

## Stats 2 Hypothesis Testing Answers

<b>6(a)</b>	$H_0 : \mu = 65$ $H_1 : \mu < 65$  $\bar{X} \sim N\left(65, \frac{81}{35}\right)$  $z_{crit} = -1.6449$  $z = \frac{61.5 - 65}{\frac{9}{\sqrt{35}}} = -2.30$	B1		1-tailed test
		B1		
	Reject $H_0$ at 5% level of significance	A1✓		for $\sigma^2/n$ used  (on their z-values)
	Evidence to suggest students may be under-achieving	E1	6	
<b>(b)</b>	Reject $H_0$ when $H_0$ true <div style="text-align: center;">⇓</div> Conclude that students are under-achieving when in fact they are not	E1  E1		
<b>Total</b>			<b>8</b>	

<b>8</b>	$H_0 : \mu = 1000$ $H_1 : \mu \neq 1000$  $\bar{x} = \frac{12036}{12} = 1003$  $S = 5.444$  $\nu = 12 - 1 = 11$  $t = \frac{\bar{x} - \mu}{\frac{S}{\sqrt{n}}} = \frac{1003 - 1000}{\frac{5.444}{\sqrt{12}}} = 1.91$	B1		2-tailed test
		B1		
		B1		( $S^2 = 29.6$ )
		B1		
		M1 A1ft A1		
	$t_{crit} = \pm 2.201$	B1✓		(on their $\nu$ )
	Accept $H_0$	A1✓		(on their t-values)
	Insufficient evidence to indicate a change in the mean content of sherry in a bottle	E1✓	10	
<b>Total</b>			<b>10</b>	

<b>6(a)</b>	$\bar{x} = \frac{471}{5} = 94.2$	B1	
	$s = 6.058$	B1	Or $s^2 = 36.7$
	$\nu = 4$ 1-tailed test	B1	
	$t_{\text{crit}} = -2.132$	B1	Or on diagram
	$H_0 : \mu = 100$		
	$H_1 : \mu < 100$	B1	
	$t = \frac{94.2 - 100}{6.058 / \sqrt{5}} = -2.14$	M1A1	$\frac{\text{their } \bar{x} - 100}{(\text{their } s) / \sqrt{5}}$
	Reject $H_0$ at 5% level of significance	A1✓	On their $t$ and critical value
	Evidence at the 5% level of significance to support the members' belief that the batteries last less than 100 hours.	E1✓	9
	<b>(b)</b>	$\bar{x} = \frac{8080}{80} = 101$	
$s^2 = \frac{6399}{79} = 81$ (or $\frac{6399}{80} = 79.9875$ )			
$s = 9$ (or $s = 8.944$ )		B1	For $s$ (or $s^2$ ) and $\bar{x}$
$H_0 : \mu = 100$			
$H_1 : \mu \neq 100$		B1	
$\bar{X} \sim N\left(100, \frac{81 \text{ (or } 79.9875)}{80}\right)$ under $H_0$		B1	Or $100, \frac{9}{\sqrt{80}}$ used
$z = \frac{101 - 100}{9 / \sqrt{80}} = 0.99$		M1 A1	Allow use of $t$ method AWFW 0.99 to 1.00 (allow 1)
2-tailed test			
$z_{\text{crit}} = \pm 1.96$		B1	Or $z = 1.96$
Accept $H_0$ at 5% level of significance.		A1✓	On their $z$ and critical value Or $t$
Sufficient evidence at the 5% level of significance to support the manufacturer's belief.	E1✓		
<b>Total</b>		<b>17</b>	<b>8</b>

3	$\bar{x} = 83.5$	B1	
	$s^2 = \frac{1}{99}(15321) = 154.76$		$(154 < s^2 \leq 155)$
	$s = 12.44$	B1	$(12.4 \leq s \leq 12.45)$
	$H_0 : \mu = 85.9$	B1	
	$H_1 : \mu \neq 85.9$	B1	
	Under $H_0$ , $\bar{X} \sim N\left(85.9, \frac{(12.44^2)}{100}\right)$		
$z_{\text{crit}} = \pm 1.96$	B1	$z = 1.96 + 2$ tail test used	
$z = \frac{83.5 - 85.9}{12.44/\sqrt{10}} = -1.929$	M1	$\frac{(\text{their } \bar{x}) - 85.9}{(\text{their } s)/10}$	
	A1		
accept $H_0$ , reject the claim	A1✓	AWFW -1.94 to 1.92 On their z	
Insufficient evidence to suggest that the mean has changed from 85.9 at the 5% level of significance.	E1✓	8	
<b>Total</b>			<b>8</b>

5(a)	$H_0 : \mu = 30$	B1	
	$H_1 : \mu > 30$	B1B1	$\sigma = 4.03$ ( $\sigma^2 = 16.25$ )
	$\bar{x} = 33.5$ and $s = 4.25$ ( $s^2 = 18.06$ )		$\downarrow$
	Under $H_0$ , $\bar{X} \sim N\left(30, \frac{(4.25^2)}{10}\right)$		
	$t = \frac{33.5 - 30}{4.25/\sqrt{10}} = 2.60$	M1A1	$\frac{33.5 - 30}{4.03/\sqrt{9}}$ (2.6 - 2.61)
	$t_{\text{crit}} = 2.821$	B1	
do not reject $H_0$			
Insufficient evidence at the 1% level of significance that Jasmine's teacher is underestimating the time that it takes to complete the homework assignments.	E1✓	7	
(b) Times are Normally distributed	B1	1	
<b>Total</b>			<b>8</b>

3	$H_0 : \mu = 36$		
	$H_1 : \mu < 36$	B1	
	$\bar{x} = \frac{1730}{50} = 34.6$	B1	
	$s^2 = \frac{784}{49} = 16$	B1	
	Test statistic: $z = \frac{34.6 - 36}{\frac{4}{\sqrt{50}}} = -2.47$	M1 A1	(-2.48 to -2.47)
	$z_{\text{crit}} = -2.3263$	B1	
	Reject $H_0$ Sufficient evidence at the 1% level of significance to support David's claim	A1✓ E1✓	
<b>Total</b>			<b>8</b>

8(a)	$\bar{x} = 225.25$	B1	
	$s = 5.06 \quad (s^2 = 25.6)$	B1	$(\sigma = 4.74) , (\sigma^2 = 22.4)$
	$H_0 : \mu = 230$		
	$H_1 : \mu \neq 230$	B1	both
	$\nu = 8 - 1 = 7$	B1	
	$t_{\text{crit}} = \pm 2.365$	B1	accept $t_{\text{crit}} = -2.365$
	Test statistic:		
	$t = \frac{225.25 - 230}{\frac{5.064}{\sqrt{8}}} = -2.65$	M1	$\frac{225.25 - 230}{\frac{4.74}{\sqrt{7}}} = -2.65$
	Reject $H_0$ at 5% level No evidence to support the producer's claim	A1 A1✓ E1✓	(-2.66 to -2.65)
			9
(b)	We have rejected $H_0$ when in fact $H_0$ may be true. This indicates that a Type I error may have been made.	B2	2
<b>Total</b>			<b>11</b>