

Question Number	Scheme	Marks
1.	<p>Total in School = <math>(15 \times 30) + 150 = 600</math></p> <p>random sample of <math>\frac{30}{600} \times 40</math>                      = <u>2</u> from each of the 15 classes</p> <p>random sample of <math>\frac{150}{600} \times 40</math>                      = <u>10</u> from sixth form;</p> <p>Label the boys in each class from 1 – 15 and the girls from 1 – 15.                      use random numbers to select 1 girl and 1 boy</p> <p>Label the boys in the sixth form from 1 – 75 and the girls from 1 – 75. use random numbers to select <u>5</u> different boys and 5 different girls.</p>	<p>B1</p> <p>(Use of <math>\frac{40}{their\ 600}</math>) M1 A1</p> <p>Either A1</p> <p>B1 B1</p> <p>B1</p> <p>(7)</p>

Question Number	Scheme	Marks
2. (a)	$E(R) = 20 + 10 = 30$	B1 (1)
(b)	$\text{Var}(R) = 4 + 0.84, = 4.84$	M1, A1 (2)
(c)	$R \sim N(30, 4.84)$ (Use of normal with their (a),(b))  $P(28.9 < R < 32.64) = P(R < 32.64) - P(R < 28.9)$ $= P\left(Z < \frac{32.64 - 30}{2.2}\right) - P\left(Z < \frac{28.9 - 30}{2.2}\right)$ Stand their $\sigma$ and $\mu$  $= P(Z < 1.2) - P(Z < -0.5)$  $= 0.8849 - (1 - 0.6915)$ Correct area  $= 0.8849 - 0.3085 = 0.5764$ ( accept AWRT 0.576)	B1ft  M1  A1, A1  M1  A1  (6)

3. (a)	$\hat{\mu} = \frac{82 + 98 + 140 + 110 + 90 + 125 + 150 + 130 + 70 + 110}{10}$ $= 110.5$ $\hat{\sigma}^2 = \frac{1}{9}(128153 - 10 \times 110.5^2)$ $= 672.28$	M1 A1 128153 B1 (AWRT 672) M1 A1 (5)
(b)	<p>95% confidence limits are</p> $110.5 \pm 1.96 \times \frac{25}{\sqrt{10}}$ <p>95% conf. lim. = AWRT(95, 126)</p>	(condone use of 5 instead of 25) (for 1.96) M1 B1 A1√ A1 A1 (5)
(c)	<p>Number of intervals = <math>\frac{95}{100} \times 15</math></p> $= 14.25$	(Allow 14 or 14.3 if method is clear) M1 A1 (2)
		12

4.

$H_0$  : No association between gender and acceptance  
 $H_1$  : gender and acceptance are associated

	Accept	Not accept	Total
Males	170 (180)	110 (100)	280
Females	280 (270)	140 (150)	420
Totals	450	250	700

Expected Values

$O$	$E$	$\frac{(O - E)^2}{E}$
170	180	0.5556
110	100	1.0000
280	270	0.3704
140	150	0.6667

$$\sum \frac{(O - E)^2}{E} = 2.59 \text{ (Yates' 2.34)}$$

(Condone use of Yates')

$$\nu = 1; (5\%) = 3.841$$

$3.841 > 2.59$ . There is insufficient evidence to reject  $H_0$   
 There is no association between a persons gender and their acceptance (of the offer of a flu jab.)

B1

M1 A1

M1 A1

B1; B1

M1  
 A1√

(9)

9

<p>5. (a)</p>	<p><math>\mu_b =</math> mean mark of boys, <math>\mu_g =</math> mean mark of girls.</p> <p><math>H_0 : \mu_b = \mu_g</math>  <math>H_1 : \mu_b \neq \mu_g</math></p> <p><math display="block">z = \frac{53 - 50}{\sqrt{\frac{144}{80} + \frac{144}{80}}}</math></p> <p><math>= 1.58</math></p> <p>Critical region <math>z \geq 1.96</math>  <math>1.58 &lt; 1.96</math> insufficient evidence to reject <math>H_0</math>.  No diff. between mean scores of boys and girls.</p>	<p>both</p> <p>B1</p> <p>M1 A1</p> <p>A1 B1 M1 A1</p> <p>(7)</p>
<p>(b)</p>	<p><math>H_0 : \mu_b = \mu_g</math>  <math>H_1 : \mu_b &lt; \mu_g</math></p> <p><math display="block">z = \frac{62 - 59}{\sqrt{\frac{36}{80} + \frac{36}{80}}}</math></p> <p><math>= 3.16</math></p> <p>Critical region <math>z \geq 1.6449</math> (accept 1.645)  <math>3.16 &gt; 1.6449</math> sufficient evidence to reject <math>H_0</math>.  the mean mark for boys is less than the mean mark of the girls.</p>	<p>B1</p> <p>M1</p> <p>A1</p> <p>B1</p> <p>A1</p> <p>(5)</p>
<p>(c)</p>	<p>Girls have improved more than boys  or girls performed better than boys after 1 year</p>	<p>B1</p> <p>(1)</p> <p>13</p>

<p>6. (a)</p>	<p><math>r = 27.07</math>,  <math>s = 18.04</math>,  <math>t = 0.11</math> using tables or <math>0.12</math> using totals</p>	<p>M1 A1  B1  B1 ft  (4)</p>
<p>(b)</p>	<p> <math>H_0</math> : A Poisson model <math>Po(2)</math> is a suitable model.  <math>H_1</math> : A Poisson model <math>Po(2)</math> is not a suitable model.   both   Amalgamate data  <math display="block">\sum \frac{(O - E)^2}{E} = 3.28</math> (awrt)   <math>\nu = 6 - 1 = 5</math>   <math>\chi^2_5(5\%) = 11.070</math> (follow through their degrees of freedom)   <math>3.25 &lt; 11.070</math> There is insufficient evidence to reject <math>H_0</math>, <u><math>Po(2)</math> is a suitable model.</u> </p>	<p>B1   M1  M1 A1  B1  B1ft  A1ft  (7)</p>
<p>(c)</p>	<p>The expected values, and hence <math>\sum \frac{(O - E)^2}{E}</math> would be different, and the degrees of freedom would be 1 less.</p>	<p>B1  B1  (2)</p>

7. (a) The variables cannot be assumed to be normally distributed B1 (1)

(b) 

	20-29	30-39	40-49	50-59	60-69	70+
Rank $x$	5	6	4	3	1	2
Rank $y$	6	5	4	1	3	2
$d$	1	1	0	2	2	0
$d^2$	1	1	0	4	4	0

M1 A1

	20-29	30-39	40-49	50-59	60-69	70+
Rank $x$	5	6	4	3	1	2
Rank $y$	6	5	4	1	3	2
$d$	1	1	0	2	2	0
$d^2$	1	1	0	4	4	0

dM1 (depends on ranking attempt)

$\sum d^2 = 10$  (follow through their rankings) A1 ft

$r_s = 1 - \frac{6\sum d^2}{n(n^2 - 1)} = 1 - \frac{60}{210} = 0.714$  ( $\frac{5}{7}$  or awrt 0.714) M1 A1 (6)

(c)  $H_0: \rho = 0$  B1  
 $H_1: \rho \neq 0$  (or  $\rho > 0$ ) B1

$n = 6 \Rightarrow 5\%$  critical value = 0.8857 (or 0.8286) B1✓

$0.714 < 0.8857$  M1

No evidence to reject  $H_0$ ;  
 No evidence of correlation between deaths from pneumoconiosis and lung cancer. A1

(5)