Sampling and Estimation 3 MS

Q1.

5 (i)	$p = \frac{184}{400}$ or 0.46	B1	Used
	$z = 1.96$	B1	Seen
	$"0.46" \pm z \times \sqrt{\frac{"0.46"(1-"0.46")}{400}}$	M1	Using expression of correct form
	$= 0.411$ to 0.509	A1 [4]	Must be an interval
(ii)	0.5 within CI Claim not supported or not justified	B1√ [1]	Both needed. No contradictions. ft their **(i)**
(iii)	$z \times \sqrt{\frac{"0.46"(1-"0.46")}{400}} = 0.05$	M1	Allow M1 for $z \times \sqrt{\frac{"0.46"(1-"0.46")}{400}} = 0.1$
	$z = 2.006$	A1	
	$\Phi('2.006') = 0.9775$		
	$\alpha = '0.9775' - (1 - '0.9775')$	M1	or $1 - 2(1 - '0.9775')$
	$= 95.5\%$	A1 [4]	

Q2.

3	$p = 0.56$	B1	Used
	$'0.56' \pm z \times \sqrt{\frac{0.56 \times 0.44}{100}}$	M1	Equation of correct form condone just +ve or –ve Must be z
	$z = 2.17$, or 2.169 or 2.171	B1	
	0.452 to 0.668 (3 s.f.)	A1 [4]	Seen Must be an interval

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Q3.

4 (i)	$\text{Var}(P_s) = \dfrac{\frac{33}{150}\times\frac{150-33}{150}}{150}$ (= 0.001144) $z = 2.576$ $\dfrac{33}{150} \pm z\sqrt{\text{'0.001144'}}$ = 0.133 to 0.307 (3 sf)	M1 B1 M1 A1 4	Seen. Accept 2.574 to 2.579 Expression of correct form. Any z Must be an interval
(ii)	$\dfrac{19035}{150}$ (= 126.9 =127(3sf)) $\dfrac{150}{149}\left(\dfrac{4054716}{150} - \left(\dfrac{19035}{150}\right)^2\right)$ o.e. = 11001.17 or 11000(3 sf)	B1 M1 A1 3	 For use of a correct formula
(iii)	4-digit nos. each digit 0-9 Ignore nos > 9526 Ignore repeats	B1 B1 B1 3	Some valid way of generating 4 digit random nos from valid method from valid method SR If zero score, full explanation of method for drawing numbers out of a hat can score B1. NB Systematic sampling follows the scheme with first B1 for some way of generating a random starting point.
		Total: 10	

Q4.

3 (i)	$\dfrac{3420}{60}(= 57)$ $\dfrac{60}{59}\left(\dfrac{195200}{60} - \text{'57'}^2\right)$ (= 4.40678) = 4.41 (3 sf)	**B1** **M1** **A1** [3]	 Oe As final answer
(ii)	$\text{'57'} \pm z\sqrt{\dfrac{\text{'4.40678'}}{60}}$ $z = 2.326$ [56.4 to 57.6] (3 sf)	**M1** **B1** **A1** [3]	 2.326 – 2.329 (accept 2.33 if no better seen) NB: use of biased variance in (ii) can score in full
		Total: 6	

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Q5.

1	(i)	N(352, …) Variance = 2.9	B1 B1	[2]	no recovery in (ii) for each B mark accept sd = √ 2.9 = 1.70(29) stated
	(ii)	$\frac{354-352}{\sqrt{2.9}}$ (= 1.174) 1 – Φ('1.174') = 0.120 (3 sf)	M1 M1 A1	[3]	with their mean and var Or $\frac{354.05-352}{\sqrt{2.9}}$ or correct restart (= 1.204) (accept sd/var mix)1 – Φ('1.204') = 0.114 (3 sf) Incorrect cc can score M1M1A0
Total				**[5]**	

Q6.

3	(i)	0.4 or 2/5 or 26/65	B1	[1]	no recovery in (ii) for the B mark
	(ii)	" 0.4 " + $z \times \sqrt{\frac{0.4\times0.6}{65}}$ = 0.516 oe $z = \left(0.116 \times \sqrt{\frac{65}{0.4\times0.6}}\right) = 1.909$ (Φ('1.909') = 0.97(18)) 2 ('0.97' – 1) $\alpha = 94$	M1 A1 M1 A1	[4]	or " 0.4 " – $z \times \sqrt{\frac{0.4\times0.6}{65}}$ = 0.284 or $z \times \sqrt{\frac{0.4\times0.6}{65}}$ = 0.116 oe for fully correct method to find α from their z allow 94.36 or 94.4 or 94.374
Total				**[5]**	

Q7.

2	(i)	Each employee has an equal chance of being chosen	B1	[1]	oe
	(ii)	Est (μ) = 4 Est (σ^2) = $\frac{10}{9}(\frac{199.22}{10} - '4'^2)$ = 4.36 (3 sf)	B1 M1 A1	[3]	sub in correct formula attempted working may not be seen
	(iii)	Distances travelled by all employees at the firm	B1	[1]	oe

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Q8.

3	(i)	$((0.5672 + 0.6528) \div 2)$ $= 0.61$	**B1** [1]	
	(ii)	$'0.61' + z\sqrt{\frac{'0.61'\times(1-'0.61')}{350}} = 0.6528$	**M1**	oe
		$z = 0.0428 \times \sqrt{\frac{700}{'0.61'\times(1-'0.61')}}$ oe	**M1**	correct rearrangement of correct equn, ft '0.61'
		$= 2.321$	**A1**	
		98% confidence	**A1 ft** [4]	ft their z (dep on both Ms)