Note: '(3 sfs)' means 'answer which rounds to … to 3 sfs'. If correct ans seen to > 3sfs, ISW for later rounding. Penalise < 3 sfs only once in paper.

1		B(200, $\frac{1}{6}$) → N($\frac{100}{3}$, $\frac{250}{9}$) $\frac{25.5-\frac{100}{3}}{\sqrt{\frac{250}{9}}}$ = –1.486 comp '1.486' with 1.282 Evidence to reject H_0 There is some evidence that $p < \frac{1}{6}$ or, e.g. It is likely that $p < \frac{1}{6}$ oe	**B1** **M1** **A1** **M1** **A1 ft**	[5]	seen or implied allow with wrong or no cc (Accept alternative correct methods) or comp ('1.486') with 0.1 No contradictions
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
3	**(i)**	((0.5672 + 0.6528) ÷ 2) = 0.61	**B1**	[1]	
	(ii)	'0.61' + $z\sqrt{\frac{'0.61'\times(1-'0.61')}{350}}$ = 0.6528 z = 0.0428 × $\sqrt{\frac{700}{'0.61'\times(1-'0.61')}}$ oe = 2.321 98% confidence	**M1** **M1** **A1** **A1 ft**	[4]	oe correct rearrangement of correct equn, ft '0.61' ft their z (dep on both Ms)

4	**(i)**	$H_0: \mu = 12.5$ $H_1: \mu \neq 12.5$	**B1**		
		$\frac{13.5-12.5}{4.2\div\sqrt{50}}$	**M1**		allow $4.2 \div 50$
		$= 1.68(4)$	**A1**		
		'1.684' < 1.96	**M1**		comp 1.96 allow comp 1.645 if H1: $\mu >$ 12.5 or comp 1 – ('1.684') with 0.025
		No evidence that mean time has changed	**A1 ft**	[5]	No contradictions ft their 1.684, but not comp 1.645
	(ii)	0.05	**B1**	[1]	
5	**(i)**	$T \sim N(6 \times 2.4, 6 \times 0.3^2)$			
		$(= N(14.4, 0.54)$	**M1**		seen or implied
		$\frac{16-'14.4'}{\sqrt{'0.54'}}$ $(= 2.177)$	**M1**		ft their E and Var; allow without √ (Accept alternative method N(2.4,(0.3²)/6))
		1 – ('2.177')	**M1**		correct area consistent with their working
		$= 0.0147$ (3 sf)	**A1**	[4]	
	(ii)	$D = X_1 - 1.1X_2$			
		$E(D) = -0.24$	**B1**		
		$Var(D) = 0.3^2 + 1.1^2 \times 0.3^2$ $(= 0.1989)$	**M1**		
		$\frac{0-(-0.24)}{\sqrt{'0.1989'}}$ $(= 0.538)$	**M1**		ft their E and Var; allow without √
		('0.538')	**M1**		correct area consistent with their working
		$= 0.705$ (3 sf)	**A1**	[5]	
6	**(i)**	2 m	**B1**	[1]	allow without units
	(ii)	$k\int_0^2 x^2(2-x)\mathrm{d}x = 1$	**M1**		attempt integ f(x) and '= 1'. Ignore limits
		$k\left[\frac{2x^3}{3} - \frac{x^4}{4}\right]_0^2$	**A1**		correct integration and limits
		$k \times \left[\frac{16}{3} - 4\right] = 1$ or $k \times \frac{4}{3} = 1$ oe			
		$k = \frac{3}{4}$ **AG**	**A1**	[3]	No errors seen
	(iii)	$\frac{3}{4}\int_0^2 x^3(2-x)\mathrm{d}x$	**M1**		attempt integ xf(x), condone missing k
		$= \frac{3}{4} \times \left[\frac{2x^4}{4} - \frac{x^5}{5}\right]_0^2$	**A1**		correct integration and limits, condone missing k
		1.2 m oe	**A1**	[3]	allow without units

	(iv)	$\frac{3}{4}\int_0^1 x^2(2-x)\mathrm{d}x$ $(=\frac{3}{4}\times(\frac{2}{3}-\frac{1}{4}))$ $=\frac{5}{16}$ or 0.3125 oe $400\times\frac{5}{16}=125$	**M1** **A1** **A1 ft** [3]	attempt integ f(x), 0 to 1, condone missing k ft their $\frac{5}{16}$
7	**(a) (i)**	0.01×80 and 0.015×60 $(1-\mathrm{e}^{-0.8})\times(1-\mathrm{e}^{-0.9})$ $= 0.327$ (3 sf)	**M1** **M1** **A1** [3]	$(1-\mathrm{e}^{-\lambda})\times(1-\mathrm{e}^{-\mu})$ any λ, μ $(\lambda\neq\mu)$ allow one end error
	(ii)	$\lambda = 0.02\times 40 + 0.015\times 60$ $\mathrm{e}^{-1.7}\times(1+1.7+\frac{1.7^2}{2})$ $= 0.757$ (3 sf)	**M1** **M1** **A1** [3]	or their 0.8 + 0.9
	(b)	$\mathrm{e}^{-\lambda}\times\lambda = p$ and $\mathrm{e}^{-\lambda}\times\frac{\lambda^2}{2}=1.5p$ $\lambda = 3$ $p=\mathrm{e}^{-3}\times 3$ $= 0.149$ (3 sf)	**M1** **A1** **M1** **A1** [4]	or $\mathrm{e}^{-\lambda}\times\frac{\lambda^2}{2}=1.5\times\mathrm{e}^{-\lambda}\times\lambda$ seen or implied their λ

[Total for paper 50]