Mark Scheme 4734
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STATISTICS 3

1	(i)	$p_S \pm z\sigma_{est}$	M1		Use formula, σ involving p_S and 400.
		p_s=186/400(0.465)	A1		
		$\sigma_{est}= \sqrt{\dfrac{0.465\times 0.535}{400}}$	B1		
		z=1.96	A1		
		(0.416,0.514)	A1	**5**	
	(ii)	Councillor statement implies p=0.5. CI does contain 0.5 but only juat so councillor probably correct.	B1	**1**	Any justifiable comment **Not too assertive**
2	(i)	σ^2 unknown	B1	**1**	
	(ii)	H_0: μ=2000 (or ≥), H_1: μ <2000	B1		
		$\bar{x}$ =1958.2, s=115.57	B1B1		or 1958,115.6
	EITHER:	Test statistic = $\dfrac{1958.2-2000}{115.57/2}$	M1		
		=-0.7234	A1		art –0.723
		Critical value –1.638	B1		
		Test statistic not in CR, accept H_0		M1	Or equivalent
		Accept that specification is being met	A1		Conclusion in context
	OR:	Critical region:			
		$\dfrac{\bar{x}-2000}{115.57/2} < t$	M1		
		t=-1.638		B1	
		$\bar{x}$ < 1905.2	A1		art 1900 or 1910
		As above	M1A1	**8**	Conclusion in context
3	(i)	Use of $\int_{20}^{a} \mathrm{f}(t)\mathrm{d}t$	M1		With limits and f(t) substituted
		$\left[-\dfrac{2}{3}\cos\dfrac{\pi t}{60}\right]_{20}^{a}$	A1		
		AG	A1	**3**	Properly obtained
	(ii)	3×(i) + 2×(1-(i))	M1		Idea of expectation
			A1		All correct
		Equate to 2.80 and attempt to solve		M1	From equation in a, 2 or 3
		a=44.8	A1	**4**	Accept 45
					SR: ⅓(1-2cos..)= 0.8 give max3/4

4	(i)	Use Poisson distribution	M1		Po(5.5) or Po(55) seen
		With μ=55	B1		
		σ^2=55	A1		
		$(39.5-55)/\sqrt{55}$	A1		Standardising, with ,without or wrong cc
		-2.09	A1		
		art 0.982		A1 **6**	
	(ii)	E(*X*- *Y*)=37	B1√		ft μ above
		Var(*X*-*Y*)=55+18		M1	
		=73	A1√	**3**	ft μ above
	(iii)	EITHER: Expectation not equal to variance OR: *X*-*Y* could be negative OR: Difference of two Poisson variables could have a negative expectation		M1	Any one
		So *X*-*Y* does not have a Poisson distn	A1	**2**	
5	(i)EITHER:	Use ⅛$(3-1)^2$=a(3-2)			
	OR:	a(4-2)=1		M1	Continuity of F
		a=½	A1	**2**	
	(ii)	F(1.8)=⅛$(0.8)^2$ =0.08	M1		Appropriate use of F
		$C_X(8)$=1.8	A1	**2**	
	(iii)	G(*y*)=P(*Y*≤*y*)=P($(X-1)^{1/2}$≤*y*)	M1		
		=P(*X* ≤ y^2+1)		A1	
		=F(y^2+1)	A1		
		$$G(y)=\begin{cases}\frac{1}{8}y^4 & (0\le y\le\sqrt{2}),\\ \frac{1}{2}(y^2-1) & (\sqrt{2}<y\le\sqrt{3}).\end{cases}$$	A1		
		Ignore others, A1 for both ranges of y	B1	**5**	
	(iv)	Use G(*y*) to find $C_Y(8)$	M1		
		Obtain √(0.8)	A1		
		Correct verification	B1	**3**	

6	**(i)**	s^2 =(8×0.7400+9×0.8160)/17	M1		Formula for pooled estimate
		=0.7802	A1		At least 4DP shown
		0.780 AG		**2**	
	(ii)	Assumes braking distances have normal distributions	B1		
		Use $\bar{x}_A - \bar{y}_B \pm t\sigma$	M1		Must be *t* value
		t=2.567	A1		
		σ=√[0.7802(1/10+1/9) (0.40584)	B1		Allow 0.780
		(1.518,3.602)	A1	**5**	art (1.52, 3.60)
	(iii)	H_0:μ_A-μ_B =2, H_1:μ_A-μ_B > 2	B1		For both hypotheses
		Use of CV, 1.740	B1		
	EITHER:	Test statistic=(2.56-2)/σ	M1		Standardising, σ as above
		=1.38	A1		Rounding to 1.38
	OR:	Critical region			
		$\bar{x}_A - \bar{x}_B > 2 + 1.74 \times 0.4054$	M1		
		=2.7054	A1		2.70 or 2.71
		Indication that test statistic is not in critical region	M1		Not from different signs test statistic
		and Insufficient evidence to accept claim and H_1	A1	**6**	critical value. A1 dep on correct H_0
7	(i)	Use $\int_1^\infty x\alpha x^{-\alpha-1}dx = (\int_1^\infty \alpha x^{-\alpha}dx)$	M1		
		$\left[\frac{-\alpha x^{-\alpha+1}}{\alpha-1}\right]_1^\infty$	B1		Correct limits not required
		= α/(1-α) AG	A1	**3**	Properly obtained
	(ii)	α/(1-α)=1.92 giving 2.087 AG	B1	**1**	
	(iii)	Integral of 2.087$x^{-3.087}$ from 2 to 3		M1	
		$[-x^{-2.807}]_2^3$	A1		
		×200	A1		
		Obtain AG	A1	**4**	Evidence required
	(iv)	Combine last 3 cells	B1		
		X^2 =6.9²/152.9+6.1²/26.9 + 4.9²/9.1 + 4.1²/11.18	M1		Accept one error
			A1		All correct
		=5.847…	A1		art 5.8
		Use CV 5.991	B1 √		ft number of sells used.
		Accept that data supports Zipf's law	B1	**6**	
		SR: From 6 cells: B0M1A1 (for 9.34) then B1 for 9.488, B1 Max 4/6			