Question Number		Scheme	Marks		
1 (a)	Rankings	s 2, 9, 7, 8, 6, 5, 1, 4, 3, 10	B1		
	$\sum d^2 = 9 + 0 + 16 + 0 + 16 + 16 + 25 + 0 + 16 + 0 [= 98]$				
	$r_s = 1 - \frac{6 \times '98'}{10(10^2 - 1)} = 0.4060$ awrt 0.406				
			(4)		
(b)	$H_0: \rho =$	$0 H_1: \rho > 0$	B1		
	Critical V	Value $r_s = 0.7455$ or CR: $r_s \ge 0.7455$	B1		
	Not in th	e critical region/not significant/Do not reject H ₀	M1		
	There is insufficient evidence of a positive correlation between the final position of a football team in the English Premier League and their average match day attendance .				
			(4)		
		Notes	Total 8		
(a)	B1 For all 8 correct missing rankings. If in the table and in the working space and different then award the highest scoring response.				
	M1 For an attempt at $\sum d^2$ (at least 5 correct values seen, with an attempt to add) May be implied by 98				
	M1 For using $1 - \frac{6\sum d^2}{10(99)}$ with their $\sum d^2$ (you will need to check their $\sum d^2$ if no value shown)				
	A1	awrt 0.406 Allow $\frac{67}{165}$ NB awrt 0.406 or $\frac{67}{165}$ scores 4/4			
(1-)	B1	For both hypotheses correct. Must be in terms of ρ or ρ_s (Condone <i>p</i>). Must be attac	ched to H_0		
(0)		and H ₁			
	B1	For CV of 0.7455			
	M1	A correct statement ft part (a) and their CV– no context needed but do not allow cont non contextual statements. This may be implied by a correct contextual conclusion or	radicting n its own.		
	A1ft	Correct conclusion in context. Must mention words in bold oe, ft their r in part (a) ar critical value.	nd their		

Question Number	Scheme			
2 (a)	[0×5]·	$\frac{[0\times5]+1\times38+2\times32+3\times17+4\times7+5\times1}{100}[=1.86]*$		
(b)	[r = 1.203] because total expected frequency must equal 100			
			(1)	
(c)	[The manager needed to do this] to ensure that [all] expected frequencies were greater than 5			
			(1)	
(1)	H ₀ : Poisson (distribution) is [a] suitable/ sensible (model)			
(d)	H ₁ : Poisson (distribution) is not [a] suitable/ sensible (model)			
	v = [5 -	-1-1] = 3	B1	
	$\chi_3^2(0.01) = 11.345 \implies CR: X^2 \ge 11.345$			
	[Lies in	n the CR/Reject H ₀]	A 1 C	
	Suffici	ent evidence to say that Poisson is not a suitable model	AIII	
			(4)	
		Notes	Total 7	
	For a correct method to show the mean is 1.86 (Ignore use of 6×0)			
(a)	B 1*	Allow $\frac{[0]+38+64+51+28+5}{2}$		
		100		
(h)	B1	A correct explanation referring to the fact that total/sum expected frequency/ E_i must explanation referring to the fact that total/sum expected frequency/ E_i must explanation referring to the fact that total sum expected frequency E_i must explanation for the fact that total sum expected frequency E_i must explanation for the fact that total sum expected frequency E_i must explanation for the fact that total sum expected frequency E_i must explanation for the fact that total sum expected frequency E_i must explanation for the fact that total sum expected frequency E_i must explanation for the fact that total sum expected frequency E_i must explanation for the fact that total sum expected frequency E_i must explanation for the fact that total sum expected frequency E_i must explanation for the fact that total sum expected frequency E_i must explanation for the fact that total sum expected frequency E_i must explanation for the fact that total sum expected frequency E_i must explanation for the fact that total sum expected frequency E_i must explanation for the fact that total sum expected frequency E_i must explanation for the fact that total sum expected frequency E_i must explanation for the fact that total sum expected frequency E_i must explanation for the fact that total sum expected frequency E_i must explanation for the fact that total sum expected frequency E_i must explanation for the fact that total sum expected frequency E_i must explanation for the fact that total sum expected frequency E_i must explanation for the fact that total sum expected frequency E_i must explanation for the fact that total sum expected frequency E_i must explanation for the fact that total sum expected frequency E_i must explain the fact that total sum expected frequency E_i must explain the fact total sum expected frequency E_i must explain the fact total sum expected frequency E_i must explain the fact total sum expected frequency E_i must explain the fact total	equal total	
(0)		observed frequency e.g. $100 - (15.567 + 28.955 + 26.928 + 16.696 + 7.763 + 2.888) = 100 - (15.567 + 28.955 + 26.928 + 16.696 + 7.763 + 2.888) = 100 - (100 - (100 - 10$	~	
		A correct explanation referring to the fact that [all] E_i /expected frequencies/values need to be		
(c)	B1	greater than 5 e.g because expected 5 customers and [expected] 6 or more customers are both less than 5 Allow $2.88 < 5$ and $1.203/r < 5$ or $4.091 < 5$		
(d)	B1	Both hypotheses correct. Must mention Poisson/Po at least once.		
	B1	v = 3 This mark can be implied by a correct critical value of 11.345 if no DoF given		
	M1	For 11.345 or ft their degrees of freedom $\left[\chi_4^2(0.01) = 13.277\right]$		
	A1ft A correct conclusion based on their χ^2 critical value. Must mention Poisson			

Question Number	Scheme			
3 (a)	$\left[p = \frac{118}{40}\right]$	=]2.95	B1	
	$[q=]\frac{350.05 - 40('2.95')^2}{39} = 0.05$			
			(3)	
(b)	$H_0: \mu_A =$	$\mu_B \qquad H_1: \mu_A < \mu_B$	B1	
	2.	.65-'2.95'		
	$z = \pm \overline{\sqrt{0}}$	0.07 '0.05'	M1 M1	
	$ \sqrt{-}$	$\frac{1}{50} + \frac{1}{40}$		
	= 5.827	$a \text{ or } = -5.827$ $a \text{ wrt } \pm 5.83$	A1	
	CV = 1.64	449	B1	
	Reject H	⁰ There is significant evidence to support the biologist's belief	M1 A1ft	
	J		(7)	
(c)	Large sat	mple sizes so		
	both sam	ple means are normally distributed (CLT)	B1	
	$s_A^2 = \sigma_A^2$	² and $s_{B}^{2} = \sigma_{B}^{2}$	B1	
			(2)	
		Notes	Total 12	
(a)	B1	2.95 only		
	M1	For use of $\frac{\sum x^2 - n\overline{x}^2}{n-1}$ of their \overline{x} May be implied 0.05 provided no incorrect work	king seen	
	A1	cao		
(b)	B1	B1 Both hypotheses correct. Allow equivalent hypotheses. Must be in terms of μ		
	M1 For the denominator. Ft their 0.05			
	M1 Fully correct. Ft their 2.95 and their 0.05			
	A1 awrt 5.83 allow $ z = 5.827$ accept $p = 2.8(1) \ge 10^{-9}$			
	B1 $ CV = 1.6449$ or better			
	M1	A correct conclusion not in context ft their z value and CV or a correct p value (2 sf)		
	A 1 C4	ft their z value and their CV (NB their CV must be consistent with their z value) or a	correct p	
	AIII	value (2 si). Correct conclusion in context, need bellet/claim . May be in words with region e α the weights in region A are smaller	weights and	
(c)	B1	Must comment on both sample means e.g. the sample means are normally distributed	1	
	D1	Must comment on both variances/standard deviations e.g. sample variances can be us	sed as	
	RI	values for the population variances		

Question Number	Scheme			
4 (a)	2×awrt	$2 \times \text{awrt } 2.5758 \times \text{SE} = 0.964 - 0.9$ or $\text{awrt } 2.5758 \times x = 0.032$		
	$\Rightarrow \frac{0.9}{2 \times av}$	$\Rightarrow \frac{0.964 - 0.9}{2 \times \text{awrt } 2.5758} [= 0.0124]^* \text{ or } x = \frac{0.032}{\text{awrt } 2.5758} [= 0.0124]^*$		
			(3)	
(b)	$[\overline{x} =] \frac{0.9}{}$ $[\overline{x} =] 0.9$	$[\overline{x} =]\frac{0.964 + 0.9}{2} [= 0.932] \text{ or } [\overline{x} =]0.964 - 2.5758 \times 0.0124 [= awrt0.932] \text{ or}$ $[\overline{x} =]0.9 + 2.5758 \times 0.0124 [= awrt0.932]$		
	'0.932'±	1.96×0.0124	M1 B1	
	(0.9076.	, 0.9563) awrt (0.908, 0.956)	A1	
			(4)	
(c)	$2 \times z \times 0.0$	0124 = 0.04	M1	
	z = 1.612	2 awrt 1.61	A1	
	P(Z > '1)	(61') = P(Z < -'1.61') = 1 - '0.9463'	M1	
	= 0.0537	7 (Calculator gives 0.05371) awrt 0.0537		
	Confider	nce level = $[100 \times](1-2 \times 0.0537)$ or $[100 \times](0.9463 \times 2-1)$	M1	
	= 89.26	awrt 89.3	Al	
			(5)	
		Notes	Total 12	
		NotesFor $2 \times z$ value \times SE = 0.964 - 0.9 oe or z value $\times x = 0.032$ oe where $2 < z < 3$	Total 12	
(a)	M1	NotesFor $2 \times z$ value \times SE = 0.964 - 0.9 oe or z value $\times x = 0.032$ oe where $2 < z < 3$ May be implied by $\frac{0.964 - 0.9}{2 \times awrt \ 2.5758}$ or $\frac{0.032}{awrt \ 2.5758}$	Total 12	
(a)	M1 B1	NotesFor $2 \times z$ value \times SE = 0.964 - 0.9 oe or z value $\times x = 0.032$ oe where $2 < z < 3$ May be implied by $\frac{0.964 - 0.9}{2 \times awrt 2.5758}$ or $\frac{0.032}{awrt 2.5758}$ awrt 2.5758	Total 12	
(a)	M1 B1 A1*	NotesFor $2 \times z$ value \times SE = 0.964 - 0.9 oe or z value $\times x = 0.032$ oe where $2 < z < 3$ May be implied by $\frac{0.964 - 0.9}{2 \times awrt \ 2.5758}$ or $\frac{0.032}{awrt \ 2.5758}$ awrt 2.5758Answer is given so no incorrect working must be seen. Must be at least one line of colspan="2">working between M1 and the final answer. Must use awrt 2.5758 May be implied by 0.01242	Total 12 Dirrect awrt	
(a)	M1 B1 A1* M1	NotesFor $2 \times z$ value \times SE = 0.964 - 0.9 oe or z value $\times x = 0.032$ oe where $2 < z < 3$ May be implied by $\frac{0.964 - 0.9}{2 \times awrt 2.5758}$ or $\frac{0.032}{awrt 2.5758}$ awrt 2.5758Answer is given so no incorrect working must be seen. Must be at least one line of ccworking between M1 and the final answer. Must use awrt 2.5758 May be implied by0.01242Accept awrt 0.932 to imply a correct method.If using a z value, then this must be awrt 2.5758 or consistent with the z value used ir	Total 12 prrect awrt n part (a)	
(a)	M1 B1 A1* M1 M1	NotesFor $2 \times z$ value \times SE = 0.964 - 0.9 of or z value $\times x = 0.032$ of where $2 < z < 3$ May be implied by $\frac{0.964 - 0.9}{2 \times awrt 2.5758}$ or $\frac{0.032}{awrt 2.5758}$ awrt 2.5758Answer is given so no incorrect working must be seen. Must be at least one line of colspan="2">working between M1 and the final answer. Must use awrt 2.5758 May be implied by 0.01242Accept awrt 0.932 to imply a correct method.If using a z value, then this must be awrt 2.5758 or consistent with the z value used in For $\overline{x} \pm z$ value $\times 0.0124$ ft their \overline{x} and where $1.5 < z < 2$	Total 12 prrect awrt n part (a)	
(a)	M1 B1 A1* M1 M1 B1	NotesFor $2 \times z$ value \times SE = 0.964 - 0.9 oe or z value $\times x = 0.032$ oe where $2 < z < 3$ May be implied by $\frac{0.964 - 0.9}{2 \times awrt 2.5758}$ or $\frac{0.032}{awrt 2.5758}$ awrt 2.5758Answer is given so no incorrect working must be seen. Must be at least one line of ccworking between M1 and the final answer. Must use awrt 2.5758 May be implied by0.01242Accept awrt 0.932 to imply a correct method.If using a z value, then this must be awrt 2.5758 or consistent with the z value used inFor $\overline{x} \pm z$ value $\times 0.0124$ ft their \overline{x} and where $1.5 < z < 2$ awrt 1.96	Total 12 prrect awrt n part (a)	
(a) (b)	M1 B1 A1* M1 M1 B1 A1	NotesFor $2 \times z$ value \times SE = 0.964 - 0.9 oe or z value $\times x = 0.032$ oe where $2 < z < 3$ May be implied by $\frac{0.964 - 0.9}{2 \times awrt 2.5758}$ or $\frac{0.032}{awrt 2.5758}$ awrt 2.5758Answer is given so no incorrect working must be seen. Must be at least one line of colspan="2">working between M1 and the final answer. Must use awrt 2.5758 May be implied by 0.01242Accept awrt 0.932 to imply a correct method.If using a z value, then this must be awrt 2.5758 or consistent with the z value used irFor $\overline{x} \pm z$ value $\times 0.0124$ ft their \overline{x} and where $1.5 < z < 2$ awrt 1.96for (awrt 0.908, awrt 0.956) Allow awrt 0.908 < μ < awrt 0.956	Total 12 prrect awrt n part (a)	
(a) (b)	M1 B1 A1* M1 M1 B1 A1 M1	NotesFor $2 \times z$ value \times SE = 0.964 - 0.9 oe or z value $\times x = 0.032$ oe where $2 < z < 3$ May be implied by $\frac{0.964 - 0.9}{2 \times awrt 2.5758}$ or $\frac{0.032}{awrt 2.5758}$ awrt 2.5758Answer is given so no incorrect working must be seen. Must be at least one line of ccworking between M1 and the final answer. Must use awrt 2.5758 May be implied by0.01242Accept awrt 0.932 to imply a correct method.If using a z value, then this must be awrt 2.5758 or consistent with the z value used inFor $\overline{x} \pm z$ value $\times 0.0124$ ft their \overline{x} and where $1.5 < z < 2$ awrt 1.96for (awrt 0.908, awrt 0.956) Allow awrt $0.908 < \mu < awrt 0.956$ For $2 \times z \times 0.0124 = 0.04$ oe May be implied by awrt 1.61	Total 12 prrect awrt n part (a)	
(a) (b)	M1 B1 A1* M1 M1 B1 A1 M1 A1	NotesFor $2 \times z$ value \times SE = 0.964 - 0.9 of or z value $\times x = 0.032$ of where $2 < z < 3$ May be implied by $\frac{0.964 - 0.9}{2 \times awrt 2.5758}$ or $\frac{0.032}{awrt 2.5758}$ awrt 2.5758Answer is given so no incorrect working must be seen. Must be at least one line of colspan="2">working between M1 and the final answer. Must use awrt 2.5758 May be implied by 0.01242Accept awrt 0.932 to imply a correct method.If using a z value, then this must be awrt 2.5758 or consistent with the z value used in For $\overline{x} \pm z$ value $\times 0.0124$ ft their \overline{x} and where $1.5 < z < 2$ awrt 1.96for (awrt 0.908, awrt 0.956) Allow awrt $0.908 < \mu < awrt 0.956$ For $2 \times z \times 0.0124 = 0.04$ of May be implied by awrt 1.61For $z = awrt 1.61$	Total 12 prrect awrt h part (a)	
(a) (b) (c)	M1 B1 A1* M1 B1 A1 M1 A1 M1 A1 M1	NotesFor $2 \times z$ value \times SE = 0.964 - 0.9 of z value $\times x = 0.032$ of where $2 < z < 3$ May be implied by $\frac{0.964 - 0.9}{2 \times awrt 2.5758}$ or $\frac{0.032}{awrt 2.5758}$ awrt 2.5758Answer is given so no incorrect working must be seen. Must be at least one line of colspan="2">working between M1 and the final answer. Must use awrt 2.5758 May be implied by 0.01242Accept awrt 0.932 to imply a correct method.If using a z value, then this must be awrt 2.5758 or consistent with the z value used in For $\overline{x} \pm z$ value $\times 0.0124$ ft their \overline{x} and where $1.5 < z < 2$ awrt 1.96for (awrt 0.908, awrt 0.956) Allow awrt 0.908 $< \mu <$ awrt 0.956For $2 \times z \times 0.0124 = 0.04$ of May be implied by awrt 1.61For $z = awrt 1.61$ For awrt 0.946 or awrt 0.947 or awrt 0.053 or awrt 0.054	Total 12 prrect awrt h part (a)	
(a) (b) (c)	M1 B1 A1* M1 B1 A1 M1 A1 M1 A1 M1	NotesFor $2 \times z$ value $\times SE = 0.964 - 0.9$ oe or z value $\times x = 0.032$ oe where $2 < z < 3$ May be implied by $\frac{0.964 - 0.9}{2 \times awrt 2.5758}$ or $\frac{0.032}{awrt 2.5758}$ awrt 2.5758Answer is given so no incorrect working must be seen. Must be at least one line of colspan="2">working between M1 and the final answer. Must use awrt 2.5758 May be implied by 0.01242Accept awrt 0.932 to imply a correct method.If using a z value, then this must be awrt 2.5758 or consistent with the z value used in For $\overline{x} \pm z$ value $\times 0.0124$ ft their \overline{x} and where $1.5 < z < 2$ awrt 1.96for (awrt 0.908, awrt 0.956) Allow awrt $0.908 < \mu < awrt 0.956$ For $2 \times z \times 0.0124 = 0.04$ oe May be implied by awrt 1.61For awrt 0.946 or awrt 0.947 or awrt 0.053 or awrt 0.054NB awrt 0.946 or or awrt 0.947 or awrt 0.053 or awrt 0.054 scores M1A1M1To $1.024 < 0.0267$ or $1.024 < 0.0267$ or $1.024 < 0.027$ or $1.024 < 0.027 < 0.024 < 0.027$ or $1.024 < 0.027 < 0.024 < 0.027 < 0.027 < 0.024 < 0.027 < 0.024 < 0.027 < 0.027 < 0.024 < 0.027 < 0.027 < 0.027 < 0.027 < 0.027 < 0.027 < 0.027 < 0.027 < 0.027 < 0.027 < 0.027 < 0.027 < 0.027 < 0.027 < 0.027 < 0.027 < 0.027 < 0.027 < 0.027 < 0.027 < 0.027 < 0.027 < 0.027 < 0.027 < 0.027 < 0.027 < 0.027 < 0.027 < 0.027 < 0.027 < 0.027 < 0.027 < 0.027 < 0.027 < 0.027 < 0.027 < 0.027 < 0.027 < 0.027 < 0.027 < 0.027 < 0.02$	Total 12 prrect awrt n part (a)	
(a) (b) (c)	M1 B1 A1* M1 B1 A1 M1 A1 M1 M1 M1	NotesFor $2 \times z$ value $\times SE = 0.964 - 0.9$ or z value $\times x = 0.032$ or where $2 < z < 3$ May be implied by $\frac{0.964 - 0.9}{2 \times awrt 2.5758}$ or $\frac{0.032}{awrt 2.5758}$ awrt 2.5758Answer is given so no incorrect working must be seen. Must be at least one line of colspan="2">Colspan="2">Colspan="2">NotesAnswer is given so no incorrect working must be seen. Must be at least one line of colspan="2">Colspan="2">Colspan="2">May be implied byAnswer is given so no incorrect working must be seen. Must be at least one line of colspan="2">Colspan="2"Colspa	Total 12 prrect awrt n part (a)	
(a) (b) (c)	M1 B1 A1* M1 B1 A1 M1 A1 M1 M1 M1	NotesFor $2 \times z$ value $\times SE = 0.964 - 0.9$ oe or z value $\times x = 0.032$ oe where $2 < z < 3$ May be implied by $\frac{0.964 - 0.9}{2 \times awrt 2.5758}$ or $\frac{0.032}{awrt 2.5758}$ awrt 2.5758Answer is given so no incorrect working must be seen. Must be at least one line of colspan="2">working between M1 and the final answer. Must use awrt 2.5758 May be implied by 0.01242Accept awrt 0.932 to imply a correct method.If using a z value, then this must be awrt 2.5758 or consistent with the z value used in For $\overline{x} \pm z$ value $\times 0.0124$ ft their \overline{x} and where $1.5 < z < 2$ awrt 1.96for (awrt 0.908, awrt 0.956) Allow awrt $0.908 < \mu < awrt 0.956$ For $2 \times z \times 0.0124 = 0.04$ oe May be implied by awrt 1.61For $z = awrt 1.61$ For awrt 0.946 or awrt 0.947 or awrt 0.053 or awrt 0.054NB awrt 0.946 or or awrt 0.947 or awrt 0.053 or awrt 0.054NB awrt 0.946 or or awrt 0.947 or awrt 0.053 or awrt 0.054NB awrt 0.946 or or awrt 0.947 or awrt 0.053 or awrt 0.054NB awrt 0.946 or or awrt 0.947 or awrt 0.053 or awrt 0.054NB awrt 0.946 or or awrt 0.947 or awrt 0.053 or awrt 0.054NB awrt 0.946 or or awrt 0.947 or awrt 0.053 or awrt 0.054NB awrt 0.946 or or awrt 0.947 or awrt 0.053 or awrt 0.054NB awrt 0.946 or or awrt 0.947 or awrt 0.053 or awrt 0.054NB awrt 0.946 or or awrt 0.947 or awrt 0.053 or awrt 0.054NB awrt 0.946 or or awrt 0.947 or awrt 0.053 or awrt 0.054 scores M1A1M1<	Total 12 orrect awrt a part (a) 0.893)	

Question Number	Scheme				Marks	
5(a)(i)	Quota sampling would remove the need for a sampling frame oe				B1	
(ii)	Quota san	ta sampling [can be/introduce] bias			B1	
					(2)	
(b)(i)	(66+40)	$) \times 120 = 63.6$				M1 A1
(0)(1)	200) 05.0				
(ii)	(66+40)	-63.6 = 42.4	4 or $\frac{(66+40)\times 8}{100}$	$\frac{80}{2} = 42.4$		A1
			200			(2)
	Ho: Stude	ents favourite	e science subject and	place lived are independent/not asso	ciated	(3)
(c)	H ₁ : Stude	ents favourite	e science subject and	placed lived are not independent/ass	ociated	B1
	Ob	served	Expected	$(O-E)^2$		
		Serveu	Enperiod	E		
		66	63.6	$\frac{(66-63.6)^2}{24} = 0.09056$		M1
				63.6 265		1411
		40	·47 4'	$\left[\frac{(40-42.4')^2}{(40-42.4')^2}\right] = \frac{36}{(40-42.4')^2} = 0.13584$		
		10	12.1	'42.4' 265		
	$\sum \frac{(O-)}{(O-)}$	$\frac{E^{2}}{E} = 4.549 + 1000$	'0.09056'+ '0.13584.			M1
	$\square E$	75			4 4 70	A 1
	= 4./	(3)		av	vrt 4.78	AI D1
	v = (2 - 1)	$\frac{1}{(3-1)-2}$	b . $\mathbf{V}^2 > 4.605$			DI D1A
	$\chi_2(0.1) =$	$\frac{1}{2} 4.003 \rightarrow Cr$	Λ $A \neq 4.003$	with a subsect of a success that at	danta?	BIII
	[In the CK/significant/Reject H ₀] There is sufficient evidence to suggest that students' favourite science subject is not independent of the place they live.					dA1ft
		avourte serence subject is not independent of the place they five.			(7)	
		-	Ν	otes		Total 12
(a)(i)	B1	For a correct	t advantage. Possible a	dvantages (but not an exhaustive list): ind	cludes all !	key
		subgroups, e	tective for small popu	lations (Do not allow quick oe or cheap	oe or easy	fl non
(ii)	B1	random [sele	ection], difficulty in set	ting quotas	<i>st)</i> . [115K 0	1] 11011-
(b)(i)	M1	1 For a correct method to find either expected frequency May be implied by 63.6 or 42.4				
(ii)	A1	For either 63.6 or 42.4				
	A1	For both 63.	6 and 42.4			
(c)	B1 For both hypotheses correct. Must mention subject and place at least once. Do not allow					
	M1 A correct method for finding both contributions to the x^2 value fit their 63.6 and their 42.4					
	M1	M1 Adding their two values to 4.540 (may be implied by a full x^2 calculation do not ISW)				
	Adding their two values to 4.349 (may be implied by a full χ calculation, do not ISW)					
	R1	v = 2 This i	nark can be implied by	v a correct critical value of 4.605		
	R1ft	4 605 or bett	ter ft their degrees of fr	$eedom \left[\chi^{2}(0,1) - 6.251\right]$		
	DIII	Dependent of	up both M marks being	$\chi_3(0.1) = 0.251$	n which k	ns the
		words subject	ct and place. Allow an	answer in terms of association. Do not al	low corre	las ine
	dA1ft	imply associ	ation. Allow dependen	t to imply not independent		
		ft their $\sum \frac{1}{2}$	$(O-E)^2$ and their γ^2	critical value This mark is independent	of hvpothe	eses
	<u> </u>		E	- · · · · · · · · · · · · · · · · · · ·	, r =	.=

Question Number	Scheme			ks	
6 (a)	$\left[E\left(\overline{X} \right) \right] =$	$= \left[\frac{2a+3+4a+9}{2}\right]$	M1		
	=-	$\frac{6a+12}{2} = 3a+6 \neq a $ (So biased)	A1*		
				(2)	
(b)	'(3a+6)'	-a = 2a + 6	B1ft		
				(1)	
(c)	$c = \frac{1}{'3'}$	$c = \frac{1}{'3'}$			
	$\left \frac{1}{3} \times (3a) \right $	(+6)'+d=a	M1		
	d = -2		A1		
				(3)	
(d)	$'\frac{1}{3}' \times 7.32$	$a - 2' = 0.44$ or $3a + 6 = 7.32 \implies a = 0.44$	M1		
	4×'0.44	'+9	M1		
	=10.76		A1		
				(3)	
		Notes	Tota	ul 9	
(a)	M1	For using the formula $\left(\frac{a+b}{2}\right)$ May be implied by $\frac{6a+12}{2}$ or $3a+6$			
	A1*	For $\frac{6a+12}{2}$ or $3a+6$ and $\neq a$ (Allow $3a+6-a$ or $2a+6$ and $\neq > 0$)			
(b)	B1ft	For $2a + 6$ or ft their part (a)			
(c)	B 1	For $\frac{1}{3}$ or $\frac{1}{\text{coefficient of } a \text{ (from part a)}}$			
	M1	For $c \times$ their $(3a + 6) + d = a$ oe written or used May be implied by $d = -2$			
	A1	Cao			
(d)	M1	For their $c \times 7.32$ – their d oe or $7.32 = 3a + 6$			
	M1	For $4 \times \text{their } 0.44 + 9$			
	A1	cao Do not ISW but condone rounding			

Question Number		Scheme	Marks	
7 (a)	$W = S_1 +$	$-S_2 + S_3 + L_1 + L_2 + L_3 + L_4$		
	$W \sim N(3)$	$3 \times 7.7 + 4 \times 20, 3 \times 0.01^2 + 4 \times 0.02^2$) So $W \sim N(103.1, 0.0019)$	M1 A1	
	$\left[P(W > $	$103.15) =]P\left(Z > \frac{103.15 - '103.1'}{'\sqrt{0.0019}'}\right) [= P(Z > 1.1470)]$	M1	
	[1-0.874	(49] = 0.1251 (Calculator gives 0.12567) awrt 0.13	A1	
			(4)	
(b)	Let $Y = I$	$L_1 - L_2$		
	$Y \sim N(0$	$(0, 2 \times 0.02^2)$ So $Y \sim N(0, 0.0008)$	M1 A1	
	$P\left(Z > \frac{0.01 - 0'}{\sqrt{0.0008'}}\right) \text{or} P\left(Z < \frac{-0.01 - 0'}{\sqrt{0.0008'}}\right)$			
	$2 \times (1 - 0)$	$(.6368) = 0.7264$ (Calculator gives 2×0.36183) awrt $0.724 \sim 0.726$	M1 A1	
			(5)	
(c)	$T \sim N(\mu$	(ι, σ^2)		
	$\mu = 7.7n$	n - 7.7n [= 0]	M1	
	$\sigma^2 = 0.0$	$001n^2 + 0.0001n$	M1	
		2-'0' 1.00		
	√'0.000	$\frac{1}{1n^2 + 0.0001n'} = 1.99$	M1 B1	
	$0.0001n^2$	$^{2} + 0.0001n - 1.01[00755] = 0$	dM1	
	<i>n</i> = 100		A1	
		N7	(6)	
(a)	M1	Notes	Total 15	
(a)	IVII	For a correct expression for variance (0.0019) or standard deviation (0.04358) Imp	olied by a	
	Al	correct variance or a correct standard deviation	J	
	M1	For standardising using 103.15, their mean and their standard deviation If their mean and/or their standard deviation/variance are incorrect then working mus	st be shown	
	A1	awrt 0.13		
(b)	M1	For $L_1 - L_2$ May be implied by a correct mean or variance		
	A1	For $N(0, 0.0008)$		
	M1 For standardising using 0.01, their mean and their standard deviation (May be implied by awrt 0.6368 or awrt 0.3632 or awrt 0.3618 or awrt 0.6382)			
	M1	For 2 times <i>p</i> where 2 <i>p</i> is a probability (Calculator gives 2×0.36183)		
(2)	AI M1	For a correct expression for μ Implied by a mean of 0		
(c)	MI M1	For a context expression for μ implied by a mean of 0		
		For a correct expression for σ For standardising using 2, their mean and their standard deviation and set = to a z value	ue where	
	M1	1.95 $< z < 2$		
	B1	awrt 1.99 seen or used		
	dM1	Dependent on 2 nd M1. For rearranging to get a correct 3 term quadratic e.g. $n^2 + n - n^2 + n - 10102$	10101 or	
I				