

Question	Answer	Marks	Guidance
1	$\frac{0.801 \times (1 - 0.801)}{2000}$ (= 0.0000797)	M1	
	$0.801 \pm z \times \sqrt{0.0000797}$	M1	Allow any z-value
	$z = 1.96$	B1	
	0.784 to 0.818 (3 sf)	A1	As final answer. Must be an interval Allow 0.783 to 0.819
	Total:	4	
2(i)	$E(X) = 4.197$	B1	
	$\text{Var}(X) = 4.196$	B1	Both to 3dp or better
	Total:	4	
2(ii)	$E(X) \approx \text{Var}(X)$	B1	Condone =
2(iii)	$e^{-4.1968} \left(1 + 4.1968 + \frac{4.1968^2}{2} + \frac{4.1968^3}{3!} + \frac{4.1968^4}{4!} \right)$	M1	Any λ . Allow with one end error
	= 0.59(0) (3 sfs)	A1	Allow 0.591
	Total:	2	

Question	Answer	Marks	Guidance
3(i)	Est (μ) = 923/400 or 2.3075 or 2.31 (3 sf)	B1	
	Est(σ^2) = $\frac{400}{399} \left(\frac{3170}{400} - "2.3075"{}^2 \right)$ OE	M1	
	= 2.60696 or 2.61 (3 sf)	A1	(Note: Biased Var= 2.600 scores M0)
	Total:	3	
3(ii)	H ₀ : Pop mean (or μ) = "2.31" or "2310" H ₁ : Pop mean (or μ) > "2.31" or "2310"	B1 FT	
	$\pm \frac{2.6 - "2.310"}{\sqrt{2.60696 + 50}} = 1.27$	M1 A1	Standardising using their values, Accept 1.28
	Comp 1.645 (OE)	M1	Valid comparison z values or areas
	No evidence that incomes in the region greater	A1 FT	OE FT their z. No contradictions (No FT for 2 tail test – max score B0 M1 A1 M1 for comp 1.96 A0) Note: Accept alternative CV method
	Total:	5	

Question	Answer	Marks	Guidance
4(i)	$0.75^{20} + 20 \times 0.75^{19} \times 0.25 + {}^{20}C_2 \times 0.75^{18} \times 0.25^2$	M1	No end errors
	= 0.0913	A1	As final answer
	Total:	2	
4(ii)	H ₀ : Pop proportion=0.25 H ₁ : Pop proportion<0.25	B1	Allow p or π , not "proportion" (Accept anywhere in the question)
	$0.75^{25} + 25 \times 0.75^{24} \times 0.25$	M1	Must be B(25,0,25) No end errors
	= 0.00702	A1	
	comp 0.01	M1	Valid comparison
	There is evidence that the claim is not justified	A1 FT	OE. No contradictions
	Total:	5	

Question	Answer	Marks	Guidance
5(i)	$0.5 \times 1 \times h = 0.25$ $h = 0.5$ $\text{grad} = 0.5$	M1	$P(X < 2) = 4 \times P(X < 1)$ M1
	$f(x) = 0.5x$	A1	$P(X < 2) = 1$ A1 $a = 2$ A1
	$0.5 \times a \times 0.5a = 1$	M1	$0.5 \times 2 \times h' = 1$ M1 $h' = 1$
	$a = 2$	A1	$\text{grad} = 0.5$
	$P(X < 2) = 1$	A1	$f(x) = 0.5x$ A1
	Total:		5
5(ii)	$\int_0^m 0.5x dx = 0.5$	M1	Attempt $\int f(x) dx = 0.5$ Ignore limits
	$= \left[\frac{x^2}{4} \right]_0^m = 0.5$	A1FT	Correct integration (ft $f(x)$) & limits = 0.5
	$m = \sqrt{2}$ or 1.41 (3 sf)	A1	or by similarity $m = \frac{1}{\sqrt{2}} \times 2$ M2 $= \sqrt{2}$ A1
	Total:		3

Question	Answer	Marks	Guidance
6(i)	$e^{-2.4} \times \frac{2.4^2}{2!}$	M1	Allow incorrect λ
	= 0.261 (3 sfs)	A1	
	Total:	2	
6(ii)	N(60, 60)	B1	seen or implied
	$\frac{54.5-60}{\sqrt{60}}$ (= -0.710)	M1	allow with wrong or missing cc
	$1 - \phi(" -0.710") = \phi("0.710")$	M1	For area consistent with their working
	= 0.761 (3 sf)	A1	
	Total:	4	
6(iii)	$\lambda = 3.6 + 12 \div 7 (= 186/35)$ (= 5.314)	M1	
	$e^{-5.314} \left(1 + 5.314 + \frac{5.314^2}{2} + \frac{5.314^3}{3!} \right)$	M1	Allow incorrect λ . Allow one end error.
	= 0.224 (3 sfs)	A1	
	Total:	3	

Question	Answer	Marks	Guidance
7(a)	$E(X_1+X_2) = 2 \times 4.2 = 8.4$ $\text{Var}(X_1+X_2) = 2 \times 1.1^2 = 2.42$	B1	Both. Seen or implied (or sd = 1.56)
	$\frac{10-8.4}{\sqrt{2.42}} \quad (= 1.029)$	M1	Standardising with their mean and var (no sd / var mix)
	$1 - \phi("1.029")$	M1	For area consistent with their working
	$= 0.152$ (3 sf)	A1	
	Total:	4	
7(b)	$E(X) = 20.5$	B1	
	$\text{Var}(X) = 105 + 0.5^2 \times 15 \quad (= 108.75)$	M1	correct expression oe
	$\frac{0-"20.5"}{\sqrt{108.75}} \quad (= -1.966)$	M1	correct standardisation using their E & V (no sd/var mix) ignore any attempted cc
	$\phi("-1.966") = 1 - \phi("1.966")$ $(= (1 - 0.9754))$	M1	For area consistent with their working
	$= 0.0246$ or 2.46% (3 sf)	A1	Accept 0.0247
	Total:	5	