can be obtained by using an incorrect method, we must award **full marks**. However, the obvious penalty to candidates showing no working is that incorrect answers, however close, earn **no marks**.

Where a question asks the candidate to state or write down a result, no method need be shown for full marks.

Where the permitted calculator has functions which reasonably allow the solution of the question directly, the correct answer without working earns **full marks**, unless it is given to less than the degree of accuracy accepted in the mark scheme, when it gains **no marks**.

Otherwise we require evidence of a correct method for any marks to be awarded.

1 (a)No. turning up $(X) \sim B(60, 0.8)$ which is approximately N(48, 9.6)B1 M1 A1May be implied Attempt at any normal approximation Mean = 48 cao, variance = 9.6 cao (or SD = 3.09 ~ 3.1(0)) $P(X > 50) = P(Z > \frac{50.5 - 48}{\sqrt{9.6}})$ M1Standardizing with their μ and σ (allow missing CC or 49.5); ignore sign $= P(Z > 0.81)$ m1Use of 50.5 and correct sign (0.81 not required) $= 1.0.79103$ A1AWFW 0.208-0.212 (more exact value 0.2099) $= 0.20897$ A1AWFW 0.208-0.212 (more exact value 0.2099)(b)Fairly high probability (of disgruntled customers.)B1No, would not recommend continuing.B4Sensible comment on size of prob (may say 0.21 is 'high' or 'low'; if prob < 0.21 should be 'high; if <th>Q</th> <th>Solution</th> <th>Marks</th> <th>Total</th> <th>Comments</th>	Q	Solution	Marks	Total	Comments
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No, would not recommend continuing. Bdep1 All correct (as bracket above) with clear, sensible conclusion (eg fairly low prob so recommend continuing gets 2/2) 2 Total 2					attempt at a conclusion
Clear, sensible conclusion (eg fairly low prob so recommend continuing gets 2/2) 2		No, would not recommend continuing.	Bdep1		All correct (as bracket above) with
Total 8					clear, sensible conclusion (eg
2 Continuing gets 2/2)					fairly low prob so recommend
Tatal 2				<u> </u>	continuing gets $2/2$)
Tatal 9				2	
		Total		8	

Q	Solution	Marks	Total	Comments
2 (a)(i)	Use of 2.5758	B1		Accept 2.57~2.58 (even if called t)
	99% CI is $6.75 \pm 2.5758 \times \frac{1.29}{\sqrt{1403}}$	M1		Use of $\frac{1.29}{\sqrt{1403}}$ (= 0.0344)
		m1		Correct interval, allow any Z
	$= 6.75 \pm 0.088(7)$	A1		Either for $6.75 \pm (0.088 \sim 0.089)$
	= (6.66, 6.84)		_	or AWRT 6.66 and 6.84
			4	
(ii)	Comparing upper limit of CI for males with lower limit of CI for females.	M1		Comparing limits of two CIs
	There is a difference between males and females.	A1		Requires implication of "difference" and clearly implied comparison of their upper limit with 6.87
			2	
(b)(i)	$H_0: p = 0.15$ $H_1: p > 0.15$	B1		For both
	Under H_0 , number sleeping over 8 hours ~ Bin(14, 0.15)	B1		Use of correct distribution
	Then $p(X \ge 4) = 1-0.8535$	M1		For finding $p(X \ge 4)$ or $p(X > 4)$ from a bin arrival distribution
	= 0.1465	A1		$(0.146 \sim 0.147)$
	Cannot reject H_0 at the 5% level	M1		Their binomial prob compared
	No evidence of difference from 15 percent.	E1		Correct conclusion in context. Needs all previous marks.
			6	Note p(X > 4) = 1 - 0.9533 = 0.047 so reject H ₀ gets B1B1M1A0M1E0 max 4/6
			0	
(ii)	Roughly the same age (not all teenagers) Same school/location. (not all UK) Similar social backgrounds etc	B1		Any sensible comment on the restricted nature of Rowan's sample.
	May not know/remember how long they slept. May not be truthful.	B1	2	Any sensible comment on issues such as inability to remember or truthfulness or accuracy.
	Total		14	

Q	Solution	Marks	Total	Comments
3 (a)	Total weight when Safeerah's riding			
	is:			
	65 + 15 = 80kg on steel bike			
	00 + 10 = 70 kg on carbon blke Then % reduction = $5/80 \times 1000/$	N/1		For attempt to include Safaarah's
	$1 \text{ Hen } 70 \text{ reduction} = 3/80 \times 100\%$	111		roi allempt to include Safeeran's
	= 6.25%	Α1		Correct calculation (Accept
	0.2570.	211		"approx 6").
				Alternatively, something like
				"94% of 80 is approx 75"
	Hence Josh's figure			
			2	
	- 00.175 4 (000	D1		
(b)	x = 88.175 $s = 4.6809$	BI		For 88.2 and $s_{n-1} = 4.68$ or
	$H \rightarrow \mu = 90$			s_n = 4.40(10) (ignore labels)
	$m_0 . \mu = 90$	B1		Both
	$H_1: \mu < 90$			
	88.175-90			S_{n-1} S_n .
	$i = \frac{1}{4.6809/\sqrt{12}}$	M1		Mill for use of $\frac{n}{\sqrt{n}}$ or $\frac{n}{\sqrt{n-1}}$ in
				test statistic formula
		m1		Correct formula, ignore sign for
				m1.
				88.175-90
				Or $t = \frac{44816}{\sqrt{11}}$
	= -1.351	A1		AWFW –1 36 to –1 33
	Critical value $t_{\rm eff} = -1.796$	B1		For 11 df may be implied (eg by
		B1		1.80 or 2.20(1)
				For $t_{11} = (-1.80 \sim -1.79)$
				or $p = 0.10197$ (AWFW 0.1005 to
				0.1055)
	Accept H_0 at 5% level.	E1		Their t and critical t (both
	No evidence that mean journey time is < 00 minutes			negative) OR their <i>p</i> -value and
	> 50 mmutes.			Requires M1 and m1 and "ace Ha"
				In context
				Alternatives
				Full marks available for:
				(i) one-sided CI
				88.1/5 + 2.42/ = 90.6 then cf 90
				(11) critical region 90 - 2427 = 87.6 then of 88.175
				70 - 2.427 - 07.0 men ei 80.175
			8	
	Total		10	

4 (a)Distributed at random/independently/ at constant average rate.B1For any of these.(b) $H_0: \lambda = 12$ $H_1: \lambda < 12$ Find $P(X \le 8)$ from Poisson tablesB1IFor both. Allow μ or "rate".(c)Number of lob worms in 10 m² (Y) has a Poisson distribution with $\lambda = 142$ Then 95% CI for Y using Z=1.96 is 142 ± 1.96 $\sqrt{142}$ B1For 1.96(c)Number of lob worms in 10 m² (Y) has a Poisson distribution with $\lambda = 142$ Then 95% CI for Y using Z=1.96 is 14.2 ± 2.3.45B1For 1.96(c)Number of lob worms in 10 m² (Y) has a Poisson distribution with $\lambda = 142$ Then average density per m² is 14.2 ± 2.3.4B1For 1.96(d)(i) $M_A = 56$ and $M_B = 13$ (ii)M1Dividing this (or limits) by 10 For AWRT (11.9, 16.5) or 14.2 ± 1.96 $\sqrt{14.2}$ gets B1M1A0 then B1 for answer 14.2 ± 7.4 getting max 3/5. (ii) Using 14.2 ± 1.96 $\sqrt{\frac{14.2}{10}}$ gets potentially full marks.	Q	Solution	Marks	Total	Comments
(d) (i) $M_A = 56$ and $M_B = 13$ (b) $H_0: \lambda = 12$ $H_1: \lambda < 12$ Find $P(X \le 8)$ from Poisson tables $H_1: \lambda < 12$ For both. Allow μ or "rate". Attempt to calculate $P(X \le 8)$ or $P(X < 8)(= 0.0895)$ Compare their Poisson prob with 0.10 All correct including 0.155. Allow "accept H ₀ " here and isw. 4 (c) Number of lob worms in 10 m ² (Y) has a Poisson distribution with $\lambda = 142$ Then 95% CI for Y using Z=1.96 is 142 ± 23.356 Then average density per m ² is 14.2 ± 2.34 (i) $M_A = 56$ and $M_B = 13$ (ii) $M_A = 56$ and $M_B = 13$ (iii) $M_A = 56$ and $M_B = 13$ (iv) $M_B = 13$ (iv) $M_A = 56$ and $M_B = 13$ (v) $M_$	4 (8) Distributed at random/independently/	B1		For any of these.
(b) $H_0: \lambda = 12$ $H_1: \lambda < 12$ Find $P(X \le 8)$ from Poisson tables MI = 0.155(0) MI This is > 0.10 so no evidence it's reduced. (c) Number of lob worms in 10 m ² (Y) has a Poisson distribution with $\lambda = 142$ Then 95% CI for Y using Z=1.96 is 142 ± 1.96 $\sqrt{142}$ MI $= 142 \pm 23.356$ A1 Then average density per m ² is 14.2 ± 2.34 (11.86, 16.54) A1 (11.86, 16.54) A1 (d) (i) $M_A = 56$ and $M_B = 13$ B1 (d) (i) $M_A = 56$ and $M_B = 13$ B1 (d) (i) $M_A = 56$ and $M_B = 13$ B1 (d) (i) $M_A = 56$ and $M_B = 13$ B1 (d) (i) $M_A = 56$ and $M_B = 13$ B1 (d) (i) $M_A = 56$ and $M_B = 13$ B1 (d) (i) $M_A = 56$ and $M_B = 13$ B1 (d) (i) $M_A = 56$ and $M_B = 13$ B1 (d) (i) $M_A = 56$ and $M_B = 13$ B1 (d) (i) $M_A = 56$ and $M_B = 13$ B1 (d) (i) $M_A = 56$ and $M_B = 13$ B1 (d) (i) $M_A = 56$ and $M_B = 13$ B1 (ii) Using 14.2 ± 1.96 $\sqrt{\frac{14.2}{10}}$ gets potentially full marks. For both		at constant average rate.		1	
(b) $H_0: \lambda = 12$ $H_1: \lambda < 12$ Find $P(X \le 8)$ from Poisson tables = 0.155(0) This is > 0.10 so no evidence it's reduced. (c) Number of lob worms in 10 m ² (Y) has a Poisson distribution with $\lambda = 142$ Then 95% CI for Y using Z=1.96 is $142 \pm 1.96\sqrt{142}$ $= 142 \pm 23.356$ Then average density per m ² is 14.2 ± 2.34 (11.86, 16.54) (d) (i) $M_A = 56$ and $M_B = 13$ (d) (i) $M_A = 56$ and $M_B = 13$ (ii) Using $14.2 \pm 1.96\sqrt{14.2}$ gets BIMIA0 then BI for answer 14.2 ± 7.4 getting max 3/5. (ii) Using $14.2 \pm 1.96\sqrt{14.2}$ gets BIMIA0 then BI for answer 14.2 ± 7.4 getting max 3/5. (ii) Using $14.2 \pm 1.96\sqrt{14.2}$ gets BIMIA0 then BI for answer 14.2 ± 7.4 getting max 3/5. (ii) Using $14.2 \pm 1.96\sqrt{14.2}$ gets BIMIA0 then BI for answer 14.2 ± 7.4 getting max 3/5. (ii) Using $14.2 \pm 1.96\sqrt{14.2}$ gets BIMIA0 then BI for answer 14.2 ± 7.4 getting max 3/5. (ii) Using $14.2 \pm 1.96\sqrt{14.2}$ gets BIMIA0 then BI for answer 14.2 ± 7.4 getting max 3/5. (ii) Using $14.2 \pm 1.96\sqrt{14.2}$ gets BIMIA0 then BI for answer 14.2 ± 7.4 getting max 3/5. (ii) Using $14.2 \pm 1.96\sqrt{14.2}$ gets BIMIA0 then BI for answer 14.2 ± 7.4 getting max 3/5. (ii) Using $14.2 \pm 1.96\sqrt{14.2}$ gets BIMIA0 then BI for answer 14.2 ± 7.4 getting max 3/5. (ii) Using $14.2 \pm 1.96\sqrt{14.2}$ gets BIMIA0 then BI for answer 14.2 ± 7.4 getting max 3/5. (ii) Using $14.2 \pm 1.96\sqrt{14.2}$ (j) BI marks. (j) Second joint (j) Secon				1	
(d) (i) $M_A = 56$ and $M_B = 13$ (d) (i) $M_A = 56$ and $M_B = 13$ (j) $M_B = 10$ (j) $M_A = 56$ and $M_B = 13$ (j) $M_A = 56$ and $M_B = 13$ (j) $M_A = 56$ and $M_B = 13$ (j) $M_B = 56$ (j) $M_A = 56$ and $M_B = 13$ (j	a	$H^{-1} \lambda = 12$			
(d) (i) $M_A = 56$ and $M_B = 13$ (d) (i) $M_A = 56$ and $M_B = 13$ (j) Would expect $V_A > M_A$ (j) $M_A = 56$ and $M_B = 13$ (j) $M_B = 56$ (j) $M_A = 56$ and $M_B = 13$ (j) $M_A = 56$ (j) $M_B = 15$	Ì	H = 2 < 12	B1		For both. Allow μ or "rate".
(d) (i) $M_A = 56$ and $M_B = 13$ (d) (i) $M_A = 56$ and $M_B = 13$ (i) Would expect $V > M_A$ (i) Number of lob worms in 10 m ² (Y) has a Poisson distribution with $\lambda = 142$ Then 95% CI for Y using Z=1.96 is B1 142 ± 2.3.356 Then average density per m ² is 14.2 ± 2.3.4 (ii) Using 14.2 ± 1.96 $\sqrt{\frac{14.2}{10}}$ gets potentially full marks. 5 For both		$H_1 \cdot \lambda < 12$	MI		$\mathbf{h} = \mathbf{h} + $
$ \begin{array}{c c c c c c c c c c c c c c c c c c c $		Find $P(X \le 8)$ from Poisson tables	IVIII		Attempt to calculate $P(X \le 8)$ or $P(X \le 8)$ or
		0.155(0)	2.01		P(X < 8) (= 0.0895)
(d) (i) $M_A = 56$ and $M_B = 13$ (c) Number of lob worms in 10 m ² (Y) has a Poisson distribution with $\lambda = 142$ Then 95% CI for Y using Z=1.96 is 142 ± 1.96 $\sqrt{142}$ = 142 ± 23.356 Then average density per m ² is 14.2 ± 2.34 (11.86, 16.54) A1 (i) $M_A = 56$ and $M_B = 13$ (ii) Would expect $V_{x \ge x}$ (ii) $M_A = 56$ and $M_B = 13$ (iii) $M_A = 56$ and $M_B = 13$ (iii) $M_A = 56$ and $M_B = 13$ (iii) $M_A = 56$ and $M_B = 13$ (iv) $M_A = 56$ and $M_B = 13$ (v) $M_A = 56$ and $M_B =$		= 0.155(0)	MI		Compare their Poisson prob with
(c) Number of lob worms in 10 m ² (Y) has a Poisson distribution with $\lambda = 142$ Then 95% CI for Y using Z=1.96 is $142 \pm 1.96\sqrt{142}$ $= 142 \pm 23.356$ Then average density per m ² is 14.2 ± 2.34 (11.86, 16.54) (d) (i) $M_A = 56$ and $M_B = 13$ (d) (i) $M_A = 56$ and $M_B = 13$ (d) (i) $M_A = 56$ and $M_B = 13$ (d) (ii) $M_A = 56$ and $M_B = 13$ (d) (ii) $M_A = 56$ and $M_B = 13$ (d) (ii) $M_A = 56$ and $M_B = 13$ (j) Would expect $V_{i} \ge M_{i}$ (j) Would expect $V_{i} \ge M_{i}$ (k) $M_{i} = 56$ and $M_B = 13$ (k) $M_{i} = 56$ and $M_{i} = 13$ (k) $M_$		This is > 0.10 so no evidence it's	A1		All correct including 0.155.
(c) Number of lob worms in 10 m ² (Y) has a Poisson distribution with $\lambda = 142$ Then 95% CI for Y using Z=1.96 is $142 \pm 1.96\sqrt{142}$ $= 142 \pm 23.356$ Then average density per m ² is 14.2 ± 2.34 (11.86, 16.54) (11.86, 16.54)		reduced.			Allow "accept H_0 " here and isw.
(c) Number of lob worms in 10 m ² (Y) has a Poisson distribution with $\lambda = 142$ Then 95% CI for Y using Z=1.96 is $142 \pm 1.96\sqrt{142}$ $= 142 \pm 23.356$ Then average density per m ² is 14.2 ± 2.34 (11.86, 16.54) (11.86, 16.54) MI For $c \pm z\sqrt{c}$. Allow $c \pm z\sqrt{\frac{c}{10}}$ Dividing this (or limits) by 10 For AWRT (11.9, 16.5) or $14.2 \pm (2.3 \sim 2.4)$ Notes: (i) SR: Using $14.2 \pm 1.96\sqrt{14.2}$ gets B1M1A0 then B1 for answer 14.2 ± 7.4 getting max 3/5. (ii) Using $14.2 \pm 1.96\sqrt{\frac{14.2}{10}}$ gets potentially full marks. For both				4	-
(c) Number of lob Worms in 10 m ⁻ (Y) has a Poisson distribution with $\lambda = 142$ Then 95% CI for Y using Z=1.96 is $142 \pm 1.96\sqrt{142}$ = 142 ± 23.356 Then average density per m ² is 14.2 ± 2.34 (11.86, 16.54) (11.86, 16.54) A1 (11.86, 16.54) A1 A1 A1 A1 A1 A1 A1 A1 For 1.96 For $c \pm z\sqrt{c}$. Allow $c \pm z\sqrt{\frac{c}{10}}$ Dividing this (or limits) by 10 For AWRT (11.9, 16.5) or $14.2 \pm (2.3 \sim 2.4)$ Notes: (i) SR: Using $14.2 \pm 1.96\sqrt{14.2}$ gets B1M1A0 then B1 for answer 14.2 ± 7.4 getting max 3/5. (ii) Using $14.2 \pm 1.96\sqrt{\frac{14.2}{10}}$ gets potentially full marks. For both		\sim N 1 C1 1 \sim 10 2 (X) 1			
Then 95% CI for Y using Z=1.96 is $142 \pm 1.96\sqrt{142}$ $= 142 \pm 23.356$ Then average density per m ² is 14.2 ± 2.34 (11.86, 16.54) A1 A1 For $AURT$ (11.9, 16.5) or $14.2 \pm (2.3 \sim 23.4)$ or (119, 165) Dividing this (or limits) by 10 For AWRT (11.9, 16.5) or $14.2 \pm (2.3 \sim 2.4)$ Notes: (i) SR: Using $14.2 \pm 1.96\sqrt{14.2}$ gets B1M1A0 then B1 for answer 14.2 ± 7.4 getting max 3/5. (ii) Using $14.2 \pm 1.96\sqrt{\frac{14.2}{10}}$ gets potentially full marks. For both For both	(0	Number of lob worms in 10 m ⁻ (Y) has a Poisson distribution with $\lambda = 1.42$			
		Then 95% CI for Y using $Z=1.96$ is	B1		For 1.96
(d) (i) $M_A = 56$ and $M_B = 13$ (d) (i) $M_A = 56$ and $M_B = 13$ (i) Would expect $V_L \ge M_A$ (1) $M_A = 56$ and $M_B = 13$ (i) $M_A = 56$ and $M_B = 13$ (i) $M_A = 56$ and $M_B = 13$ (ii) $M_A = 56$ and $M_B = 13$ (ii) $M_A = 56$ and $M_B = 13$ (iii) $M_A = 56$ and $M_B = 13$ (iv) $M_A = 56$ and $M_B = $		$142 + 1.96\sqrt{142}$	M1		
(d) (i) $M_A = 56 \text{ and } M_B = 13$ (d) (i) $M_A = 56 \text{ and } M_B = 13$ (d) (i) $M_A = 56 \text{ and } M_B = 13$ (d) (i) $M_A = 56 \text{ and } M_B = 13$ (ii) Would expect $V_A > M_A$ (iii) Would expect $V_A > M_A$ (iv) $M_A = 56 \text{ and } M_B = 13$ (iv) $M_A = 56 a$					For $c \pm z\sqrt{c}$. Allow $c \pm z\sqrt{\frac{c}{10}}$
Then average density per m ² is 14.2 ± 2.34 (11.86, 16.54) (11.86, 16.54)		= 142 + 23356	A1		$142 \pm (23.3 \sim 23.4)$ or (119.165)
(d) (i) $M_A = 56$ and $M_B = 13$ (ii) W_{avald} expect $V_{v} \ge M_v$ (d) (i) $M_A = 56$ and $M_B = 13$ (ii) W_{avald} expect $V_{v} \ge M_v$ (b) M_{avald} (c) M_{avald		Then average density per m^2 is			
(d) (i) $M_A = 56 \text{ and } M_B = 13$ (d) (i) $M_A = 56 \text{ and } M_B = 13$ (ii) Would expect $V_L \ge M_L$ (iii) $M_A = 56 \text{ and } M_B = 13$ (iv) $M_A = 56 \text{ and } M_B = 13$ (v)		14.2 ± 2.34	M1		Dividing this (or limits) by 10
(d) (i) $M_A = 56$ and $M_B = 13$ (ii) $M_A = 56$ and $M_B = 13$ (iii) $M_A = 56$ and $M_B = 13$ (iv) $M_A = 56$ and $M_B =$		(11.86, 16.54)	A1		For AWRT (11.9, 16.5) or
(d) (i) $M_A = 56$ and $M_B = 13$ (i) $M_A = 56$ and $M_B = 13$ (ii) $M_A = 56$ and $M_B = 13$ (iii) Would expect $V_L \ge M_L$ (iv) Would expect $V_L \ge M_L$ (iv) Notes: (i) SR: Using $14.2 \pm 1.96\sqrt{14.2}$ gets B1M1A0 then B1 for answer 14.2 ± 7.4 getting max $3/5$. (ii) Using $14.2 \pm 1.96\sqrt{\frac{14.2}{10}}$ gets potentially full marks. For both					$14.2 \pm (2.3 \sim 2.4)$
(i) SR: Using $14.2 \pm 1.96\sqrt{14.2}$ gets B1M1A0 then B1 for answer 14.2 ± 7.4 getting max 3/5. (ii) Using $14.2 \pm 1.96\sqrt{\frac{14.2}{10}}$ gets potentially full marks. 5 For both For both					Notes:
(d) (i) $M_A = 56$ and $M_B = 13$ (ii) Would expect $V_L \ge M_A$ (ii) $M_A = 56$ and $M_B = 13$ (iii) $M_A = 56$ and $M_B = 13$ (iv) $M_A = 56$ and $M_B =$					(i) SR: Using
(d) (i) $M_A = 56$ and $M_B = 13$ (ii) Would expect $V_L \ge M_L$ (ii) Would expect $V_L \ge M_L$ (iii) Here B1 for answer 14.2 ± 7.4 getting max $3/5$. (ii) Using $14.2 \pm 1.96\sqrt{\frac{14.2}{10}}$ gets potentially full marks. For both					$14.2 \pm 1.96 \sqrt{14.2}$ gets B1M1A0
(d) (i) $M_A = 56$ and $M_B = 13$ (ii) Would expect $V_L \ge M_L$ (ii) $M_A = 56$ and $M_B = 13$ (iii) Would expect $V_L \ge M_L$ (iv) $M_A = 56$ and $M_B = 13$ (iv) $M_A = 56$ and $M_B = 1$					then B1 for answer 14.2 ± 7.4
(d) (i) $M_A = 56$ and $M_B = 13$ (ii) $W_{abc} = 56$ and $M_B = 13$ (iii) $W_{abc} = 13$ (iv) $W_{abc} = 13$					getting max 3/5.
(d) (i) $M_A = 56$ and $M_B = 13$ (ii) Would expect $V_L \ge M_L$ (iii) Would expect $V_L \ge M_L$ (iii) Would expect $V_L \ge M_L$ (iii) B1 (iii)					(ii) Using 14.2 ± 1.96 14.2 gets
(d) (i) $M_A = 56$ and $M_B = 13$ (ii) Would expect $V_L \ge M_L$ B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1 B1					(ii) Using $14.2 \pm 1.90 \sqrt{\frac{10}{10}}$ gets
(d) (i) $M_A = 56$ and $M_B = 13$ (ii) Would expect $V_A \ge M_A$ B1					potentially full marks.
(a) (i) $M_A = 56$ and $M_B = 13$ (ii) Would expect $V_A > M_A$ B1 For both			D1	5	
	(d) ($M_A = 56 \text{ and } M_B = 13$ $Would expect V > M$	BI R1		For both
Ants 'attract' each other \rightarrow tendency B1 Or equiv. Any indication of why		Ants 'attract' each other \rightarrow tendency	B1		Or equiv. Any indication of why
for small or large numbers in a sq $m \rightarrow$ they would expect "large"		for small or large numbers in a sq m \rightarrow	21		they would expect "large"
larger variation (than expected from variation (more than just saying		larger variation (than expected from			variation (more than just saying
Poisson) they live in colonies).		Poisson)			they live in colonies).
(iii) Would expect $V_p \le M_p$ B1 Note: B1's indep in either order	(;;	Would expect $V_p < M_p$	R1		Note: B1's indep in either order
Beetles 'repel' each other \rightarrow more B1 Or equiv. Any indication of why	(II)	Beetles 'repel' each other \rightarrow more	B1		Or equiv. Any indication of why
evenly spread (eg unlikely to have high they would expect "small"		evenly spread (eg unlikely to have high			they would expect "small"
$concentrations) \rightarrow smaller variation$ variation (more than just saying		concentrations) \rightarrow smaller variation			variation (more than just saying
(than expected from Poisson). they are territorial). As note in (ii)		(than expected from Poisson).		5	they are territorial). As note in (ii).
				5	
Total 15		Total		15	

Q	Solution	Marks	Total	Comments
5 (a)	$P(dizziness) \times P(swollen jnts)$			
	$= 0.12 \times 0.15 = 0.018$	M1		For 0.12×0.15
	= given value for joint probability.			
	Hence independent.	A1	_	On correct reasoning.
			2	
(D) (1)	No. with dry skin $\sim B(90, 0.01)$	D1		For Doisson (may be implied)
	$\lambda = 00 \times 0.01 = 0.0$	DI D1don		May be implied
	Then $P(X > 2) = 1 - 0.937(1)$	M1		Allow for $1 = 0.7725$
	$11011(X \times 2) = 1 = 0.957(1)$	1011		(may be implied by $0.227 \sim 0.228$)
	= 0.0629	A1		$0.0629 \sim 0.063$
				Note: Exact binom $\rightarrow 0.0619 \rightarrow (0/4)$
			4	
(ii)	H_0 : $p = 0.12$			
	$H : n \neq 0.12$	B1		Both
	$\boldsymbol{H}_1 \cdot \boldsymbol{p} \neq 0.12$			
	$X \sim B(90, 0.12) \approx N(10.8, 9.504)$	B1 D1		B1 for mean 10.8 cao
		BI		B1 for variance $(9.5(0) \sim 9.51)$
	21 10.0	M1		of SD $(3.08 \sim 3.09)$
	$TS = \frac{21 - 10.8}{2} = 3.31$			$\frac{11011}{225} = \frac{1}{24}$
	$\sqrt{9.504}$	AI		5.25~5.4
	20.5 - 10.8	(M1)		3 13 ~ 3 15
	or $TS = \frac{20.5 - 10.6}{\sqrt{2.504}} = 3.15$	(A1)		Note: wrong CC (21.5) gives 3.47
	√9.504			for M1A0
	or using proportions			
	Use of N(0.12, .00117)	(B1)		B1 for mean 0.12 cao
		(B1)		B1 for variance $(0.0011 \sim 0.0012)$
				or SD (0.033~0.035)
	$\hat{n} = \frac{21}{2} = 0.233$			
	90			
	0.233 - 0.12 2.21			
	$15 = \frac{1}{\sqrt{0.12 \times 0.88}} = 5.51$	(M1)		Their mean/SD
	$\sqrt{\frac{0.12\times0.00}{0.0}}$	(A1)		3.25 ~ 3.4
	V 90			
	Critical values are + 2,5759	D1		2.57 2.59
	Ciffical values are $\pm 2.3/38$	ы		$2.37 \sim 2.38$ or $n=0.000028$ (AWEW 0.00065
				to 0.00115) from TS=3.31
				or $p=0.00163$ (AWFW 0.00163 to
				0.00175) from TS=3.15
				Allow $p=0.000466$ or 0 000816
				only if compared with 0.005
				~ ×
	Reject H ₀ at the 1% level	A1		ft their TS and critical z value or
				their <i>p</i> -value and 0.01 or their $\frac{1}{2}$ p
				and 0.005. Must correctly reject H_0
	There is satisfy the the time	F 1		In contract on the literation
	I here is evidence that the proportion	EI		In context, requires all previous
	of patients really does differ from 0.12.		Q	marks m (0)(11).
	Total		0 14	
	I Otal	I	14	l

Q	Solution	Marks	Total	Comments
6(a) (i)	Let L be the height of cut trees			
	Then $L = H + G - S$	D1		For 100 and Mathed most he say
	E(L) = 50 + 150 - 10 = 190	BI		and correct
	$V(L) = 1.49^2 + 2.67^2 + 0.51^2 (= 9.6091)$	M1		Correct expression for V(L) seen
	Then $SD(L) = 3.10$ as required.	A1		AWRT 3.10 answer given.
			3	
(ii)	195–190			
	$P(L < 1.95) = P(Z < \frac{1.50}{3.10})$	M1		Allow wrong tail but needs 195,
	$P(7 \rightarrow 1, (1/2))$			190 and 3.10 or their $E(L)$ &SD(L)
	= P(Z < 1.61(3))	A 1		(0.04(0.047)
	= 0.9463(0)	AI		$(0.946 \sim 0.947)$ SC (1.95-1.9)/3.1 = 0.0161 gets B1
			2	
(b) (i)	P(97 < height < 103) = P(-1 < Z < 1)			
	= 0.84134 - (1 - 0.84134)	M1		Correct method for z and 0 841
	0.01151 (1 0.01151)	1011		seen.
	= 0.68268	A1		(0.682 ~ 0.683)
	Can expect $100 \times 0.683 = 68.3$ trees	B1		For their probability \times 100. May
			3	be rounded up of down.
(ii)	Let P be the tree length for shredding			Marks in (ii) can be earned in (iii)
	Then $E(P) = 190 - 100 = 90$ and $V(D) = 2.1^2 + 2^2 = 18.61$			No montra soft Nood to suga thaga
	and $v(P) = 3.1 + 3 = 18.01$			values for income.
	Income (Y) = $500 + 100 \times 0.02 \times P$	M1		For 500 + attempt at pulp income
	= 500 + 2P Then $F(X) = 500 + 2x00 = 680$	A 1		
	and $V(Y) = 2^2 \times V(P) = 74.44$	AF1		$(74.4 \sim 74.5)$
				ft for $4 \times$ their V(P)
		D 1		
	Thus $Y \sim N(680, 74.44)$	BI	4	For normal distribution
(iii)	Since council's offer gets $\pounds 680 < \pounds 750$	M1		Their E(Y) compared with 750
		F 1		(may be implied)
	she was NOT wise to take it up.	EI		All clear & correct, including 680
				May use their distribution to find a
				probability (eg P(Y > 750) \approx 0).
				I nen MII for attempt at relevant probability and E1 as above
				SC Something like "no guarantee
				she will sell them all so should
			2	take what is firmly offered" B1
	Total		14	
	TOTAL		75	