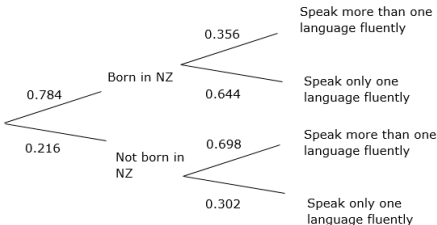
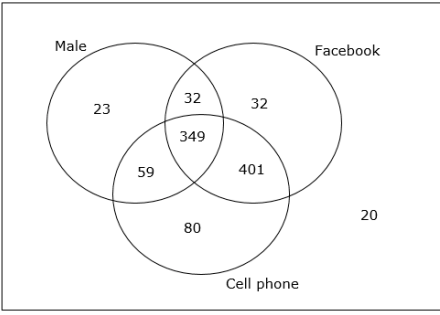


**Assessment Schedule – 2017**

**Mathematics and Statistics (Statistics): Apply probability concepts in solving problems (91585)**

**Evidence Statement**

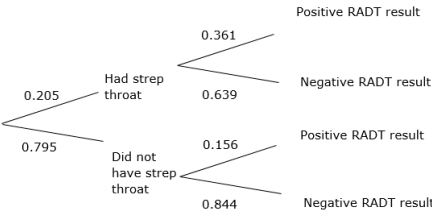
One	Expected Coverage	Achievement (u)	Merit (r)	Excellence (t)
(a)(i)	 <p> <math>P(\text{only one language})</math>  <math>= 0.784 \times 0.644 + 0.216 \times 0.302</math>  <math>= 0.570</math> (3 d.p.)         </p>	Correct probability calculated.		
(a)(ii)	<p>           Test: <math>P(A).P(B) \neq P(A \cap B)</math>  <math>P(\text{NZ} \cap &gt;1\text{L}) = 0.784 \times 0.356 = 0.279</math>  <math>P(\text{NZ}) \cdot P(&gt;1\text{L}) = 0.784 \times 0.430</math>  <math>= 0.337 \neq 0.279</math>            Therefore the events are not independent.         </p> <p> <i>Accept equivalent explanation, eg:</i>  <math>P(\text{speaking more than one language fluently given born in NZ}) = 0.356</math>  <math>P(\text{speaking more than one language fluently given not born in NZ}) = 0.698</math>            The events are not independent, since the probability of speaking more than one language is different depending on whether a student was born in NZ or not.         </p>	Relevant probability calculation.	Full explanation that links the decision that the two events are not independent to the calculations.	
(b)(i)	<p> <math>P(\text{female} \cap \text{does not own cell phone})</math>  <math>= \frac{52}{996} = 0.052</math> (3 d.p.)         </p>	Correct probability calculated.		
(b)(ii)	<p>           Test: <math>P(A \cap B) = 0</math>.  <math>P(\text{Facebook account} \cap \text{cell phone})</math>  <math>= \frac{750}{996} \neq 0</math> ( <math>0.753 \neq 0</math> )            Therefore the events are not mutually exclusive.         </p>	Correct probability calculated.	Full explanation that links the decision that the two events are not mutually exclusive to the calculations.	

<p>(b)(iii)</p>	 <p>Male: 23          Facebook: 32          Cell phone: 80          Male ∩ Facebook: 32          Male ∩ Cell phone: 59          Facebook ∩ Cell phone: 401          Male ∩ Facebook ∩ Cell phone: 349          Outside: 20</p> <p><math>P(\text{female} \cap \text{no Facebook account} \cap \text{no cell phone}) = \frac{20}{996} = 0.020 \text{ (3 d.p.)}</math></p>	<p>Two correct values in a relevant Venn diagram.</p>	<p>Diagram completed and value of 20 found.</p>	<p>Correct probability calculated.</p>
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NØ	N1	N2	A3	A4	M5	M6	E7	E8
No response; no relevant evidence.	Reasonable start / attempt at one part of the question.	1 of u	2 of u	3 of u	1 of r	2 of r	1 of t (with minor omission or error)	1 of t

Two	Expected Coverage	Achievement (u)	Merit (r)	Excellence (t)																
(a)(i)	<table border="1"> <thead> <tr> <th></th> <th>Air NZ</th> <th>Not Air NZ</th> <th>Total</th> </tr> </thead> <tbody> <tr> <td>Delayed</td> <td>24</td> <td>7</td> <td>31</td> </tr> <tr> <td>Not delayed</td> <td>40</td> <td>12</td> <td>52</td> </tr> <tr> <td>Total</td> <td>64</td> <td>19</td> <td>83</td> </tr> </tbody> </table> <p> <math>P(\text{Delayed} \mid \text{Not Air NZ}) = \frac{7}{19}</math>  <math>= 0.368</math> (3 d.p.)                 </p>		Air NZ	Not Air NZ	Total	Delayed	24	7	31	Not delayed	40	12	52	Total	64	19	83	Correct probability calculated for (a)(i).	Correct probability calculated for (a)(i). AND Two reasons given for (a)(ii).	
	Air NZ	Not Air NZ	Total																	
Delayed	24	7	31																	
Not delayed	40	12	52																	
Total	64	19	83																	
(a)(ii)	Two reasons of any type: <ul style="list-style-type: none"> <li>• Amount of data.</li> <li>• Nature of data:                             <ul style="list-style-type: none"> <li>- the next day is likely to have different weather conditions</li> <li>- the next day could be a different day of the week.</li> </ul> </li> </ul>																			
(a)(iii)	If $P(A \cup B) = 0.54$ , then $P(A' \cap B') = 0.46$ If $P(A' \cup B) = 0.86$ , then $P(A \cap B') = 0.14$ Therefore, $P(B') = 0.46 + 0.14 = 0.6$ and $P(B) = 1 - 0.6 = 0.4$ <i>Accept other valid chains of reasoning or use of diagrams (e.g. a two way table) to determine probability.</i>		One example of correct use of probability theory / method to deduce a relevant probability that was not provided (eg. 0.46 or 0.14 on a Venn diagram).	The probability is correctly calculated using a logical chain of reasoning.																
(b)(i)	Percentage of predictions correct $= \frac{172 + 94}{400} = 0.665 = 66.5\%$	Correct proportion calculated.																		
(ii)	$P(\text{predict female} \mid \text{actually female})$ $= \frac{172}{172 + 26} = 0.869$ $P(\text{predict male} \mid \text{actually male})$ $= \frac{94}{108 + 94} = 0.465$ So model predicts less than half of males as being male. <i>Accept other valid reasoning e.g. 198 females used website, but 280 females were predicted, so model predicting nearly 50% more females than used the website.</i>	At least one correct additional proportion calculated as part of reasoning.	At least one correct additional proportion calculated and used appropriately to support reasoning about a potential issue with the model.																	

N0	N1	N2	A3	A4	M5	M6	E7	E8
No response; no relevant evidence.	Reasonable start / attempt at one part of the question.	1 of u	2 of u	3 of u	1 of r	2 of r	1 of t (with minor omission or error)	1 of t

Three	Expected Coverage	Achievement (u)	Merit (r)	Excellence (t)															
(a)(i)	$P(\text{Not strep throat}) = 0.124 + 0.671 = 0.795$  As this proportion is over 50%, the data supports the statement.	Correct proportion calculated.	Correct proportion calculated AND justification of support for the statement.																
(a)(ii)	$P(\text{positive RADT result} \mid \text{strep}) = \frac{0.074}{0.074 + 0.131} = 0.361$ $P(\text{positive RADT result} \mid \text{not strep}) = \frac{0.124}{0.124 + 0.671} = 0.156$  	Correct probabilities calculated for the first set of branches.	Correct probabilities calculated for all branches (don't penalise a lack of rounding to 3 dp).																
(b)(i)	Estimated $P(S = 1) = \frac{7}{50} = 0.14$	Correct estimated probability calculated.																	
(b)(ii)	A score of 1 requires at least two of the spinners to show a 1. In total, there are $4 \times 4 \times 4 = 64$ possible outcomes. Of these, 10 would have at least two of the spinners showing one: 111, 112, 113, 114, 121, 131, 141, 211, 311, 411 $\text{Theoretical } P(S = 1) = \frac{10}{64} = 0.156 \text{ (3 d.p.)}$  <i>Accept use of probability tree or similar diagram to determine theoretical probability.</i>	Probability of one outcome found, ie $\left(\frac{1}{4}\right)^3 = \frac{1}{64}$	Correct theoretical probability calculated.																
(b)(iii)	<table border="1" data-bbox="239 1556 699 1646"> <tr> <td>s</td> <td>1</td> <td>2</td> <td>3</td> <td>4</td> </tr> <tr> <td>P(S = s)</td> <td>0.156</td> <td>0.344</td> <td>0.344</td> <td>0.156</td> </tr> </table> <table border="1" data-bbox="239 1653 699 1684"> <tr> <td>P(S=s)</td> <td>5/32</td> <td>11/32</td> <td>11/32</td> <td>5/32</td> </tr> </table>  <i>Requires knowledge that distribution is symmetric, so <math>P(X = 2) = 0.5 - P(X = 1) = 0.344</math>. Could use systematic approach like (b)(ii).</i>	s	1	2	3	4	P(S = s)	0.156	0.344	0.344	0.156	P(S=s)	5/32	11/32	11/32	5/32	$P(S = 4) = P(S = 1)$	$P(S = 2)$ or $P(S = 3)$ correct.	Probability distribution table completed.
s	1	2	3	4															
P(S = s)	0.156	0.344	0.344	0.156															
P(S=s)	5/32	11/32	11/32	5/32															

<b>N0</b>	<b>N1</b>	<b>N2</b>	<b>A3</b>	<b>A4</b>	<b>M5</b>	<b>M6</b>	<b>E7</b>	<b>E8</b>
No response; no relevant evidence.	Reasonable start / attempt at one part of the question.	1 of u	2 of u	3 of u	1 of r	2 of r	1 of t (with minor omission or error)	1 of t

### Cut Scores

<b>Not Achieved</b>	<b>Achievement</b>	<b>Achievement with Merit</b>	<b>Achievement with Excellence</b>
0 – 7	8 – 12	13 – 18	19 – 24