Question number	Mark scheme	Marks
1. (*a*)	Treatments are allocated *at random* within a block where *a block is a group of experimental units.*	B1 B1 (2)
(*b*)	12	B1 (1)
(*c*)	$F_{3,\,12} = 3.49$ 3, 12 3.49	B1 B1 (2)
		(5 marks)
2. (*a*)	H_0: $\beta = 0.6$	
	H_1: $\beta > 0.6$ both	B1
	$s^2 = \dfrac{0.145}{8} = 0.018125$	M1
	$t = \dfrac{0.631 - 0.6}{\sqrt{\dfrac{0.0181}{2.4137}}}$ $\dfrac{0.631-0.6}{\sqrt{\dfrac{s^2}{S_{xx}}}}$	M1
	$= 0.357737$ Awrt 0.358	A1
	Critical region $t > 1.860$	B1
	$0.358 < 1.860$ $\therefore$ not in critical region. Insufficient evidence to reject H_0 $\therefore$ the regression coefficient is not greater than 0.6	A1 ft
		(6 marks)

(ft = follow through mark)

Question number	Mark scheme	Marks
3.	H_0: $\mu_A = \mu_B = \mu_C$	
	H_1: $\mu_A \neq \mu_B \neq \mu_C$ both	B1
	$\Sigma x_{ij} = 419$	
	$\Sigma x^2_{ij} = 11883$	
	$T_A = 153$ $T_B = 144$ $T_C = 122$	
	Between Diets SS = $\frac{153^2}{5} + \frac{144^2}{5} + \frac{122^2}{5} - \frac{419^2}{15}$	M1
	= 101.73…..	A1
	Source of variation / d.f / SS / MSS / Ratio	
	Between diets / 2 / $101.7\dot{3}\ldots$ / 50.86 / 7.91 d.f	B1
	Within diets / 12 / 77.2 / 6.433…. within	B1
	Total / 14 / 178.933 ratio	M1 A1
	CR is $F_{2,12}$ (0.01)> 6.93	B1
	or $F_{2,12}$ (0.05) > 3.89	
	7.90 is in the critical region ∴ we can conclude that diet does have an effect on the performance of female swimmers.	A1
		(9 Marks)

(ft = follow through mark)

Question number	Mark scheme		Marks
4. (*a*)	H$_0$: $m_1 - m_0 = 0$		B1
	H$_1$: $m_1 - m_0 > 0$		B1
	$E(S) = \frac{1}{4}(25) \times 26 = 162.5$		M1 A1
	$\text{Var}(S) = \frac{25 \times 26 \times 51}{24} = 1381.25$		M1 A1
	$z = \frac{106 - 162.5 + 0.5}{\sqrt{1381.25}}$ or $\frac{106 - 162.5}{\sqrt{1381.25}}$	normal	M1
		Their μ, σ	A1 ft
	$= -1.506....$ $\quad = -1.5202....$	$-1.506...$, -1.51 $-1.5202.....$, -1.52	A1
	Critical region $z \leq -1.6449$		
	$-1.506 < -1.6449$		B1
	Insufficient evidence that athletes are faster on indoor than outdoor tracks		A1 ft
			(11 marks)

Question number	Mark scheme		Marks	
5. (*a*)	50 g		B1	(1)
(*b*)	If the weight is below the mean the consumer may complain		B1	
	If the weight is above the mean it would cost the company money		B1	(2)
(*c*)	$50 \pm 1.9600 \times \frac{2.4}{\sqrt{10}} = (48.5, 51.5)$	$50 \pm z \times \frac{2.4}{\sqrt{10}}$	M1	
		1.96	B1	
		3sf	A1	
	$50 \pm 2.5758 \times \frac{2.4}{\sqrt{10}} = (48.0, 52.0)$	3sf	A1	(4)
(*d*)	Graph	labels	B1	
		lines	B1	(2)
(*e*)	Means plotted			
	The values have increased and the last one is above the action limit $\therefore$ the machine needs to be reset		B1	(2)
(*f*)	If the standard deviation changes the control chart limits will no longer be valid which could result in some bags containing too little/much crisps.		B1	(1)
			(12 marks)	

(ft = follow through mark)

Question number	Mark scheme	Marks
6. (*a*)	H_0: $m = 30$	
	H_1: $m \neq 30$	B1
	+ – + + – + + + + +	M1
	$R = 8$	
	$n = 10$	A1
	$P(R \geq 8/n = 10) = 1 - P(R \leq 7)$	M1
	$= 0.0547$	A1
	$0.0547 > 0.05$ $\therefore$ no evidence to reject H_0. The median fuel consumption is 30 mpg	A1 ft (6)
(*b*)	H_0: $m_1 = m_2$	
	H_1: $m_2 > m_1$	B1
	Sample 1 7 15 11 8 14 4 12 9 5 10	M1
	Sample 2 1 2 3 6 13	A1
	$T = 13 + 6 + 3 + 2 + 1 = 25$ $T' = 55$ If rank smallest first $T = 55$ $T' = 25$	M1 A1
	Critical region $T \leq 26$	B1
	$\therefore$ T is in the critical region $\therefore$ there is insufficient evidence that the median fuel consumption has increased	A1 (7)
		(13 marks)

(ft = follow through mark; (*) indicates final line is given on the paper)

Question number	Mark scheme		Marks	
7. (*a*)	$\hat{\beta} = \frac{898}{6000} = 0.14966\ldots$	0.150	B1	
	$\hat{\alpha} = 13.544 - \frac{898}{6000} \times 50$		M1	
	$= 6.0606\ldots$	6.06	A1	(3)
(*b*)	$\text{RSS} = 150.36 - \frac{(898)^2}{6000}$		M1	
	$= 15.9593\ldots$		A1	
	$S^2 = \frac{15.96}{7}$		M1	
	$= 2.27 - 2.28$		A1	
	$\text{CJ} = 0.150 \pm 2.365\sqrt{\frac{2.28}{6000}}$	2.365	B1	
		$0.150 \pm t\sqrt{\frac{S^2}{S_{xx}}}$	M1	
	(0.104, 0.196)	Both	A1	
		3 sf	A1	(8)
(*c*)	$r = 10.9 - (6.06 + 0.15 \times 30)$		M1	
	$= 0.34$	2 dp	A1	
	$s = 16.3 - (16.06 + 0.15 \times 70)$			
	$= -0.26$	2 dp	A1	(3)
(*d*)	Graph	Label	B1	
		plotting	M1	
			A1 ft	(3)
(*e*)	Points not randomly scattered about the axis; indicating it is not linear		B1; B1	(2)
			(19 Marks)	