

Question number	Scheme	Marks
<p>1. (a)</p> <p>(b)</p>	<p>$H_0 : \sigma_A^2 = \sigma_B^2, H_1 : \sigma_A^2 \neq \sigma_B^2$</p> <p>critical values $F_{24,25} = 1.96$ and $\frac{1}{F_{24,25}} = 0.510$</p> <p>$\frac{s_B^2}{s_A^2} = 2.10$ or $\frac{s_A^2}{s_B^2} = 0.476$</p> <p>Since 2.10 or 0.476 are in the critical region we reject H_0 and conclude there is evidence that the two variances are different.</p> <p>The populations of pebble lengths are normal.</p>	<p>both B1</p> <p>both B1</p> <p>both M1A1</p> <p>A1J (5)</p> <p>B1 (1)</p> <p style="text-align: center;">6</p>
<p>2.</p>	<p>$H_0 : \mu = 5.1, H_1 : \mu < 5.1$</p> <p>$\nu = 9$</p> <p>Critical Region $t < -2.262$</p> <p>$\bar{x} = 4.91$</p> <p>$s^2 = \frac{241.89 - 10 \times (4.91)^2}{9} = 0.0899$</p> <p>$s = 0.300$</p> <p>$t = \frac{4.91 - 5.1}{\frac{0.3}{\sqrt{10}}} = -2.00$</p> <p>There is no evidence to suggest that the mean height is less than those grown previously</p>	<p>both B1</p> <p>9 B1</p> <p>B1</p> <p>4.91 B1</p> <p>M1</p> <p>0.0899 or 0.300 A1</p> <p>M1A1</p> <p>context A1J (9)</p> <p style="text-align: center;">9</p>

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<p>3 (a)</p> <p>(b)</p> <p>(c) (i)</p> <p>(ii)</p>	<p>1-0.8891=0.1109</p> <p>1-(P(0)+P(1)+P(2)) $= 1 - ((1-p)^{12} + 12p(1-p)^{11} + 66p^2(1-p)^{10})$ $= 1 - (1-p)^{10}((1-p)^2 + 12p(1-p) + 66p^2)$ $= 1 - (1-p)^{10}(1+10p+55p^2)$ **given**</p> <p>1-0.5583=0.442 1-0.00281=0.997</p> <p>The test is more discriminating for the larger value of p</p>	<p>B1</p> <p>M1</p> <p>M1A1</p> <p>cs0 A1</p> <p>M1A1</p> <p>A1</p> <p>B1</p> <p>(1)</p> <p>(4)</p> <p>(3)</p> <p>(1)</p> <p style="text-align: center;">9</p>
<p>4 (a)</p> <p>(b)</p>	<p>$s^2 = \frac{2962 - 15 \times \left(\frac{208}{15}\right)^2}{14} = 5.55$ or $(n-1)s^2 = 2962 - \frac{208^2}{15} = 77.3$</p> <p>$\frac{14 \times 5.55}{23.685} < \sigma^2 < \frac{14 \times 5.55}{6.571}$</p> <p>$3.28 < \sigma^2 < 11.83$</p> <p>Since 9 lies in the interval, yes</p>	<p>either M1A1</p> <p>23.685,6.571 M1B1,B1</p> <p>A1A1</p> <p>(7)</p> <p>B1,B1(dep)</p> <p>(2)</p> <p style="text-align: center;">9</p>



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5 (a)(i) (ii)	Type I - H_0 rejected when it is true	B1
	Type II - H_0 is accepted when it is false	B1
(b)	$H_0 : \lambda = 5, H_1 : \lambda > 5$ $P(X \geq 7 \lambda = 5) = 1 - 0.7622 = 0.2378 > 0.05$ (OR $P(X \geq 9) = 0.0681, P(X \geq 10) = 0.0318, CV=10, 7$ not in CR. No evidence of an increase in the number of chicks reared per year.	both B1 M1A1 probabs, 10 M1A1 context A1
(c)	$P(X \geq c \lambda = 5) < 0.05$ $P(X \geq 9) = 0.0681, P(X \geq 10) = 0.0318, c=10$ $P(\text{Type I Error}) = 0.0318$	may be seen in (b) M1 A1
(d)	$\lambda = 8$ $P(X \leq 9 \lambda = 8) = 0.7166$ (OR if $c=9$ in (d), $P(X \leq 8 \lambda = 8) = 0.5925$	M1A1 M1A1 11 (2)
6 (a)	$E\left(\frac{2}{3}X_1 - \frac{1}{2}X_2 + \frac{5}{6}X_3\right) = \frac{2}{3}\mu - \frac{1}{2}\mu + \frac{5}{6}\mu = \mu$ $E(Y) = \mu \Rightarrow$ unbiased	M1A1 B1 (3)
(b)	$E(aX_1 + bX_2) = a\mu + b\mu = \mu$ $a + b = 1$ $\text{Var}(aX_1 + bX_2) = a^2\sigma^2 + b^2\sigma^2$ $= a^2\sigma^2 + (1-a)^2\sigma^2$ $= (2a^2 - 2a + 1)\sigma^2$	M1 A1 M1A1 M1 A1 (6)
(c)	Min value when $(4a - 2)\sigma^2 = 0$ $\Rightarrow 4a - 2 = 0$ $a = \frac{1}{2}, b = \frac{1}{2}$	$\frac{d}{da}(\text{Var}) = 0$, all correct M1A1 A1 A1A1f (5)

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<p>7 (a)</p>	$s_p^2 = \frac{7 \times 7.84 + 7 \times 4}{7 + 7} = 5.92$ $s_p = 2.433105$ $H_0 : \mu_A = \mu_B, H_1 : \mu_A \neq \mu_B$ $t = \frac{26.125 - 25}{2.43 \sqrt{\frac{1}{8} + \frac{1}{8}}} = 0.92474$ $t_{14}(2.5\%) = 2.145$ <p>Insufficient evidence to reject H_0 that there is no difference in the means.</p>	<p>M1</p> <p>awrt 2.43 A1</p> <p>both B1</p> <p>awrt 0.925 M1A1</p> <p>2.145 B1</p> <p>A1J</p> <p style="text-align: right;">(7)</p>
<p>(b)</p>	$d = M1 - M2$ <p>2,5,-2,1,3,-4,1,3</p> $\bar{d} = \frac{9}{8} = 1.125$ $s_d^2 = \frac{69 - 8 \times 1.125^2}{7} = 8.410714$ $H_0 : \delta = 0, H_1 : \delta \neq 0$ $t = \frac{1.125}{\sqrt{\frac{8.41}{8}}} = 1.0972$ $t_7(2.5\%) = 2.365$ <p>There is no significant evidence of a difference between method A and method B.</p>	<p>M1</p> <p>1.125 B1</p> <p>awrt 8.41 M1A1</p> <p>both B1</p> <p>awrt 1.10 M1A1</p> <p>2.365 B1</p> <p>A1J</p> <p style="text-align: right;">(9)</p>
<p>(c)</p>	<p>Paired sample as they are two measurements on the same orange</p>	<p>B1</p> <p style="text-align: right;">(1)</p>